Inside the Cosmic Dispersive Prism

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Abstract-The universe has the characteristics of a dispersive prism with areas having different indexes of refraction. A material with a varying index of refraction can have areas that produce magnification, reflection, refraction and alter other characteristics of electromagnetic waves over distance. Radio astronomers have identified that electromagnetic waves have to travel through extensive regions of plasma. The interaction of electromagnetic waves in a plasma can produce heterodyne products. These products can mimic redshift, blueshift and produce a prodigious amount of radio noise which can be referred to as cosmic static.

Introduction

We have a point source view of the electromagnetic (EM) emissions from many celestial sources where we and the sources are inside a very large dispersive prism that has areas with different levels of density. The basic characteristics of a light transparent homogeneous prism are well known and there are many demonstrations where the diffraction index is changed. Unlike an optical prism made from a transparent homogeneous molecular material, the universe appears as a transparent gas-like material interspersed with clumps of solid materials that is intermixed with patches of cloud-like material that may or may not be optically transparent. Less than a century ago, optical astronomers (OA) accepted the assumption that the intervening material between the Earth and a celestial object consisted primarily of *empty space* and that included the space between our Sun and the planets.

Radio astronomy did not start until after the 1940 article titled, "Cosmic Static," was published in a traditional astronomical publication.[1] It was already known in 1940 that radio emissions with specific frequency ranges were reflected by an optically invisible layer, the ionosphere, that existed well above the Earth's atmosphere. The *radio window* is defined by the EM frequencies that can pass through the atmosphere and ionosphere. It is doubtful that all the EM frequencies that can pass through the *radio window* have been identified due to limitations in our detection instruments.

After the Explorer satellites were launched in the late 1950s, the terms *free space*, *empty* space and *vacuum of space* became oxymorons. The discovery of the Van Allen Belts in the so-called *free, empty* or *vacuum of space* above the Earth's atmosphere has required the scientific community to temper the use of these terms, but it is not difficult to find scientific literature still using the terms without any qualification. Some of the current theories about the universe were made well before the 1950s when it was an *accepted fact* that space was empty except for visible objects. OA and radio astronomers (RA) are currently using the term *interstellar medium* (ISM) to describe what exists between celestial objects; this avoids the messy ambiguity of what *free, empty* and *vacuum* means in regards to space.

By equating the universe to a very large lens, it can be described using examples of the optical aberrations an individual experiences that has a certain type of cataract. A cataract creates an area in the lens that has a different index of refraction. Multiple cataracts create significant distortions. The aberrations are apparent to a human subject because the retina contains millions of photo receptor cells and a cataract will cause a single object to appear at more than a single focal point. Optical and most radio telescopes are equivalent to a single photo receptor cell. This single point source view of the universe does not allow us to readily determine whether the view to a specific cosmic EM source is presenting to us an EM image that would be identical from a significantly different viewing position. Our maximum angular viewing offset to a distant point source is determined by our planet's orbit around the Sun; this offset is negligible considering astronomical distances.

OA are limited to dark nights and cloudless skies. Optical telescopes have aperture diffraction issues and radio telescope antennas have side lobes and require a fairly large angular offset from the Sun, unless they are studying the Sun's EM emissions. The strip charts and spectrum displays used by radio astronomers can yield significant information, but a radio telescope that uses a single or closely spaced antenna structures provides poor spatial information. Large array interferometer radio telescopes can improve spatial resolution. Even with the limitations of current radio astronomy instruments, the discovery of various celestial radio sources has added more complexity to an already complex optically visible universe.

Density Ducts

We know that atmospheric conditions can cause optical aberrations and radio waves can be reflected by ionosphere layers. RA experienced pointing errors and it was theorized there were density changes above the atmosphere that caused the problem. In 2015, density ducts were imaged with the Murchison Widefield Array (MWA).[2] MWA researchers used refraction shifts to identify the location of the density ducts. “A multitude of unresolved celestial radio sources (mostly radio galaxies and quasars) back-illuminate the plasma, allowing one to probe fluctuations at high spatial completeness by measuring the angular distribution of source refractive shifts.” Please note the term *plasma*.

Density ducts are composed of energetic particles, activated by the Sun, that form along the Earth's magnetic field lines and provide the conduits for what are termed *whistlers*, very low frequency electromagnetic waves generated by lightning. Radio wave containment would be by reflection from the layers of ionized particles; the reflection based upon the ionization density, EM wavelength and angle of incidence. The density ducts are in some degree hollow, with the major densities at their outer radial extremities. Density ducts above the Earth change shape diurnally. OA experience no apparent problems with the density ducts.

The shape of the Sun's heliosphere is now considered to have a bubble type shape.[3] It is quite possible that the Sun is surrounded by its own density ducts.[4] Ref (4) refers to the solar wind, but this could be measuring the activity of the energized particles associated with the Sun's density ducts that align with the Sun's magnetic field. There should be higher densities near the poles.

Pulsar timing can be altered when a pulsar is viewed within 60 degrees of the Sun. The Sun's density duct shape and their distance above the Sun would be altered by whatever causes the sunspot cycle, the magnetic field reversal and the long cycles that modify the sunspot cycle peaks. It is quite possible that solar flares would cause variations in the Sun's density ducts. It should be considered that our galaxy itself is surrounded by its own density ducts. Each of our galaxy's arms can be considered a type of galaxy density duct. The refractive index changes caused by density ducts will present optical and radio astronomers with different EM observation characteristics.

Space is never truly empty because it is flooded with EM waves of all frequencies and EM waves can interact with each other when space contains charged particles, a plasma.

Spectrum and Sensor Issues

Traditional optical telescopes view celestial objects that reflect or emit visible light The visible light spectrum covers violet to red, the range that covers what our eye photo receptors respond to. Sensors have been developed to observe EM emissions in the ultraviolet and infrared spectrum. Spectographic instruments now reveal to OA that objects being viewed can have discrete spectrum differences. There are conditions in space that can alter propagating EM emissions. Deducing the form of these space conditions from afar requires making assumptions about the composition of the material in a particular viewing coordinate.

Radio astronomy covers a very broad spectral range, but have to do this with antennas and receivers that each cover just a small segment. Multiple receivers are used to cover a broader spectrum range. There is an anomalous condition where the frequency output of certain objects appear at a number of widely separated frequencies. The reason they know these signals are from the same source is because the source is a pulse that has a specific pulse rate, a pulsar. This phenomena is currently called *multi-frequency scattering* and has been observed from multiple pulsars.

Radio and Optical Astronomy Terms

It has become apparent to astronomers that space is not truly empty. To explain what can happen to EM waves that encounter particulate matter in space OA use the terms *extinction, reddening* and *redshift*, whereas RA use the term *dispersion measure* (DM). OA and RA recognize Doppler shift.

OA state that extinction and reddening are caused by dust particles. It is postulated that the size of the dust particles are close to the wavelength of blue light, causing extinction at the shorter blue wavelength, which produces reddening when there are sufficient dust particles between the object source and the viewer.

'**DM** is the "integrated column density of free electrons between an observer and a pulsar".'[6] DM is used to aid in determining the distance to pulsars. A comprehensive history of the establishment of DM is provided in a paper by Cordes and Lazio.[7] The paper points out the shortcomings in the original establishment of DM. The Summary of ref.(7) contains the statement, 'We must take into account the distribution of electrons in the local ISM, and we require "clumps" and "voids" of electrons, mesoscale structures distributed throughout the galaxy on a large number of lines of sight in order to produce reasonable agreement with the observations.' A DM line of sight that is aligned parallel with an arm of our galaxy will pass through an extended density area, Figure 2 of ref. (7).

The DM column is treated as a straight line from viewer to the distant source. A dispersive prism, with multiple areas having different densities, can cause multiple refractions and we do not know the refraction directions. If a material density changes smoothly an EM wave will curve. Instead of a column it should be referred to as a tunnel, which could curve and have a number of changes in direction from the object being viewed to our viewing location. Additionally, what we observe through the dispersive prism is the apparent position of the source since we do not know any of the direction changes through the dispersive tunnel. The DM tunnel is equivalent to an elongated vacuum tube filled with electrons, a plasma.

It is reasonable to expect from what is presented in ref. (7), there are different ionization levels in different parts of the DM *plasma tunnel* (DMPT) being viewed. It is a plasma tunnel in regards to the monocular view of a telescope, but the plasma tunnel is a segment of a large scale plasma cloud. A plasma cloud can contain plasma waves. These waves will further agitates the electrons and ions in the plasma cloud, producing more EM waves.

Because of side lobes, a radio telescope can detect signals coming through DMPTs with other pointing coordinates.

RA have identified sources that produce a predictable frequency, those produced by specific atoms, but in general, even if a frequency is close to a known frequency, they will not know if the frequency being detected is in its original form or has been altered within the DMPT. A Doppler shift can produce a redshift or blueshift, but not both at the same time. Another type of spectrum shift needs to be considered, that of a *heterodyne* signal, which will produce what would appear to be a redshift and blueshift at the same time.[8]

Heterodyne

The simplest heterodyne case involves two EM waves with different frequencies. When these two signals interact, in a non-linear medium, they will produce a predictable sum and difference signal. With just two sources, a higher frequency Source(A) and a lower frequency Source(B), they will produce a Source(A+B) wave and a Source(A-B) wave. Now you have four EM waves with different frequencies in the DMPT. The magnitude of the heterodyne wave is a function of the magnitude of the two original EM waves. To observe the two sources and two heterodyne products, it is necessary that they remain parallel at the DMPT observation point; this assumes the proper frequencies are being monitored.

How many of the heterodyne signals produced will survive in the DMPT being viewed will depend upon their magnitude and frequency. If the frequencies are substantially different, one or more of the original four frequencies could be dispersed from the DMPT being viewed. What eventually comes through the DMPT could be just one of the heterodyne products. The simple two signal heterodyne case probably does not exist because multiple intragalactic and intergalactic EM signals will be interacting from all directions all the time.

The three dimensional synergistic heterodyne interaction of EM signals in galactic scale plasma concentrations are probably the source of *cosmic static*. Even if two original source EM waves were pure sine waves, once the angle of coincidence changes from a parallel interaction the heterodyne products will become chopped up segments of the original sine waves. The greater the angle of interaction the narrower the heterodyne segments, eventually becoming very short pulses, which would give the appearance of noise in a receiver.

The current of a terrestrial lightning strike flows through a concentrated plasma channel where it excites electrons and ions into motion that create EM waves that propagate in all directions. The interaction of these waves produce synergistic heterodyne products that we call *radio static*.

The multi-frequency scattering of a radio pulsar could be the result of the pulsar EM wave source interacting with a single sine wave source.[9] The simplest case would be an original pulsar EM wave interacting with a pure sine wave source, which then produces two heterodyne waves that mimic the pulsar pulse. These two heterodynes can now heterodyne with the original sine wave source again, producing additional heterodynes, etc., etc. The EM spectrum images presented in ref (9) suggest such a scenario. It is not known if the original sine wave source was detected. Ref. (9) did not list the specific frequencies detected, just the bands. The frequencies were plotted in Fig. 2 of ref. (9), but they were on ten small log scale graphs that do not allow the precise frequency to be extracted. It is not possible to state that the highest frequency detected is that of the original pulsar signal or that of a heterodyne product. The heterodyne products detected in ref (9) had to remain parallel in the DMPT being viewed.

Heterodynes are produced when EM waves interact in a nonlinear medium. All plasmas are not created equal. The study of plasmas typically involves what are termed *confined plasmas*. Technically all plasmas are confined in the universe, but therein it is a matter of the degree of confinement. The density ducts around the Earth provide some degree of plasma confinement by the Earth's magnetic field. The magnetic field of the Sun and our galaxy will impart some degree of confinement to all plasmas within their influence.

Subtle Radiation from Space

Arthur Eddington, in his treatise titled, “The Constitution of Stars,” mentioned a suggestion that someone forwarded that could explain the cause of variable stars; “that there is some subtle radiation traversing space that the star picks up.”[10] Eddington and all the scientists of that era and before were unaware that there was any radiation, other than light, coming from the cosmos. I mentioned the Eddington quote in a paper titled, “Galactic Schumann Resonance Type Waves”.[11]

The universe itself can be considered an EM container. This container probably has established standing waves that all the other EM waves produced by various sources within this container have to travel through. There are constant energy exchanges, mixing, between all the waves. The standing waves in the universe probably have a variety of wave periods, some not measurable even by the duration of human existence on this planet. You have to move through a standing wave to detect its period. Propagating waves moving through a standing wave, even those standing waves with very long periods, will quickly produce heterodyne products with higher and higher and lower and lower frequencies. Since we cannot directly detect the original low frequency wave we will not detect the lower frequency heterodyne products. We should be able to detect the higher frequency products that are within the range of contemporary detectors.

Summary and Conclusions

The conclusions made by astronomers, physicists and others that delve into astronomical issues are dependent upon how they apply the factors that alter EM waves that propagate great distances through various concentrations of plasma and other material in space.

Heterodyne signals can exhibit the same type of spectra that is attributed to a redshift, blueshift or Doppler shift. Because of EM wave heterodynes and other interactions with space conditions, it will always be difficult for astronomers to determine if an object being viewed has been altered and how it was altered.

It is necessary to identify all the ways that EM waves can interact with a plasma, and what frequency relationship between waves will produce the maximum power transfer to the heterodyne products.

RA should examine the spectra associated with those pulsars attributed to having multi-frequency scattering to determine whether a steady-state signal exists that has a frequency that could produce multiple frequencies by heterodyne action with the pulsar frequency.

Space contains material that is technically a plasma. A plasma can produces its own waves that further agitate the charged particles that compose the plasma, producing more EM waves that will interact with other waves passing through the plasma. The three dimensional interaction of EM waves within the plasma will create a synergistic production of heterodynes. It is quite possible that some cosmic static has a universe scale standing wave origin that has mixed with other waves.

It is reasonable to state that galaxies are clumps of high density plasma which exist within a large plasmasphere or plasmaspheroid that we call the universe. Some of the plasma waves that exist in the universe are probably standing waves, and they will mix with propagating waves generated in the galaxies to transfer energy throughout the universe at a broad range of frequencies. Because of the prodigious amount of EM energy being transferred within the universe, it can be considered an *energy transfer structure* (ETS).

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