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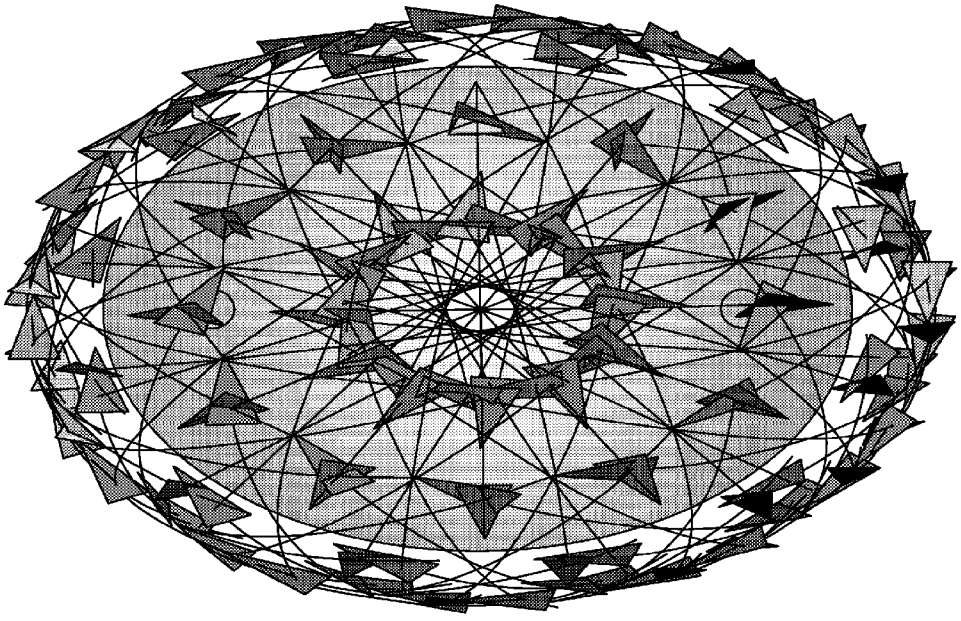
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(54) Title: DIGITAL LOW-ATTENUATION COMMUNICATION SYSTEM

Fig. 1



(57) Abstract: A neutrino telecommunication system having a transmitter comprising H_2(l/p) to absorb cosmological neutrinos that propagate through space essentially perfectly parallel and uniform in intensity and then detecting a pulsed deficit signals by neutrino absorption by a receiver comprising H_2(l/p) that subsequently converts the signals into digital signals is the basis of a telecommunications system that can send essentially unattenuated signals through objects including the Earth. The ability to excite neutrino emission from a transmitter comprising H_2(l/p) using lasers and the ability to detect the corresponding neutrino signals by their absorption by a receiver comprising H_2(l/p) that subsequently converts the signals to photon signals that are processed following optoelectronic conversion is the basis of a neutrino telecommunications system.

[Continued on next page]

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DIGITAL LOW-ATTENUATION COMMUNICATION SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

The present application claims priority to and the benefit of U.S. patent application Serial No. 63/775,535, filed on March 21, 2025 and to U.S. patent application Serial No. 63/954,361, filed on January 5, 2026, the contents of each of which are hereby incorporated by reference in their entirety.

FIELD OF DISCLOSURE

The present invention relates to the field of transmission of information and, in particular, to systems, devices, and methods for the transmission of information. More specifically, embodiments of the present invention are directed to telecommunication devices and systems, as well as related methods, which transmit and receive telecommunication signals with low attenuation by encoding and transmitting the information as digital neutrino pulses comprising telecommunication signals that are capable of penetrating any form of medium with the exclusion of a medium comprising molecular hydrino with essentially no attenuation of the signals.

BACKGROUND OF THE INVENTION

Electromagnetic (EM) radiation, particularly at visible, microwave and radio wavelengths, is today's carrier of choice for moving information due to ease of transmission and detection and fast data and information transfer rates. However, EM telecommunication requires line-of-sight transmission or expensive satellites and repeaters, and there are some situations where EM radiation performs poorly such as in the case of transmission of information to nuclear submarines. Nuclear submarines such as those that carry intercontinental ballistic missiles (ICBMs) can remain submerged almost indefinitely, but seawater is opaque to electromagnetic radiation at the wavelengths short enough to transmit information at a useful rate. Consequently, submarines are forced to float a wire antenna to the surface, which restricts their speed and depth, making them easier to detect.

Neutrino communication uses massless, neutral neutrino photons to send messages through Earth or space, offering secure signals that pass through solid matter, ideal for deep-sea, underground, or interstellar communication as well as being a superior approach than that of EM signal transmission in general applications. Scientists have demonstrated (e.g. D. D. Stancil, et. al., "Demonstration of Communication using Neutrinos", Mod. Phys. Lett. A 27 (2012) 1250077, arXiv:1203.2847v2, https://doi.org/10.48550/arXiv.1203.2847; Brumfiel, G. Neutrinos

transmit message through solid rock. Nature (2012). https://doi.org/10.1038/nature.2012.10241) the transmission and reception of pulses comprising bunches of neutrinos that were decoding to the digital sending of the simple digital message "neutrino" using a particle accelerator (Fermilab's NuMI) that created a focused beam of neutrinos by smashing 120 GeV protons into a target and a massive detector (MINERvA). However, prior art neutrino communication systems are incredibly impractical, due to extremely low data rates (bits per second) due to neutrinos' rare interactions and the massive size and extreme cost of the equipment needed, typically requiring an international effort.

SUMMARY OF THE INVENTION

Neutrinos are a form of photon with a different multipolarity and angular momentum than those of photons emitted by lasers in communications system of the prior art (e.g. the angular momentum in the electric and magnetic fields of neutrinos correspond to spin ½ whereas those of laser photons correspond to spin 1). Telecommunication systems can take many forms, transmitting information as digital neutrino light pulses. Successful commercialization of neutrino telecommunication systems depend on neutrino sources of sufficient controllability and power that serve as transmitters and systems capable of effectively receiving the signals and converting them into another form of signal.

The transmitter and receiver each include a transducer comprising a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]n$) wherein the transmitter controllably causes neutrinos to be emitted as digital pulses, and the receiver absorbs neutrinos and converts the corresponding signals to another form. A transmitter transducer may comprise a source of spin 1 photons or energetic particles that excite ro-vibrational states in the $H_2(1/p)$ of the transmitter wherein the ro-vibrational state relaxation results in neutrino emission. $H_2(1/p)$ molecules of a receiver may absorb neutrinos of an arriving signal to cause excitation of ro-vibrational states in the $H_2(1/p)$ molecules that emit spin 1 photons or energetic particles during de-excitation. A receiver transducer may convert the spin 1 photons or energetic particles into another form of signal. Other system components support the input of information to be converted into emitted neutrino pulses, the encoding of the information in the neutrino pulses comprising telecommunication signals as well as the output of the received signals and reading of the corresponding information.

Alternatively, the transmitter and receiver can each include a molecular hydrino species wherein a transmitter produces a time streamed deficit pattern in the background neutrino flux to encode telecommunication signals that are received as a background neutrino flux difference signals that are processed to receive the transmitted telecommunication data and information.

The neutrino communication system and associated methods of the present invention convert input signals to digital neutrino signals by a neutrino transmitter and receiving the neutrino signals and converting them to another form of signal such as a digital or analog electronic, microwave, optical, or other form of signal known in the art. The present invention is directed to neutrino telecommunication systems that digitally transmit signals comprising information using neutrino pulses that encode the information. The digital neutrino telecommunication system includes (i) a source of signal comprising information; (ii) an analog to digital converter in the case that the input data is analog; (iii) an excitor capable of pulsed exciting ro-vibrational states in a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]n$); (iv) a bus to transfer the information signal; (v) a pulsed neutrino transmitter comprising a composition of matter having a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]n$) that receives the digital signals and emits pulses of neutrinos to comprise telecommunication signals wherein the pulses encode the information in digital format; (vi) a neutrino receiver that receives the pulsed neutrinos and converts them into another form of pulsed emission such as at least one of photons or energetic particles; (vii) a transducer or detector of the converted neutrino signals employing at least one of an electro-optical converter, a photodiode, an electron detector and an ion detector; (viii) a processor to process or store the digital signals or an optional digital to analog converter to output analog signals that are transmitted, wherein the converter can include a transmitter modem that transmits data by modulating one or more carrier wave signals to encode digital information; (ix) an optional receiver to receive the analog signal from the converter and reconstitute the original digital information to be processed or stored as data by the processor, wherein the receiver receiving the analog signals can include a modem to receive the analog modulated wave signals and demodulate the signal to reconstitute the original digital information to be processed or stored as data; and (x) an optional additional processor to record the received signal information as data and output or store the data wherein the data may be output to a video screen, memory element, speaker, or other output device known in the art or stored in a memory medium.

The digital neutrino telecommunication system can further include upstream communication systems and information processing systems to provide the streaming signals, such as at least one of fiber optic transmitters and receivers, RF or microwave transmitters and receivers, modems, fiber optic the cables, antennas, routers, the internet, Wi-Fi systems, computers such as desktops, main frames, laptops, mobile devices, such as smart phones and wearables, and printers, cameras, microphones, wherein the system transmits information as telecommunication signals comprising at least one of data, text, video, and audio signals. The excitor capable of pulsed exciting ro-vibrational states in a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) can include at least one of a

(a) pulsed energy source of the group of an electro-optical converter, a pulsed source of photons, a pulsed laser, a pulsed diode, gas, or solid state laser, a pulsed source of energetic particles, a pulsed particle beam, and a pulsed electron beam, or

(b) a fast switch of the energy of at least one ro-vibrational transition to cause pulsed excitation by a pulsed or continuous energy source such as a photon source such as a laser such as a diode, gas, or solid state laser and a particle beam such as an electron beam.

The composition of matter comprising $H_2(1/p)$ comprises at least one of solid gas@$H_2(1/p)$, liquid gas@$H_2(1/p)$, gaseous gas@$H_2(1/p)$, argon(l)@$H_2(1/p)$, argon(g)@$H_2(1/p)$, ice@$H_2(1/p)$, water@$H_2(1/p)$, steam@$H_2(1/p)$, CO_2(s)@$H_2(1/p)$, solid compounds further comprising $H_2(1/p)$, KOH-KCl@$H_2(1/p)$, KOH-KI-Ga@$H_2(1/p)$, $KHCO_3$-KCl@$H_2(1/p)$, $NaHCO_3$-KCl@$H_2(1/p)$, ZnO@$H_2(1/p)$, FeOOH@$H_2(1/p)$, GaOOH@$H_2(1/p)$, and metal@$H_2(1/p)$, such as In@$H_2(1/p)$ and Mn@$H_2(1/p)$, wherein at least one of deuterium (D) and tritium (T) may replace hydrogen (H). The composition of matter may comprise a scintillation or phosphor solid, liquid, or gas further comprising $H_2(1/p)$ to convert ro-vibrationally excited state $H_2(1/p)$ to photon emission (e.g. at least one of X-ray, EUV, visible, infrared, microwave, and radio wave).

The hydrino species of at least one of the transmitter and receiver such as $H_2(1/p)$ or $[H_2(1/p)]n$ may undergo ro-vibrational transitional excitation due to energy absorption by at the least one of one of neutrino, collisional, one-photon, and two-photon excitation and ro-vibrational transitional de-excitation due to energy emission by at the least one of one of neutrino, collisional, one-photon, and two-photon de-excitation, at the transmitter and receiver, respectively.

The excitor may excite at least one transition of a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) of the group of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, and magnetic tilt transition. The excitor may also comprise at least one of a (a) diode laser to directly achieve pulsed excitation of at least one ro-vibrational transition of the molecular hydrino species that can be switched rapidly, achieving short-duration pulses (e.g. 10^{-3}s to 10^{-12}s) and repetition rates in the range of 100 Hz to 10 gigahertz through methods including current modulation, electro-optical modulation, Q-switching, and mode locking, and (b) a fast speed magnetization switch based on causing electric current or laser opto-magnetic interactions by ultrafast lasers applied to the molecular hydrino species such as $H_2(1/p)$ or $[H_2(1/p)]_n$ embedded in a magnetic matrix to switch the energy of at least one ro-vibrational transition to cause pulsed excitation of at least one ro-vibrational transition by a pulsed or continuous energy source comprising at least one of a photon source, a laser, a diode laser, a particle beam, and an electron beam. The laser may output light in the energy range of about the energies of $H_2(1/p)$ ro-vibrational levels (Eqs. (11-12)) in the energy range of X-ray to infrared (e.g. 10 keV to 0.05 eV)

comprising one of infrared, visible, UV, or X-ray laser light. The transmitted neutrinos may excite at least one transition of a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) of the group of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, and magnetic tilt transition. The receiver may comprise a molecular hydrino species absorber that forms an excited ro-vibrational state that decays or at least partially undergoes internal conversion to a 1 or 2-photon emission to a photodetector that transduces the photon signal to an electronic signal, or the energy of the decay or partial decay of the ro-vibrational state may be down converted to a lower energy photon emission such as an infrared photon emission, or the energy of the decay or partial decay of the ro-vibrational state accelerates an electron that in turn may be detected by a particle detector to transduce the energy to an electronic signal.

The digital neutrino telecommunication system may further comprise a plurality of digital neutrino telecommunication subsystems, each subsystem comprising a (i) pulsed transmitter to transmit information via a pulsed neutrino stream; (ii) a receiver to receive the pulsed neutrino stream and emit one of pulsed photons (e.g. at least one of X-ray, EUV, visible, infrared, microwave, and radio wave) or pulsed particles such as electrons; (iii) a transducer such as an opto-electronic or electron detector to convert the emitted pulsed photons or pulsed electrons to a digital electrical signal, and (iv) a processor to reconstitute the information or a modem to further transmit the signal such as an analog signal.

Alternatively, the digital neutrino telecommunication system may further comprise a multiplexer and demultiplexer to encode multiple signal streams of independent information multiplexed within the band width of the neutrino wavelength and neutrino pulse lengths and separate the received signals, respectively.

In an embodiment, the multiplexing of independent neutrino telecommunication signals combines multiple signals into a single transmission using at least one technique of the group of Wavelength-Division Multiplexing (WDM), Time-Division Multiplexing (TDM), Code-Division Multiplexing (CDM), Polarization-Division Multiplexing (PDM), or Selection Rule Division Multiplexing (SRDM) wherein the signals are combined (multiplexed) at the pulsed neutrino transmitter, and at the receiver, they are separated (demultiplexed).

The neutrino telecommunication system may comprise (i) a transmitter and (ii) a receiver, each comprising $H_2(1/p)$ molecules that absorb at least a portion of an incident cosmological neutrino beam at the transmitter along a certain selected beam path in a controlled temporal order to encode information, and the receiver records the deficit in neutrinos signal relative to a receiver that records the constant background cosmological neutrino flux, and (iii) a processor that processes the signal as a telecommunication signal wherein the neutrinos absorption or interactions encode the telecommunications signal as at least one of amplitude modulation, frequency modulation, and digital pulses. The digital pulses may be given by the

magnitude of the difference between the signal streams and the constant background stream of neutrinos, wherein a zero difference as an output may be registered as a zero and a non-zero difference may be registered as a one of a binary code. The neutrino telecommunication system may further comprise at least one of a transmitter and receiver comprising a system for coincide detection of the 1's and 0's of the neutrino pulse stream that carries the encoded information wherein the at least one transmitter and receiver can function as both a receiver and transmitter and exchange neutrino signals comprising attenuation of counterpropagating neutrino beams as signals to permit alignment of the transmitter and receiver along a common axis by at least one actuator that moves one transmitter/receiver relative to the other. The neutrino telecommunication system may comprise a plurality of transmitters comprising a plurality transmitter pairs (e.g. a duality of transmitters) that are synchronized to send at least one verification pulse with every pulse stream wherein the corresponding receiver coincidently detects each pulse stream and corresponding verification pulse, and a processor confirms the legitimacy of each pulse by processing the coincidences.

According to another embodiment, the neutrino telecommunication system of the present invention can comprise (i) a source of signal comprising information; (ii) a bus to transfer the information signal to at least one signal transmitter; (iii) at least one signal transmitter comprising an electron paramagnetic (EPR) spectrometer and a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) wherein the EPR spectrometer is capable of at least one of causing or allowing electron paramagnetic (EPR) transitions in the molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) wherein the transitions are at least partially excited by the cosmological neutrinos to cause flux deficit signals over time that encodes the information signal; (iv) at least one receiver that receives the flux deficit signals over time comprising an electron paramagnetic (EPR) spectrometer and a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) wherein the EPR spectrometer is capable of at least one of causing or allowing electron paramagnetic (EPR) transitions in the molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) wherein the transitions are at least partially excited by the cosmological neutrinos flux deficit signals over time; (v) at least one cosmological neutrino background receiver that receives the cosmological neutrino background flux over time comprising an electron paramagnetic (EPR) spectrometer and a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) wherein the EPR spectrometer is capable of at least one of causing or allowing electron paramagnetic (EPR) transitions in the molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) wherein the transitions are at least partially excited by the cosmological neutrinos to record the constant background signal over time; (vi) a processor that determines the difference spectrum over time of the transmitter signals and the background signals wherein the difference signals recover or receive the signal information; (vii) an optional additional processor to process or store and reconstitute the original information to be

processed or stored as data, and (viii) an optional additional processor to record the received signal information as data and output or store the data.

According to still another embodiment, the digital neutrino telecommunication system may comprise (i) a source of signal comprising information; (ii) an optional analog to digital converter in the case that the input data is analog; (iii) a bus to transfer the information signal to at least one pulsed signal transmitter; (iv) at least one transmitter comprising an optional electron paramagnetic (EPR) spectrometer capable of at least one of causing or allowing pulsed electron paramagnetic (EPR) transitions in a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$), wherein the transitions are at least partially excited by the cosmological neutrinos to cause pulsed flux deficit signal over time that encodes the digital signal in neutrino deficit pulses; (v) a neutrino receiver comprising a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) that receives the pulsed neutrinos and converts them into another form of pulsed emission; (vi) a transducer or detector of the converted neutrino signals; (vii) a processor to process or store the digital signals or a digital to analog converter to output analog signals that are transmitted; (viii) a receiver to receive the analog signal and reconstitute the original digital information to be processed or stored as data; and (ix) a processor to record the received signal information as data and output or store the data. At least one of the information signal and reconstituted signal may be analog or digital, and the transmitted signal and received signal may be at least one of digital, amplitude modulated, and frequency modulated. The neutrino telecommunication system may further comprise at least one of analog to digital converter and a digital to analog converter. The attenuation of the neutrinos may be determined by synchronously comparing the unattenuated background signal with the attenuated signal received by the receiver wherein the time dependent neutrino signal intensity diminution or deficit encodes the telecommunications signal or information; the difference signal may be determined by the synchronous recording of the neutrino signal by at least one other receiver off axis to the attenuated neutrino beam having no attenuation of the constant cosmological neutrino background flux, and at least one background neutrino flux detector may be mounted on the same plate (e.g. in the same plane) as each receiver such that it is incident cosmological neutrinos at the same angle and same distance as the receivers to provide an accurate background signal. At least one of (i) one or more signal transmitters, (ii) one or more signal receivers, and (iii) one or more background receivers may be periodically standardized or calibrated relative to each other to correct for a differential in responsiveness to the flux of cosmological neutrinos (e.g. due to at least one of differential or drifting geometry and electronics, and the responsive of the molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$)).

The EPR spectrometer may comprise a continuous wave electron paramagnetic resonance (EPR) spectrometer comprising (i) a microwave antenna that supplies a microwave magnetic

field B_1 within a resonator/cavity and an external magnet to produce a static external magnetic field B_0 generated by an electromagnet or permanent magnet providing a constant direction for electron spins to align with or against B_0 wherein the fields are oriented such that the microwave magnetic field B_1 is perpendicular to the field B_0; (ii) a sample that absorbs neutrinos comprising a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) is placed in a resonator between the magnet poles where B_1 is maximum and B_0 is uniform; (iii) the microwave field B_1 is generated by a microwave bridge and directed via waveguide/antenna into the cavity (resonator); (iv) the resonator is designed to ensure the oscillating magnetic component of the microwaves B_1 is perpendicular to the static field B_0 which is required for maximum transition probability for $S = 1/2$ systems based on selection rules, or (v) in a "parallel mode" B_1 is parallel B_0 to excite otherwise forbidden transitions. The unpaired electron of molecular hydrino may be aligned along a magnetic field axis B_0, or the unpaired electron may be flipped perpendicularly to the magnetic field axis by a pulse of electromagnetic energy (e.g. a $\pi/2$ microwave pulse) wherein the electron magnetic moment direction causes a selective directional absorption or attenuation neutrinos based on selection rules. The electron magnetic moment flipped into the transverse plane may interact with the nuclear spins (e.g. protons and ^3H nucleus with S = ½, and ^2H nucleus with S = 1) to increase the cross-section of neutrino absorption or interactions. Transitions involving interactions between electron spin and at least one other spin states may give rise to at least one of new absorption and emission peaks in the EPR spectrum, the other spin state interaction resulting in energy level splitting comprising electron spin-nuclear spin; nuclear-nuclear spin; splitting due to excited ro-vibrational states; splitting due to electron spin-orbital coupling and fluxon linkage; electron-spin splitting with matrix unpaired electrons; electron-spin splitting with matrix nuclear magnetic moments; nuclear-spin splitting with matrix unpaired electrons; and nuclear-spin splitting with matrix nuclear magnetic moments.

The electron paramagnetic resonance (EPR) spectrometer may apply a short, high-power microwave pulse (typically a $\pi/2$ pulse) that tips the equilibrium magnetization into the xy-plane to produce a free induction decay (FID) signal in the continuous-wave regime that is modified by the absorption of cosmological neutrinos that encodes data and information, and the FID is optionally recorded then processed by FFT to generate the EPR spectrum of the molecular hydrino species modified by the encoded data and information. A rapid scan (RS) EPR technique may be utilized wherein the magnetic field is swept through the molecular hydrino species resonance so quickly that it creates a signal like an FID that is modified by cosmological neutrino absorption to encode data and information, which is optionally processed by FFT and deconvolution to generate the EPR spectrum of the molecular hydrino species spectrum modified by the encoded data and information. The rapid scan (RS) EPR may comprise small permanent magnets and miniaturized electronic components such as voltage-controlled oscillators (VCO)

capable of sweeping the frequency at a fixed magnetic field that replace the bulky electromagnets and microwave parts that operate with a fixed microwave frequency and scan the magnetic field. The EPR spectrometer may be fully integrated into a single silicon microchip, a so called EPR-on-a-Chip (EPRoC) device comprising a source of magnetic field (e.g. an electromagnet or permanent magnet) and either (i) a conventional microwave bridge or variants of it integrated in a single integrated circuit and a fixed-frequency oscillator, or (ii) in place of a microwave (MW) resonator, voltage-controlled oscillator (VCO)-based EPRoC detectors comprising an array of injection-locked VCOs, each incorporating a miniaturized planar coil as a combined microwave source and detector. The magnetic field strength may produce at least one EPR energy resonance that matches the energy of cosmological neutrinos wherein cosmological neutrinos are absorbed during the EPR spectroscopy scan to encode the data and information. Embedding the VCO in a high-bandwidth phase-locked loop (PLL) may allow for (i) a precise definition of the phase of the exciting B_1 field from an external reference, even in the presence of temperature and other experimental fluctuations, and the amplitude-sensitive mode of encoding the information due to cosmological neutrino absorption, and (ii) detection with a high-bandwidth AM demodulator built directly into the LC VCO that is also used to detect the sample magnetization with a high bandwidth. The EPRoC may encoded the information due to cosmological neutrino absorption during the EPR spectroscopy scan as pulsed or digital, amplitude modulation, and frequency modulation encoding, and the spin response may be detected by amplitude-sensitive detection (AM) and frequency-sensitive detection (FM) wherein the AM and FM sensor signals correspond to the EPR-induced changes in the VCO amplitude and frequency, respectively. At least one of VCO-based EPRoC transmitters and receivers may comprise an array of injection-locked VCOs, each incorporating a miniaturized planar coil as a combined microwave source and detector.

The neutrino telecommunication system may further comprise an alignment system to maintain the transmitter and matched receiver perpendicular and centered on the correct aligned axis wherein, neutrino beams are adjusted periodically to prevent misalignment comprising at least one of (i) an alignment signal and the telecommunication signal; (ii) a neutrino-beam-position-sensing detector in at least one of the transmitter and receiver system that detects incoming signals and automatically adjusts the transmitter to steer the beam toward the center of the receiver; (iii) a signal optimizer that monitors the received signal strength using an indicator (RSSI) at a plurality of spatial positions; (iv) a frequency difference of arrival (FDOA) used to track signals wherein the transmitter dynamically exchanges positioning signals and corresponding information; (v) time of flight or a device for tracking a spatial phase angle based on spatial position used as an alignment mechanism; (vi) a transmitter and receiver that continuously scans their surroundings to dynamically identify the optimal beam pair with the

highest signal strength; (vii) antenna alignment tools (AAT) tools (e.g. 3Z RF Vision or LinkAlign) that use GPS and digital compasses used to measure tilt, roll, and azimuth; (viii) GPS, gyroscopes, and digital compasses, and antenna alignment tools that calculate precise azimuth and elevation for moving targets, enabling rapid re-pointing; (ix) inertial navigation systems (INS/GPS) that track at least one of transmitter and receiver positions using systems such as fiber optic gyros (FOGs) to provide data for highly accurate pointing, stabilization, and geo-location to guide self-alignment; (x) an inertial navigation system (INS) comprising a self-contained device using accelerometers and gyroscopes (within an inertial measurement unit or IMU) to track at least one of the transmitter's and receiver's position, velocity, and orientation by measuring motion and rotation, relying on "dead reckoning" from a known starting point; (xi) an INS that fuses data with GPS/GNSS for periodic correction to correct for tiny accumulated sensor errors (drift), offering reliable alignment even when external signals are lost; and (xii) at least one fast alignment actuator (e.g. electromechanical, galvanometers, or piezo stages) to move at least one of the transmitter and receiver relative to each other to constantly adjust the relative positions of the transmitter and receiver to maintain alignment.

The alignment system to maintain the transmitter and matched receiver perpendicular and centered on the correct aligned axis may maintain sender and receiver point-to-point communication by pre-program motion synchronization algorithms between each of the sender's and receiver's transmitter/receiver such that possible point-to-point communication ray paths or axes are scanned according to the algorithms, initially weighting the most probable paths external information until the path of least time is locked on, and the transmission proceeds along that selected ray path with alignment of the devices.

At least one of the transmitter and receiver may further comprise a collimator to cause the attenuation of the cosmic cosmological neutrino background flux that is not about perpendicular to the transmitter or receiver. The collimator may comprise a material comprising embedded molecular hydrino or atomic hydrino wherein at least one of a magnetic field is applied to the material and the material is intrinsically magnetic such that spin flip transitions of the embedded molecular hydrino or atomic hydrino are induced by the magnetic field to attenuate cosmological neutrino background flux that is not about perpendicular to the transmitter or receiver.

Rather than or in addition to EPR detection the receiver may comprise a source of magnetic field comprising a permeant or an electromagnet wherein the energy of neutrino absorption or interaction by a $H_2(1/p)$ species (e.g. excitation of a ro-vibrational state transition, a hyperfine state, a spin-orbital coupling, an electron-nuclear magnetic moment coupling, and fluxon linkage transition), may be down converted by at least one of the decay or partial decay to cause a lower energy photon emission comprising at least one of an infrared, microwave, and radio photon emission that may be received by the receiver comprising a sensor responsive to the

photon emission and converted to electrical signals, and processed wherein the difference signal between the cosmological neutrino background and the telecommunication signal encoded by at least one of an amplitude modulation, frequency modulation, and pulse or digital encoding may be processed to receive the telecommunications data and information.

The application of a magnetic field to a molecular hydrino species such as $H_2(1/p)$, $H_2(1/p)$ dimer, and $H_2(1/p)$ multimer may give rise to at least one transition (e.g. at least one of an electron spin-flip, nuclear spin flip, ro-vibrational, spin-orbital coupling, electron-nuclear magnetic moment coupling, fluxon linkage, and other hyperfine transition) that may be excited by neutrinos (e.g. cosmological neutrinos). The transmitter and receiver may comprise a means to cause or detect at least one of electron-spin-flip transitions and microwaves emitted due to spin-flip transitions such as at least one of (i) an antenna, (ii) an optoelectronic oscillator (OEO) detector, (iii) a bolometer, (iv) a high frequency superconducting quantum interference (SQUID) device such as one comprising a molecular hydrino species as part of the inductor of an RLC circuit, (v) a III-V nanowire heterostructure and a magnetic tunnel junction (MTJs) that exploit quantum-confined energy levels or spintronic effects, (vi) an optomechanical system and photonic-based references in phase-locked loops (PLLs) that can convert microwave signals into the optical domain or provide ultra-low noise references which improves detection sensitivity and phase noise analysis, (vii) Rydberg atom sensors, (viii) a network analyzer, (ix) an organic molecular quantum receiver that uses organic molecular spins, (x) a microwave photon counter such as a superconducting qubit such as a single-microwave photon detector, (xi) scanning tunneling microscope, (xii) an optical detector using Faraday rotation of a laser pulse, and (xiii) a single photon calorimeter.

In another embodiment, the communication system may comprise an electromagnet, a power source, a processor-controller, and a source of data and information stream that is encoded in the absorbed neutrino flux as a function of time by the processor-controller controlling the magnetic field as a function of time wherein the magnetic field is controlled or modulated as a function of time to control and modulate the absorption of the neutrino flux incident the molecular hydrino species to encode or read data and information wherein the encoding is least one of pulsed or digital, amplitude modulation, and frequency modulation.

In still another embodiment, the neutrino telecommunication system may comprise at least one of the transmitter and receiver that comprises a source of magnetic field (e.g. a permeant or an electromagnet) wherein the application of the magnetic field to a species comprising $H_2(1/p)$ creates energy states in the energy range of the absorption cross section of at least one of cosmological and solar neutrinos, and the telecommunications signal is encoded (e.g. during transmission) or decoded (e.g. during reception) in the time dependent absorption of neutrinos producing at least one of an amplitude modulated, a frequency modulated, and a pulsed

or digital telecommunications signal one conveying data and information. The encoding or decoding may be controlled by controlling at least one of the magnitude and direction of the applied magnetic field and spatial-temporal displacement of a neutrino absorber comprising a molecular hydrino species such as $H_2(1/p)$, $H_2(1/p)$ dimer, and $H_2(1/p)$ multimer. In a digital signal transmitter embodiment at least one of (i) the magnetic field is pulsed on and off to demagnetized and remagnetize; (ii) at least one of a transmitter and receiver comprises magneto-optic memory cells that offer non-volatile storage with sub-nanosecond programming speeds wherein neutrino photons may serve the role of optical photons, and the source of magnetic field comprises "reciprocal ferromagnet/3D topological insulator" heterostructures where the switching of one magnet affects the current, and conversely, the current can switch a magnet.

The neutrino telecommunication system can comprise a mover or excitor to cause a spatial-temporal displacement of a neutrino absorber wherein (i) the spatial-temporal displacement of a neutrino absorber comprises a vibration wherein at least one of the (a) presence or absence of motion, (b) amplitude of motion, and (c) frequency of motion is controlled to control the telecommunications signal transmitted or received along the axis perpendicular to the positional center of the motion to encode or decode a (aa) puled or digital signal, (bb) an amplitude modulated signal, and (cc) a frequency modulated signal, respectively; (ii) the transmitter and receiver are aligned on the axis perpendicularly to the motion or relative motion with a separation distance between the transmitter and receiver; (iii) the transmitter creates a neutrino deficit signal, and the receiver receives the signal comprising a deficit of neutrinos due to the absorption by the transmitter; (iv) the difference signal between the at least one of the cosmological neutrino background and solar neutrino background and the telecommunication signal comprising at least one of (a) a pulsed or digital, (b) an amplitude modulated, and (c) a frequency modulated signal is processed to receive the telecommunications data and information. The communication system may comprise at least one of one or more of a transmitter and a receiver comprising a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]n$), and each transmitter and a receiver and further may comprise at least one of (a) an EPR spectrometer, (b) an EPR spectrometer and a magnet that applies another magnetic field to the molecular hydrino species to cause an energy transition (e. g. an electron spin flip transition) that is excited by cosmological neutrinos, and (c) a magnet that applies a magnetic field to the molecular hydrino species to cause an energy transition (e.g. an electron spin flip transition that is excited by cosmological neutrinos alone or the absence of either (a) or (b). The neutrino telecommunication system may further comprise a means to spatially-temporally move the least one of one or more of a transmitter and a receiver wherein (i) the motion is transverse to the propagation direction of the neutrino beam in which the data and information are encoded by the motion; (ii) the data and information are encoded by at least one of pulses or digital encoding,

amplitude modulation, and frequency modulation, and (iii) the mover that provides the time-dependent motion comprises at least one of piezoelectric, electromechanical, micro-electro-mechanical systems (MEM), plasmonic modulator, acousto-optic modulator or resonator, acousto-optic resonator or phase modulator, tiltable stage or mount, nanophotonic opto-mechanical resonator, acoustic modulator, and a device that uses surface acoustic waves for at least one of deformation and displacement that is mediated optically.

The actuator may comprise at least one of a reciprocal device and capable of absorbing spatial-temporal streams of received neutrino deficit signals and transducing the signals into at least one of displacement (e.g. a vibration, strain, or deformation) and another form of signal encoding the same data and information as the neutrino deficit signals such as electrical signals. The reciprocal device may comprise a piezoelectric actuator (e.g. by a photothermal + piezoelectric mechanism) that can convert electric signals into displacements and displacements into electrical signals. At least one of a transmitter and receiver may comprise a photothermal, a photo-mechanical, a crystal cantilever device, an optomechanical actuator, and a device controlled using magneto-optical driving further comprising a magnet to provide an applied magnetic field wherein neutrino photons serve the role of optical photons. In an embodiment, each receiver may comprise a plurality of smaller sub-receiver elements that cover an area that includes the transverse extrema or transverse spatial amplitude of the neutrino deficit beam wherein the beam amplitude is determined by the amplitude of the transverse displacement at the transmitter during encoding the data and information in the spatial-temporal neutrino deficit signals, and variation of the difference signal over the sub-receiver elements as a function of time is recorded to receive the transmitted signals.

The neutrino telecommunication system may further comprise an excitor that causes spatial-temporal displacements of the neutrino absorber comprising a molecular hydrino species to transmit and receive neutrino deficit signals wherein the data and information is encoded in the temporal stream of the neutrino deficit signals. The excitor may excite at least one transition such as at least one of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, magnetic tilt, phonon, plasmon, and electronic transition in at least neutrino absorber material comprising: (i) a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$); (ii) a molecule or compound to which molecular hydrino species is at least one of embedded, absorbed, or bonded to; (iii) a crystalline lattice to which molecular hydrino species is at least one of embedded, absorbed, or bonded to; (iv) metallic lattice such as a magnetic or non-magnetic lattice to which molecular hydrino species is at least one of embedded, absorbed, or bonded to; (v) a semiconductor to which molecular hydrino species is at least one of embedded, absorbed, or bonded; and (vi) an organic or inorganic crystalline lattice to which molecular hydrino species is at least one of embedded, absorbed, or bonded, to at least one of encode data and information in

transmitted time dependent neutrino deficit signals or receive the time dependent neutrino deficit signals. The excitor may comprise at least one of a (a) diode laser to directly achieve pulsed excitation of at least one transition of the neutrino absorber material that can be switched rapidly, achieving short-duration pulses (e.g. 10^{-3}s to 10^{-12}s) and repetition rates in the range of 100 Hz to 10 gigahertz through methods of the group of current modulation, electro-optical modulation, Q-switching, and mode locking; and (b) a fast speed magnetization switch based on causing electric current or laser opto-magnetic interactions by ultrafast lasers applied to a magnetic neutrino absorber material to switch the energy of at least one transition to cause pulsed excitation of at least one transition by a pulsed or continuous energy source comprising at least one of a photon source, a laser, a diode laser, a particle beam, and an electron beam.

At least one of one or more of a transmitter and a receiver may each comprise a mover or excitor such as an acoustic mover wherein a plurality of at least one or more of a transmitter and a receiver are organized in a plane of a card or plate transverse to the axis of signal propagation, and a plurality of cards are further arranged in parallel that are stacked along the axis of the signal propagation enabled by the lack of attenuation or electrical interference of the neutrino beam through the stack. At least one of one or more of a transmitter and a receiver on one card may be at least one of spatially displaced in the transverse plane relative to another on a different card, and multiple sensors along a common axis is spatial temporally multiplexed to avoid any interference of corresponding neutrino deficit signals. The multiplexing may comprise at least one of Wavelength-Division Multiplexing (WDM), Time-Division Multiplexing (TDM), Code-Division Multiplexing (CDM), Polarization-Division Multiplexing (PDM), or Selection Rule Division Multiplexing (SRDM) wherein the signals are combined (multiplexed) at the pulsed or modulated neutrino transmitter, and at the receiver, they are separated (demultiplexed).

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the disclosure and together with the description, serve to explain the principles of the disclosure. In the drawings:

Figure 1 shows the z-axis view of the bound electron MO, a prolate spheroidal two-dimensional supercurrent comprising an extended continuous distribution of charge and current completely surrounding the nuclei at the foci, obtained by stretching $Y_0^0(\theta,\phi)$ along the semimajor axis wherein the surface that generates two orthogonal components of angular momentum the phenomenon of electron spin having $\mathbf{L}_z = \frac{\hbar}{2}$ along the z-axis in accordance with an embodiment of the present disclosure.

Figure 2 shows the MO that forms from two H(1/p) atoms wherein the two photons of the 2H(1/p) combine to form a single photon of total angular momentum $\hbar$ that supports surface currents on the dimensional prolate spheroidal current density membrane that have angular momentum components of $\frac{\hbar}{2}$ along the z-axis, $\frac{\hbar}{2\sqrt{2}}$ along the $\left(0\mathbf{i}_x,\mathbf{i}_y,\mathbf{i}_z\right)$ and $\left(0\mathbf{i}_x,-\mathbf{i}_y,\mathbf{i}_z\right)$-axes, and yz-plane projections of the latter of $+/-\frac{\hbar}{4}$ along the $\left(\mathbf{i}_x,\mathbf{i}_y,0\mathbf{i}_z\right)$-axis. The photon-induced currents are equivalent to those a paired and an unpaired electron in the same MO with a current density given by $\frac{1}{2}\left(\uparrow\uparrow+\downarrow\uparrow\right)$ wherein the corresponding angular momentum projections relative to the Cartesian coordinates are shown in accordance with an embodiment of the present disclosure.

Figure 3 is the gas chromatograph (GC) of hydrino gas evolved by acid reaction to $Fe_2O_3@H_2(1/4)$ formed by ball milling FeOOH, wherein @ refers to trapped, bonded, bound, absorbed, impregnated, or embedded in the correspond crystalline matrix or metallic lattice. The GC was run following equal wt% addition of concentrated HCl and allowing the sample to stand in a sealed vessel for 24 hours. The two peaks observed at 4.049 minutes and 4.2 minutes before the H_2 peak at 4.597 minutes were assign to p-$H_2(1/4)$ and o-$H_2(1/4)$, respectively, and O_2 and N_2 were observed at 7.451 and 13.682 minutes, respectively, in accordance with an embodiment of the present disclosure.

Figure 4 shows the EPR spectrum of $GaOOH@H_2(1/4)$ recorded by Bruker using the EMXplus instrument wherein the spin flip transition of the unpaired MO electron of $H_2(1/p)$ gives rise to the observed by electron paramagnetic spectrum. The theoretically predicted g factor for the spin flip transition with the predicted extraordinary features of a series of multiplets due to fluxon linkage within a series of multiplets due to spin-orbital splitting between the diamagnetic paired and paramagnetic unpaired electron of the MO during the EPR transition were observed in accordance with an embodiment of the present disclosure. 1 is the raw data; 2 is the filtered (RC filtered) data; 3 is the low filtered data X 10, and 4 is the high field data X 10.

Figure 5 shows the two very different types of EPR spectra from molecular hydrino samples, $ZnO@H_2(1/4)$ prepared Zn wire detonation in humidified air atmosphere (1 trace) and $Ga(O)OH@H_2(1/4)$ prepared by aqueous KOH treatment of gallium oxide collected following a plasma reaction in a SunCell comprising molten gallium as one of the electrodes (2 trace). The

$ZnO@H_2(1/4)$ and $Ga(O)OH@H_2(1/4)$ spectra are assigned to dimer $[H_2(1/4)]_2$ and an included low-pressure gas of $H_2(1/4)$, respectively, in accordance with an embodiment of the present disclosure.

Figure 6 shows the effect on the EPR signal of 9845 MHz EPR spectrum of $H_2(1/4)$ embedded in a KOH-KI-Ga matrix of different compositions as indicated in the legend showing the fine structure in the first derivative spectrum due to excitation of at least one of ro-vibrational and spin-flip transitions of $H_2(1/4)$ by at least one of the solar and cosmological neutrino flux in accordance with an embodiment of the present disclosure.

Figure 7 is the overlaid 3rd derivative spectra of the 1st derivative spectrum of Figure 6 with spectra of other samples wherein some have different ratios of KOH, KI, and Ga and have been stored for long periods of time showing the stability and reproducibility of the spectra. The third derivative signal isolates the components of the EPR spectrum due excitation of at least one of ro-vibrational and spin-flip transitions of $H_2(1/4)$ by at least one of the solar and cosmological neutrino flux in accordance with an embodiment of the present disclosure. The top curve is the overlaid essentially identical spectra of a KOH-KI-Ga 80-10-10 wt% sample run in 2025 and 2023. The bottom curve is the overlaid essentially identical spectra of a KOH-KI-Ga 80-10-10 wt% sample run in 2025 and a KOH-KI-Ga 18-72-10 wt% sample run in 2025.

Figure 8 is a schematic block diagram of the neutrino telecommunication system showing a neutrino transmitter and receiver and upstream and downstream signal and information sources, storage, transfer, display, transducers, converters, and processing components that may be incorporated in different embodiments in accordance with the present disclosure.

Figure 9 shows the Raman anti-Stokes (-50 cm^{-1} to -8000 cm^{-1}) and Stokes (100 cm^{-1} to 8000 cm^{-1}) of a ball milled FeOOH sample recorded with 25% and 50% 300 mW 785 nm laser power and 100X objective wherein the single-photon anti-Stokes emission is due to two-photon excitation of $H_2(1/4)$ rotaional levels in accordance with an embodiment of the present disclosure in accordance with an embodiment of the present disclosure. 1 is the antiStokes spectrum at 25% laser power; 2 is the antiStokes spectrum at 50% laser power; 3 is the Stokes spectrum at 25% laser power, and 4 is the Stokes spectrum at 50% laser power.

Figure 10 shows the Raman anti-Stokes (-50 cm^{-1} to -8000 cm^{-1}) of the Ni and tin-coated Ni foil samples run in the SunCell® and control Ni foil recorded with 50% of 300 mW 785 nm laser power and 100X objective wherein the single-photon anti-Stokes emission is due to two-

photon excitation of $H_2(1/4)$ rotaional levels in accordance with an embodiment of the present disclosure in accordance with an embodiment of the present disclosure. 1 is nickel foil; 2 is Sn drop, and 3 is nickel control.

Figure 11 shows the Raman Stokes (3000 cm^{-1} to 8000 cm^{-1}) of the Ni and tin-coated Ni foil samples run in the SunCell® and control Ni foil recorded with 50% of 300 mW 785 nm laser power and 100X objective. The peaks match the corresponding second and third order lines of the anti-Stokes lines shown in Figure 10 in accordance with an embodiment of the present disclosure in accordance with an embodiment of the present disclosure. 1 is nickel foil; 2 is Sn drop, and 3 is nickel control.

Figure 12 shows the 325 nm Raman spectrum (12,250-14,750 cm^{-1}) emission spectrum obtained on the Ni foil sample maintained in a SunCell® during a hydrino plasma reaction for 10 minutes showing the series of single-photon emission peaks matching $H_2(1/4)$ rotational transitions due single-photon excitation by the 587.8 nm laser. A tin coating on the Ni foil did not show the peaks in accordance with an embodiment of the present disclosure.

Figure 13 shows the single-photon ultraviolet 6kV electron-beam excitation emission spectrum recorded on KCl getter impregnated with hydrino reaction product gas $H_2(1/4)$ gas from a sealed reactor of the gun powder reaction, KNO_3 with softwood charcoal having the formulation C_7H_4O. The corresponding energy spectrum in the ultraviolet comprised a series of 0.24 eV evenly spaced peaks centered at about 260 nm that comprised the ro-vibration band from the $H_2(1/4)$ $v=1$ to $v=0$ vibrational transition shifted by the higher effective mass of $H_2(1/4)$ in a solid matrix and the 1950 cm^{-1} spaced lines of the free rotor P-branch of $H_2(1/4)$ in accordance with an embodiment of the present disclosure.

Figure 14 shows the single-photon ultraviolet emission spectrum from electron beam excitation of $H_2(1/4)$ gas released from heating $FeOOH@H_2(1/4)$ and mixed with atmospheric pressure argon gas absent $H_2(1/4)$ gas. The cutoff of 8.2 eV and the line spacing of 0.25 eV matched the $v=1$ to $v=0$ vibrational transition with the P-branch rotational spectrum of $H_2(1/4)$ in accordance with an embodiment of the present disclosure.

Figure 15 is the 325 nm, 300 grating Raman-mode photoluminescence spectrum from two-photon excitation of ro-vibrational levels of ball milled KOH-KCl. The two-photon first order $H_2(1/4)$ rotational $v=1$ to $v=0$ vibrational transition emission lines were observed at ½ the energy of each transition with the corresponding second, third, and fourth order lines in

accordance with an embodiment of the present disclosure. 1 is no filter; 2 is filter before sample, and 3 is filter after sample.

Figure 16 is the high resolution (0.5 cm^{-1}) FTIR spectrum (490–4000 cm^{-1}) of KI@H_2(1/4) showing unique sharp peaks assigned to H_2(1/4) rotational excitation as well other sharp peaks assigned to rotational, spin orbital, and fluxon linkage transitions in accordance with an embodiment of the present disclosure.

Figure 17 shows the CNB, C-Nu-B, or CγB (cosmological neutrino background) flux, solar neutrino flux, and the flux of other cosmic sources as a function of neutrino energy as well as the EPR transition energy range in accordance with an embodiment of the present disclosure.

Figure 18 is the 3rd derivative EPR signal at 9782 MHz recorded on H_2(1/4) embedded in a ZnO matrix (e.g. ZnO@H_2(1/4)) (1 trace) overlaid on the third derivative EPR spectrum of H_2(1/4) in a KOH, KI, and Ga matrix (2 trace) showing a matrix effect on the absorption or interaction of cosmological neutrinos with H_2(1/4) in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION

Neutrino Telecommunication System

Disclosed herein are telecommunication systems and methods that transfer information over distances with low attenuation using neutrino pulses that encode information of corresponding telecommunication signals. In one embodiment, the communication signal may be transmitted digitally as pulses of neutrinos. In an exemplary embodiment, a pulse in a temporal signal stream represents a 1 and an absence of a pulse represents a 0. The digital neutrino signals may be transmitted in all directions or in a selective direction. In an embodiment, a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) may be trapped, dissolved, mixed, or bonded in a gas, liquid, or solid as a solution, mixture, or compound. In an exemplary embodiment, molecular hydrino such as $H_2(1/4)$ may be trapped a metal lattice such as a nickel lattice, in an inorganic lattice such as that of a powdered sample such as that of GaOOH, or a crystalline matrix such as that of a single crystal serves as a neutrino communications transceiver/receiver such as one that transmits and receives at least one of audio, data, or video information. The theoretical background of the present invention is presented in "Mills GUT" [R. Mills, The Grand Unified Theory of Classical Physics, April 2023 Edition, ISBN 979-8-218-17988-5, Library of Congress Control Number 2023905641, https://brilliantlightpower.com/GUT/GUT-CP-2020-Ed-Web.pdf], the contents of which are herein incorporated by reference in its entirety. Equations and figures of the disclosure of the type X.X refer those given by Mills GUT.

Nature of Neutrinos

The structure and characteristics of antineutrinos and neutrinos is given in Mills GUT Chapter 39. Due to its unusual angular momentum, the antineutrino and neutrino interact extremely weakly with matter. Essentially, it only has a finite cross-section for processes which conserve spin of two fundamental particles participating in a nuclear reaction such as beta decay, inverse beta decay, and photoneutron production reaction (Eq. (5.119)).

$$\begin{array}{l} \gamma + p^+ \rightarrow n + \pi^+ + \pi^0 \\ \qquad\qquad\quad \downarrow \qquad\quad \downarrow \\ \qquad\qquad\quad \mu^+ + \nu_\mu \qquad 2\gamma \\ \qquad\qquad\quad \downarrow \\ \qquad\quad e^+ + \nu_e + \bar{\nu}_\mu \\ \qquad\quad \downarrow e^- \\ \qquad\quad 2\gamma \end{array} \tag{1}$$

where p^+ is the proton, n is the neutron, π^+ is the positive pion, μ^+ is the positive muon, ν_e is

the electron neutrino, ν_μ is the muon neutrino, and $\bar{\nu}_\mu$ is the muon antineutrino. There are three classes (flavor) of neutrinos (antineutrinos) corresponding to the electron (antielectron), muon (antimuon), and tau (antitau) as described in the Leptons section. Each flavor corresponds to its multipolarity and polarization, $\cos^2\theta$, $\sin^2\theta$, and the superposition of $\cos^2\theta$ and $\sin^2\theta$. Its particle versus antiparticle type corresponds to its handedness. The determination of the flavor and type assignment can be determined by the multipolarity and polarization and handedness of the particle reaction that gives rise to the neutrino that conserves these aspects as well as energy and linear momentum. The energy of the electric and magnetic fields given by Eq. (1.154) and Eq. (1.263), respectively, equals the energy given by the Planck equation (Eq. (4.8)).

Thus, neutrinos are each a type of photon that travels at the speed of light, and each has an exceptional $\frac{\hbar}{2}$ angular momentum in its electric and magnetic fields giving rise to an intrinsic weak interaction with to nuclei. Light speed is characteristic of and identifies photons, but each has of an angular momentum of $\hbar$ in its electric and magnetic fields as given in Mills GUT the Equation of the Photon section. Neutrinos have been confirmed to be a type of photon by the measurement of the neutrino velocity with the OPERA detector to be the speed of light to within a relative difference of $\left(2.48 \pm 0.28(sat) \pm 0.30(sys)\right) X10^{-5}$ [T. Adam, et. al., "Measurement of the neutrino velocity with the OPERA detector in the CNGS beam", Sept., (2011), http://arxiv.org/abs/1109.4897]. Moreover, the speeds of photons and neutrinos are identical within a part per billion from the coincidence of optical and neutrino detection of supernova 1987A [L. M. Krauss, S. Tremaine, "Test of the weak equivalence principle for neutrinos and photons", Phys. Rev. Lett., Vol. 60, (1988), pp. 176-177].

A neutrino interaction with a particle such as absorption requires that the particle possesses current along two orthogonal axes perpendicular to the incident neutrino propagation direction to match the $\sin 2\theta$ variation of the neutrino E&B fields in space and time. Whereas photon absorption requires that the particle possess current along one axis to match the $\sin\theta$ variation of the photon E&B fields in space and time as shown in Mills GUT the Equation of the Photon section. The single directional electron current corresponding to spin and orbital angular momentum is given in Mills GUT the One Electron Atom and Excited States of the One Electron Atom (Quantization) sections. Baryons such as protons and neutrons are spin ½ particles possessing current variation along three orthogonal axes corresponding to current along two orthogonal axes relative to a neutrino propagation direction as shown in Mills GUT the Proton and Neutron section. Furthermore, molecular hydrino such as $H_2(1/p)$ comprises a paired and an unpaired electron in a single molecular orbital (MO) with a current density function given by ½ (↑↑ + ↓↑) wherein the current density function of $H_2(1/p)$ is given graphically by the sum of current density of Figure 11.2 (Figure 1) plus ½ times the current of Figure 11.2 superimposed

on its mirror image as given in Mills GUT the Parameters and Magnetic Energies Due to the Spin Magnetic Moment of $H_2(1/4)$ section. Specifically as shown in Figure 2 the $H_2(1/p)$ MO forms from two H(1/p) atoms wherein the two photons of the 2H(1/p) combine to form a single photon of total angular momentum $\hbar$ that supports surface currents on the dimensional prolate spheroidal current density membrane that have angular momentum components of $\frac{\hbar}{2}$ along the z-axis, $\frac{\hbar}{2\sqrt{2}}$ along the $\left(0\mathbf{i}_x,\mathbf{i}_y,\mathbf{i}_z\right)$ and $\left(0\mathbf{i}_x,-\mathbf{i}_y,\mathbf{i}_z\right)$-axes, and yz-plane projections of the latter of $+/-\frac{\hbar}{4}$ along the $\left(\mathbf{i}_x,\mathbf{i}_y,0\mathbf{i}_z\right)$-axis. Molecular hydrino $H_2(1/p)$ has dimensions of 1/p those of H_2 and consequently migrates faster on a molecular sieve chromatographic column as shown in Figure 3.

The unpair MO electron of $H_2(1/p)$ with a net electron spin of ½ of the $H_2(1/p)$ MO gives rise to spin flip transitions observed by electron paramagnetic spectroscopy (EPR) and well as magnetism observed by magnetic susceptibility measurements [R. Mills, "Hydrino States of Hydrogen", https://brilliantlightpower.com/pdf/Hydrino_States_of_Hydrogen.pdf, submitted for publication ("Mills HSH"); Wilfred R. Hagen, Randell L. Mills, "Electron Paramagnetic Resonance Proof for the Existence of Molecular Hydrino", Vol. 47, No. 56, (2022), pp. 23751-23761; https://www.sciencedirect.com/science/article/pii/S0360319922022406 ("Hagen and Mills 2022"); Wilfred R. Hagen, Randell L. Mills, "General EPR pattern from molecular hydrino produced in various reactors", (2024), submitted; https://brilliantlightpower.com//pdf/General_EPR_pattern_from_molecular_hydrino_produced_in_various_reactors.pdf ("Hagen and Mills 2024)]. EPR was reported on a matrix material Ga(O)OH that had the rare ability to trap individual $H_2(1/4)$ molecules in a gas-like state that allowed for the study of theoretically predicted fine structure in the EPR hydrino signature. Specifically, Hagen and Mills 2022 reported (Figure 4) the theoretically predicted g factor for the spin flip transition with the predicted extraordinary features of a series of multiplets due to fluxon linkage within a series of multiplets due to spin-orbital splitting between the diamagnetic paired and paramagnetic unpaired electron of the MO during the EPR transition. The EPR spectrum of GaOOH@H2(1/4) was replicated by Bruker using two instruments wherein the data recorded with the EMXplus instrument is shown in Figure 4.

Another consideration is that molecular hydrino can also form dimers that would shift the EPR spectrum. In an embodiment, the transmission band or energy band of the communication signals caried by neutrinos may be controlled by controlling the energy or energy band of the emitted neutrinos. The energy of the emitted neutrinos may be controlled by selecting the monomer, dimer, timer, … multimer type of H2(1/p) (e.g. $H_2(1/p)$, $[H_2(1/p)]_2$, $[H_2(1/p]]_4$,…,

$[H_2(1/p)]_n$) and the p state of $H_2(1/p)$ or mixed p states of $H_2(1/p)$ in the case of $H_2(1/p)$ multimers.

In Hagen and Mills 2024, a large down-field singlet signature and temperature dependencies recorded by EPR were reported that confirm the theoretical prediction of the formation of molecular hydrino dimers $[H_2(1/p]]_2$ as an extension of ordinary hydrogen chemistry. H_2 is known to form dimers $[H_2]_2$ at cryogenic temperatures whereas $[H_2(1/p]]_2$ was shown to be stable at elevated temperatures. Unlike the free-gas $H_2(1/4)$ monomer spectrum of $Ga(O)OH@H_2(1/4)$ shown in high resolution in Figure 4, the dimer $[H_2(1/4)]_2$ EPR spectra were very broad. Specifically, Figure 5 shows two very different types of EPR spectra from molecular hydrino samples, $ZnO@H_2(1/4)$ prepared by Zn wire detonation in humidified air atmosphere (blue trace) and $Ga(O)OH@H_2(1/4)$ prepared by aqueous KOH treatment of gallium oxide collected following a plasma reaction in a SunCell [Mills HSH] comprising molten gallium as one of the electrodes (red trace).

Moreover, at low temperatures, it was observed that $[H_2(1/4]]_2$ dimers side to side anti-paired to form tetramers that were not EPR active. As the temperature was raised the EPR singlet for the dimer reappeared at the predicted temperature. The results further show the production of $H_2(1/8)$ and $[H_2(1/8]]_2$ dimers indicating greater release of energy than production of $H_2(1/4)$. The observation of the formation of a dimer between molecular hydrino $H_2(1/4)$ and H_2 ($[H_2\text{-}H_2(1/4)]$) and the temperature dependence of hydrogen release explains the massive amounts of hydrogen observed from salts containing molecular hydrino reported previously [Mills HSH].

Absorption and Emission of de Novo Neutrinos

The hydrino molecular orbital has current variation along two orthogonal axes and therefore can absorb a neutrino to excite molecular rotation. The rotational energies of low-p-state molecular hydrino correspond to photons in the visible and UV range, and are higher energy for high p-state $H_2(1/p)$. The energy of the absorbed neutrino can be emitted as two photons, one from the paired and one from the unpaired electron source currents. Similarly, molecular hydrino can directly absorb and emit a combination of two of the group of one photon, two photons, and a neutrino during molecular rotational transitions [Mills HSH]. The geometric cross section of the hydrino molecular orbital is about 8 orders of magnitude greater than that of a baryon. Further given that nuclear-neutrino interactions occur at MeV energies and higher whereas neutrino-vibrational excitation of $H_2(1/p)$ occurs at about 10 eV or higher and EPR transitions are excited with 10^{-5} to 10^{-4} eV, the energy dependency factor of the geometric cross section of the latter interaction is between 10^{10} to 10^{20} times higher wherein the neutrino geometric cross section is proportion to its wavelength squared. Thus, the cross-section for

neutrino absorption by molecular hydrino approaches 28 orders of magnitude higher (i.e. 10^{28} times) than that of nuclei. Molecular hydrino ro-vibrational states may also be excited by collisions such as by electron beam excitation wherein de-excitation may result in the emission of one or two photons or a neutrino.

Rotational and vibrational excited states cause a shift and give rise to fine structure in the EPR spectrum of small molecules [Clough, A.H. Curran, B. A. Thrush, The e.p.r. spectrum of vibrationally excited hydroxyl radicals, 1971; Royal Society; Volume: 323; Issue: 1555 Linguagem: Inglês, 10.1098/rspa.1971.0122; https://royalsocietypublishing.org/doi/10.1098/rspa.1971.0122]. Figure 6 shows the 1st derivative EPR spectrum of $H_2(1/4)$ embedded a KOH-KI-Ga matrix. The fine structure in the first derivative spectrum is due to excitation of at least one of ro-vibrational and spin-flip transitions of $H_2(1/4)$ by at least one of the solar and cosmological neutrino flux. Figure 7 is overlaid the 3rd derivative spectra of the 1st derivative spectrum of Figure 6 with spectra of other samples wherein some have different ratios of KOH, KI, and Ga and have been stored for long periods of time showing the stability and reproducibility of the spectra. The third derivative signal isolates the components of the EPR spectrum due excitation of at least one of ro-vibrational and spin-flip transitions of $H_2(1/4)$ by at least one of the solar and cosmological neutrino flux.

The ability to excite digital pulses of neutrino emission from molecular hydrino using pulsed or modulatable lasers or particle beams such as electron beams and neutrino to photon conversion using molecular hydrino detection as part of digital detector is the basis of a telecommunications system that can send essentially unattenuated signals through objects including the Earth. Vulnerable systems such as repeater towers and satellites may be eliminated, and challenging transmission applications may be solved (e.g. a neutrino communication system may be used for submarine communication whereas, unlike electromagnetic waves and spin 1 photons, neutrinos are essentially unattenuated by water). In an embodiment to provide and transfer telecommunication signals over distances, the neutrino communication system of the present invention can include at least one transducer such as an audio or video transducer or other source of data to produce a communication signal or data stream, a data stream such as data stored or processed in a computer, at least one memory element to store and to provide a communication signal or data stream, a data stream and communication signal output bus, and a processor such as a computer that receives the data stream and communication signal output that is transferred through space encoded and decoded using pulsed neutrinos to carry the signal.

Specifically, as shown in Figure 8, a neutrino communication system 20 of the present invention can be employed to transmit selected types of information, such as telecommunication signals including at least one of data, text, video, and audio signals. The system 20 can include a

source of input information 1, such as signals, such as analog or digital signals that may be live streamed from a sensor or other transducer or feed, or stored information where such information is stored on a storage medium such as a hard drive. The neutrino telecommunication system can also include an optional analog to digital converter 2 in the circumstances where the input information or data is analog. The system also includes an excitor 3 capable of pulsed exciting ro-vibrational states in a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$). The excitor 3 can include at least one of (a) a pulsed energy source such as a pulsed electro-optical converter, a pulsed source of photons such as a pulsed laser such as a pulsed diode laser, or a pulsed source of energetic particles such as a pulsed particle beam such as a pulsed electron beam, and (b) a fast switch of the energy source of at least one ro-vibrational transition to cause pulsed excitation by a pulsed or continuous energy source, such as a photon source, such as a laser (e.g., a diode laser) and a particle beam such as an electron beam. The illustrated neutrino telecommunication system 20 can optionally include a wireless or physical connection 4 to transfer or receive energy or signals, such as excitation or a conduit of the information. The connection 4 can be a bus, such as a data, text, video, or audio signal bus 4. The bus can be an electronic or optical fiber pathway through which signals can be transferred between or to hardwired components, such as to the excitor 3. In other embodiments, the connection 4 can be a wireless connection. The components of the neutrino telecommunication system 20 can be wirelessly or physically connected, or the components can be juxtaposed optionally comprising a multifunctional component. The neutrino telecommunication system can also include a neutrino transmitter 5, such as a pulsed neutrino transmitter having a composition of matter comprising a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$), such as at least one of solid gas@$H_2(1/p)$, liquid gas@$H_2(1/p)$, or gaseous gas@$H_2(1/p)$ such as argon(l)@$H_2(1/p)$, argon(g)@$H_2(1/p)$, ice@$H_2(1/p)$, water@$H_2(1/p)$, steam@$H_2(1/p)$, CO_2(s)@$H_2(1/p)$ and solid compounds further comprising $H_2(1/p)$ such as KOH-KCl@$H_2(1/p)$, FeOOH@$H_2(1/p)$, or GaOOH@$H_2(1/p)$. It is contemplated herein that at least one of deuterium (D) and tritium (T) may replace hydrogen (H) that receives the digital signals and emits pulses of neutrinos to form telecommunication signals, wherein the neutrino pulses encode selected information in a digital or analogue format.

The neutrino telecommunication system 20 can also include a neutrino receiver 6 that receives the telecommunication signals from the transmitter 5. The telecommunication signals can include neutrinos, such as pulsed neutrinos, and converts the signal into another form of emission, such as a pulsed emission, an example of which is a photon emission (e.g. at least one of X-ray, EUV, visible, infrared, microwave, and radio wave) or energetic particle emission. In another embodiment, the neutrino transmitter 5 comprises a cosmological neutrino background attenuator which encodes data and information in a time dependent reduction in the cosmological neutrino background along the line of sight between the transmitter 5 and receiver 6. The system

20 can further include a transducer or detector 7 of the converted neutrino signals. The transducer or detector 7 can be an electro-optical converter, such as a photodiode, or an electron or ion detector. The neutrino telecommunication system 20 also includes a processor 8 to process or store the digital signals from the detector 7. The system 20 can include an optional analog-to-digital converter, such as a transmitter modem 8, to output analog signals if the signals are analog in nature, wherein the modem may transmit data by modulating one or more carrier wave signals to encode the digital information. The neutrino telecommunication system 20 can also include an optional receiver modem 9 to receive the analog modulated wave signals and demodulate the signal to reconstitute the original digital information to be processed or stored as data. The system 20 further includes an optional additional processor 10 to record the received signal information as data and output the data to a video screen, memory element, speaker, or other output device known in the art or store the data in a storge medium. Other upstream communication systems and information processing systems can provide the streaming signals are within the scope of the present invention, such as fiber optic transmitters and receivers, RF or microwave transmitters and receivers, modems, fiber optic the cables, antennas, routers, the internet, Wi-Fi systems, computers such as desktops, main frames, and laptops, mobile devices such as smart phones and wearables, and printers, cameras, microphones.

The excitor 3 may excite at least one transition of a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$), such as at least one of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, and magnetic tilt transition. In an embodiment, the excitor 3 comprises a diode laser to directly achieve pulsed excitation of at least one ro-vibrational transition of the molecular hydrino species that can be switched rapidly, achieving short-duration pulses (e.g. 10^{-3}s to 10^{-12}s) and repetition rates in the range of 100 Hz to 10 gigahertz as used in telecommunications known in the art through methods like current modulation, electro-optical modulation, Q-switching, and mode locking. The laser can output light in the energy range of about the energies of $H_2(1/p)$ ro-vibrational levels such as those given by Eqs. (11-12) such as an energy in the range of X-ray to infrared (e.g. 10 keV to 0.05 eV). An exemplary light source comprises an infrared, visible, UV, or X-ray laser. In an embodiment of the present invention, a fast switch of the energy of at least one ro-vibrational transition of the molecular hydrino species to cause pulsed excitation by a pulsed or continuous energy source, such as a photon source, such as for example a laser (e.g., a diode laser) or a particle beam, such as an electron beam comprises a fast speed magnetization switch, such as that achieved with electric current or laser opto-magnetic interactions by ultrafast lasers [C. Wang, Y. Liu, "Ultrafast optical manipulation of magnetic order in ferromagnetic materials", Nano Convergence, Vol. 7, No. 35, (2020), https://nanoconvergencejournal.springeropen.com/articles/10.1186/s40580-020-00246-3] applied

to the molecular hydrino such as $H_2(1/4)$ or $[H_2(1/p)]_n$ wherein the molecular hydrino species may be embedded in a matrix, such as Fe_2O_3 or $Cu(OH)_2$-ZnO-Ga that may be magnetic.

The transmitted neutrinos may excite at least one transition of a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$) of the receiver 6 such as at least one of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, and magnetic tilt transition. In an embodiment, the receiver 6 includes a molecular hydrino species absorber that forms an excited ro-vibrational state that decays or at least partially undergoes internal conversion to 1 or 2-photon emission to a photodetector that transduces the photon signal to an electronic signal. In an embodiment, the energy of the decay or partial decay of the ro-vibrational state is down converted to a lower energy photon emission such as an infrared photon emission that may be detected by a detector 7 of the receiver and converted to an electrical signal for processing by the processor/modem 8. In an alternative embodiment, the receiver 6 can include a magnetic field source, such as a permeant magnet or an electromagnet. In another embodiment, a magnetic field from a magnetic field source, such as an electromagnet or permanent magnet, is applied to the molecular hydrino species such as $H_2(1/p)$ to facilitate or cause neutrino absorption or interaction and to convert the energy from neutrinos to another form of energy. In an exemplary embodiment, the absorption or interaction, such as an excited thermal or ro-vibrational state or an electron spin transition or an electron spin-flip transition, may cause the emission of at least one or microwave and radio waves that may be received by the receiver 6 and converted to electrical signals and processed. At least one of the transmitter 5 and receiver 6 may include a means to cause or detect at least one of an electron-spin-flip transition and microwaves emitted due to spin-flip transitions. The receiver 6, for example, may include at least one of (i) an antenna; (ii) an optoelectronic oscillator (OEO) detector; (iii) a bolometer; (iv) a high frequency superconducting quantum interference (SQUID) device, such as one comprising a molecular hydrino species as part of the inductor of an RLC circuit; (v) a III-V nanowire heterostructure and a magnetic tunnel junction (MTJs) that exploit quantum-confined energy levels or spintronic effects; (vi) an optomechanical system and photonic-based references in phase-locked loops (PLLs) that can convert microwave signals into the optical domain or provide ultra-low noise references which improves detection sensitivity and phase noise analysis; (vii) Rydberg atom sensors; (viii) a network analyzer; (ix) an organic molecular quantum receiver that uses organic molecular spins; (x) a microwave photon counter, such as a superconducting qubit, such as a single-microwave photon detector; (xi) a scanning tunneling microscope; (xii) an optical detector using Faraday rotation of a laser pulse; (xiii) a single photon calorimeter; and (xiv) other detectors known in the art. The signal to noise may be improved by modulating the magnetic field and filtering the signal accordingly. An exemplary system to convert absorbed energy into microwave mission when the absorbing material is placed in a magnetic field is that reported by

Safranski et al. [Safranski, C., Barsukov, I., Lee, H.K. et al. Spin caloritronic nano-oscillator. Nat Commun 8, 117 (2017). https://doi.org/10.1038/s41467-017-00184-5] which is herein incorporated by reference in its entirety. Alternatively, the energy of the decay or partial decay of the ro-vibrational state may accelerate a particle, such as an electron that in turn is detected by a particle detector to transduce the energy to an electronic signal.

Since neutrinos are not attenuated by non-molecular hydrino matter. The neutrino telecommunication system of the present invention can include at least one repeater that repeats and boosts the signal intensity when below a threshold intensity wherein the intensity is diminished only by the spatial distance of flight. The repeater may comprise the receiver 6 and the transmitter 5 of the present invention.

Exemplary lattices or matrices for the molecular hydrino species such as $H_2(1/4)$ or $[H_2(1/4)]_n$ are nickel, iron, manganese, cobalt, and gold metals, silicon, an alkali halide, an alkali hydroxide, mixtures of an alkali halide and alkali hydroxide, an oxyhydroxide such as FeOOH, and an oxide such as Fe_2O_3. In one embodiment, the molecular hydrino $H_2(1/p)$ is embedded or impregnated in a matrix that changes the lifetime of the $H_2(1/p)$ ro-vibrational excited states such as decreases the lifetime. The matrix may be a crystalline matrix that decreases the lifetime by selected mechanisms, such as by resonance, with at least one other transition of the matrix material, interaction between $H_2(1/p)$ molecules that is increased with packing, the formation of multimers such as $[H_2(1/p)]_2$ or $[H_2(1/p)]_n$,wherein Fermi resonance may occur between modes. Vibrational state lifetimes may be very short on the order of picoseconds (e.g. 10^{-3}s to 10^{-13}s).

In another embodiment, as shown in Figure 8, the neutrino telecommunication system of the present invention can include a plurality of neutrino telecommunication subsystems to transmit a plurality of independent signal streams. Each subsystem can include, for example, a (i) pulsed transmitter 5 to transmit information via a pulsed neutrino stream, (ii) a receiver 6 to receive the pulsed neutrino stream and emit one of pulsed photons or particles such as pulsed electrons, (iii) a transducer such as an opto-electronic or electron detector to convert the emitted pulsed photons or pulsed electrons to a digital electrical signal, and (iv) a processor to reconstitute the information or a modem to further transmit the signal such as an analog signal. Alternatively, the neutrino telecommunication system 20 can include an optional multiplexer and demultiplexer combination 12 to encode multiple signal streams 22 of independent information multiplexed within the band width of the neutrino wavelength and neutrino pulse lengths and separate the received signals, respectively. The signal streams 22 can come from any selected portion of the system 20 or from a remote telecommunications system, and for illustrative purposes, is shown as multiplexing the signals 22 received therefrom. Those of ordinary skill in the art will readily recognize that the functions of the illustrated multiplexer and demultiplexer 12 can be distributed between the transmitter 5 and the receiver 6. In this configuration, the

transmitter 5 can be configured to multipex (e.g., combine) the signals and the receiver 6 can be configured to demultiplex (e.g., separate) the signals. In another embodiment, the multiplexing of independent neutrino telecommunication signals combines multiple signals into a single transmission using techniques like Wavelength-Division Multiplexing (WDM), Time-Division Multiplexing (TDM), Code-Division Multiplexing (CDM), Polarization-Division Multiplexing (PDM), or Selection Rule Division Multiplexing (SRDM) allowing efficient resource utilization. In an embodiment, signals are combined (multiplexed) at the pulsed neutrino transmitter, and at the receiver, they are separated (demultiplexed).

Wavelength-Division Multiplexing (WDM) may be achieved using excitors that operate at different energies to cause the emission and reception of neutrinos of different wavelengths corresponding to different ro-vibrational transition energies due to (i) at least one of different p states and multimer states of molecular hydrino, such as $H_2(1/p)$ or $[H_2(1/p)]_n$; (ii) different ro-vibrational energy transitions of molecular hydrino such as $H_2(1/p)$ or $[H_2(1/p)]_n$, (iii) a common ro-vibrational energy transition with different matrices in which the molecular hydrino species such as $H_2(1/p)$ or $[H_2(1/p)]_n$ is embedded; (iv) common ro-vibrational energy transition with different temperatures of the matrices in which the molecular hydrino species, such as $H_2(1/p)$ or $[H_2(1/p)]_n$ is embedded; and (v) common ro-vibrational energy transition of a molecular hydrino species, such as $H_2(1/p)$ or $[H_2(1/p)]_n$ wherein at least one of deuterium (D) and tritium (T) may replace hydrogen (H); and (vi) common ro-vibrational energy transition of the molecular hydrino species such as $H_2(1/p)$ or $[H_2(1/p)]_n$ with different applied fields or field strengths, such as magnetic and electric fields. For example, the emission and absorption of neutrinos by the transmitter and receiver, respectively, at a series of energies corresponding to those of at least one of spin-orbital coupling and fluxon linkage transitions of a rovibrational transition may be achieved by at least one of (a) application of a magnetic field to magnetize the matrix comprising an embedded molecular hydrino such as $H_2(1/4)$ or $[H_2(1/p)]_n$, and (b) using a molecular hydrino species embedded in a magnetic material such as one comprising a magnetic or ferromagnetic species such as Fe, Co, Ni, or transition element metal or compound such as an oxide.

Time-Division Multiplexing (TDM) may allocate time slots within a fixed frame to multiple pulsed neutrino signals from the transmitter 5, by transmitting the multiple signals in rapid succession, each assigned to a specific time slot in the frame. The pulsed neutrino transmitter 5 may comprise a time multiplexer to interleave the signals in time, creating a composite signal. The receiver 6 may comprise a time demultiplexer that separates the signals based on their time slots.

Code-Division Multiplexing (CDM) may assign each neutrino signal a unique code, and the signals may be transmitted simultaneously, with the neutrino receiver using the code to separate the signals.

Polarization-Division Multiplexing (PDM) may use different polarizations of the neutrinos used to transmit different signals. The neutrino telecommunication system can include a source of at least one of an electric and magnetic field and a ro-vibrational transition polarizing laser to produce polarized neutrinos, wherein different signals have different polarizations. In an exemplary embodiment, a magnetic field aligns the magnetic moment of at least one of the molecular hydrino species that serves as the emitter or receiver to affect the transfer of the corresponding signals. The effect on the EPR signal of the relative neutrino propagation direction and magnetic field alignment of the magnetic moment of the $H_2(1/p)$ absorber or receiver is shown in Figures 6 and 7. Specifically, EPR spectra of $H_2(1/4)$ embedded in a KOH-KI-Ga matrix showing the fine structure in the first derivative spectrum and the third derivative spectrum due to excitation of at least one of ro-vibrational and spin-flip transitions by at least one of solar and cosmological neutrino flux are shown in Figures 6 and 7, respectively. In an embodiment, at least one of the neutrino transmitter and receiver may comprise at least one of an EPR spectrometer and a source of electromagnetic radiation such as a source of radio frequency or microwave radiation.

Multiplexing may also be achieved by using ortho and para spin isomers of $H_2(1/p)$ due to the different energies of at least one of the ro-vibrational, spin orbital, fluxon linkage, and nuclear spin transitions.

In still another embodiment, at least one of the transmitter and a receiver can include an electron paramagnetic resonance (EPR) spectrometer, such as one comprising a permanent magnet, a means to vary or scan the magnetic field over time, a source of microwave transmission to irradiate a population of magnetically aligned hydrino molecules, and a receiver and processor to receive the microwaves and record the absorption of the microwave power. The source of microwaves may comprise a frequency tunable microwave cavity. The neutrino transmitter may further comprise excitor such as a pulsed laser or electron beam wherein the excitation of a ro-vibrational state of the molecular hydrino species shifts the energy of the EPR signal of the species and vice versa such that the shifts are encoded in the transmitted pulsed neutrinos from emission during de-excitation. The receiver may also comprise an EPR spectrometer. At the receiver, the energy of the excited ro-vibrational state of the molecular hydrino species such as $H_2(1/p)$ or $[H_2(1/p)]_n$ may shift the EPR signal which is processed by the processor to receive the signals encoded in the incident pulsed neutrinos.

Selection Rule Division Multiplexing (SRDM) may use ro-vibrational transitions with differ selection rules to transmit different signals. The telecommunications system may comprise a source of at least one of an electric and magnetic field and a ro-vibrational transition polarizing laser to select transitions with different selection rules for neutrinos transmission or reception wherein different signals are carried by the different selected transitions.

In still another embodiment, the neutrino emission direction may be controlled to provide a preferred broadcast pattern such as omnidirectional or line of sight. The line of sight may be through physical structures or even the Earth. The alignment of emitter and receiver may be determined by the locational information such as GPS coordinates of the emitter and receiver. In an embodiment, the communication system further comprises at least one of a steerable source of magnetic field such as a permanent or electromagnet and a steerable source of photons such as a laser to cause directional neutrino emission. The directionality may be achieved by magnetic alignment of at least one of the nuclear and electron spins of the hydrino molecules, and polarization of at least one of the electron and nuclear spins of the hydrino molecules. The polarization may be achieved by laser irradiation. In an embodiment, directionality may be achieved by applying a field such as an electric or magnetic field to molecular hydrogen species, such as hydrino molecules $H_2(1/p)$, such that neutrino emission from an excited rotational, vibrational, or both a rotational and vibrational excited state (herein referred to as a ro-vibrational state), is of a directionality such as the directionality corresponding to an E2 transition, such as given by at least one of Eqs. (2-10). In yet another embodiment, at least one of the transmission and reception of the neutrino signal may be directional by at least one of aligning molecular hydrino in the lattice and by directional application of at least one of the electric field, magnetic field, photons, energetic particles, and neutrinos. The alignment of molecular hydrino in the lattice may be achieved by at least one of applying one or more of an alignment electric field and an alignment magnetic field, and by embedding the hydrino molecules in a lattice such as a crystalline lattice that may be at least one of magnetized and electrically polarized.

In other embodiments, at least one of two-photon emission, one photon emission, neutrino emission, and particle kinetic energy emission during de-excitation of a ro-vibrational state of $H_2(1/p)$ may give rise to lasing from the excited ro-vibrational state to at least one of amplify the communication signal and cause it to be directional in a desired direction. In embodiments of the present invention, molecular hydrino can comprise at least one of a gas in a cavity and $H_2(1/p)$ molecules embedded in a column of crystalline matrix wherein the cavity or column length may be sufficient to achieve pulsed lasing. In other embodiments, pulsed neutrino lasing occurs from excited $H_2(1/p)$ vibrational or ro-vibrational states to produce an amplified directional communication signal that it transmitted from a transmitter to a receiver.

The hydrino molecule comprises two hydrogen isotope nuclei and two electrons in a single molecular orbital (MO). Uniquely, the MO comprises a paired and unpaired electron (Mills GUT, Parameters and Magnetic Energies Due to the Spin Magnetic Moment of $H_2(1/4)$ section). To conserve spin angular momentum during the formation of a bond between two

hydrino atoms, the bond energy must be released as a neutrino such as an electron neutrino of spin ½:

$$H\left(1/p\right)+H\left(1/p\right)\rightarrow H_2\left(1/p\right)+\upsilon_e \quad (2)$$

Specifically, a neutrino comprises a photon having $\frac{\hbar}{2}$ angular momentum in its electric and magnetic fields (Mills GUT, Neutrinos section). During the reaction of Eq. (2), the angular momentum of the reactants is conserved in the products wherein each of the two reacting hydrino atoms are electron spin ½, and the product molecular hydrino and electron neutrino are also each spin ½. The neutrino emission from the $H_2(1/p)$ bond-formation reaction (Eq. (2)) or ro-vibrational transitions involving one or more of neutrinos, photons, and particle collisions such as ones of spin ½ such as electrons may be exploited for transmitting and receiving signals comprising information such as communication signals. Further transitions that result in at least one of neutrino (ν_e), photon (γ), two-photon (2γ), and third body kinetic energy (M^*) absorption or emission involving transitions between an unexcited rovibrational state $H_2(1/p)$; (J,v) and an excited rovibrational state $H_2(1/p)$; (J',v') are

$$H_2\left(1/p\right);\left(J,\nu\right)+\gamma\rightarrow H_2\left(1/p\right);\left(J',\nu'\right) \quad (3)$$

$$H_2\left(1/p\right);\left(J,\nu\right)+2\gamma\rightarrow H_2\left(1/p\right);\left(J',\nu'\right) \quad (4)$$

$$H_2\left(1/p\right);\left(J,\nu\right)+\nu_e\rightarrow H_2\left(1/p\right);\left(J',\nu'\right) \quad (5)$$

$$H_2\left(1/p\right);\left(J,\nu\right)+M^*\rightarrow H_2\left(1/p\right);\left(J',\nu'\right)+M \quad (6)$$

$$H_2\left(1/p\right);\left(J',\nu'\right)\rightarrow H_2\left(1/p\right);\left(J,\nu\right)+\gamma \quad (7)$$

$$H_2\left(1/p\right);\left(J',\nu'\right)\rightarrow H_2\left(1/p\right);\left(J,\nu\right)+2\gamma \quad (8)$$

$$H_2\left(1/p\right);\left(J',\nu'\right)\rightarrow H_2\left(1/p\right);\left(J,\nu\right)+\nu_e \quad (9)$$

$$H_2\left(1/p\right);\left(J',\nu'\right)+M\rightarrow H_2\left(1/p\right);\left(J,\nu\right)+M^* \quad (10)$$

The vibrational energies, E_{vib}, for the $\upsilon=0$ to $\upsilon=1$ transition of hydrogen-type molecules $H_2\left(1/p\right)$ are

$$E_{vib}=p^2 0.515902\ eV \quad (11)$$

where p is an integer.

The rotational energies, E_{rot}, for the J to $J+1$ transition of hydrogen-type molecules $H_2\left(1/p\right)$ are

$$E_{rot}=E_{J+1}-E_J=\frac{\hbar^2}{I}\left[J+1\right]=p^2\left(J+1\right)0.01509\ eV \quad (12)$$

where p is an integer and I is the moment of inertia.

The molecular hydrino species, such as $H_2(1/p)$ or $[H_2(1/p)]_n$, may undergo ro-vibrational transitional excitation due to energy absorption by at the least one of one of neutrino, collisional,

one-photon, and two-photon excitation, and ro-vibrational transitional de-excitation due to energy emission by at the least one of one of neutrino, collisional, one-photon, and two-photon de-excitation. In one embodiment, the selection rules permit at least one of a (i) ro-vibrational transitional excitation due to energy absorption by at the least one of one of neutrino, collisional, one-photon, and two-photon excitation, and (ii) ro-vibrational transitional de-excitation due to energy emission by at the least one of one of neutrino, collisional, one-photon, and two-photon de-excitation. In other embodiments, the emission type (Eqs. (7-10)) may be enabled by application of a directional external field to a composition of matter comprising molecular hydrino. The telecommunications system may comprise a source of at least one of an electric and magnetic field and a ro-vibrational transition polarizing laser to provide the corresponding directional external field. In still other embodiments, the source of the external field, such as an electric or magnetic field, comprises the chemical environment or matrix of molecular hydrino species, such as $H_2(1/p)$ or $[H_2(1/p)]_n$. Exemplary matrices that each provide an external magnetic field are FeOOH, CoOOH, and $Cu(OH)_2$-ZnO-Ga. Exemplary ro-vibrational excitation by two photons or a neutrino may be an E2 or quadrupole transition. The selection rules may be changed to encode the communication signals by application of at least one of the electric and magnetic field, wherein the field or fields may be time dependent such as varied in at least one of direction and intensity to at least one of encode or decode the data and cause the pulsed communication signals to be separated from background noise. The field dependent alteration of the selection rules may also serve to multiplex a plurality of signal streams.

In one embodiment of the present invention, a composition of matter, such as a compound comprising hydrino, such as molecular hydrino $H_2(1/4)$ including $FeOOH@H_2(1/4)$, $Fe_2O_3@H_2(1/4)$, $CoOOH@H_2(1/4)$, and $Cu(OH)_2$-ZnO-$Ga@H_2(1/4)$, may undergo two-photon absorption to excite at least one of a rotational and a vibrational energy state followed by decay as a neutrino or a single photon. In an exemplary embodiment, $Fe_2O_3@H_2(1/4)$ was prepared by ball milling FeOOH. The 785 nm anti-Stokes and Stokes spectra recorded with a Horiba Jobin Yvon LabRAM Aramis Raman spectrometer using the 300 mW 785 nm laser and 1200 line/mm grating are shown in Figure 9. The series of peaks match a $H_2(1/4)$ rotational transition with spin orbital coupling and fluxon linkage fine structure with assignments given in Mills HSH. Mills HSH also reports that the series of Raman peaks recorded on FeOOH ball milled to $Fe_2O_3@H_2(1/4)$ are eliminated by HCl treatment that releases H_2 and $H_2(1/4)$. Figure 3 shows an exemplary gas chromatograph of $H_2(1/4)$ gas released by reaction of HCl with $Fe_2O_3@H_2(1/4)$. Molecular hydrogen occurs in two nuclear isomeric forms, one with its two proton nuclear spins aligned parallel (orthohydrogen), the other with its two proton spins aligned antiparallel (parahydrogen). Parahydrogen is in a lower energy state than is orthohydrogen. Ordinally hydrogen ortho para spin isomers may be separated chromatographically at cryogenic

temperature such as liquid nitrogen temperature. However, due to the much higher energies of hydrino compared to ordinary hydrogen ortho para hydrogen they may be separated at room temperature. The gas released upon addition of concentrated HCl to $Fe_2O_3@H_2(1/4)$ showed both ortho and para hydrogen by gas chromatography as shown in Figure 3.

To further test the two-photon excitation mechanism, the spectra were obtained at 100X objective with the power varied from 25% to 50% wherein it was found that the series of peaks was not observed at 25% laser power but was observed at 50% laser power. The anti-Stokes and Stokes spectra are remarkable in that the energy ranges are higher than any prior recorded, there is a threshold laser intensity to observe the emission lines, and the first, second, and third order peaks are observed that match the rotational transitions of $H_2(1/4)$ and not any known source. The Raman results provide strong confirmation of $H_2(1/4)$ and the two-photon excitation mechanism of the rotational energy levels of $H_2(1/4)$. The results further demonstrate the two-photon rotational excitation mechanism for $H_2(1/4)$ embedded in a powdered magnetic metal oxide matrix that gives rise to spin-orbital and fluxon linkage transitional fine structure.

$Ni(s)@H_2(1/4)$ nickel foil Raman samples were prepared by flowing a hydrino reaction mixture comprising 1500 standard cubic centimeters per minute (sccm) H_2 and 1 sccm O_2 into a one-liter reaction volume SunCell® comprising a quartz dome for optical power transfer, two molten tin injectors electrodes each having a reservoir and an electromagnet pump that injected a molten metal stream wherein the intersection of the streams maintained an electrical connection for a low-voltage-high-current ignition power source that maintained a hydrino reaction plasma by maintaining the high current. The operating pressure was 5.9 Torr. Plasma was maintained by an ignition current of 200 A at a voltage of 15 V. The electromagnetic pump rate was 100 g/s, and the optical output power recorded with a Thor S322C Power Meter was over 30 kW for an input ignition power of 3 kW corresponding to a gain of 10 times. The Ni foils (1 X 1 X 0.1 cm) to make the Raman samples were placed under a quartz reflector in the SunCell® reaction cell chamber. The hydrino reaction was run for 10 minutes, and Ni and tin-coated surfaces of the foils were analyzed by Raman spectroscopy using the Horiba Jobin Yvon LabRAM Aramis Raman spectrometer using the 300 mW 785 nm laser and 600 line/mm grating at 100X objective and 50% power. In addition, the 785 nm Raman spectrum was recorded under identical conditions on a control Ni foil sample run in the SunCell® and stored for six months to allow hydrino to dissipate by diffusion. The series of lines observed in the anti-Stokes spectrum and corresponding Stokes spectrum shown in Figures 10 and 11, respectively, matched those recorded on FeOOH ball milled to $Fe_2O_3@H_2(1/4)$ (Figure 9). Specifically, the series of peaks match a $H_2(1/4)$ rotational transition with spin orbital coupling and fluxon linkage fine structure with assignments given in Mills HSH. The peaks were absent in the control. The results

demonstrate the two-photon rotational excitation mechanism for $H_2(1/4)$ embedded in a magnetic metal matrix that gives rise to spin-orbital and fluxon linkage transitional fine structure.

Figures 9, 10, and 11 show a series of Superconducting Quantum Inference Device (SQUID)-like fluxon transitions of a single rotational and spin-orbital spilt level observed by Raman spectroscopy on magnetic samples such as that $Fe_2O_3@H_2(1/4)$ and $Ni(s)@H_2(1/4)$. These unique one/zero-type magneto-optical signals at different energies are enabling of multiplexing a plurality of different pulsed signals streams at one or more of different fluxon transition wavelengths and spin orbital splitting (WDM). In an embodiment, at least one of the excitor such as a laser may be capable of fast frequency switching and fast speed magnetization switching such as that achieved with electric current or laser opto-magnetic interactions by ultrafast lasers [C. Wang, Y. Liu, "Ultrafast optical manipulation of magnetic order in ferromagnetic materials", Nano Convergence, Vol. 7, No. 35, (2020), https://nanoconvergencejournal.springeropen.com/articles/10.1186/s40580-020-00246-3] applied to the molecular hydrino such as $H_2(1/4)$ or $[H_2(1/p)]_n$, may be enabling of a fast multiplexing by frequency shifting. The emission and absorption of neutrinos by the transmitter and receiver, respectively, at a series of energies corresponding to those of at least one of spin-orbital coupling and fluxon linkage transitions of a rovibrational transition may be achieved by at least one of (i) application of a magnetic field to at least one of magnetize and magnetically align the magnetic moment of the molecular hydrino species such as $H_2(1/4)$ or $[H_2(1/p)]_n$, (ii) application of a magnetic field to magnetize the matrix comprising an embedded molecular hydrino such as $H_2(1/4)$ or $[H_2(1/p)]_n$, and (iii) using a molecular hydrino species embedded in a magnetic material such as one comprising a magnetic or ferromagnetic species such as Fe, Co, Ni, or transition element metal or compound such as an oxide.

In a further embodiment, the telecommunication signals may be encoded in the frequencies of emitted and received neutrinos, wherein the frequency switching may be achieved by excitation or activation of at least one transition split by application of a magnetic field, such as at least one of spin orbital and fluxon linkage transitions of a ro-vibrational transition excited by the excitor, such as a laser. The laser may be capable of fast frequency switching. Fast speed magnetization switching, such as that achieved with applied electric current or laser opto-magnetic interactions by ultrafast lasers applied to at least one of the transmitter and receiver molecular hydrino species, may also cause the desired splitting and corresponding frequency variations. The frequency of the received neutrinos of variable frequency may be read by a corresponding variable photon frequency emission and detection by an optoelectronic detector such as a photodiode or other optical signal detectors known in the art that may further comprise a grating or a filter to determine the frequency (wavelength) of the received signals. In another embodiment, a combination of digital and analog signal encoding may be used to encode the

signal in the transmitted and received neutrinos using frequency shifting and pulsing of the excitor, such as a laser, as well fast speed magnetization switching, such as that achieved with electric current or laser opto-magnetic interactions by ultrafast lasers applied to the molecular hydrino species.

Single-photon excitation of $H_2(1/4)$ was achieved using a 325 nm Raman spectroscopy was also performed on the nickel foil samples having the 785 nm spectra shown in Figure 12 wherein the samples were prepared by flowing a hydrino reaction mixture comprising 1500 sccm H_2 and 1 sccm O_2 into the one-liter reaction volume SunCell® with molten tin injection to maintain the hydrino plasma reaction. The energies $E_{Emission}$ of the novel emission lines that are nearly resonant with the 587.8nm laser line of the 325 nm Raman laser match the double transition for final rotational quantum numbers $J_p^{'}=3; J_c^{'}=1,2$ with energies given by the sum of the independent transitions. Corresponding spin-orbital coupling energy and fluxon linkage energies were also observed with the double transitions wherein the assignments are given in Mills HSH:

$$\begin{aligned} E_{Emission} &= \Delta E_{J=0\to J_p^{'}=3} + \Delta E_{J=0\to J_c^{'}=1,2} + E_{SIO,rot} + E_{\Phi,rot} \\ &= 15{,}602\ cm^{-1}\left(19{,}502\ cm^{-1}\right) + m528\ cm^{-1} + m_{\Phi}31\ cm^{-1} + m_{\Phi 3/2}46\ cm^{-1} \end{aligned} \tag{13}$$

A laser line was observed at 13,750 cm^{-1}.

$H_2(1/p)$ rotational and vibrational transitions may be excited by bombardment of solid getter materials that trapped $H_2\left(1/4\right)$ wherein the particle collisions are of sufficient energy being at least that of the excitation energy of the ro-vibrational energy of the molecular hydrino species. Figure 13 shows the single-photon ultraviolet emission spectrum recorded on KCl getter impregnated with hydrino reaction product gas $H_2(1/4)$ gas from a sealed reactor of the gun powder reaction, KNO_3 with softwood charcoal having the formulation C_7H_4O that was incident a high energy (6kV) electron beam. The corresponding energy spectrum in the ultraviolet comprised a series of 0.24 eV evenly spaced peaks centered at about 260 nm. The intense fluorescence spectra in all such cases comprised the ro-vibration band from the $H_2\left(1/4\right)$ $\nu=1$ to $\nu=0$ vibrational transition shifted by the higher effective mass of $H_2\left(1/4\right)$ in a solid matrix and the 0.24 eV (1950 cm^{-1}) spaced lines of the free rotor P-branch of $H_2\left(1/4\right)$.

Further regarding Figure 13, the intense fluorescence spectra of the ro-vibration band from the $H_2(1/4)$ $\nu=1$ to $\nu=0$ vibrational transition recorded with a EUV spectrometer on emission from 6 keV electron beam bombardment of solid getter materials that trapped $H_2(1/4)$ was shifted by the higher effective mass of $H_2(1/4)$ in a solid matrix wherein the evenly 1950 cm^{-1} spaced lines were from free rotor P-branch of $H_2(1/4)$. The unshifted spectrum was recorded on $H_2(1/4)$ gas released from heating Fe_2O_3@$H_2(1/4)$ was observed by 12 -16 keV electron beam

excitation wherein the electron beam passed through a silicon nitride window of a plasma cell. The ultraviolet emission spectrum from electron beam excitation of $H_2(1/4)$ gas (Figure 14) showed the ro-vibrational P branch of $H_2(1/4)$. The spectral fit was a good match to $4^2 0.515eV - 4^2(J+1)0.01509; J = 0,1,2,3....$ wherein 0.515 eV and 0.01509 eV are the vibrational and rotational energies of ordinary molecular hydrogen, respectively. The R-branch is not expected to be observed due to the lack of population of ro-vibration states with the plasma gas temperature being lower than the ro-vibrational excitation temperature. The fine structure in the spectrum is due to spin-orbital splitting.

Two photon excitation and de-excitation corresponding to Eqs. (4) and (8) were achieved using a high-energy laser. Using Raman spectroscopy was performed on a KCl getter exposed to gas from the thermal decomposition of $Ga_2O_3@H_2(1/4)$ collected from the SunCell®. The spectrum was recorded with a Horiba Jobin Yvon LabRam ARAMIS spectrometer with a 325nm laser and a 1200 grating over a range of 8000-19,000 cm-1 Raman shift. A series of 1000 cm^{-1} (0.1234 eV) equal-energy spaced Raman peaks were observed in the 8000 cm^{-1} to 18,000 cm^{-1} region (Figure 15) wherein conversion of the Raman spectrum into the fluorescence or photoluminescence spectrum revealed a match as the ½ -energy ro-vibrational spectrum of $H_2(1/4)$ corresponding to the e-beam excitation emission spectrum of $H_2(1/4)$ in a KCl matrix (Figure 13) given by 5.8eV-4^2(J+1)0.01509eV; J=0,1,2,3.. and comprising the matrix shifted v=1 to v=0 vibrational transition with 0.25 eV energy-spaced rotational transition peaks. A long-pass edge filter confirmed the assignments wherein the series of peaks match the theoretical energies to within an error of less than 1%. The excitation energy of these ro-vibrational states required two-photon absorption. Due to the unique electronic structure of $H_2(1/4)$ comprising a paired and an unpaired electron in the $H_2(1/4)$ molecular orbital (MO) requiring spin ½ conservation during ro-vibrational transitions, the corresponding energy levels matched theoretical predictions of ro-vibration states of molecular hydrino with excitation and decay involving two-photons [Mills HSH], each emission of ½ the energy of the ro-vibrational state.

325 nm Raman spectra were further obtained using a Horiba Jobin Yvon LabRam ARAMIS spectrometer with a 325 nm laser on exemplary materials comprising $H_2(1/4)$@ (i) $GaOOH@H_2(1/4)$, (ii) NaOH@KCl (1:1 wt%) getter of the $H_2(1/4)$ product gas from high current detonation of hydrated silver shots, (iii) solid web-like fibers prepared by wire detonation of an ultrahigh purity Fe wire in 20 Torr water vapor-air atmosphere, (iv) $Fe_2O_3@H_2(1/4)$ powder prepared by ball milling FeOOH for 10 hours, and (v) KOH-KCl (50/50 wt%) prepared by ball milling for10 hours. In all five cases, the series of 1000 cm^{-1} separated peaks were observed in the 17,000 to 22,000 cm^{-1} region as shown in the exemplary spectrum recoded on gas released from Ga_2O_3/$GaOOH@H_2(1/4)$ collected from a SunCell® and trapped in a KCl getter (Figure

15). Due to the unique electronic structure of $H_2(1/4)$, the corresponding energy levels matched the ro-vibration states of $H_2(1/4)$ with 325 nm photon excitation involving two-photons and two-photon decay, each of ½ the energy of the ro-vibrational state.

A dipole or E1 transition may also be excited in $H_2(1/p)$ through interacts with the crystalline matrix in which it is embedded to cause it to be allowed. Infrared spectroscopy records direct photon absorption rather than scattered photon absorption corresponding to E1 and E2 transitions, respectively. The ability of interactions with a crystalline site to permit $H_2(1/4)$ to be FTIR active due to an induced dipole was tested by embedding $H_2(1/4)$ in a KI lattice. The FTIR spectrum recorded on KI@$H_2(1/4)$, potassium iodide matrix with embedded $H_2(1/4)$ and F-centers as indicated by the blue colorization. The F-centers were likely due to high energy light produced by the hydrino reaction. The high resolution (0.5 cm^{-1}) FTIR spectrum (490–4000 cm^{-1}) of KI@$H_2(1/4)$ showing unique sharp peaks assigned to $H_2(1/4)$ [Mills HSH] is shown in Figure 16. A major sharp peak was observed by FTIR on KI@$H_2(1/4)$ at 1943 cm^{-1} that matched near identically the J = 0 to J' = 1 rotational transition of $H_2(1/4)$. Other sharp peaks in the FTIR spectrum matched this rotational transition with spin-orbital and fluxon linkage splitting.

Radioactive Decay Neutrino Source

In embodiments of the present invention, the neutrino emitter includes at least one radionuclide (e.g. ^{40}K, ^{14}C, ^{3}H) that decays by emitting neutrinos. In an embodiment, the molecular hydrino that serves as at least one of the emitter or absorber of neutrinos to serve as the transmitter or receiver of neutrinos, respectively, comprises at least one tritium nucleus (e.g. HT(1/p), DT(1/p), $T_2(1/p)$) wherein the tritium decay is serves at least one source of neutrino emission according to the reaction:

$$ {}_1^3H \rightarrow {}_2^3He + e^- + \bar{\nu}_e $$

In another embodiment, where the molecular hydrino comprises a tritium nucleus, the hydrino molecular orbital (MO) may absorb the emitted tritium nuclear neutrino and thereby at least partially block the neutrino emission. The emission of neutrinos may be modulated or controlled by controlling the cross section of neutrino absorption by the molecular hydrino MO. In an exemplary embodiment, the relative magnetic moments of the tritium nucleus and the unpaired electron of the MO may be controlled by at least one of an applied magnetic field and electromagnetic radiation such as microwave radiation to the control the interaction between the nucleus and the electron. The controlled neutrino emission may comprise the telecommunications signal such as at least one of a pulsed or digital signal, an amplitude modulated signal, and a frequency modulated signal.

In an embodiment, at least one of tritium nuclear neutrino emission and MO neutrino absorption may be made directional based on the relative alignment of the nuclei and the tritium

nuclei and the electron magnetic moment of the MO. The relative alignment may influence at least one of the rates of a neutrino emission by the tritium nucleus or the rates of neutrino absorption by the $H_2(1/p)$ MO and thereby control the telecommunication signal as a function of time. In an exemplary embodiment to control the rate of neutrino emission as a function of time, a magnetic field is applied to the molecular hydrino comprising tritium and electromagnetic radiation such as microwave radiation is applied to cause a spin flip of the unpaired electron of molecular hydrino. The microwave pulse may cause the electron to flip into the transverse plane relative to the direction of the applied magnetic field such that the electron magnetic moment is aligned with nuclei. The neutrino signal may be received at a receiver as the relative flux of neutrinos from molecular hydrino comprising at least one tritium nucleus is varied in time producing at least one of an amplitude modulated, a frequency modulated, and a pulsed or digital telecommunications signal such as one conveying information.

Telecommunication Signal Encoding in Background Neutrino Flux

Consider that cosmological neutrinos have the same distribution as the cosmic microwave background radiation, which is isotropic to about a part million over the entire sky, and locally it is essentially perfectly isotropic. Cosmological neutrinos, like photons of the cosmic microwave background radiation, travel billions of light years to Earth. Consequently, from any given point of the universe corresponding to an axis of propagation cosmological neutrino rays are essentially perfectly parallel in all directions and perfectly uniform in intensity in all directions. The parallel propagation of photons at large distances is due to a spherical wave from an emitting source becoming a plane wave at great distances. Consider the case of tiling a surface of a sphere the size of the solar system with neutrino transmitters or receivers. Due to the vast distances of more than 10 billion light years for the propagation of cosmological neutrinos, even at a radius of the solar system, the neutrino flux incident the transmitters or receivers comprises parallel rays perpendicular to each transmitter or receiver on the sphere demonstrating that the same cosmological neutrino flux conditions exist at any given angle on the Erath as well as any position in space.

The universe provides a flux of about 10 trillion low energy cosmological neutrinos per second perpendicular to a given surface that have constant intensity, parallel rays of spin ½ photons in all directions, and throughout the entire universe. The universe provides an infinity of utilizable constantly powered omnidirectional telecommunication laser beams of precisely the energy range needed for encoding and receiving a telecommunication signal enabled by absorption and interactions with molecular hydrinos. The rays of the Cosmic Neutrino Background, or $C\nu B$, may be manipulated to provide the equivalent of an infinite number of near perfect telecommunications channels or fiber optic cables capable of transmitting data and

information undispersed or unattenuated over interstellar distances to enable an internet of the universe.

In an embodiment, $H_2(1/p)$ molecules absorb an incident neutrino beam, such as a cosmological neutrino beam at the transmitter, along a certain selected beam path in a controlled temporal order to encode information, and a receiver records the deficit in cosmological neutrinos signal relative to a receiver that records the constant background cosmological neutrino flux, and a processor processes the signal as a telecommunication signal. The neutrinos absorption or interactions may encode the telecommunications signal as at least one of amplitude modulation, frequency modulation, and digital pulses. In the digital case, pulses may be given by the magnitude of the difference between the signal stream and the constant background stream of neutrinos. In an embodiment, a zero difference as an output is registered as a zero, and a non-zero difference is registered as a one of a binary code. Pulsed telecommunication signals corresponding to digital transmission and processing typically may be the easiest signal to detect or receive.

Cosmological neutrinos, also known as the Cosmic Neutrino Background or $C\nu B$, have a significantly greater flux than solar neutrinos. Cosmological neutrino density is determined by observing their subtle effects on the universe's expansion and structure, primarily through the Cosmic Microwave Background (CMB) and large-scale galaxy surveys. Current cosmology models give a $C\nu B$ density of approximately 336 neutrinos per cubic centimeter cm^3 throughout the universe, and their flux perpendicular to every direction of propagation is estimated to be around $1 \text{ X } 10^{13}$ $cm^{-2}s^{-1}$. The $C\nu B$ density may be determined from first principes by using the equations of Mills GUT Chp. 32. Mills Eq. (32.168) gives the closed or equation of the cosmic microwave background temperature as a function of time of the expansion contraction cycle of the universe. Assume that the cosmological neutrinos have thermalized with the photons of the cosmic microwave background of 2.73 K corresponding to an energy of $2.35 \text{ X } 10^{-4}$ eV ($3.77 \text{ X } 10^{-23}$ J). Using Eq. (32.161) for the power of the universe and (32.147) for the area of the universe, the power per unit area is $2.56 \text{ X } 10^{-9}$ Wcm^{-2}. The percentage of energy carried away by neutrinos in a nuclear reaction varies significantly depending on the type of reaction, ranging from 3% to 5% in stars and reactors to over 99% in core-collapse supernovae. Assuming neutrinos comprise about 15% of the energy inventory of photons, the corresponding cosmological neutrino flux is $(0.15)(2.56 \text{ X } 10^{-9} \text{ Wcm}^{-2})/ 3.77 \text{ X } 10^{-23}$ J per neutrinos = $1 \text{ X } 10^{13}$ neutrinos $cm^{-2}s^{-1}$.

In contrast, the flux of solar neutrinos arriving at Earth is approximately $60\text{-}100 \text{ X } 10^9$ $cm^{-2}s^{-1}$ as shown in Figure 17. Thus, the cosmological neutrino flux is roughly 100 to 1,000 times higher than the solar neutrino flux. Moreover, cosmological neutrinos have very low energy (e.g. μeV -1meV range) when compared with solar neutrinos (~1 MeV), such that solar

neutrinos having energies in the range of those recorded by electron paramagnetic resonance spectroscopy (EPR) are negligible (Figure 17); whereas the energies of $C\nu B$ are about the same as those of electron spin-flip transitions recorded during EPR spectroscopy, as indicated in Figure 17 (e.g. X-band (Most Common): ~9-10 GHz (e.g. 9.5 GHz), requiring fields around 0.34 Tesla (3400 Gauss) corresponding to an energy of 3.93×10^{-5} eV. Photons closing matching with EPR energy levels are expected to have a very large cross-section for interaction whereas high energy neutrinos are not expected to interact with the EPR transitions. Cosmological neutrinos are isotropic, constant intensity and travel in straight lines as parallel rays and may serve as a carrier of neutrino telecommunications over large distance unimpeded by intervening matter between a transmitter and receiver wherein the constant neutrino flux is altered from the background flux by the neutrino telecommunication system of the disclosure to encode the telecommunications signal.

Given the very high energy distribution of solar neutrinos and their constant parallel flux, their presence may be essentially inconsequential for hydrino-interaction-based telecommunications that exploit low energy neutrinos. In an embodiment wherein solar neutrinos can be exploited to transmit signals, then the corresponding methods and system may be applied such as those of the disclosure for altering and detecting the intensity of solar neutrinos as a function of time.

Background neutrino flux, such as flux from solar and cosmological neutrinos, is essentially constant, especially compared to the digital signal rate of telecommunications. However, the telecommunication system of the present invention further comprises systems and methods to transmit the pulsed neutrino signals in the presence of background neutrino flux. In one embodiment, the telecommunication system comprises at least one of a transmitter and receiver that has a subsystem for coincide detection of the 1's and 0's of the neutrino pulse stream that carries the encoded information. The transmitter can include a plurality of transmitters, such as a plurality of transmitter pairs (e.g. a duality of transmitters), that are synchronized to send at least one verification pulse with every pulse stream, wherein the corresponding receiver coincidently detects each pulse stream and corresponding verification pulse. A processor can be employed to confirm the legitimacy of each pulse by processing the coincidences. The transmitter can encode each bit of information as a series of pulses from a lookup table of the bits of information to transmit the information without interference from background. The receiver can include a plurality of spatially separated receivers to detect pulses and compare time of arrival to verify the legitimacy of each pulse from background.

In one embodiment, the attenuation of the neutrinos can be determined by synchronously comparing the unattenuated background signal with the attenuated signal received by the receiver, wherein the time dependent neutrino signal intensity diminution or deficit encodes the

telecommunications signal or information. The neutrino difference signal may be determined by the synchronous recording of the neutrino signal by at least one other receiver off axis to the attenuated neutrino beam having no attenuation of the constant cosmological neutrino background flux. In another embodiment, at least one background neutrino flux detector is mounted on the same plate (e.g. in the same plane that may be flat or comprise another geometry such as curved) as each receiver such that it is incident cosmological neutrinos at ideally, exactly the same angle and same distance (or have constant relative positional coordinates) as the receivers to provide an accurate background signal. In an embodiment, at least one of (i) one or more signal transmitters, (ii) one or more signal receivers, and (iii) one or more background receivers are periodically standardized or calibrated relative to each other to correct for a differential in responsiveness to the flux of cosmological neutrinos. Source of differential responsiveness between receivers may be due to at least one of differential or drifting geometry and electronics, and the responsive of the molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$).

In an embodiment, at least one of the transmitter and receiver include a collimator, such as a material comprising embedded molecular hydrino or atomic hydrino, wherein at least one of a magnetic field is applied to the material and the material is intrinsically magnetic. The applied or intrinsic magnetic field can produce a magnetic field applied to the molecular or atomic hydrinos, such that spin flip transitions induced by the magnetic field cause the attenuation of the cosmic cosmological neutrino background flux that is not about perpendicular to the transmitter or receiver. In still another embodiment, the collimator can have a geometry that results in the cosmological neutrinos passing through the collimator are thereby attenuated, while the perpendicular propagating cosmological neutrinos do not intersect or pass through the collimator, such that they are not attenuated. In another embodiment, the collimator magnetic field is aligned in at least one direction that causes selective attenuation along at least one non-perpendicular axis of cosmological neutrino background flux propagation.

In an embodiment, at least one of the transmitter and receiver can include at least one electron spin flip detector, such as an EPR spectrometer, a microwave photon counter such as a superconducting qubit (e.g., a single-microwave photon detector), a scanning tunneling microscope, and an optical detector using Faraday rotation of a laser pulse. In an embodiment, a continuous wave electron paramagnetic resonance (EPR) spectrometer can have a microwave antenna, such as one within a resonator/cavity to supply a microwave magnetic field B_1, an external magnet such as a large electromagnet or permanent magnet to supply a static external magnetic field B_0 wherein the microwave antenna and the external magnet are oriented so that the microwave magnetic field B_1 is perpendicular to the static external magnetic field B_0 that provides a constant direction for electron spins to align with or against B_0. In an embodiment of a standard continuous-wave (CW) EPR spectrometer, a sample that absorbs neutrinos (e.g. a

molecular hydrino species such as. $H_2(1/p)$ or $[H_2(1/p)]_n$) is placed in the resonator between the magnet poles where B_1 is maximum and B_0 is uniform. The microwave field B_1 may be generated by a microwave bridge and directed via a waveguide/antenna into the cavity (resonator). The resonator may be designed to ensure the oscillating magnetic component of the microwaves B_1 is perpendicular to the static field B_0 which is required for maximum transition probability for $S = 1/2$ systems based on selection rules. In some cases, a "parallel mode" B_1 parallel B_0 is used to study or excite otherwise forbidden transitions.

In an embodiment, the unpaired electron of molecular hydrino may be aligned along a magnetic field axis B_0, or the unpaired electron may be flipped perpendicularly to the magnetic field axis by a pulse of electromagnetic energy (e.g. a $\pi/2$ microwave pulse), wherein the electron magnetic moment direction causes a selective directional absorption or attenuation of a population of unpolarized neutrinos based on selection rules. This eliminates neutrino components that excite or interact with the selected orientation of the electron magnetic moment, thereby creating a polarized beam of neutrinos comprising the unabsorbed or non-interacting neutrino polarization. Thus, a polarized beam of polarized neutrinos may be transmitted by a transmitter, and by the same mechanism a receiver may absorb polarized neutrinos by having a cross electron magnetic moment orientation relative to that of the transmitter. In an alternative embodiment, the neutrino flux is attenuated by the transmitter without being polarized and is received by the receiver.

Photons are S = 1; so the section rules allow for the transition of the S = ½ electron from parallel to antiparallel to the applied magnetic field corresponding to an angular momentum change of $\hbar$ matching that of the photon and a selection rule of $\Delta S = 0, \pm 1$. In contrast, neutrinos carry $\frac{1}{2}\hbar$, and in an embodiment, can flip the electron spin perpendicularly to the magnetic field axis by $\pi/2$ into the plane transverse to the applied magnetic field corresponding to a selection rule of $\Delta S = 0, \pm 1/2$. In an embodiment, the electron magnetic moment may be flipped in an orientation such as into the transverse plane, such that it interacts with the nuclear spins (e.g. protons and ^{3}H nucleus with S = ½, and ^{2}H nucleus with S = 1) to increase the cross-section of neutrino absorption or interactions. In an embodiment, transitions involving interactions between electron spin and nuclear spin states give rise to at least one of new absorption and emission peaks in the EPR spectrum such as ones corresponding to electron spin-nuclear spin splitting. Additional fine structure splitting and corresponding peaks may arise from nuclear-nuclear spin transitions and nuclear magnetic moment transitions during electron spin flip transitions as well as splitting due to excited ro-vibrational states. In addition, these peaks may be further split by electron spin-orbital coupling and fluxon linkage transitions. In an exemplary embodiment, neutrinos are absorbed by exciting a hyperfine transition of the electron

magnetic moment such as at least one of spin-orbital coupling, electron-nuclear magnetic moment coupling, or fluxon linkage transition. Further hyperfine transitions and corresponding peaks may arise from electron-spin splitting with matrix unpaired electrons such as those of ZnO (Figure 18) or nuclear magnetic moments such as with the iodine nucleus having spin 5/2 of the matrix comprising KOH-KI-Ga (Figure 6). These transitions may be made directional by controlling the relative orientation of the electron magnetic moment and the propagation direction of the neutrinos to favor a desired section rule for neutrino absorption or interactions.

In an embodiment, the manipulation of the $H_2(1/p)$-species selection rules for absorption of neutrino energy or emission of neutrinos by means such as at least one of the application of an external magnetic field such as at least one or a permanent and a time dependent magnetic field, the application of an electromagnetic field such as a radio or microwave field, and the application of photons such as laser photons such a ones to excite at least one of a rotational or vibrational (e.g. ro-vibrational) state may result in an inverted population of exited state $H_2(1/p)$ species that decay at least partially by stimulated emission to emit a laser-like beam comprising neutrinos rather than photons. The telecommunications signal may be encoded in the neutrino laser beam or decoded by at least one of pulsing, amplitude modulation, and frequency modulation by controlling at least one of the means of controlling the excited state excitation and the selection rules.

In an embodiment, the electron paramagnetic resonance (EPR) spectrometer produces a free induction decay (FID) signal in the continuous-wave regime that is modified by the absorption of cosmological neutrinos that encodes data and information wherein the FID may be recorded and processed by Fast Fourier Transform (FFT) to produce a frequency-domain spectrum with the encoding. In a FT-EPR embodiment, a short, high-power microwave pulse (typically a $\pi/2$ pulse) tips the equilibrium magnetization into the xy-plane. A Fast Fourier Transform (FFT) of the recorded time domain FID yields the EPR spectrum, representing the electron spins within the bandwidth of the pulse with the encoded data and information. The relaxation time of electron spins (T_2) is much shorter than that of nuclear spins recorded by NMR spectroscopy, often leading to the decay of the FIDs within nanoseconds. The EPR spectrometer may comprise high-speed digitizers (e.g. sampling at 200 MHz or higher) to capture the data. In an embodiment, the FID decays before the spectrometer's electronics can recover from the high-power excitation pulse (dead time). Thus, a spin echo may be detected rather than a direct FID. For molecular hydrino species samples with very short relaxation times, echo-detected EPR (Hahn echo) may be used instead of direct FID detection to overcome dead time limitations. In an exemplary embodiment, a 90-degree pulse is applied followed by a 180-degree pulse after a delay τ to generate a "spin echo". The refocused signal may be used to measure electron spin dynamics, distances, and properties like spin-spin relaxation (e.g. T_2) as well as encoded data and

information. Alternatively, the distinct technique of rapid scan (RS) EPR is utilized wherein the magnetic field is swept through the molecular hydrino species resonance so quickly that it creates a signal like an FID that is modified by cosmological neutrino absorption to encode data and information, which may then processed by FFT and deconvolution to generate the EPR spectrum of the molecular hydrino species modified by the encoded data and information.

In an alternative embodiment, the rapid scan (RS) EPR includes small permanent magnets and miniaturized electronic components, such as voltage-controlled oscillators (VCO) capable of sweeping the frequency at a fixed magnetic field that replace the bulky electromagnets and microwave parts that operate with a fixed microwave frequency and scan the magnetic field. In an embodiment, the telecommunication system comprises an EPR spectrometer that may be fully integrated into a single silicon microchip, a so called EPR-on-a-Chip (EPRoC) device, such as one comprising a source of magnetic field, such as an electromagnet or permanent magnet, and either (i) a conventional microwave bridge or variants of it integrated in a single integrated circuit and a fixed-frequency oscillator, or (ii) in place of a microwave (MW) resonator, voltage-controlled oscillator (VCO)-based EPRoC detectors comprising an array of injection-locked VCOs, each incorporating a miniaturized planar coil as a combined microwave source and detector. A miniaturized coil such as one with a diameter of a few hundred micrometers may be embedded in a voltage-controllable LC oscillator to serve as both microwave source and EPR detector. This allows the use of permanent magnets for smaller, more affordable, battery-driven spectrometers for encoding and reading the information and data. The magnetic field strengths of practical permanent magnets (< 1.5 T) limit the EPR excitation frequency to below 35 GHz, (<1.35 X 10^{-4} eV) limit which covers the energy spectrum of cosmological neutrinos very well wherein cosmological neutrinos are absorbed during the EPR spectroscopy scan to encode the data and information.

In an embodiment, embedding the VCO in a high-bandwidth phase-locked loop (PLL) allows for a precise definition of the phase of the exciting B_1 field from an external reference, even in the presence of temperature and other experimental fluctuations. Moreover, the amplitude-sensitive mode of encoding the information due to cosmological neutrino absorption and detection with a high-bandwidth AM demodulator built directly into the LC VCO, may also be used to detect the sample magnetization with a high bandwidth on the order of a few hundred MHz. In an embodiment of the EPRoC, pulsed or digital, amplitude modulation, and frequency modulation are three techniques of encoding the information due to cosmological neutrino absorption during the EPR spectroscopy scan that may be used, and the spin response may be detected by amplitude-sensitive detection (AM) and frequency-sensitive detection (FM). The AM and FM sensor signals correspond to the EPR-induced changes in the VCO amplitude and frequency, respectively. While the FM signal purely represents the real component of the

complex susceptibility, the AM signal represents a mixture of the imaginary, χ'', and real, χ', components of the magnetic susceptibility. Although both detection modes provide theoretically the same sensitivity, the practical advantage of detecting the AM signal is that a wideband AM demodulator can be easily integrated into an LC tank VCO which greatly reduces the system complexity to process the spectrum of the molecular hydrino species modified by the encoded data and information.

In an embodiment comprising a VCO-based EPRoC detector, the amplitude-sensitive mode of detection is used to perform very fast rapid-scan EPR scans to at least one of encode and read data and information by at least one of the transmitter and receiver with a comparatively simple setup and improved sensitivity compared to a continuous-wave regime EPR spectrometer. In an embodiment, a microwave resonator of a continuous wave EPR spectrometer is replaced by VCO-based EPRoC detectors that use an array of injection-locked VCOs, each incorporating a miniaturized planar coil as a combined microwave source and detector. An advantage of the VCO-based approach is the possibility of replacing the conventionally used magnetic field sweeps with frequency sweeps with high versatility and near-constant sensitivity. In an exemplary embodiment, a rapid-scan EPR (RS-EPRoC) instrument for at least one of signal transmission and reception comprises EPRoC VCO array capable of sweeping the frequency at a rate of up to 400 THz s^{-1}, corresponding to a field sweep rate of 14 kT s^{-1} (1.4 X 10^8 Gs^{-1}) and scan widths of more than 2.4 GHz (85.6 mT or 856 G). The methods and systems of an exemplary VCO-based EPRoC used in the disclosure to transmit and receive neutrino telecommunication signals is reported by Künstner et al. [Künstner, S., Chu, A., Dinse, K.-P., Schnegg, A., McPeak, J. E., Naydenov, B., Anders, J., and Lips, K.: Rapid-scan electron paramagnetic resonance using an EPR-on-a-Chip sensor, Magn. Reson., 2, 673–687, https://doi.org/10.5194/mr-2-673-2021, 2021] which is herein incorporated by reference in its entirety.

The intensity of the difference between the telecommunication signal and the background signal depends on the percentage of neutrinos that are attenuated from the cosmological background neutrino flux by absorption or interactions with $H_2(1/p)$, wherein p may be at least one integer greater than 1 and less than 126. During a typical electron paramagnetic resonance (EPR) experiment, the percentage of incident continuous microwave (CMW) power absorbed by the sample is extremely small, often in the range of 10^{-4} to 10^{-6} or 0.01% to 0.0001% of the power inside the resonator. The power per square centimeter of the cosmological neutrino flux is given by the flux (1 X 10^{13} neutrinos $cm^{-2}s^{-1}$) times the energy 5 X 10^{-5} J eV (8 X 10^{-24} J) corresponding to 8 X 10^{-11} W cm^{-2} of continuous power. In the case that the sample area is 1 cm^2, the CMW power is 2 mW, and 0.001% of the resonator power is absorbed by the $H_2(1/p)$ sample of the transmitter, the total absorption of the cosmological neutrino flux corresponds to a

signal of 8 X 10^{-11} W /(0.00001 X 2 X 10^{-3} W) = 0.004 or a 0.4% signal relative to the main EPR signal which is consistent with the data shown in Figures 6, 7, and 18. In an embodiment, the central field is selected to match the EPR transitional energy to the energy of the cosmological peak flux to increase the signal strength. ZnO@H_2(1/4)) was prepared by Zn wire denotations in a gaseous atmosphere that support the formation of H_2(/4) as described in Mills prior publication [Wilfred R. Hagen, Randell L. Mills, "General EPR pattern from molecular hydrino produced in various reactors", (2024), submitted; https://brilliantlightpower.com//pdf/General_EPR_pattern_from_molecular_hydrino_produced_in_various_reactors.pdf] which is herein incorporated by reference. The neutrino absorption peaks recorded by EPR may be shifted by selection of the matrix comprising embedded H_2(1/4). Figure 18 shows the change in the 3rd derivative EPR signal recorded on H_2(1/4) embedded in a ZnO matrix (e.g. ZnO@H_2(1/4)) versus KOH, KI, and Ga matrix.

Given the constant neutrino background that may be recorded by at least one synchronously recording receiver unit of a composite receiver having a plurality of receiver units, the transmitter can include a plurality of transmitters that transmit along a plurality of parallel axes to the composite receiver, such that the data transmission rate may be increased by the multiple of the number of transmitter and receiver pairs, which could number into the thousands to millions depending on the physical size of the transmitter and receiver. In an exemplary embodiment comprising a transmitter channel having an area of 1 mm^2 and a total transmitter area of 120 cm^2 (e.g. area of an iPhone), the total number of channels at a matching composite transmitter arrays and receiver arrays is 12,000.

There is no divergence or attenuation for a perfect laser beam. Consequently, the beam may be transmitted and received over infinite distance with matched area transmitters and receivers that are perfectly aligned. Cosmological neutrinos essentially behave as a perfect laser regarding divergence or attenuation in all directions, such as in opposing directions along a selected axis. Therefore, a neutrino signal from a transmitter of a given area may be practically received over an infinite distance by a receiver of the same area only limited by alignment. Consider line-of-sight (LOS) signal distances with relative motion using existing technology. Here, the distance is limited by divergence and attenuation, yet distances of thousands of kilometers are achieved for satellites/spacecraft (e.g. LEO/GEO), where motion is managed via orbital mechanics for consistent alignment or precise tracking systems are employed to counteract motion, often relying on high power/gain antennas or laser comms for precise tracking over vast gaps and powerful alignment or pointing algorithms.

As shown in Figure 8, the system 20 can include an optional alignment subsystem 26 to maintain the transmitter 5 and matched receiver 6 perpendicular and centered on the correct aligned axis. In an embodiment, at least one transmitter 5 and receiver 6 can function as both a

receiver and transmitter and exchange neutrino signals comprising attenuation of counterpropagating neutrino beams as signals to permit alignment of the transmitter and receiver along a common axis. In an embodiment, the telecommunication system 20 can send a patterned signal, such as a pulse pattern, to allow telecommunication components, such as the transmitter and receiver pair, to be aligned by a mover of the alignment subsystem 26 that moves at least one of the telecommunications pair relative to the other. Once alignment is achieved, the signal may comprise the telecommunication signal and an alignment signal that keeps the pair in alignment.

In mobile scenarios, beams are adjusted periodically to prevent misalignment. In an exemplary embodiment, aligning a transmitter and receiver between a moving object and a stationary object requires a combination of real-time tracking, high-gain directional antennas, and initial, precise setup, often utilizing GPS and sensors for dynamic adjustment. A neutrino-beam-position-sensing detector employed in at least one of the transmitter and receiver system can detect incoming signals and automatically adjust the transmitter to steer the beam toward the center of the receiver. A signal optimizer can monitor the received signal strength using an indicator (RSSI) at a plurality of spatial positions. For systems in motion, frequency difference of arrival (FDOA) may be used to track signals, the transmitter may dynamically exchange positioning signals and corresponding information. Time of flight or a device for tracking a spatial phase angle based on spatial position may be used as an alignment mechanism. The transmitter and receiver may continuously scan their surroundings to dynamically identify the optimal beam pair with the highest signal strength. Antenna alignment tools (AAT) tools like 3Z RF Vision or LinkAlign use GPS and digital compasses may be used to measure tilt, roll, and azimuth. GPS, gyroscopes, and digital compasses, and antenna alignment tools may calculate precise azimuth and elevation for moving targets, enabling rapid re-pointing. Inertial navigation systems (INS/GPS) may track at least one of transmitter and receiver positions using systems such as fiber optic gyros (FOGs) to provide data for highly accurate pointing, stabilization, and geo-location to guide self-alignment. An exemplary inertial navigation system (INS) comprises a self-contained device using accelerometers and gyroscopes (within an inertial measurement unit or IMU) to track at least one of the transmitter's and receiver's position, velocity, and orientation by measuring motion and rotation, relying on "dead reckoning" from a known starting point. Because tiny sensor errors accumulate (drift), the INS may fuse data with GPS/GNSS for periodic correction, offering reliable alignment even when external signals are lost. The alignment may be achieved by moving at least one of the transmitter and receiver relative to each other using fast actuators (e.g. electromechanical, galvanometers, or piezo stages) which may constantly adjust the relative positions of the transmitter and receiver to maintain alignment. In an embodiment, the communications or telecommunication system may comprise at least one neutrino telecommunications element such as a transmitter, a receiver, and

a transmitter/receiver that communicates by neutrinos attenuation that is large such as one having a diameter of 1 mm to 100 m to transmit data and information over large distances such as through the Earth or across vast distances in space. The telecommunications signal may be received by a neutrino telecommunications element, processed by a processor, and re-transmitted and received locally by means such as at least one of small neutrino telecommunications elements, microwave systems such as 5G, and optical telecom system such as fiber optic systems.

In an exemplary embodiment, sender and receiver point-to-point communication may be achieved by pre-program motion synchronization algorithms or techniques between each of the sender's and receiver's transmitter/receiver, such that possible point-to-point communication ray paths or axes are scanned according to the algorithms, initially weighting the most probable paths external information until the path of least time is locked on, and the transmission can proceed along that selected ray path with alignment of the devices. The alignment algorithm may be confidential and be specific to a given sender and receiver pair. Communications that are transmitted and received in this manner may be extremely difficult to be intercepted by a third-party.

In an embodiment, rather than or in addition to EPR detection, the energy of neutrino absorption or interaction, such as the excitation of a transition of a $H_2(1/p)$ species such as a ro-vibrational state transition, hyperfine state such as at least one of spin-orbital coupling, electron-nuclear magnetic moment coupling, and fluxon linkage transition, a dimer or other multimer state transition, may be down converted such as by at least one of the decay or partial decay to a lower energy photon emission. The low energy photon emission can include infrared, microwave, or radio photon emissions that may be detected by a detector of the receiver and converted to an electrical signal for processing. In an alternative embodiment, the receiver may comprise a magnetic field source, such as a permanent magnet or an electromagnet. In an embodiment, the application of a magnetic field to $H_2(1/p)$ in an excited state due to neutrino absorption or interaction, such as an excited thermal or other excited state or the decay of a stated excited by neutrino energy, may cause the emission of at least one of microwave and radio waves that may be received by the receiver such as one comprising an antenna, converted to electrical signals, and processed. The difference signal between the cosmological neutrino background and the telecommunication signal such as at least one of an amplitude modulation, frequency modulation, and pulse or digital signal may be processed to receive the telecommunications information.

The down converted energy from cosmological neutrino absorption may be detected by at least one of (i) a microwave photon counter such as a superconducting qubit such as a single-microwave photon detector, (ii) scanning tunneling microscope, (iii) an optical detector using

Faraday rotation of a laser pulse, (iv) a single photon calorimeter, and (v) other detectors of the disclosure and known in the art. In an embodiment, a single-photon calorimeter comprises a highly sensitive detector designed to measure the energy of individual photons by detecting the minute temperature rise (typically maintained below 1 K using adiabatic demagnetization) caused by their absorption. In an exemplary embodiment, an absorber with an extremely low heat capacity (e.g. graphene or a superconducting film), absorbs the photon and converts its energy into measurable heat and a thermometer such as a silicon thermistor or a superconducting transition-edge sensor (TES), (e.g. a superconducting film operating at its phase transition), converts this thermal spike into an electrical signal. Specifically, when a photon is absorbed, the material's temperature rises, increasing its resistance from zero to a finite value. This change is converted into a measurable electrical signal (voltage pulse). In an embodiment, transition edge sensors (TES) are extremely energy-sensitive, ideal for resolving the energy of individual photons, superconducting nanowire single-photon detectors (SNSPD) utilize a 10 nm thick nanowire to detect single photons through a dramatic change in resistance (a quantum phase change), and Josephson-threshold calorimeters use each a double-loop (superconductor-normal metal-superconductor) junction for detecting photons from mid-infrared to ultraviolet.

In an embodiment, the application of a magnetic field to a molecular hydrino species, such as $H_2(1/p)$, $H_2(1/p)$ dimer, and $H_2(1/p)$ multimer, gives rise to at least one transition such as at least one of an electron spin-flip, nuclear spin flip, ro-vibrational, spin-orbital coupling, electron-nuclear magnetic moment coupling, fluxon linkage, and other hyperfine transition that may be excited by neutrinos such as cosmological neutrinos. The magnetic field may be provided by at least one of an electromagnet and a permanent magnet. In an embodiment, at least one of the transmitter and receiver may comprise a means to control or modulate the magnetic field to encode or read data and information by modulating or controlling the absorption of the neutrino flux incident the molecular hydrino species by controlling the magnetic field strength and direction as a function of time. The encoding may at least one of pulsed or digital, amplitude modulation, and frequency modulation. In an embodiment, the communication system comprises an electromagnet, a power source, a processor-controller, and a source of data and information stream that is encoded in the absorbed neutrino flux as a function of time by the processor-controller controlling the magnetic field as a function of time. In an exemplary digital signal transmitter embodiment, the magnetic field may be pulsed on and off to demagnetized and remagnetize wherein the former may occur in femtoseconds. In at least one of a transmitter and receiver embodiment, magneto-optic memory cells that offer non-volatile storage with sub-nanosecond programming speeds may be used wherein neutrino photons may serve the role of optical photons. In another embodiment, the source of magnetic

field may comprise "reciprocal ferromagnet/3D topological insulator" heterostructures wherein the switching of one magnet affects the current, and conversely, the current can switch a magnet.

In an alternative embodiment, at least one of the transmitter and receiver may comprise a source of magnetic field, such as a permeant or an electromagnet. In an embodiment, the application of the magnetic field to $H_2(1/p)$ creates energy states in the energy range of the absorption cross section of at least one of cosmological and solar neutrinos. A telecommunications signal may be encoded (e.g. during transmission) or decoded (e.g. during reception) in the time dependent absorption of neutrinos producing at least one of an amplitude modulated, a frequency modulated, and a pulsed or digital telecommunications signal such as one conveying information wherein the encoding or decoding may be controlled by controlling at least one of the magnitude and direction of the applied magnetic field. In another embodiment, the encoding and decoding may be achieved by spatial-temporal displacement of a neutrino absorber comprising a molecular hydrino species such as $H_2(1/p)$, $H_2(1/p)$ dimer, and $H_2(1/p)$ multimer. In an embodiment of a digital signal transmitter embodiment, the magnetic field may be pulsed on and off to demagnetized and remagnetize wherein the former may occur in femtoseconds. In at least one of a transmitter and receiver embodiment, magneto-optic memory cells that offer non-volatile storage with sub-nanosecond programming speeds may be used wherein neutrino photons may serve the role of optical photons. In another embodiment, the source of magnetic field may comprise "reciprocal ferromagnet/3D topological insulator" heterostructures wherein the switching of one magnet affects the current, and conversely, the current can switch a magnet.

In an embodiment, the neutrino telecommunications system further optionally comprises a mover or excitor to cause spatial-temporal displacement of a neutrino absorber comprising a vibration, wherein at least one of the (i) presence or absence of motion, (ii) amplitude of motion, and (iii) frequency of motion may be controlled to control the telecommunications signal transmitted or received along the axis perpendicular to the positional center of the motion to encode or decode a (i) puled or digital signal, (ii) an amplitude modulated signal, and (iii) a frequency modulated signal, respectively. The transmitter and receiver may be aligned on the axis perpendicularly to the motion or relative motion with a separation distance between the transmitter and receiver. The transmitter may create a neutrino deficit signal, and the receiver may receive the signal comprising a deficit of neutrinos due to the absorption by the transmitter. The difference signal between the at least one of the cosmological neutrino background and solar neutrino background and the telecommunication signal such as at least one of (i) a pulsed or digital, (ii) an amplitude modulated, and (iii) a frequency modulated signal may be processed to receive the telecommunications data and information.

The motion may be traverse to the neutrino direction of propagation. Alternatively, the motion may be in any direction. Motion projected in the transverse plane may cause a spatial temporal modulation in that plane. Motion projected along the axis of propagation may cause a neutrino temporal Doppler shift along that axis. The motion may be constant with a flyback as used in Mossbauer spectroscopy to produce a specific Doppler shift, or the motion may be variable to scan through at least one of positive and negative Doppler shifts and corresponding neutrino frequency shifts. The molecular hydrino species may comprise one such as $Ga(O)OH@H_2(1/4)$ which has a gas type EPR spectrum with very narrow line widths wherein a Doppler shift is sufficient to shift the EPR transition energy. In an exemplary embodiment, the acoustic wave velocity of a piezoelectric crystal may be 6000 m/s corresponding to an EPR shift of about 0.1 G. Alternatively, at least one of phonons and molecular vibrations may be excited by an excitor such as a laser or other excitor of the disclosure or known in the art. Molecular vibrational speeds may be on the order of about 1×10^5 m/s corresponding to a Doppler EPR shift of about 3 G.

In an embodiment, the communication system comprises at least one of one or more of a transmitter and a receiver comprising a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]n$), wherein each transmitter and a receiver further comprises at least one of (i) an EPR spectrometer, (ii) an EPR spectrometer and a magnet that applies another magnetic field to the molecular hydrino species to cause an energy transition such as an electron spin flip transition that may be excited by cosmological neutrinos, and (iii) a magnet that applies a magnetic field to the molecular hydrino species to cause an energy transition such as an electron spin flip transition that may be excited by cosmological neutrinos alone or the absence of either (i) or (ii). In an embodiment, the communication system further optionally comprises a structure (e.g., a mover) to spatially-temporally move one or more of the transmitter and the receiver. The motion may be transverse to the propagation direction of the neutrino beam in which the data and information are encoded by the motion. The data and information may be encoded by at least one of pulses or digital encoding, amplitude modulation, and frequency modulation. The mover that provides the time-dependent motion may comprise at least one of piezoelectric, electromechanical, micro-electro-mechanical systems (MEM), plasmonic modulator or resonator, acousto-optic modulator, acousto-optic modulator or phase modulator, tiltable stage or mount, nanophotonic opto-mechanical resonator, acoustic modulator, magneto-optic, a device that uses surface acoustic waves (SAW) for at least one of deformation and displacement that may be mediated optically or thermally, and one or more of other actuators known in the art. In an embodiment, the actuator is at least one of a reciprocal device and capable of absorbing spatial-temporal streams of received neutrino deficit signals and transducing the signals into at least one of displacement such as vibration, strain, or deformation and another form of signal encoding the same data and

information as the neutrino deficit signals such as electrical signals. An exemplary embodiment of a reciprocal device is a piezoelectric actuator (e.g. by a photothermal + piezoelectric mechanism) that can convert electric signals into displacements and displacements into electrical signals. Other exemplary embodiments comprise a photothermal, photo-mechanical, and crystal cantilever devices, optomechanical actuators, and additional such devices known in the art wherein neutrino photons may serve the role of optical photons.

In a receiver embodiment, a spatial temporal gradient of neutrino photon absorption causes vibration or displacement in a material comprising $H_2(1/4)$ wherein the effect may be enhanced or controlled using magneto-optical properties. This phenomenon, often referred to as photo-thermal gradient, thermoelastic expansion, photoacoustic effect, or opto-magnetic driving, occurs when spatially varying energy absorption generates non-uniform heating, which in turn leads to localized expansion, thermal gradients, or force changes that induce mechanical motion. In an embodiment, the vibration may be caused by opto-thermal driving wherein the spatial-temporal variation in absorbed neutrino photon flux gives rise to corresponding variations in temperature and magnetic permeability, generating a driving force that produces vibration. In an embodiment, a magneto-optical interaction of a magneto-optical material with variation in absorption of neutrino flux gives rise to temperature changes that may alter the magnetic properties (e.g. magnetization), which, when combined with an external magnetic field, results in displacement wherein a stronger applied magnetic field and larger gradients increase the resulting magnetically induced motion.

In another embodiment, each receiver may optionally comprise a plurality of smaller sub-receiver elements that cover an area that includes the transverse extrema or transverse spatial amplitude of the neutrino deficit beam wherein the beam amplitude is determined by the amplitude of the transverse displacement at the transmitter during encoding the data and information in the spatial-temporal neutrino deficit signals. The variation of the difference signal over the sub-receiver elements as a function of time is recorded to receive the transmitted signals.

In an embodiment, the telecommunications system may further optionally comprise an excitor that causes spatial-temporal displacements of the neutrino absorber comprising a molecular hydrino species to transmit and receive neutrino deficit signals, wherein the data and information is encoded in the temporal stream of the neutrino deficit signals. The excitor may excite at least one transition, such as at least one of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, magnetic tilt, phonon, plasmon, and electronic transition, in at least a neutrino absorber material, such as (i) a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$); (ii) a molecule or compound to which molecular hydrino species is at least one of embedded, absorbed, or bonded to; (iii) a crystalline lattice to which molecular hydrino species is at least

one of embedded, absorbed, or bonded to; (iv) metallic lattice such as a magnetic or non-magnetic lattice to which molecular hydrino species is at least one of embedded, absorbed, or bonded to; (v) a semiconductor to which molecular hydrino species is at least one of embedded, absorbed, or bonded; and (vi) an organic or inorganic crystalline lattice to which molecular hydrino species is at least one of embedded, absorbed, or bonded, to at least one of encode data and information in transmitted time dependent neutrino deficit signals or receive the time dependent neutrino deficit signals. The excitor can comprise at least one of (a) a diode laser to directly achieve pulsed excitation of at least one transition of the neutrino absorber material that can be switched rapidly, achieving short-duration pulses (e.g. 10^{-3}s to 10^{-12}s) and repetition rates in the range of 100 Hz to 10 gigahertz through methods of the group of current modulation, electro-optical modulation, Q-switching, and mode locking, and (b) a fast speed magnetization switch based on causing electric current or laser opto-magnetic interactions by ultrafast lasers applied to a magnetic neutrino absorber material to switch the energy of at least one transition to cause pulsed excitation of at least one transition by a pulsed or continuous energy source comprising at least one of a photon source, a laser, a diode laser, a particle beam, and an electron beam.

In an embodiment, the excitor is at least one of a reciprocal device and capable of absorbing spatial-temporal streams of received neutrino deficit signals and transducing the signals into at least one of a transition in a molecular hydrino species such as one of the transition s (i)-(vi) above and another form of signal encoding the same data and information as the neutrino deficit signals such as at least one of magnetic switch signals, optical signals, and electrical signals . Exemplary embodiments are devices that use microwave with specific ferrite phase shifters designed to be both fast-switching and reciprocal by using specialized, balanced components and European Patent No. EP0325340A2, William K Alverson and James A. Fuller, “Fast switching reciprocal ferrite phase shifter”, which is incorporated herein by reference in its entirety. In another exemplary embodiment, magneto-optic memory cells that offer non-volatile storage with sub-nanosecond programming speeds may be used wherein neutrino photons may serve the role of optical photons. In another embodiment, the source of magnetic field may comprise "reciprocal ferromagnet/3D topological insulator" heterostructures wherein the switching of one magnet affects the current, and conversely, the current can switch a magnet. Additional such devices known in the art are anticipated by the disclosure.

In an exemplary embodiment, the at least one of one or more of a transmitter and a receiver each comprise a mover or excitor, such as an acoustic mover wherein a plurality of at least one of one or more of a transmitter and a receiver are organized in a plane of a card or plate transverse to the axis of signal propagation, and a plurality of cards may further be arranged in parallel that are stacked along the axis of the signal propagation enabled by the lack of

attenuation or electrical interference of the neutrino beam through the stack. The at least one of one or more of a transmitter and a receiver on one card may be at least one of spatially displaced in the transverse plane relative to another on a different card, and multiple sensors along a common axis may be spatial temporally multiplexed to avoid any interference of corresponding neutrino deficit signals. The multiplexing may comprise Wavelength-Division Multiplexing (WDM), Time-Division Multiplexing (TDM), Code-Division Multiplexing (CDM), Polarization-Division Multiplexing (PDM), or Selection Rule Division Multiplexing (SRDM) wherein the signals are combined (multiplexed) at the pulsed or modulated neutrino transmitter, and at the receiver, they are separated (demultiplexed).

Motion may be achieved at GHz frequencies. Further consider the exemplary embodiment comprising a transmitter channel having an area of 1 mm^2 and a total transmitter area of 120 cm^2 (e.g. area of an iPhone). The total number of channels arranged as an array at each matching array transmitter and array receiver is 12,000 per card. For a stack of 1 cm total thickness and a card thickness of 50 μm, the number of cards is 200, and the total number transmitter or receiver elements of the total stack arrays is 2.5×10^6. Motion may be achieved at GHz (e.g. 2.31 GHz) frequencies as reported for gigahertz-frequency acousto-optic phase modulator by Freeman et al. [Freedman, J.M., Storey, M.J., Dominguez, D. et al. Gigahertz-frequency acousto-optic phase modulation of visible light in a CMOS-fabricated photonic circuit. Nat Commun 16, 10959 (2025). https://doi.org/10.1038/s41467-025-65937-z] which is herein incorporated by reference in its entirety. Here, the optical waveguide of Freeman et al. may be replaced by a molecular hydrino species that absorbs neutrinos. In the case that the data transfer rate is 1 bit per cycle, the total data transfer rate is 5.775×10^{15} bits/s (5.775 petabit/s or 5.775 Pbps). As comparisons, a petabit could support millions of HD streams simultaneously or hold the content of billions of books, highlighting its immense scale in big data and advanced communication. 5G data rates vary widely with theoretical peaks up to 20 Gbps, real-world averages often 100s of Mbps (e.g. 186 Mbps in US), and home internet speeds around 33-300 Mbps, depending on frequency bands (low, mid, mmWave), network congestion, and location.

CLAIMS

What Is Claimed Is:

1. A digital neutrino telecommunication system comprising:

a source of a signal having information;

an excitor capable of pulsed exciting ro-vibrational states in a molecular hydrino species, such as $H_2(1/p)$ or $[H_2(1/p)]_n$);

a communication element to transfer the signal;

a pulsed neutrino transmitter having a composition of matter including the molecular hydrino species that receives the signals and emits pulses of neutrinos to form telecommunication signals, wherein the pulses encode the information in a digital format;

a neutrino receiver that receives the pulses of neutrinos and converts the pulses into an output pulsed emission of a different form;

a transducer for converting the output pulsed emission into a digital output signal; and

a processor to process the digital output signal

2. The digital neutrino telecommunication system of claim 1, wherein the source of the signals is a communication system.

3. The digital neutrino telecommunication system of claim 2, wherein the communication system comprise at least one of fiber optic transmitters and receivers, RF or microwave transmitters and receivers, modems, fiber optic the cables, antennas, routers, the internet, Wi-Fi systems, and a computing device.

4. The digital neutrino telecommunication system of claim 3, wherein the signals transmitted by the communication system include at least one of data, text, video, and audio signals.

5. The digital neutrino telecommunication system of claim 1, wherein the excitor is capable of pulsed exciting ro-vibrational states in the molecular hydrino, wherein the excitor includes at least one of:

(a) a pulsed energy source including one or more of an electro-optical converter, a pulsed source of photons, a pulsed laser, a pulsed diode laser, a pulsed source of energetic particles, a pulsed particle beam, and a pulsed electron beam, and

(b) a fast switch of the energy of at least one ro-vibrational transition to cause pulsed excitation by a pulsed or continuous energy source, wherein the energy source includes a photon source and a particle beam.

6. The digital neutrino telecommunication system of claim 5, wherein the composition of matter comprises at least one of solid gas@$H_2(1/p)$, liquid gas@$H_2(1/p)$, gaseous gas@$H_2(1/p)$, argon(l)@$H_2(1/p)$, argon(g)@$H_2(1/p)$, ice@$H_2(1/p)$, water@$H_2(1/p)$, steam@$H_2(1/p)$, CO_2(s)@$H_2(1/p)$, solid compounds further comprising $H_2(1/p)$, KOH-KCl@$H_2(1/p)$, FeOOH@$H_2(1/p)$, and GaOOH@$H_2(1/p)$, and wherein at least one of deuterium (D) and tritium (T) replaces hydrogen (H).

7. The digital neutrino telecommunication system of claim 6, wherein the output pulsed emission of the different generated by the neutrino receiver comprises at least one of photons and energetic particles, and wherein the photons includes one or more of an X-ray radiation, an extreme ultraviolet (EUV) radiation, a visible radiation, an infrared radiation , a microwave radiation, and a radio wave radiation.

8. The digital neutrino telecommunication system of claim 7, wherein the transducer comprises at least one of an electro-optical converter, a photodiode, an electron detector, and an ion detector.

9. The digital neutrino telecommunication system of claim 8, wherein the signal from the source is an analog signal having the information, further comprising an analog-to-digital converter for converting the analog signal having the information into a digital signal for processing by the pulsed neutrino transmitter, wherein the analog-to-digital converter includes a transmitter modem for transmitting the digital signal having the information by modulating one or more carrier wave signals to encode the information.

10. The digital neutrino telecommunication system of claim 9, wherein the analog signal is a modulated analog signal and wherein the neutrino receiver is configured to receive the modulated analog signal, wherein the neutrino receiver includes a modem configured to receive the modulated analog signal and demodulate the modulated analog signal to reconstitute the information therein, and wherein the reconstituted information is processed by the processor and stored in a memory element.

11. The digital neutrino telecommunication system of claim 1, wherein the hydrino species undergoes ro-vibrational transitional excitation due to energy absorption by at the least one of a neutrino, a collisional, one-photon, two-photon excitation, and ro-vibrational transitional de-excitation, wherein the ro-vibrational transitional de-excitation is due to energy emission by at the least one of one of a neutrino, a collisional, one-photon, and two-photon de-excitation, at the pulsed neutrino transmitter and the neutrino receiver, respectively.

12. The digital neutrino telecommunication system of claim 1, wherein the excitor excites at least one transition of the molecular hydrino species, wherein the transition is one of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, and magnetic tilt transition.

13. The digital neutrino telecommunication system of claim 12, wherein the excitor comprises at least one of a diode laser and a fast speed magnetization switch, and wherein the laser diode directly achieves pulsed excitation of at least one ro-vibrational transition of the molecular hydrino species via short-duration pulses on the order of 10^{-3}s to 10^{-12}s and repetition rates in a range of 100 Hz to 10 gigahertz via current modulation, electro-optical modulation, Q-switching, or mode locking, and wherein the fast speed magnetization switch causes electric current or laser opto-magnetic interactions by one or more ultrafast lasers applied to the molecular hydrino species to switch the energy of at least one ro-vibrational transition to cause pulsed excitation of at least one ro-vibrational transition via a pulsed or continuous energy source, wherein the energy source is at least one of a photon source, a laser, a diode laser, a particle beam, and an electron beam.

14. The digital neutrino telecommunication system of claim 13, wherein laser outputs light in at least one of an energy range of about $H_2(1/p)$ ro-vibrational levels, an energy range of X-ray to infrared including from 10 keV to 0.05 eV, and wherein the laser emits radiation in one of an infrared range, a visible light range, an ultraviolet range, and an X-ray range.

15. The digital neutrino telecommunication system of claim 1, wherein the transmitted pulsed neutrinos excite at least one transition of the molecular hydrino species of one or more of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, and magnetic tilt transition.

16. The digital neutrino telecommunication system of claim 1, wherein the neutrino receiver includes a molecular hydrino species absorber that forms an excited ro-vibrational state that decays or partially undergoes internal conversion to 1-photon emission or a 2-photon emission,

wherein the decayed transmission is received by a photodetector that transduces the photon emission into an electronic signal.

17. The digital neutrino telecommunication system of claim 16, wherein an energy of the decay of the ro-vibrational state accelerates an electron, wherein the electron is detected by a particle detector to transduce the energy to an electronic signal.

18. The digital neutrino telecommunication system of claim 1, further comprises a plurality of digital neutrino telecommunication subsystems, wherein each subsystem comprises

(i) the pulsed neutrino transmitter to transmit information via a pulsed neutrino stream;

(ii) the neutrino receiver to receive the pulsed neutrino stream and emit one of pulsed photons or pulsed particles such as electrons;

(iii) the transducer to convert the emitted pulsed photons into the digital output signal, and

(iv) the processor to reconstitute the information in the digital output signal.

19. The digital neutrino telecommunication system of claim 18, wherein the signals from the source are neutrino signal streams, further comprising a multiplexer and demultiplexer to encode multiple neutrino signal streams of independent information multiplexed within a bandwidth of a neutrino wavelength and a neutrino pulse length, and wherein the multiplexer and the demultiplexer separate the received multiple neutrino signal stream, respectively.

20. The digital neutrino telecommunication system of claim 19, wherein the multiplexer combines the multiple signal streams into a single transmission stream using a selected multiplexing technique, wherein the multiplexing technique includes one or more Wavelength-Division Multiplexing (WDM), Time-Division Multiplexing (TDM), Code-Division Multiplexing (CDM), Polarization-Division Multiplexing (PDM), and Selection Rule Division Multiplexing (SRDM), and wherein the pulsed neutrino transmitter combines the multiple signal streams to form a combined signal stream, and the combined signal stream is demultiplexed by the neutrino receiver.

21. A neutrino telecommunication system, comprising

a transmitter,

a receiver, and

a processor,

wherein each of the transmitter and receiver include $H_2(1/p)$ molecules that absorb at least a portion of an incident cosmological neutrino beam at the transmitter along a certain selected beam path in a selected temporal order so as to encode information and to transmit an output neutrino signal, and wherein the receiver is configured to receive the output neutrino signal and record a deficit in neutrinos relative to the output neutrino signal and relative to a receiver that records a constant background cosmological neutrino flux, wherein the receiver transmits an output receiver neutrino signal, and wherein the processor is configured to process either the output neutrino signal or the output receiver neutrino signal as a telecommunication signal.

22. The neutrino telecommunication system of claim 21, wherein the neutrinos absorption or interactions of the H2(1/p) molecules encodes the telecommunications signal as at least one of amplitude modulation, frequency modulation, and digital pulses.

23. The neutrino telecommunication system of claim 22, wherein digital pulses are given by the magnitude of the difference between the constant background cosmological neutrino flux and one or more of the output neutrino signal or the output receiver neutrino signal, wherein a zero difference as an output is registered as a zero and a non-zero difference is registered as a one of a binary code.

24. The neutrino telecommunication system of claim 23, wherein at least one of the transmitter and the receiver includes a detector to detect the 1's and 0's of the signals that carries the encoded information.

25. The neutrino telecommunication system of claim 24, wherein the at least one transmitter and receiver can function as both a receiver and a transmitter and exchange neutrino signals comprising attenuation of counterpropagating neutrino beams as signals to permit alignment of the transmitter and receiver along a common axis by at least one actuator that moves one of the transmitter and the receiver relative to the other.

26. The neutrino telecommunication system of claim 25 wherein the transmitter comprises a plurality of transmitters having a plurality transmitter pairs that are synchronized to send at least one verification pulse with every pulse stream, wherein the corresponding receiver coincidently detects each pulse stream and corresponding verification pulse, and the processor confirms a legitimacy of each pulse by processing the coincidences.

27. A neutrino telecommunication system comprising:

(i) a source of a signal having information to form an information signal;

(ii) a bus to transfer the information signal to at least one signal transmitter;

(iii) the at least one signal transmitter having an electron paramagnetic (EPR) spectrometer and a molecular hydrino species, wherein the EPR spectrometer is capable of at least one of causing or allowing electron paramagnetic (EPR) transitions in the molecular hydrino species, and wherein the transitions are at least partially excited by cosmological neutrinos to cause a flux deficit signal over time that encodes the information signal;

(iv) at least one receiver that receives the flux deficit signals over time and having a second electron paramagnetic (EPR) spectrometer and a second molecular hydrino species, wherein the second EPR spectrometer is capable of at least one of causing or allowing electron paramagnetic (EPR) transitions in the second molecular hydrino species, and wherein the transitions are at least partially excited by the cosmological neutrinos flux deficit signals over time;

(v) at least one cosmological neutrino background receiver that receives the cosmological neutrino background flux over time having a third electron paramagnetic (EPR) spectrometer and a third molecular hydrino species, wherein the third EPR spectrometer is capable of at least one of causing or allowing electron paramagnetic (EPR) transitions in the third molecular hydrino species, wherein the transitions are at least partially excited by the cosmological neutrinos to record the constant background signal over time;

(vi) a first processor that determines a difference spectrum over time of transmitter signals and background neutrino signals, wherein the difference signals recover the information;

(vii) a second processor to process and reconstitute the information to be processed, and

(viii) a third processor to process the received signal information as data and output the data.

28. A digital neutrino telecommunication system, comprising:

(i) a source of a signal comprising information to form an information signal;

(iii) an analog to digital converter to convert the information signal into a digital information signal if the signal is an analog signal;

(iv) a bus to transfer the information signal to at least one pulsed signal transmitter;

(iii) the at least one pulsed signal transmitter includes an electron paramagnetic (EPR) spectrometer capable of at least one of causing or allowing pulsed electron paramagnetic (EPR) transitions in a molecular hydrino species, wherein the transitions are at least partially excited by cosmological neutrinos to cause a pulsed flux deficit signal over time that encodes the information signal in neutrino deficit pulses;

(vi) a neutrino receiver having a second molecular hydrino species that receives the pulsed neutrinos and converts the pulsed neutrinos into another form of pulsed emission to form a neutrino signal;

(vii) a transducer for converting the neutrino signals;

(viii) a first processor to process the neutrino signals;

(ix) a receiver to receive the neutrino signal and reconstitute the original information to be processed as data, and

(x) a second processor to record the received signal information as data and output the data.

29. The neutrino telecommunication system of claim 28, wherein at least one of the information signal and the reconstituted signal is analog or digital, and the transmitted signal and received signal are at least one of digital, amplitude modulated, and frequency modulated.

30. The neutrino telecommunication system of claim 28, further comprising at least one of analog to digital converter and a digital to analog converter.

31. The neutrino telecommunication system of claim 28, wherein the attenuation of the neutrinos is determined by synchronously comparing an unattenuated background signal with the attenuated signal received by the receiver, wherein:

the time dependent neutrino signal intensity diminution or deficit encodes the telecommunications signal or information;

the difference signal is determined by the synchronous recording of the neutrino signal by at least one other receiver off axis to the attenuated neutrino beam having no attenuation of the constant cosmological neutrino background flux, and

at least one background neutrino flux detector is mounted in the same plane as each receiver, such that incident cosmological neutrinos at the same angle and same distance as the receivers to provide an accurate background signal.

32. The neutrino telecommunication system of claim 31, wherein, at least one of (i) one or more signal transmitters, (ii) one or more signal receivers, and (iii) one or more background receivers are periodically calibrated relative to each other to correct for a differential in responsiveness to the flux of cosmological neutrinos (e.g. due to at least one of differential or drifting geometry and electronics, and the responsive of the molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$)).

33. The neutrino telecommunication system of claim 28, wherein the EPR spectrometer is a continuous wave electron paramagnetic resonance (EPR) spectrometer, comprising:

(i) a microwave antenna that supplies a microwave magnetic field B_1 within a resonator or cavity and a magnet to produce a static external magnetic field B_0 generated by an electromagnet providing a constant direction for electron spins to align with or against B_0, wherein the fields are oriented such that the microwave magnetic field B_1 is perpendicular to the field B_0;

(ii) a sample that absorbs neutrinos comprising the molecular hydrino species is placed in the resonator between poles of the magnet, where B_1 is maximum and B_0 is uniform;

(iii) the microwave field B_1 is generated by a microwave bridge and directed via waveguide/antenna into the cavity (resonator);

(iv) the resonator is configured to ensure an oscillating magnetic component of the microwaves B_1 is perpendicular to the static field B_0, which is required for maximum transition probability for $S = 1/2$ systems based on selection rules, or

(v) in a "parallel mode" B_1 is parallel B_0 to excite otherwise forbidden transitions.

34. The neutrino telecommunication system of claim 28, wherein an unpaired electron of molecular hydrino is aligned along a magnetic field axis B_0, or the unpaired electron is flipped perpendicularly to the magnetic field axis by a pulse of electromagnetic energy (e.g. a $\pi/2$ microwave pulse) wherein the electron magnetic moment direction causes a selective directional absorption or attenuation neutrinos based on selection rules.

35. The neutrino telecommunication system of claim 34, wherein an electron magnetic moment flipped into a transverse plane interacts with the nuclear spins, including protons and ^{3}H nucleus with S = ½, and ^{2}H nucleus with S = 1, to increase a cross-section of neutrino absorption or interactions.

36. The neutrino telecommunication system of claim 35, wherein transitions involving interactions between electron spin and at least one other spin states give rise to at least one of new absorption and emission peaks in the EPR spectrum, the other spin state interaction resulting in energy level splitting comprising

(i) electron spin-nuclear spin;

(iii) nuclear-nuclear spin;

(v) splitting due to excited ro-vibrational states;

(vi) splitting due to electron spin-orbital coupling and fluxon linkage;

(vii) electron-spin splitting with matrix unpaired electrons;

(viii) electron-spin splitting with matrix nuclear magnetic moments;
(vii) nuclear-spin splitting with matrix unpaired electrons, and
(viii) nuclear-spin splitting with matrix nuclear magnetic moments.

37. The neutrino telecommunication system of claim 36, wherein at least one of (i) the electron paramagnetic resonance (EPR) spectrometer applies a short, high-power microwave pulse, such as a $\pi/2$ pulse, that tips an equilibrium magnetization into the xy-plane to produce a free induction decay (FID) signal in a continuous-wave regime that is modified by the absorption of cosmological neutrinos that encodes data and information, and (ii) the FID is recorded then processed by a FFT to generate the EPR spectrum of the molecular hydrino species modified by the encoded data and information.

38. The neutrino telecommunication system of claim 37, wherein at least one of (i) a rapid scan (RS) EPR technique is utilized wherein the magnetic field is swept through the molecular hydrino species resonance so quickly that it creates a signal like an FID that is modified by cosmological neutrino absorption to encode data and information, and (ii) the signal is processed by FFT and deconvolution to generate the EPR spectrum of the molecular hydrino species spectrum modified by the encoded data and information.

39. The neutrino telecommunication system of claim 38, wherein the rapid scan (RS) EPR comprises permanent magnets and selected electronic components, including voltage-controlled oscillators (VCO), capable of sweeping the frequency at a fixed magnetic field.

40. The neutrino telecommunication system of claim 39, wherein the EPR spectrometer is integrated into a single silicon microchip to form an EPR-on-a-Chip (EPRoC) device comprising a source of magnetic field such as a magnet and either (i) a microwave bridgeand a fixed-frequency oscillator, or (ii) voltage-controlled oscillator (VCO)-based EPRoC detectors comprising an array of injection-locked VCOs, each incorporating a miniaturized planar coil as a combined microwave source and detector.

41. The neutrino telecommunication system of claim 40, wherein the magnetic field strength produces at least one EPR energy resonance that matches the energy of cosmological neutrinos wherein cosmological neutrinos are absorbed during the EPR spectroscopy scan to encode the data and information.

42. The neutrino telecommunication system of claim 41, wherein embedding the VCO in a high-bandwidth phase-locked loop (PLL) allows for

(i) a definition of a phase of the exciting B_1 field from an external reference, and the amplitude-sensitive mode of encoding the information due to cosmological neutrino absorption, and

(ii) detection with a high-bandwidth AM demodulator provided directly into the LC VCO that is also used to detect the sample magnetization with a high bandwidth.

43. The neutrino telecommunication system of claim 42, wherein the EPRoC encodes the information due to cosmological neutrino absorption during an EPR spectroscopy scan as pulsed or digital, amplitude modulation, and frequency modulation encoding, and the spin response is detected by amplitude-sensitive detection (AM) and frequency-sensitive detection (FM) wherein the AM and FM sensor signals correspond to the EPR-induced changes in the VCO amplitude and frequency, respectively.

44. The neutrino telecommunication system of claim 43, wherein at least one of VCO-based EPRoC transmitters and receivers comprise an array of injection-locked VCOs, each incorporating a miniaturized planar coil as a combined microwave source and detector.

45. The neutrino telecommunication system of claim 44, further comprising an alignment subsystem to maintain the transmitter and matched receiver perpendicular and centered on a correct aligned axis wherein, neutrino beams are adjusted periodically to prevent misalignment comprising at least one of:

(i) an alignment signal and the telecommunication signal;

(ii) a neutrino-beam-position-sensing detector in at least one of the transmitter and receiver that detects incoming signals and automatically adjusts the transmitter to steer the beam toward a center of the receiver;

(iii) a signal optimizer that monitors the received signal strength using an indicator (RSSI) at a plurality of spatial positions;

(iv) a frequency difference of arrival (FDOA) used to track signals, wherein the transmitter dynamically exchanges positioning signals and corresponding information;

(v) time of flight device for tracking a spatial phase angle based on spatial position used as an alignment mechanism;

(vi) a selected transmitter and receiver pair that continuously scans their surroundings to dynamically identify the optimal beam pair with the highest signal strength;

(vii) an antenna alignment tool (AAT) that employs GPS, gyroscopes, and digital compasses to measure tilt, roll, and azimuth;

(viii) one or more alignment tools that calculate azimuth and elevation for moving targets, enabling rapid re-pointing;

(ix) inertial navigation systems (INS/GPS) that track at least one of transmitter and receiver positions using systems (e.g. fiber optic gyros (FOGs)) to provide data for highly accurate pointing, stabilization, and geo-location to guide self-alignment;

(x) an inertial navigation system (INS) comprising a self-contained device using accelerometers and gyroscopes (within an inertial measurement unit or IMU) to track at least one of the transmitter's and receiver's position, velocity, and orientation by measuring motion and rotation, relying on "dead reckoning" from a known starting point;

(xi) an INS that fuses data with GPS/GNSS for periodic correction to correct for tiny accumulated sensor errors (drift), offering reliable alignment even when external signals are lost, and

(xii) at least one fast alignment actuator (e.g. electromechanical, galvanometers, or piezo stages) to move at least one of the transmitter and receiver relative to each other to constantly adjust the relative positions of the transmitter and receiver to maintain alignment.

46. The neutrino telecommunication system of claim 45, wherein the alignment system is configured to maintain the transmitter and matched receiver perpendicular and centered on the correct aligned axis and maintains sender and receiver point-to-point communication by one or more pre-program motion synchronization algorithms between each of the sender's and receiver's transmitter/receiver, such that possible point-to-point communication ray paths or axes are scanned according to the algorithms, initially weighting the most probable paths external information until the path of least time is locked on, and the transmission proceeds along that selected ray path with alignment of the devices.

47. The neutrino telecommunication system of claim 46, wherein at least one of the transmitter and receiver further comprises a collimator to cause the attenuation of the cosmic cosmological neutrino background flux that is not about perpendicular to the transmitter or receiver.

48. The neutrino telecommunication system of claim 47, wherein the collimator comprises a material having embedded molecular hydrino or atomic hydrino, wherein at least one of a magnetic field is applied to the material and the material is intrinsically magnetic, such that spin flip transitions of the embedded molecular hydrino or atomic hydrino are induced by the

magnetic field to attenuate cosmological neutrino background flux that is not about perpendicular to the transmitter or receiver.

49. The neutrino telecommunication system of claim 48, wherein rather than or in addition to EPR detection, the receiver includes a source of magnetic field comprising a permeant or an electromagnet, wherein the energy of neutrino absorption or interaction by a $H_2(1/p)$ species is down converted by at least one of the decay or partial decay to a lower energy photon emission including at least one of an infrared, microwave, and radio photon emission that is received by the receiver, the receiver further includes a sensor responsive to the photon emission and converted to electrical signals, and processed, wherein a difference signal between the cosmological neutrino background and the telecommunication signal encoded by at least one of an amplitude modulation, frequency modulation, and pulse or digital encoding is processed to receive the telecommunications data and information.

50. The neutrino telecommunication system of claim 49, wherein the application of a magnetic field to a molecular hydrino species (e.g. $H_2(1/p)$, $H_2(1/p)$ dimer, and $H_2(1/p)$ multimer) gives rise to at least one transition (e.g. at least one of an electron spin-flip, nuclear spin flip, ro-vibrational, spin-orbital coupling, electron-nuclear magnetic moment coupling, fluxon linkage, and other hyperfine transition) that is excited by neutrinos (e.g. cosmological neutrinos).

51. The neutrino telecommunication system of claim 50, wherein at least one of the transmitter and the receiver comprises a means to detector of at least one of electron-spin-flip transitions and microwaves emitted due to spin-flip transitions.

52. The neutrino telecommunication system of claim 51, wherein at least one of the transmitter and the receiver comprises at least one of (i) an antenna, (ii) an optoelectronic oscillator (OEO) detector, (iii) a bolometer, (iv) a high frequency superconducting quantum interference (SQUID) device, (v) a III-V nanowire heterostructure and a magnetic tunnel junction (MTJs) that exploit quantum-confined energy levels or spintronic effects, (vi) an optomechanical system and photonic-based references in phase-locked loops (PLLs) that can convert microwave signals into the optical domain or provide ultra-low noise references which improves detection sensitivity and phase noise analysis, (vii) Rydberg atom sensors, (viii) a network analyzer, (ix) an organic molecular quantum receiver that uses organic molecular spins, (x) a microwave photon counter (e.g. a superconducting qubit comprising a single-microwave photon detector), (xi) scanning tunneling microscope, (xii) an optical detector using Faraday rotation of a laser pulse, and (xiii) a single photon calorimeter.

53. The neutrino telecommunication system of claim 50, wherein the communication system comprises an electromagnet, a power source, a processor-controller, and a source of data and information stream that is encoded in the absorbed neutrino flux as a function of time by the processor-controller controlling the magnetic field as a function of time wherein the magnetic field is controlled or modulated as a function of time to control and modulate the absorption of the neutrino flux incident the molecular hydrino species to encode or read data and information wherein the encoding is least one of pulsed or digital, amplitude modulation, and frequency modulation.

54. The neutrino telecommunication system of claim 53, wherein

(i) at least one of the transmitter and the receiver comprises a source of magnetic field;

(ii) the application of the magnetic field to a species comprising $H_2(1/p)$ creates energy states in the energy range of the absorption cross section of at least one of cosmological and solar neutrinos;

(iii) the telecommunications signal is encoded during transmission or decoded during reception in the time dependent absorption of neutrinos producing at least one of an amplitude modulated, a frequency modulated, and a pulsed or digital telecommunications signal one conveying data and information, and

(iv) the encoding or decoding is controlled by controlling at least one of the magnitude and direction of the applied magnetic field and spatial-temporal displacement of a neutrino absorber comprising a molecular hydrino species.

55. The neutrino telecommunication system of claim 54, wherein at least one of

(i) the magnetic field is pulsed on and off to demagnetized and remagnetize;

(ii) at least one of the transmitter and the receiver comprises magneto-optic memory cells that offer non-volatile storage with sub-nanosecond programming speeds wherein neutrino photons may serve the role of optical photons, and

the source of magnetic field comprises "reciprocal ferromagnet/3D topological insulator" heterostructures wherein the switching of one magnet affects the current, and conversely, the current can switch a magnet.

56. The neutrino telecommunication system of claim 55, further comprising a mover or excitor to cause spatial-temporal displacement of a neutrino absorber wherein

(i) the spatial-temporal displacement of a neutrino absorber comprises a vibration wherein at least one of the (a) presence or absence of motion, (b) amplitude of motion, and (c)

frequency of motion is controlled to control the telecommunications signal transmitted or received along the axis perpendicular to the positional center of the motion to encode or decode a (aa) puled or digital signal, (bb) an amplitude modulated signal, and (cc) a frequency modulated signal, respectively;

(ii) the transmitter and receiver are aligned on the axis perpendicularly to the motion or relative motion with a separation distance between the transmitter and receiver;

(iii) the transmitter creates a neutrino deficit signal, and the receiver receives the signal comprising a deficit of neutrinos due to the absorption by the transmitter, and

(iv) the difference signal between the at least one of the cosmological neutrino background and solar neutrino background and the telecommunication signal comprising at least one of (a) a pulsed or digital, (b) an amplitude modulated, and (c) a frequency modulated signal is processed to receive the telecommunications data and information.

57. The neutrino telecommunication system of claim 56, wherein

(i) the transmitter and the receiver includes a molecular hydrino species, and

(ii) each of the transmitter and the receiver further includes at least one of (a) an EPR spectrometer, (b) an EPR spectrometer and a magnet that applies another magnetic field to the molecular hydrino species to cause an energy transition (e. g. an electron spin flip transition) that is excited by cosmological neutrinos, and (c) a magnet that applies a magnetic field to the molecular hydrino species to cause an energy transition (e.g. an electron spin flip transition that is excited by cosmological neutrinos alone or the absence of either (a) or (b).

58. The neutrino telecommunication system of claim 57, further comprising a means to spatially-temporally move the least one of one or more of a transmitter and a receiver wherein

(i) the motion is transverse to the propagation direction of the neutrino beam in which the data and information are encoded by the motion;

(ii) the data and information are encoded by at least one of pulses or digital encoding, amplitude modulation, and frequency modulation, and

(iii) the mover that provides the time-dependent motion comprises at least one of piezoelectric, electromechanical, micro-electro-mechanical systems (MEM), plasmonic modulator or resonator, acousto-optic modulator, acousto-optic resonator or phase modulator, tiltable stage or mount, nanophotonic opto-mechanical resonator, acoustic modulator, and a device that uses surface acoustic waves for at least one of deformation and displacement that is mediated optically.

59. The neutrino telecommunication system of claim 58, wherein the actuator is at least one of a reciprocal device and capable of absorbing spatial-temporal streams of received neutrino deficit signals and transducing the signals into at least one of displacement and another form of signal encoding the same data and information as the neutrino deficit signals.

60. The neutrino telecommunication system of claim 59, wherein a reciprocal device comprises a piezoelectric actuator that can convert electric signals into displacements and displacements into electrical signals.

61. The neutrino telecommunication system of claim 60, wherein at least one of a transmitter and receiver comprises a photothermal, a photo-mechanical, a crystal cantilever device, an optomechanical actuator, and a device controlled using magneto-optical driving further comprising a magnet to provide an applied magnetic field wherein neutrino photons serve the role of optical photons.

62. The neutrino telecommunication system of claim 61, wherein each receiver comprises a plurality of smaller sub-receiver elements that cover an area that includes the transverse extrema or transverse spatial amplitude of the neutrino deficit beam wherein the beam amplitude is determined by the amplitude of the transverse displacement at the transmitter during encoding the data and information in the spatial-temporal neutrino deficit signals, and variation of the difference signal over the sub-receiver elements as a function of time is recorded to receive the transmitted signals.

63. The neutrino telecommunication system of claim 62, further comprising an excitor that causes spatial-temporal displacements of the neutrino absorber comprising a molecular hydrino species to transmit and receive neutrino deficit signals wherein the data and information is encoded in the temporal stream of the neutrino deficit signals.

64. The neutrino telecommunication system of claim 63, wherein the excitor excites at least one transition comprising at least one of a rotational, vibrational, spin flip, spin orbital coupling, fluxon linkage, magnetic tilt, phonon, plasmon, and electronic transition in at least neutrino absorber material comprising:

(i) a molecular hydrino species (e.g. $H_2(1/p)$ or $[H_2(1/p)]_n$);

(ii) a molecule or compound to which molecular hydrino species is at least one of embedded, absorbed, or bonded to;

(iii) a crystalline lattice to which molecular hydrino species is at least one of embedded, absorbed, or bonded to;

(iv) metallic lattice;

(v) a semiconductor to which molecular hydrino species is at least one of embedded, absorbed, or bonded, and

(vi) an organic or inorganic crystalline lattice to which molecular hydrino species is at least one of embedded, absorbed, or bonded,

to at least one of encode data and information in transmitted time dependent neutrino deficit signals or receive the time dependent neutrino deficit signals.

65. The neutrino telecommunication system of claim 64 wherein the excitor comprises at least one of a

(a) diode laser to directly achieve pulsed excitation of at least one transition of the neutrino absorber material that can be switched rapidly, achieving short-duration pulses between 10^{-3}s to 10^{-12}s and repetition rates in the range of 100 Hz to 10 gigahertz through one or more methods including at least one of current modulation, electro-optical modulation, Q-switching, and mode locking, and

(b) a fast speed magnetization switch based on causing electric current or laser opto-magnetic interactions by ultrafast lasers applied to a magnetic neutrino absorber material to switch the energy of at least one transition to cause pulsed excitation of at least one transition by a pulsed or continuous energy source comprising at least one of a photon source, a laser, a diode laser, a particle beam, and an electron beam.

66. The neutrino telecommunication system of claim 64, wherein the excitor is at least one of a reciprocal device and capable of absorbing spatial-temporal streams of received neutrino deficit signals and transducing the signals into at least one of a transition in a molecular hydrino species and another form of signal encoding the same data and information as the neutrino deficit signals.

67. The neutrino telecommunication system of claim 66, wherein at least one of one or more of a transmitter and a receiver each comprise a mover or excitor wherein a plurality of at least one of one or more of a transmitter and a receiver are organized in a plane of a card or plate transverse to the axis of signal propagation, and a plurality of cards are further arranged in parallel that are stacked along the axis of the signal propagation enabled by the lack of attenuation or electrical interference of the neutrino beam through the stack.

68. The neutrino telecommunication system of claim 67, wherein the at least one of one or more of a transmitter and a receiver on one card is at least one of spatially displaced in the transverse plane relative to another on a different card, and multiple sensors along a common axis is spatial temporally multiplexed to avoid any interference of corresponding neutrino deficit signals.

69. The neutrino telecommunication system of claim 68, wherein the multiplexing comprises at least one of Wavelength-Division Multiplexing (WDM), Time-Division Multiplexing (TDM), Code-Division Multiplexing (CDM), Polarization-Division Multiplexing (PDM), or Selection Rule Division Multiplexing (SRDM) wherein the signals are combined (multiplexed) at the pulsed or modulated neutrino transmitter, and at the receiver, they are separated (demultiplexed).

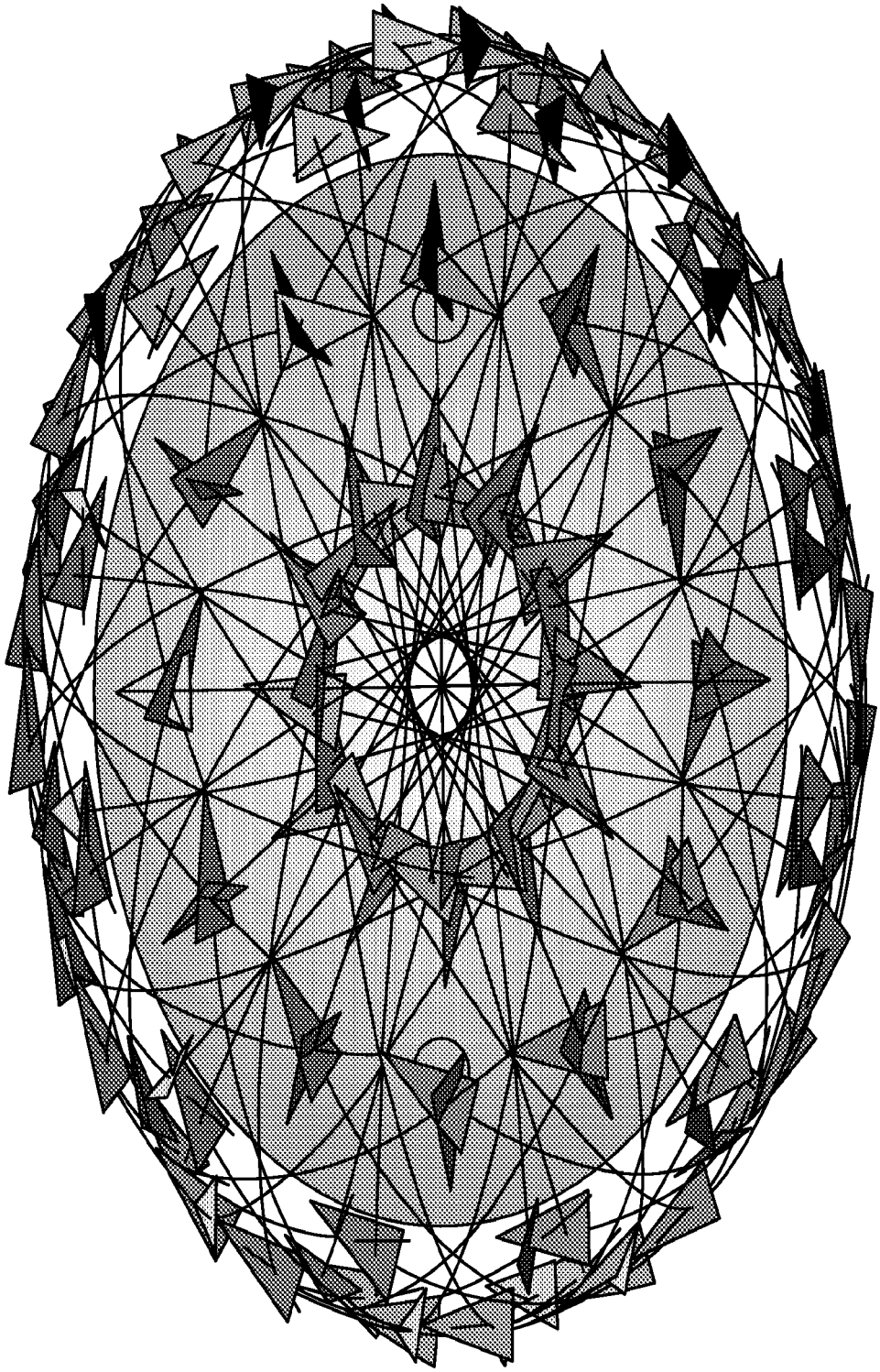


Fig. 1

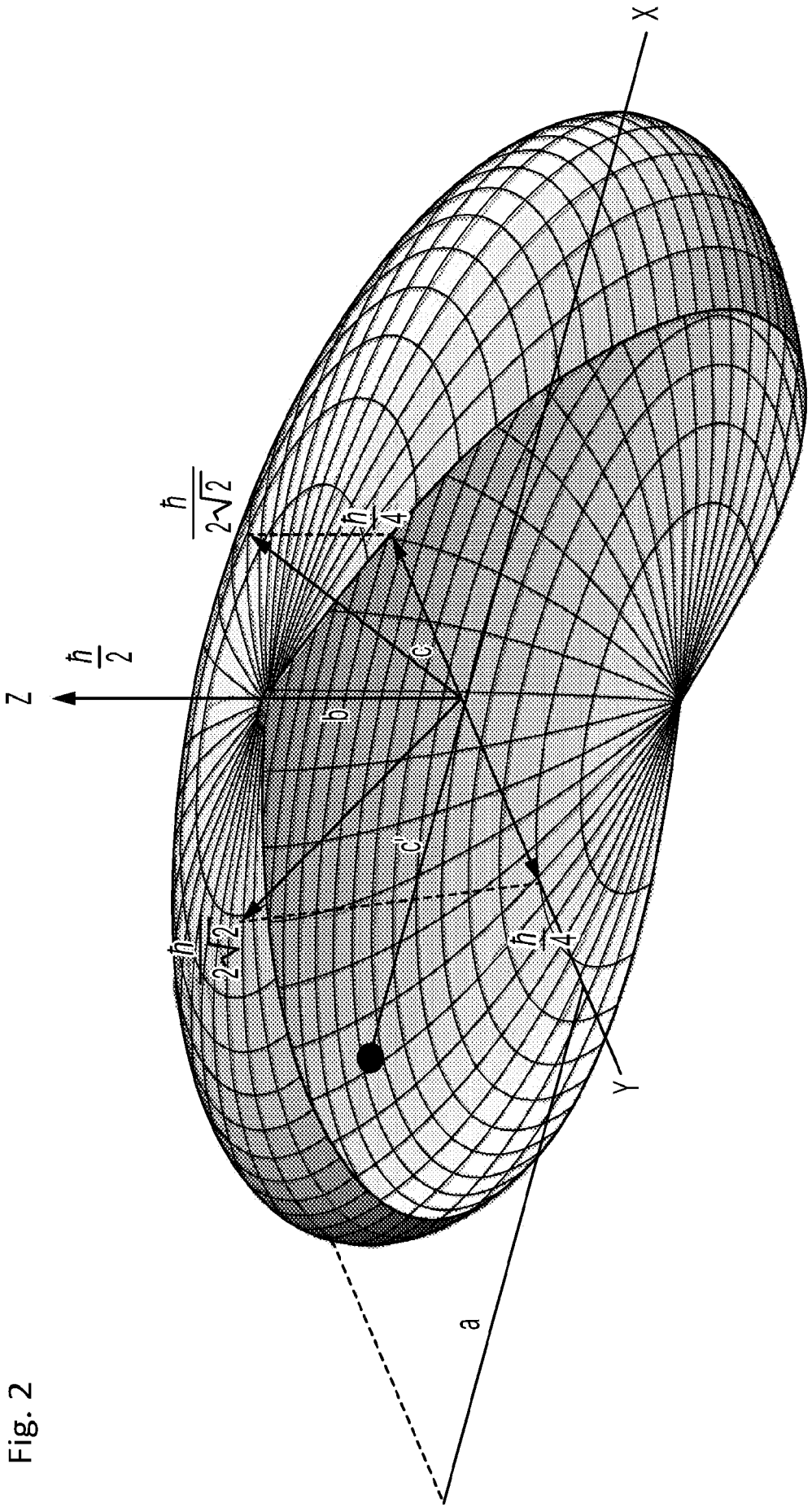


Fig. 2

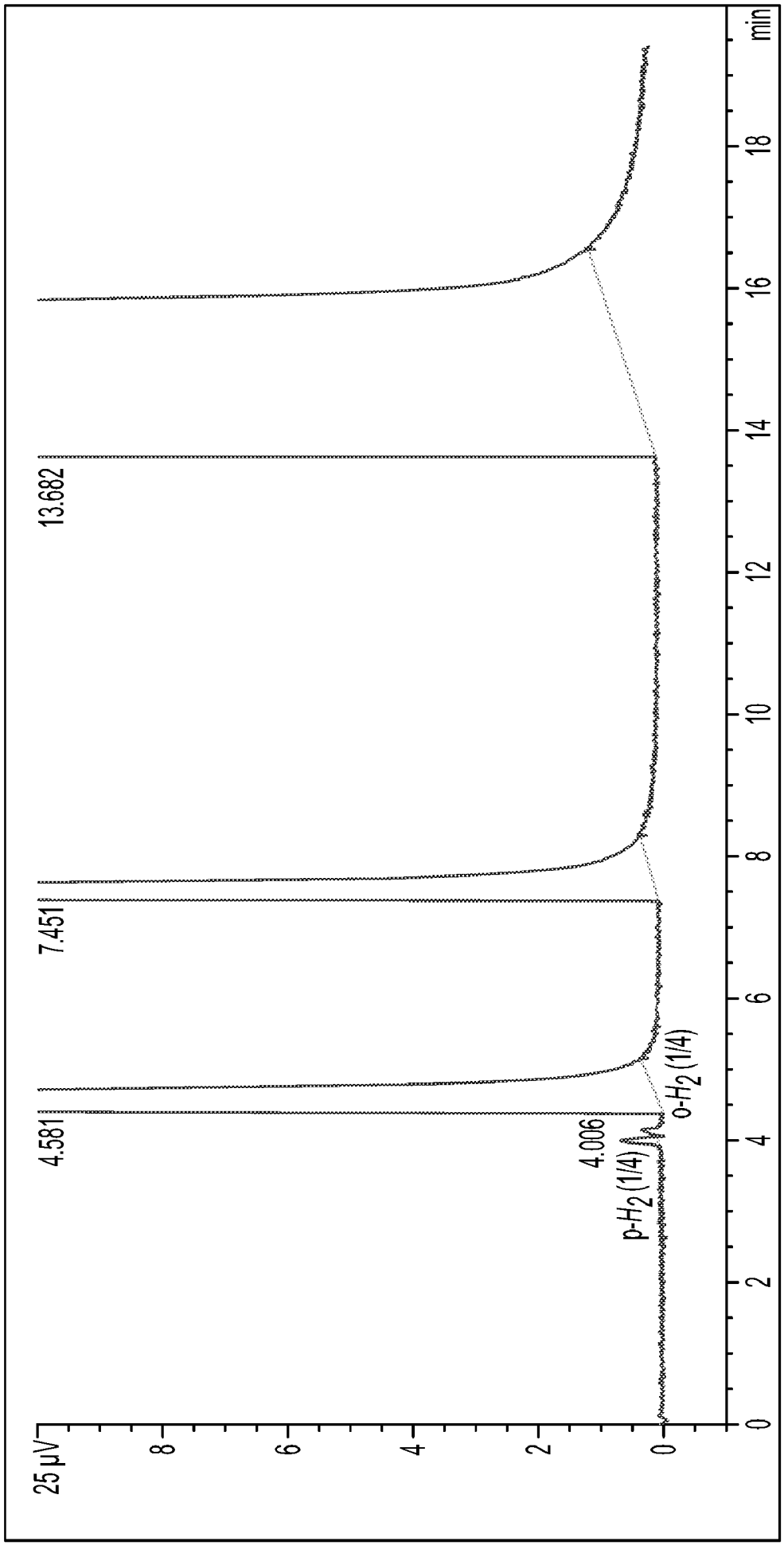

25 µV
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
min
4.581
7.451
13.682
4.006
p-H2 (1/4)
o-H2 (1/4)

Fig. 3

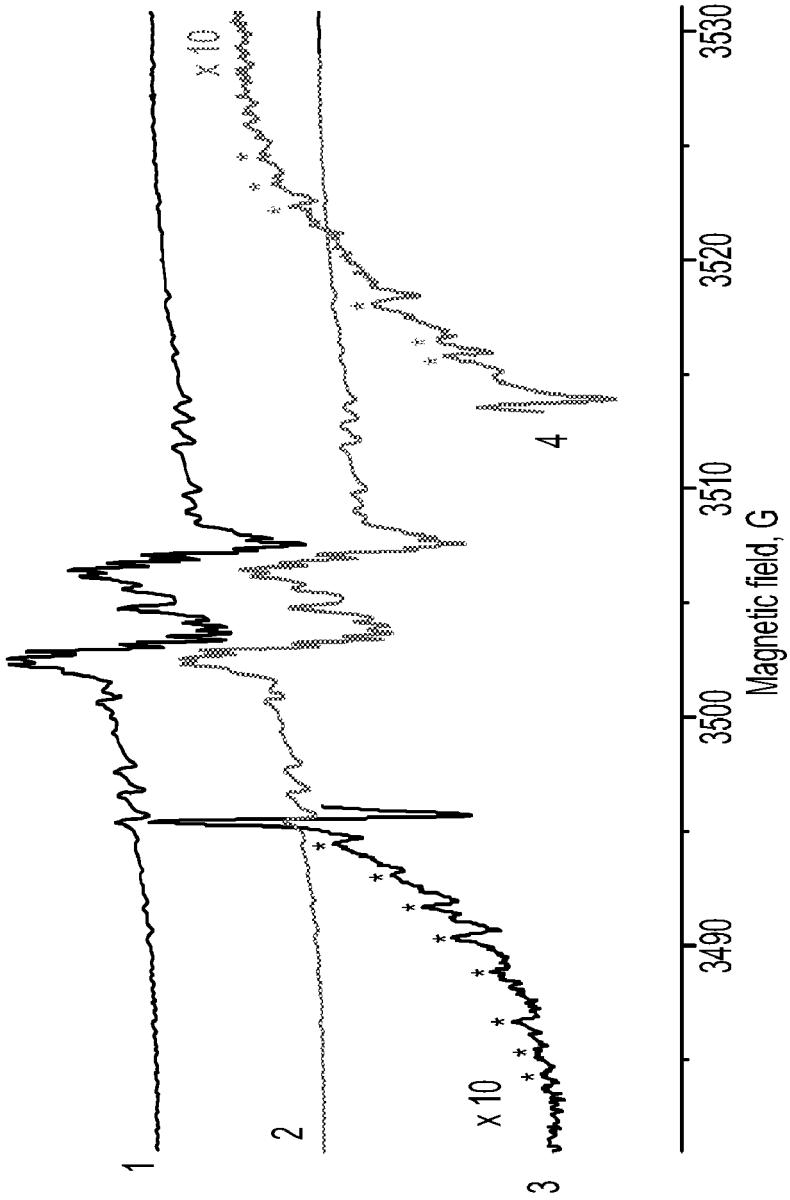


Fig. 4

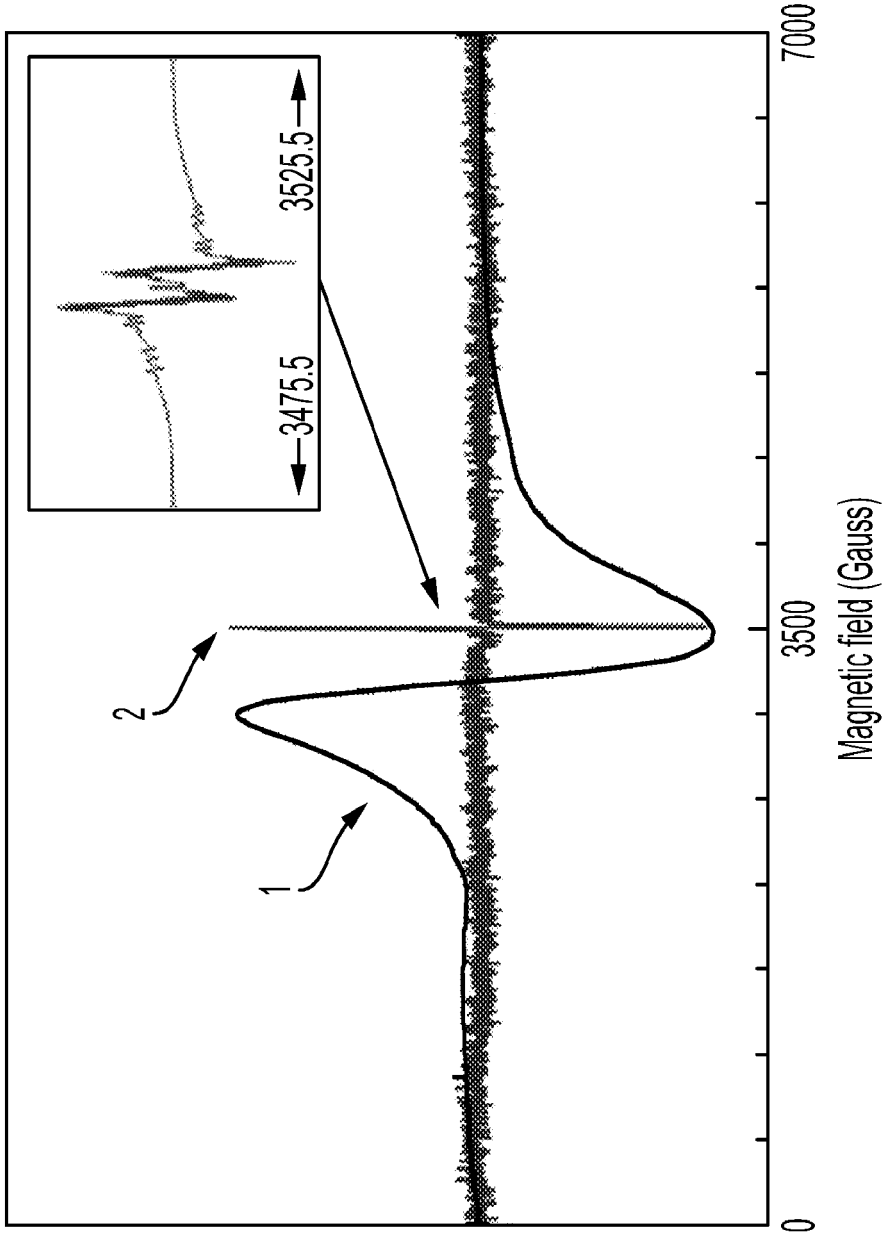


Fig. 5



Fig. 6

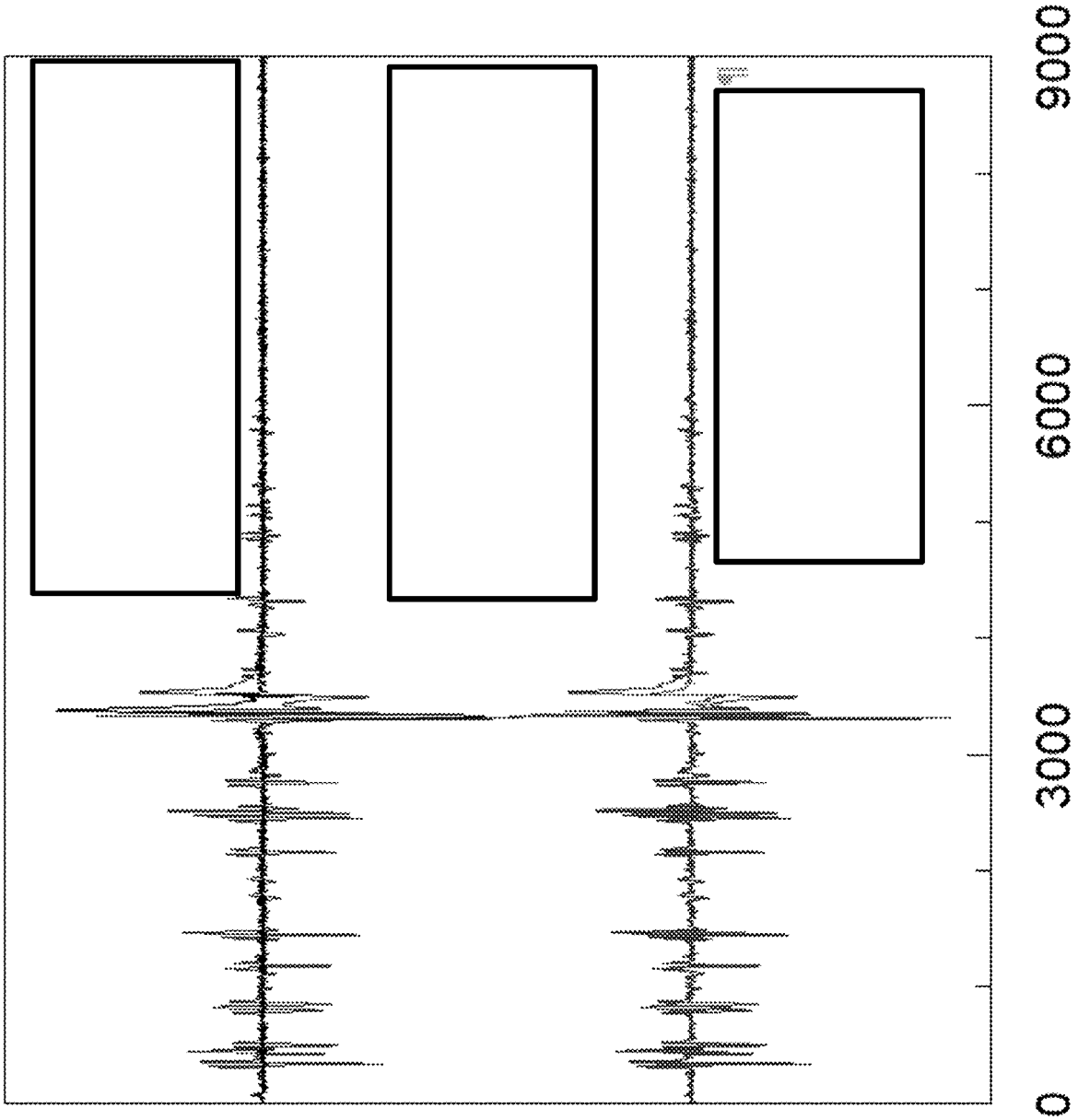


Fig. 7

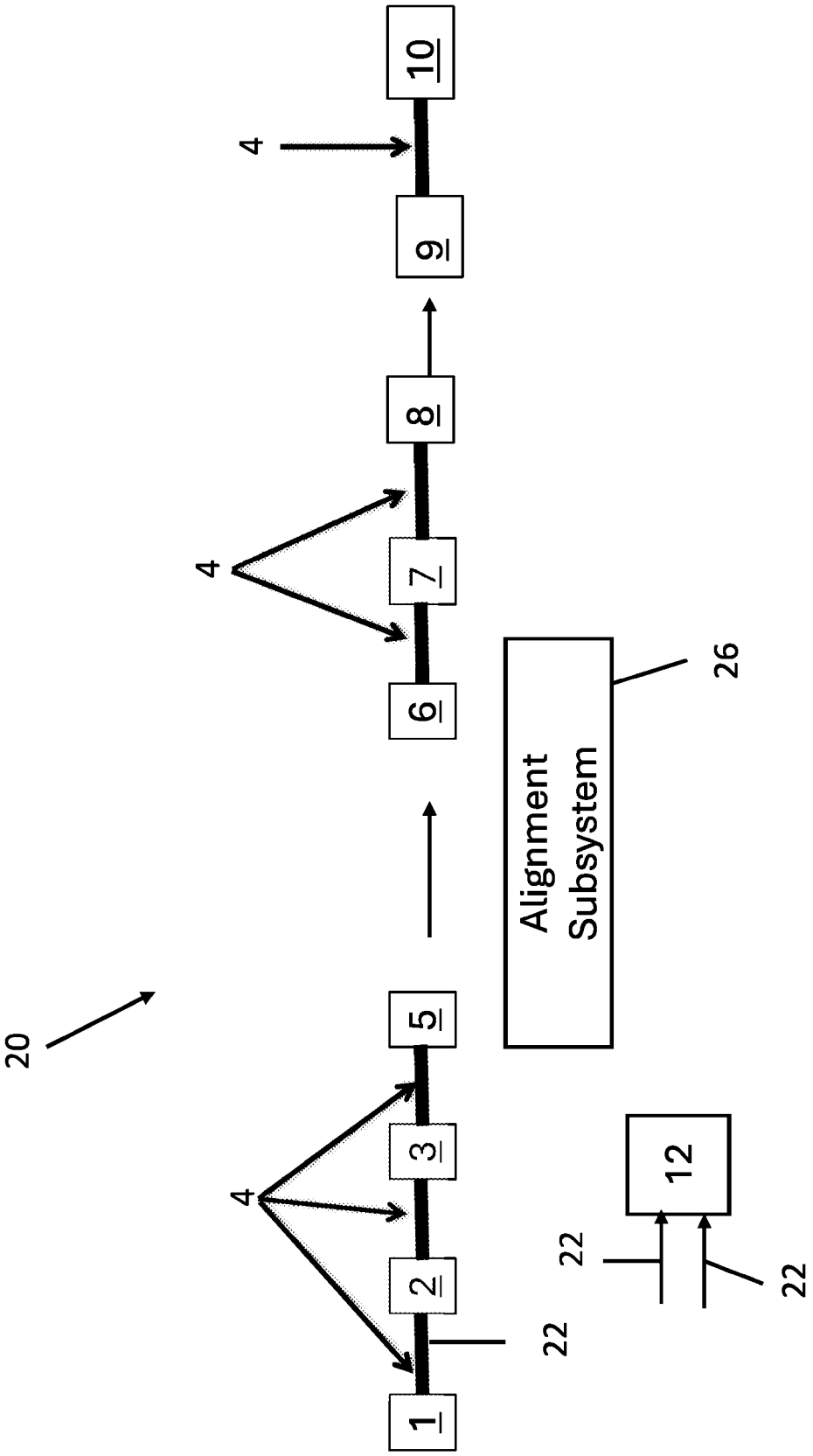


Fig. 8

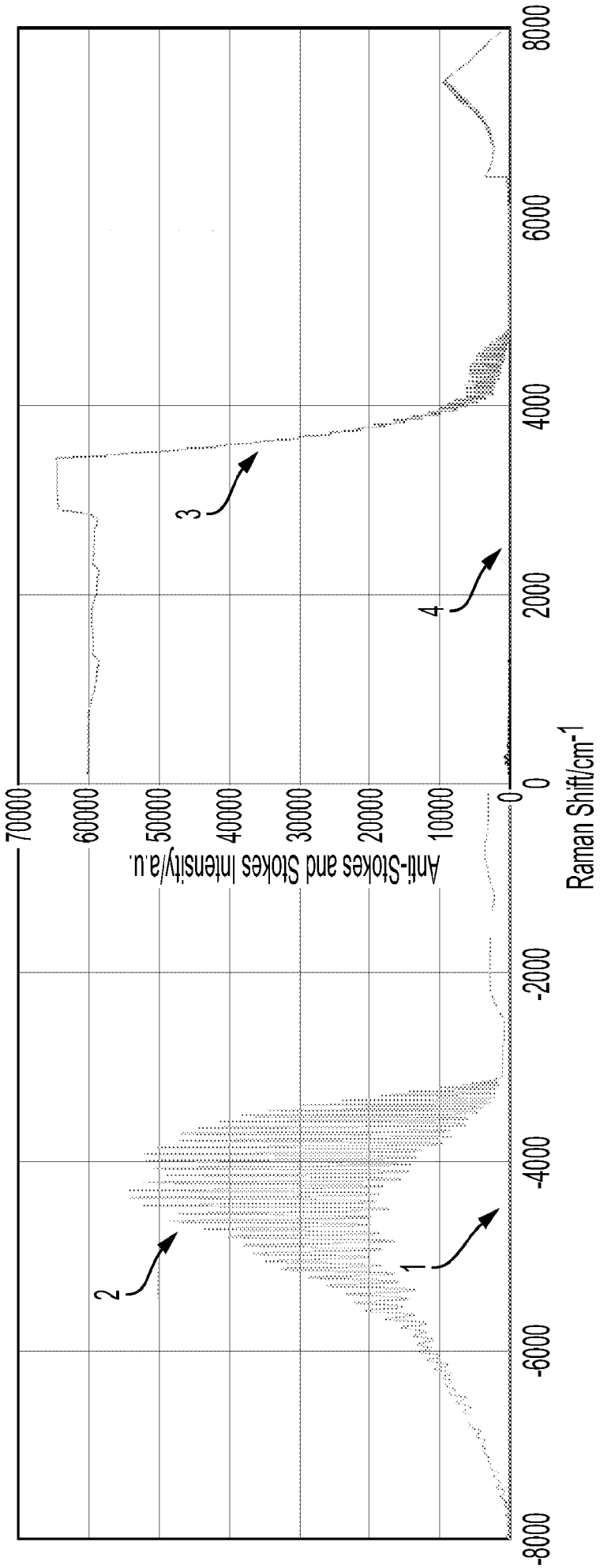

Anti-Stokes and Stokes Intensity/a.u.
70000
60000
50000
40000
30000
20000
10000
0
8000
6000
4000
2000
0
-2000
-4000
-6000
-8000
Raman Shift/cm-1
1
2
3
4

Fig. 9

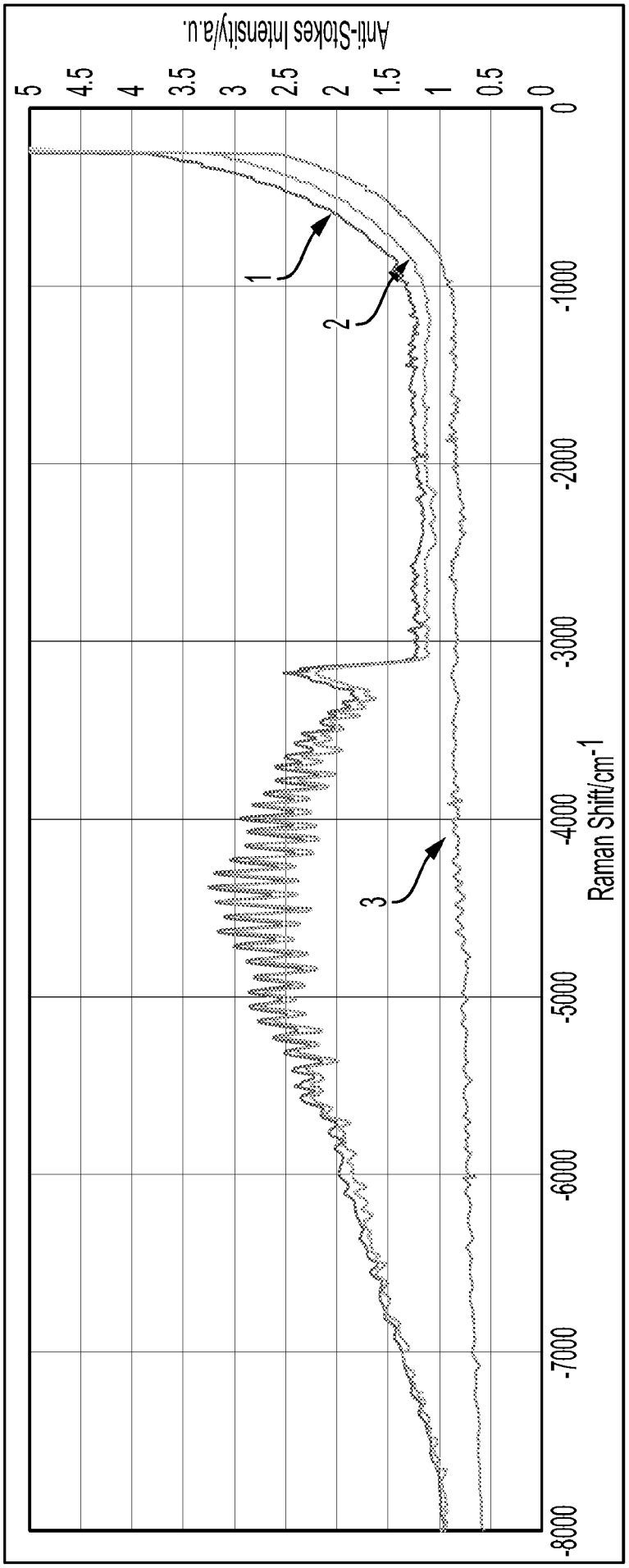

Anti-Stokes Intensity/a.u.
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1
2
3
-1000
-2000
-3000
-4000
-5000
-6000
-7000
-8000
Raman Shift/cm-1

Fig. 10

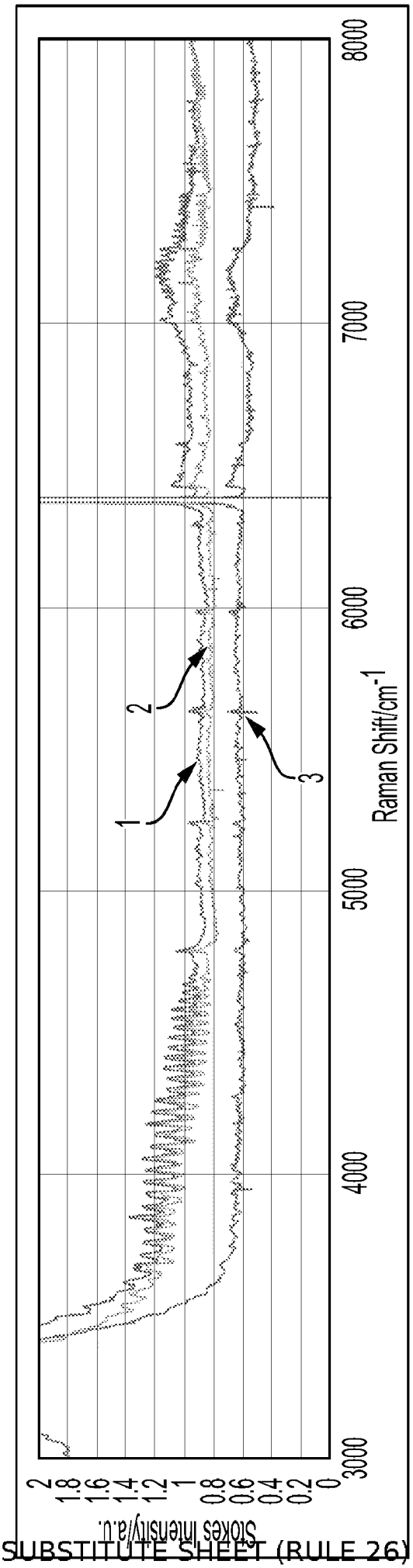

Stokes Intensity/a.u.
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3000
4000
5000
6000
7000
8000
Raman Shift/cm-1
1
2
3

Fig. 11

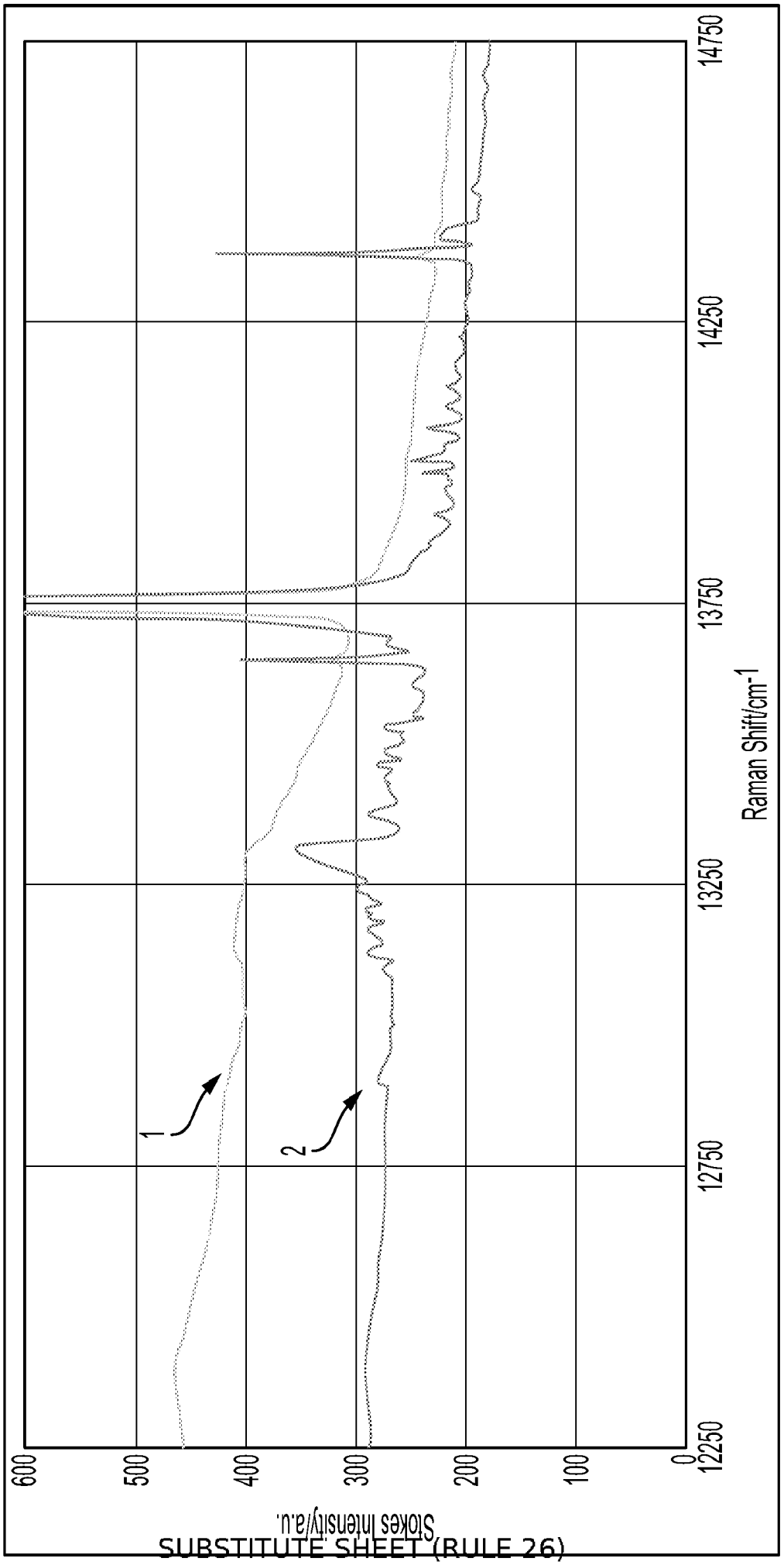

Stokes Intensity/a.u.
0
100
200
300
400
500
600
12250
12750
13250
13750
14250
14750
Raman Shift/cm-1
1
2

Fig. 12

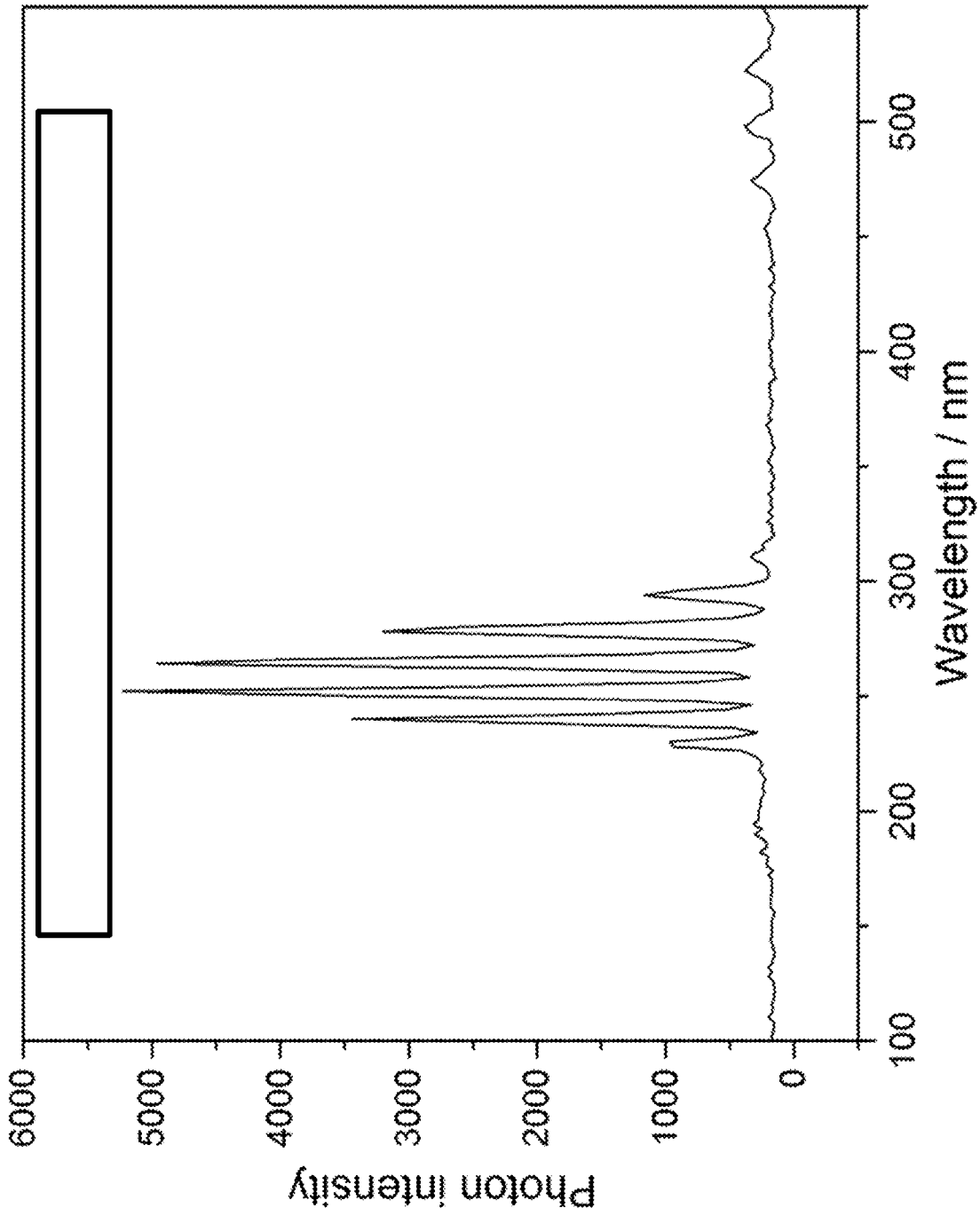

Photon intensity
6000
5000
4000
3000
2000
1000
0
100
200
300
400
500
Wavelength / nm

Fig. 13

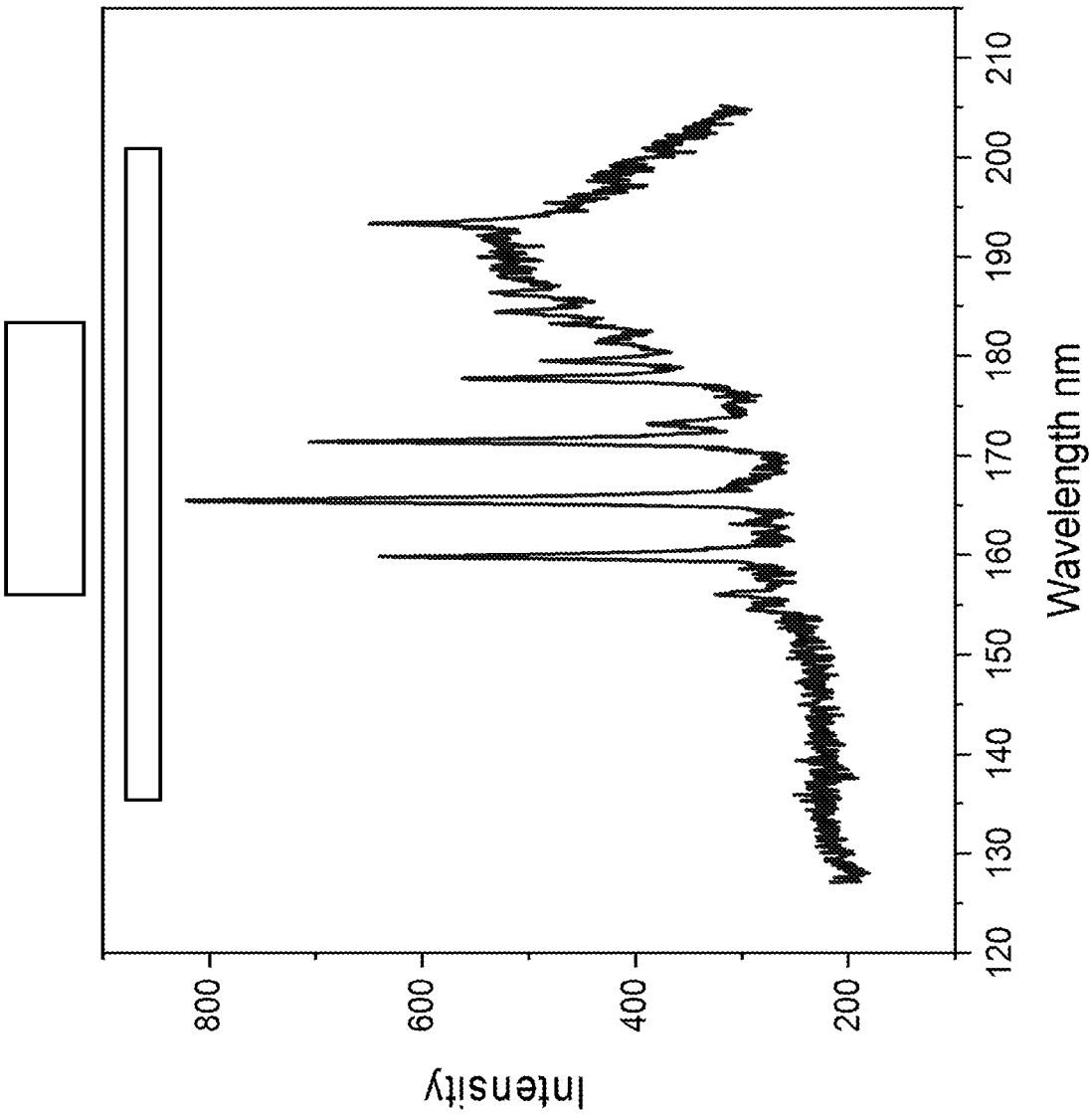

Intensity
800
600
400
200
120
130
140
150
160
170
180
190
200
210
Wavelength nm

Fig. 14

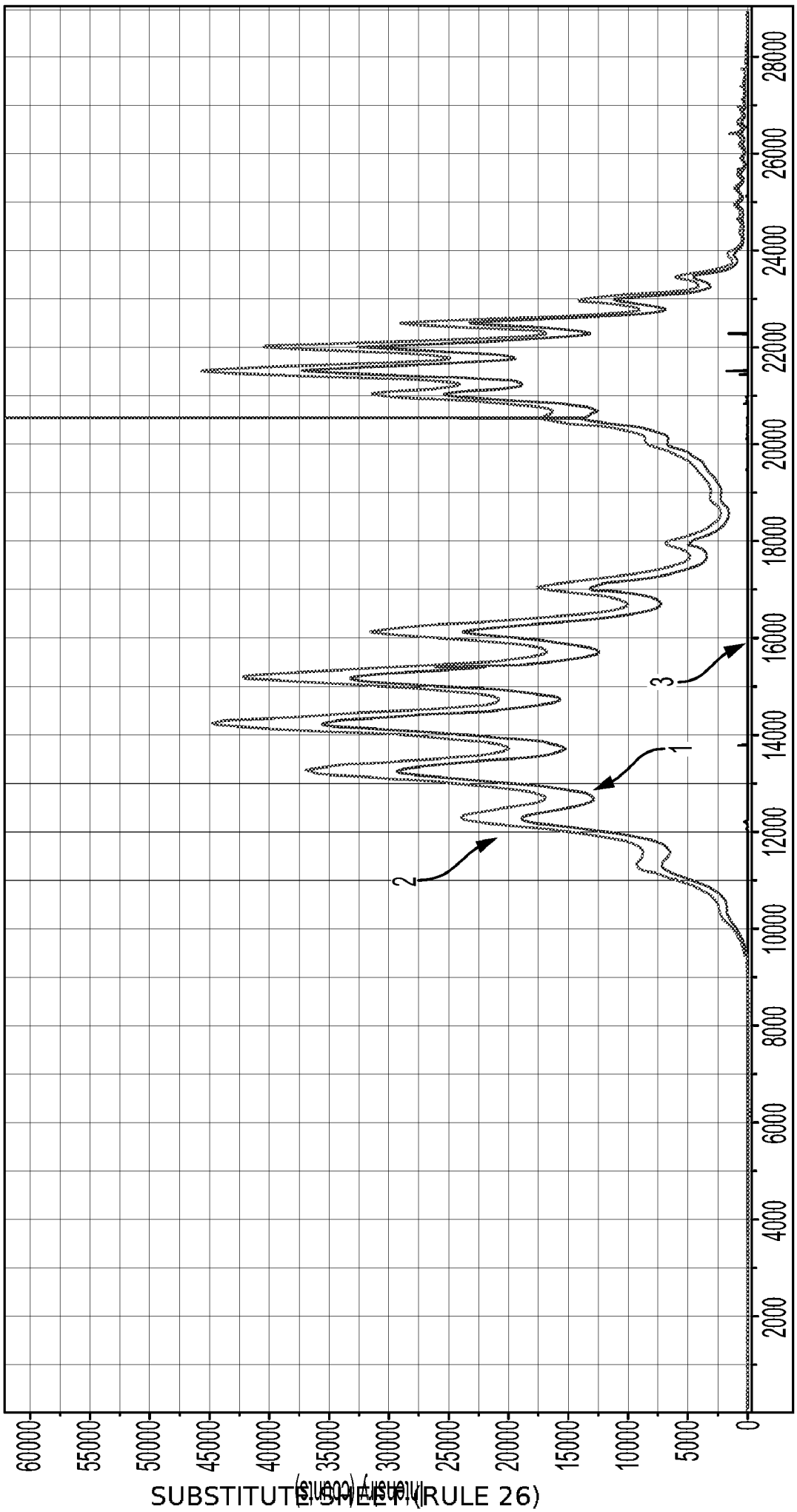

60000
55000
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
22000
24000
26000
28000
1
2
3

Fig. 15

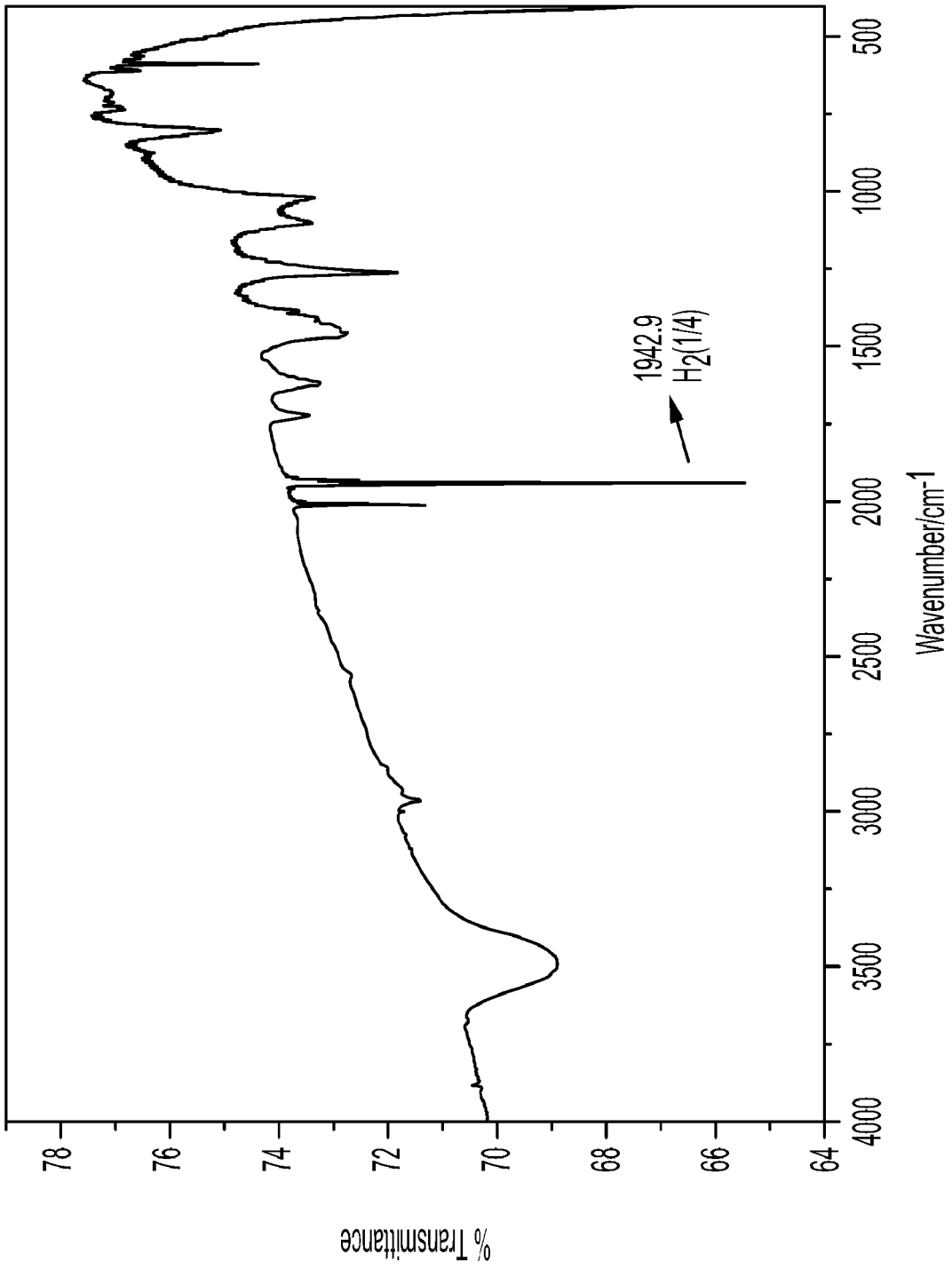
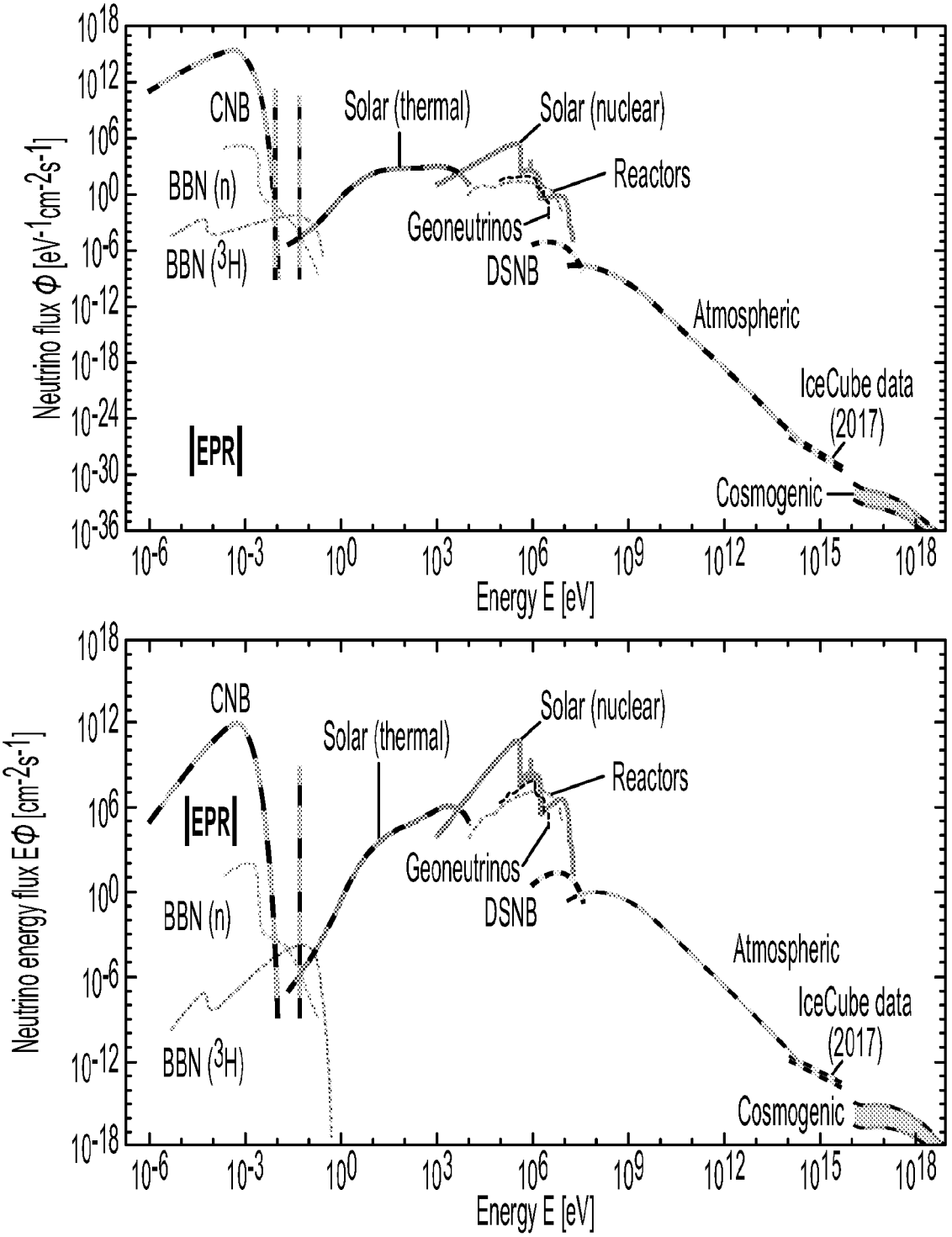

% Transmittance
78
76
74
72
70
68
66
64
4000
3500
3000
2500
2000
1500
1000
500
Wavenumber/cm-1
1942.9
H2(1/4)

Fig. 16

Fig. 17


Neutrino flux Φ [eV-1cm-2s-1]
Energy E [eV]
CNB
Solar (thermal)
Solar (nuclear)
Reactors
BBN (n)
BBN (3H)
Geoneutrinos
DSNB
Atmospheric
IceCube data (2017)
Cosmogenic
EPR
Neutrino energy flux EΦ [cm-2s-1]
Energy E [eV]
CNB
Solar (thermal)
Solar (nuclear)
Reactors
EPR
Geoneutrinos
DSNB
BBN (n)
BBN (3H)
Atmospheric
IceCube data (2017)
Cosmogenic

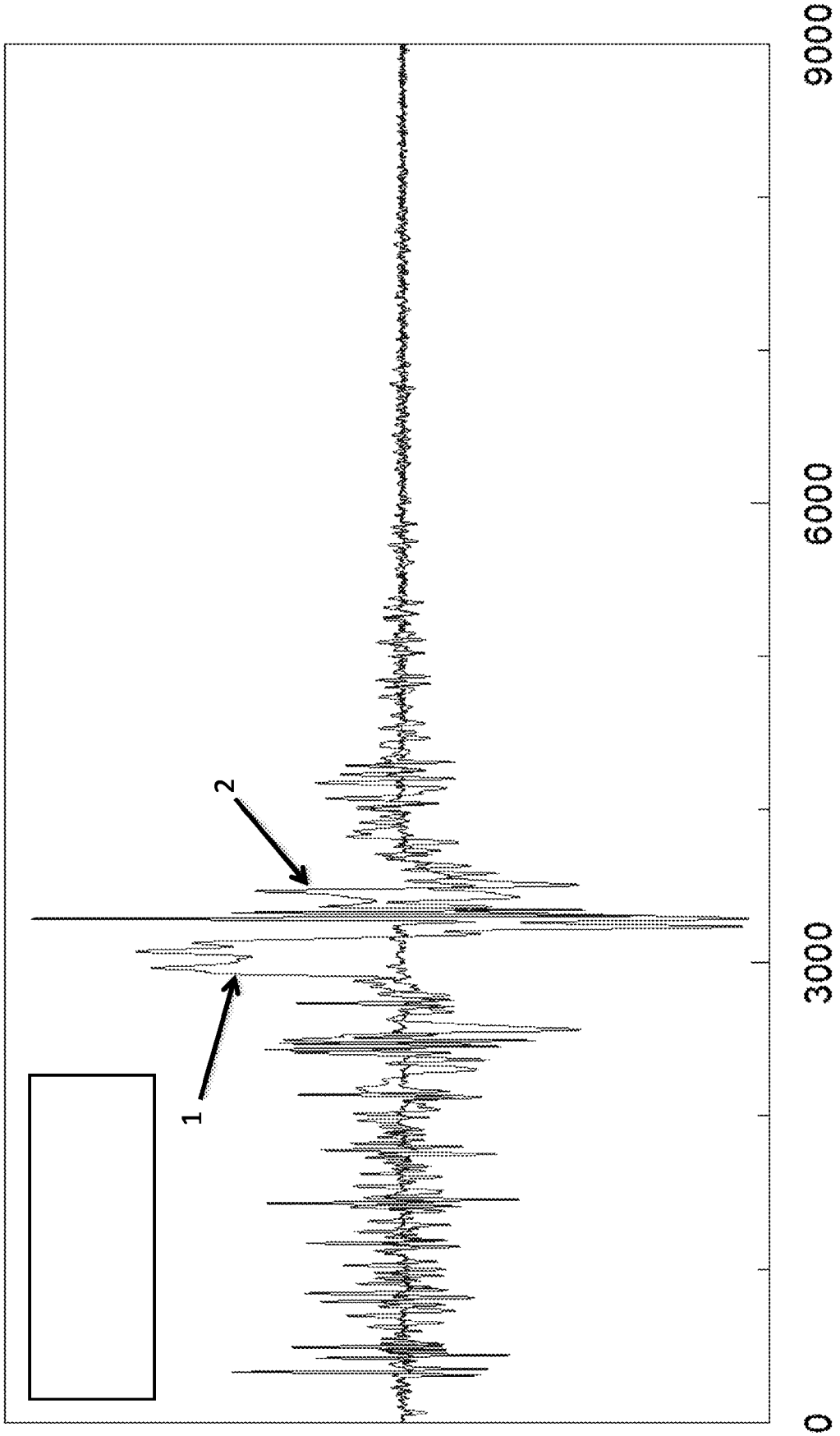


Fig. 18

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2026/020385

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04B10/90 H04B13/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2025/055363 A1 (MILLS RANDELL L [US]) 13 February 2025 (2025-02-13) paragraph [0693] - paragraph [0715] -----	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 July 2026	14/09/2026

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Inan, Beril

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2026/020385

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:
1-20

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-20

Active generation of neutrino pulses

---

2. claims: 21-69

Modulation of the cosmological neutrino background (flux-deficit)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2026/020385

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2025055363 A1	13-02-2025	----------	