Diffusion Gravity (6):
Light Deflection by the Sun-Galaxy Gravity Equipotential Interface
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ABSTRACT

Star light deflection near the sun of 1.75 arcseconds during a solar eclipse has been attributed to post-Newtonian physics for over a century; however, this can alternatively be shown as a geometric resultant of the Sun-Galaxy interface very near the Sun, and specifically conforming exactly to the curvature of the Sun's orbit in the galaxy. It is clearly demonstrable through basic geometry that the post-Newtonian light deflection is simply due to the Sun-Milky Way Galaxy EquiPotential (EP) interface, and that a simple ratio exists to explain the galactic origin of the deflection effect. This report examines data and reviews solar eclipse deflection tests for their geometry as evidence for this alternative explanation, which we now add as a component model to Diffusion Gravity(DG) theory; moreover, we present a corresponding mechanism for deflection of light near the Sun due to virtual particle behaviors for photons. This effect of gravitational equipotential surfaces on the propagation of light occurs at the interface between gravitational scale regimes, i.e., the Sun-Galaxy interface where virtual particle (VP) streams from the Sun and galaxy form a boundary interface depletion zone, where a proportional diffusion "pressure" causes the attraction of the masses toward the depleted zone, while also manifesting light deflection-refraction effects near the Sun.

Introduction

The DG model invokes the gravitational equipotential (EP) point-surface, which, due to the enormous size difference of the Milky Way Galaxy (MWG) compared to the Sun, is located very near the Sun, at 1.72 million kilometers (10^9 meters) radial distance. By invoking geometric properties of the orbit of the sun in the MWG, DG demonstrates that the deflection of light near the Sun is very likely heavily influenced by the galactic gravity, and specifically at the interface boundary of the gravitational potentials between the MWG and the Sun. Deflection of light by the DG model provides the *equivalent increase over the Newtonian model as General Relativity (GR),* as evidence for the DG alternative model of gravity, with virtual particle streams interacting and annihilating at the equipotential interface surface. The DG model has been developed previously to provide an alternative to dark matter explanation for constant velocity profiles of galaxies [3], wherein we invoked the Principle of Least Action as the most likely and economical means by Nature to maintain stars in their constant velocity orbits in galaxies. Additionally, the preceding paper in the DG project [2] presented a model that explains the advance of the perihelion of the planet Mercury by galactic *torque* and the equipotential surface between the Sun and the Milky Way Galaxy, obviating any role by GR. Now this research update continues the development of the DG theory by including interaction effects on light. Our objective is to show that the model presented herein represents a simpler explanation than the theory of GR [1,17], which was conceived and "proven" in a scientific environment that had little or no information about galactic influences in our local solar system in the early years of the 20th century; therefore there may have been premature conclusions that persist today.

This research update presents the influence of the galactic equipotential point-surface as the source of the post-Newtonian deflection of light around the Sun. The principles and proposals presented in this report are continuations of the DG project presented in earlier papers (1-5) that built a framework for the model and mechanism of Diffusion Gravity. The model now attends to the interaction of light and gravity. Since these interactions have been extensively studied by scientists in other models (metric and otherwise) of gravity, we approach this from a different perspective, using DG characteristic streams of virtual particles, and the annihilation-depletion of those flows between masses, which creates the equipotential surfaces at the interface of gravitational potentials between masses. DG is *not* a metric theory of gravity, therefore, we do not attempt to evaluate the model against the Parameterized Post Newtonian [PPN] formalism of Will [1]. Section 1 that follows provides the theoretical model of the gravitational regimes and the geometry that explains the observed deflection near the Sun. Sections 2 and 3 present the DG model of the optical effect at the equipotential surface between the MWG and the Sun, and then compare DG to the records of previous eclipses to support the model. Section 4 is a summary and recapitulation of the DG model and theory for all the research that comprises the theory to date.

Section 1 Equipotential Point-Surfaces as Interfaces Between Gravitational Regimes

The DG depletion zones between masses act as least-action equipotential surfaces and therefore least energy paths for orbiting stars at the galactic scale: we do *not* see the effect at our solar system level due to the "more closely equivalent", or *same scale* masses interacting in our solar neighborhood (see the comparative scale effects in previous work: "DG(4): Alternative to Dark Matter" [3]). Mercury does display some brief equipotential "locking" that was described in the previous report on the alternative to dark matter; however, the equipotential surface is more strongly manifested and clearly shown in the interface between our Milky Way Galaxy and the Sun, and is very near the Sun due to the vast scale difference between the mass of the MWG and the Sun, which is on the order of 10^{11}. This enormous ratio is key to DG "scaling ratios" that give rise to some phenomena that are not apparent at solar system level. A previous DG research paper [3] introduced this ratio as

$$R/r = \sqrt{R^2/r^2} = \sqrt[3]{R^3/r^3} = \sqrt[n]{R^n/r^n} \qquad \textit{(Equation 3 from [3])}$$

where r is the effective radius of the Sun, and R is the current "best estimate" for the galaxy radius at our Sun. From this earlier work[3], we calculated the *potential ratio* at equipotential:

$$M/m = R/r \approx 10^{11} \quad \text{"potential ratio"} \qquad (3a)$$

relating the mass of the Sun m to the mass of the Milky Way Galaxy M (without dark matter), with their respective radii, r and R, all derived simply from the equipotential Gm/r = GM/R. These can now be refined to a more accurate measurement ratio, using the Sun *effective* radius r of 1.72×10^9 meters (determined by Sun's approximate barycenter radius), and the estimated distance to the center of the MWG as $R = 2.46 \times 10^{20}$meters; we express this as the *inverse* potential ratio, which also shows the enormous difference in scale between galaxy and Sun as

$$r/R = 6.99 \times 10^{-12} \qquad (4)$$

where the *effective* radius of the Sun is its barycenter [4] radius at 1.72×10^9 meters (see Figure 6-1) at approximately one solar diameter from the Sun's limb [5]. Now taking the square root of the ratio, and dividing by 2, we obtain for this *heuristic* model:

$$\tfrac{1}{2} \cdot \sqrt{r/R} = \tfrac{1}{2} \cdot \sqrt{6.99 \times 10^{-12}} = 1.32 \times 10^{-6} \qquad (5)$$

which we designate the Sun-Galaxy ***Galactic Gravitational Scaling Ratio (GGSR)***, as the geometric ratio between the circular orbit of the Sun's effective radius locally (~ one diameter from Sun's limb), and the best current estimate for the Sun's orbit radius around the galaxy. The factor of one-half the square root reflects the geometry of circles and their curvature; subsequent research will detail the mathematical relations that were deduced empirically from the data. Note that this provides the GGSR as a *regime difference ratio* of areas, radii, mass, and other parameters as stated in previous papers on DG and summarized in equations 3 and 3a above. What is the significance of this ratio? For the DG theory, it provides also the "*curvature*" ratio of the two circles; see Figure 6-2 which, if we examine more closely, provides a curvature or circumference angular difference for the gravitational potential interface, using the historically well-established measured value of 1.75 arcseconds by astronomical observations of

$$\frac{1.75 \text{ arcseconds}}{3600 \text{ arcsec/degree} \times 360 \text{ degrees}} = 1.32 \times 10^{-6} \qquad (6)$$

This gives the light deflection as a *fraction* of a complete circle or proportionality ratio of the two radii. Please observe that these two values from equations 5 and 6 are *equal*, which strongly indicates that the circle ratio (and also the radius ratio) geometrically connects the MWG gravity to the Sun's gravity. This is a simple but ***astounding*** revelation about the interface between the MWG and the Sun that provides a new insight into gravitation and its interaction with matter and light: the ratio of Sun scale to the galactic scale apparently provides a "degree" of *curvature*, $\delta_C = r/R$ at the interface of the two circular orbits, which is calculated to be 6.99×10^{-12}. The implication is that the deflection of light near the Sun is due to the curvature of the Sun's orbit in the galaxy relative to the Sun's effective radius r; this is a simple derivation and ratio: we know that the measured value of 1.75 arcseconds has been verified multiple times during solar eclipse events, so this value is not in doubt. But the real question is "could the deflection of light near the Sun be due to the Sun-Galaxy GGSR, instead of General Relativity?" There may be some uncertainty in the distance to the center of the MWG, but as stated and shown in previous DG papers [ ], this would not affect the results and conclusion of the ratio effects. This application of circle curvature geometry provides us a new perspective on the enormous scala differences that may not have been previously considered, along with the key interface point-surface of the Sun-to-Galaxy potentials, i.e., the equipotential surface. The ratio of these two circle radii defines the amount of deflection of light to expect at the interface.

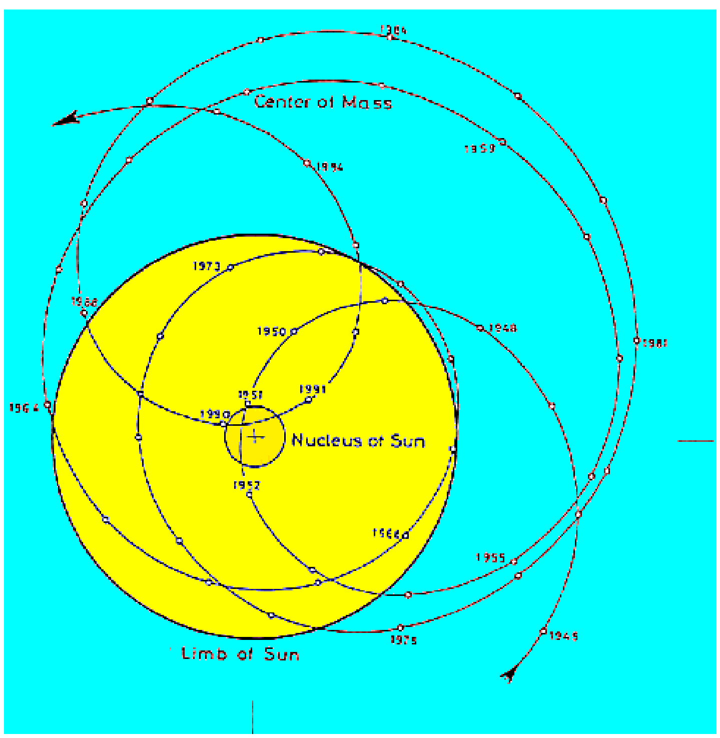


Figure 6-1 Sun Effective Radius: Barycenter diameter approximation 1.7×10^9 meters, and the Sun-Galaxy EP radius $r_{effectiv} = 1.72 \times 10^9$ m.

The geometry of the relative radii of the galaxy and Sun is illustrated in Figure 6-2. Obviously, the ratio of the radii of the two circular orbs is enormous at 10^{11} (previously defined as the "potential ratio"); we posit that it has a profound effect on the relative physics between the two regimes. The diagram is provided to show a perspective view of the Galactic Gravitational Scaling Ratio, or GGSR of 1.32 x 10^{-6}. The fact that there is a ratio that yields the 1.75 arcseconds supports the DG model which will be compared and related to eclipse data in Section 2 and 3. The prime objective of this research paper is to show the geometry and the GGSR effect on light near the Sun, and a mechanism for the light deflection that is intrinsic to the gravitational equipotential surface and to Diffusion Gravity. Section 2 will provide details that apply the ratios to geometry and light deflection.

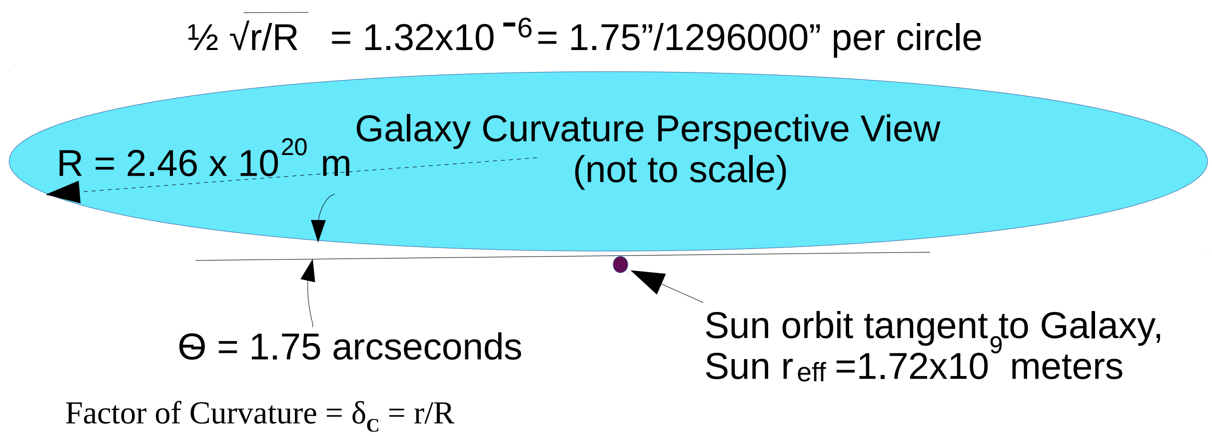


Figure 6-2 Galactic Gravitational Scaling Ratio GGSR and δ_C as factor of curvature

Section 2 Effect on Light Traversing or Reflecting Off the Equipototential Surface

At the zero-potential balance point-surface between scale-different massive objects, there will be an effect on a traveling ray of light. An intrinsic feature of DG is that both gravity and light (photons) depend on virtual particles from the vacuum to transmit their essential information (mass and wavelength with direction) in their respective trajectories.` As the photons travel on the streaming virtual particle "carriers", they will be subject to any discontinuities or changes in the VP streams due to vacuum anistropy, annihilations-depletions, and boundary interface curvature. Light traverses the equipotential surface between the two gravitational regimes in analogy to a lens; a refraction or deflection is due to the curvature ratio (GGSR) between the regimes, with deflection being directly linked to the curvature ratio, $\delta_C = r/R$ by the standard law of reflection ($\theta_i = \theta_r$) The actual mechanism of refraction and reflection lies in the quantum virtual particle carrier behaviors within the depletion zone of the equipotential surface. Annihilation sites result in a depleted location in the zone which does not have a carrier virtual particle (a "hole"), so the photon must travel a circuitous path around that site where that depletion occurs (see Figure 6-3). The photon emerges deflected by the angle 1.75" as governed by the geometry already discussed, as well as by the quantum path integral (or equivalently Fermat's principle of least time). The deflection and "lens" behavior of the equipotential depletion zone is particularly important due to the proximity of the equipotential surface to the Sun, i.e., within approximately a Sun's diameter from the Sun's limb, which will affect the observational results on deflection during solar eclipses, the classic test "proof" for GR. Straight-on incidence of photons occurs in the configuration where the photons travel perpendicular to the equipotential surface, in either direction (the Earth on either side of the surface shown in Case 1 and 2 in Fig 6-3). Case 1 applies to the 1919 Solar eclipse where GR was first "proven". Case 1 and 2 include "*symmetric*" deflection cases, where the star deflection photographic plates would show approximately balanced deflections of stars on either side of the Sun. These cases are the simplest to describe and explain, and could easily be interpreted as "proof" of spherical (Schwarzchild) gravity, due to equal deflections in all directions. The truth is more likely that the 1919 observation was a unique occurrence, which led to a false conclusion as to the causality.

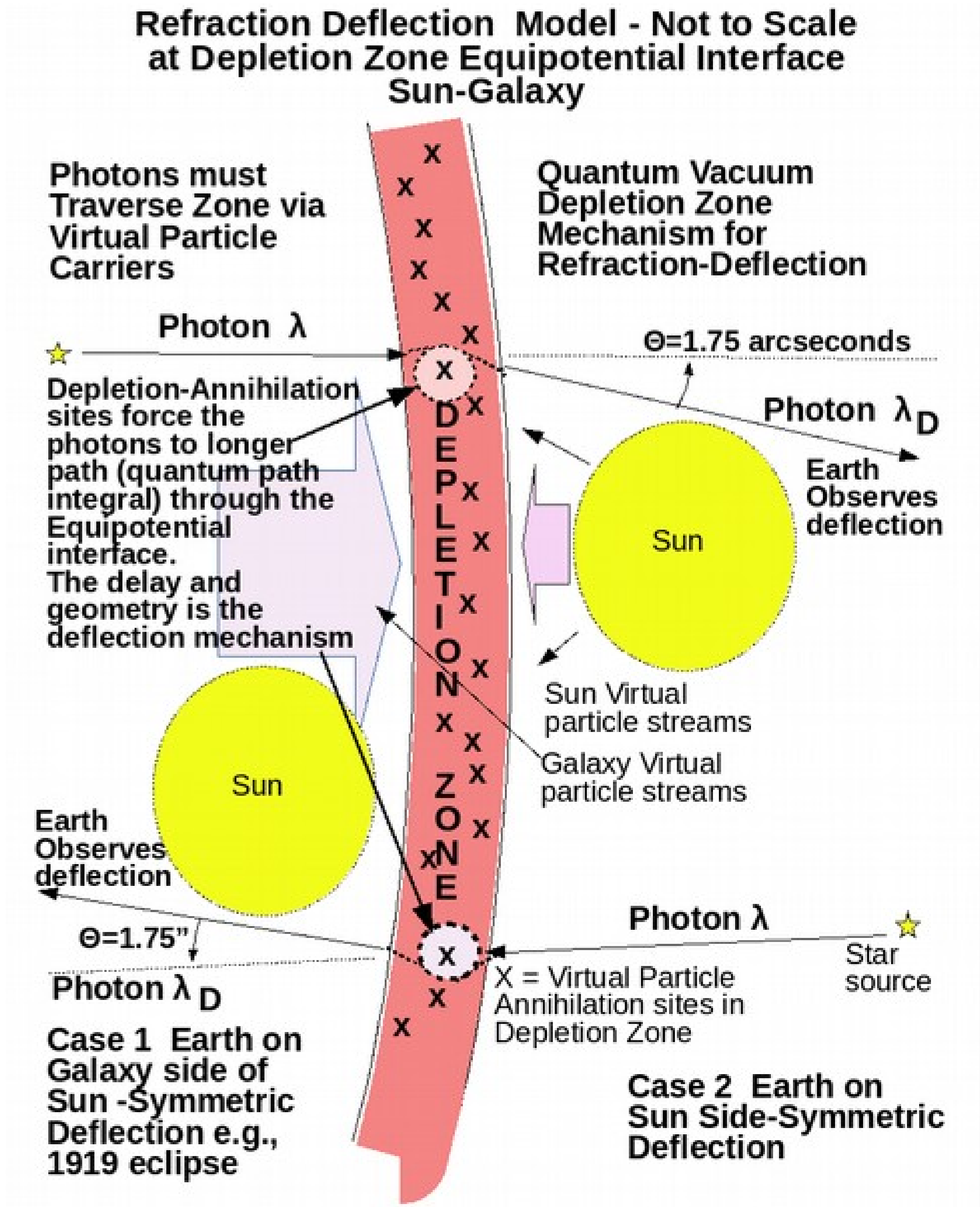


Figure 6-3 Light Deflection by Sun-Galaxy at Perpendicular to Equipotential Surface

We examined two further cases exist which we also explain as shown in Figure 6-4 for Case 3 and 4. These “*lateral*” cases are for eclipse configurations with the Earth observer line-of-sight nearly parallel

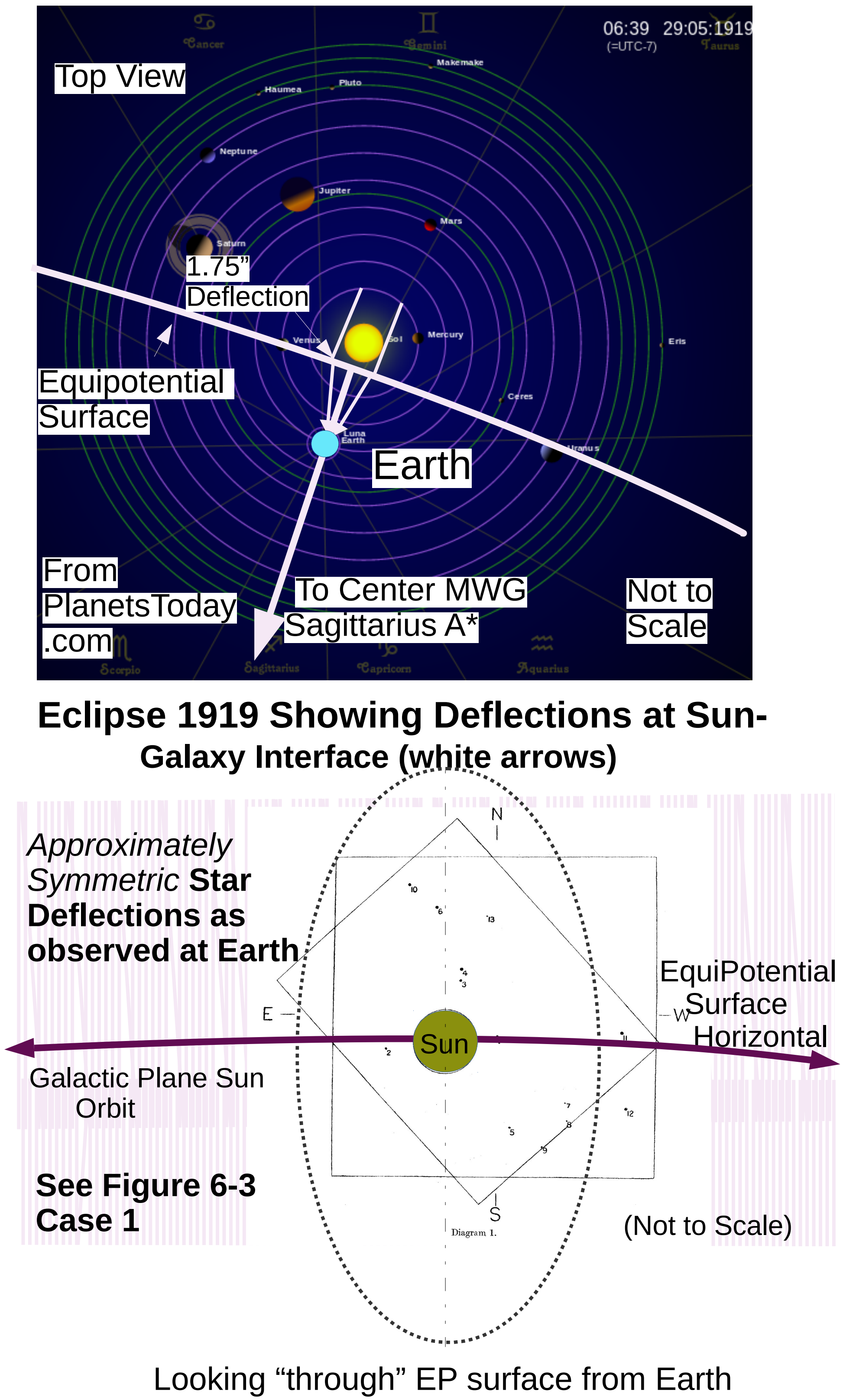


Figure 6-4 Light Deflection Symmetry from 1919 Eclipse

to the equipotential surface, or even oblique. Case 3 applies to the eclipse of 1922, in which the observation (shown in Figure 6-6) showed the most pronounced deflections toward the equipotential surface (left side of the diagram with 13 of 15 stars showing deflection toward the galactic

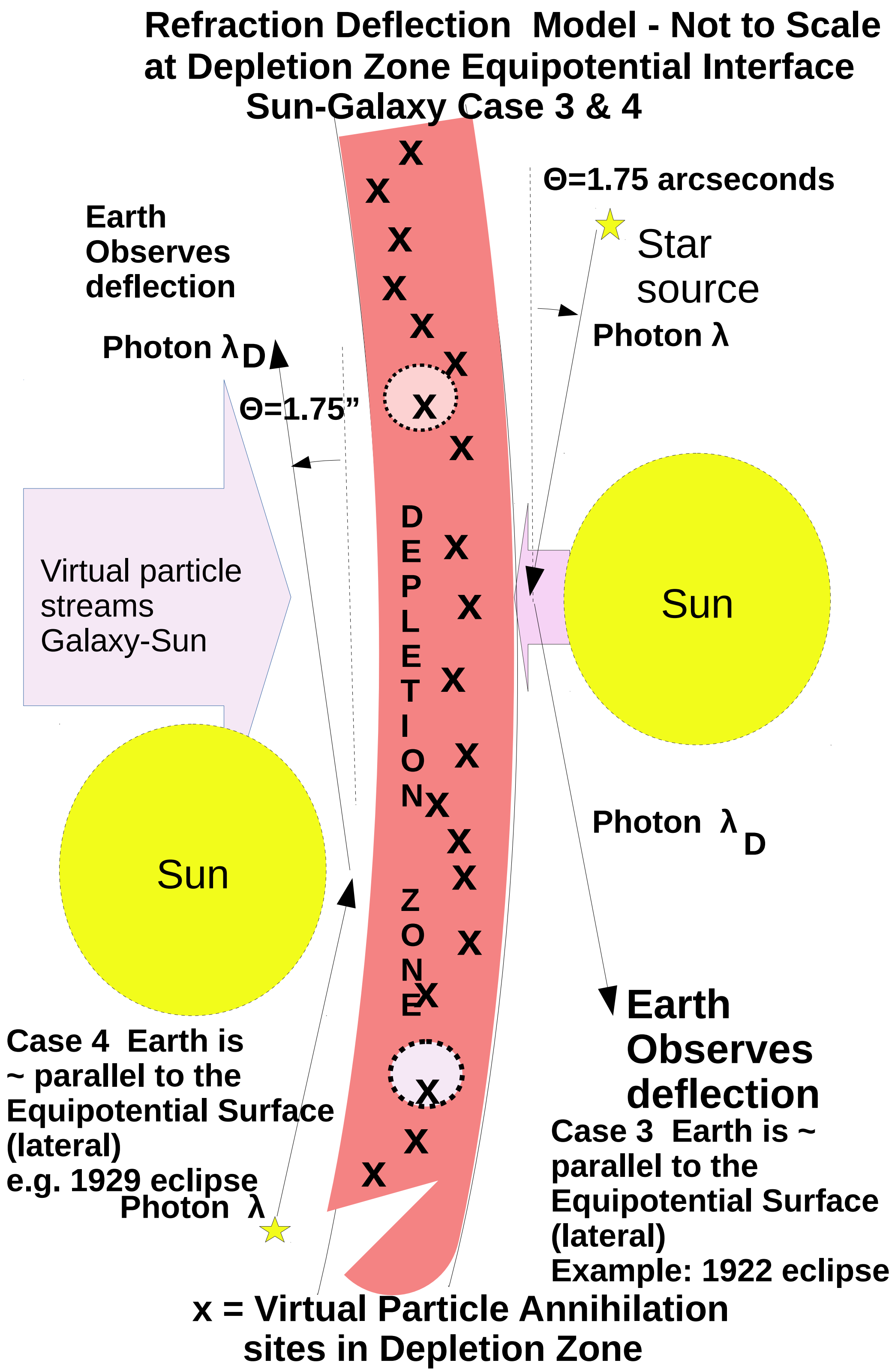
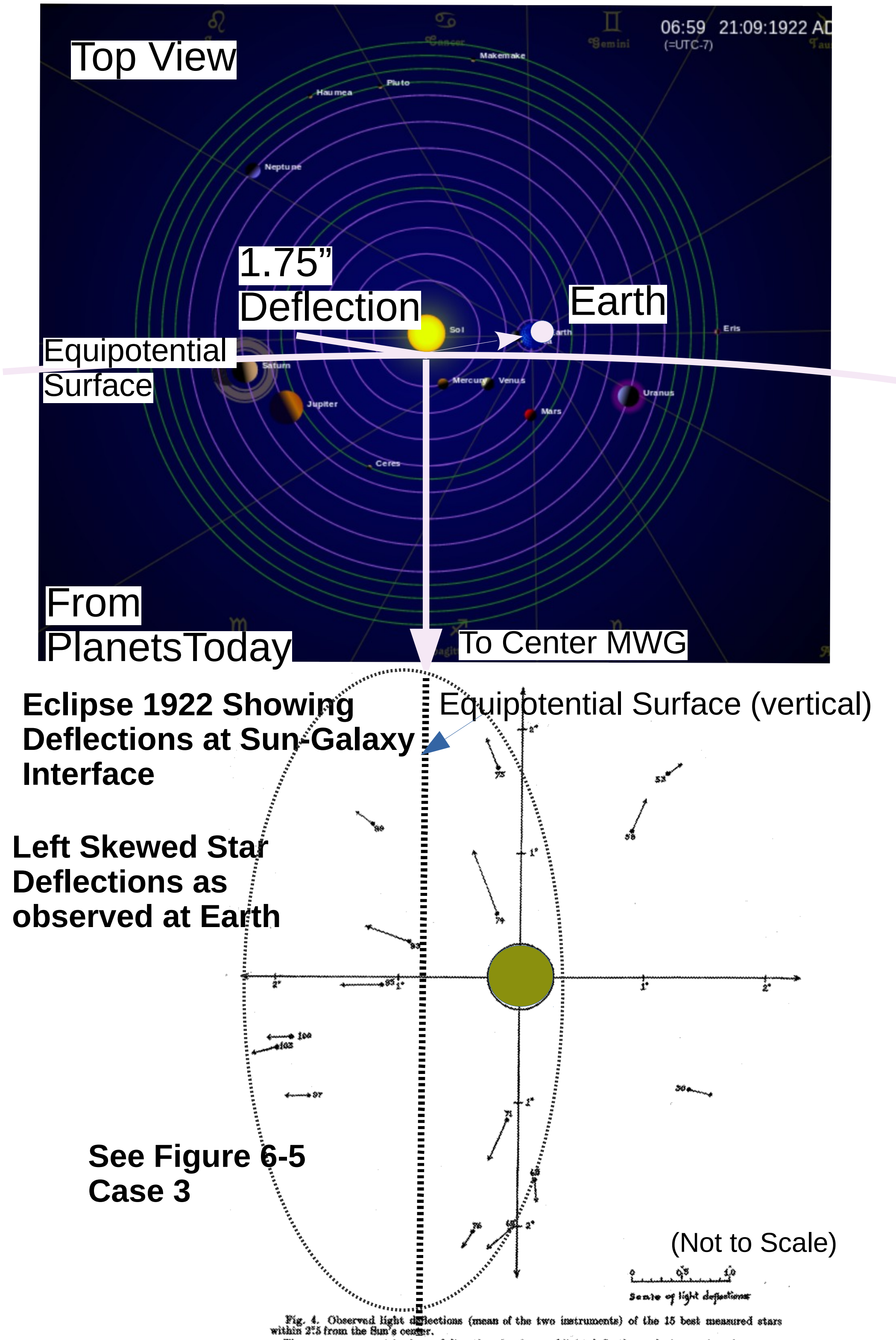


Figure 6-5 Light Deflection Sun-Galaxy Lateral Model

equipotential surface. These are asymmetric cases, where deflection is greater on one side of the sun or the other. The 1925 total solar eclipse would have been the Case 4 configuration, and would have the most deflection - opposite that of the 1922 configuraton, i.e., more stars deflected to the right of the sun, toward the equipotential surface. That information has not been found, if it even exists.

Figure 6-6 Light Deflection Eclipse 1922 Showing E-P Skewing



In an oblique alignment example, the deflection in the eclipse of 1973 was reviewed, shown here as Figure 6-7, an alignment case where Earth is NOT perpendicular or parallel to the equipotential interface.

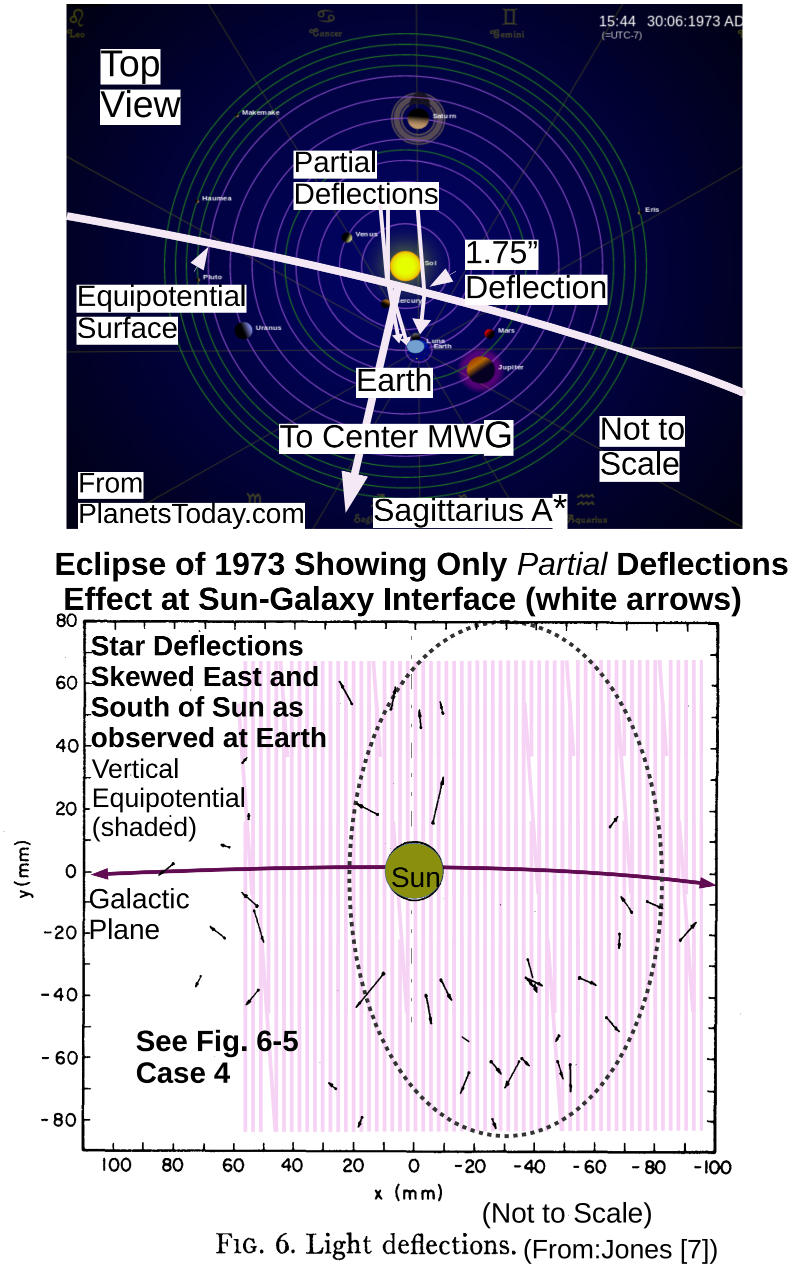


Figure 6-7 Eclipse 1973 Oblique Skewing of Deflections

The skewed results are likely the result of the difference in angular deflections from the alignment, which can be interpreted as further evidence that the *galactic* equipotential interface resulted in partial deflections near the west limb of the Sun. A further result from the 2017 Eclipse was reviewed [8], but not included here, due to doubt as to the alignment accuracy and corresponding deflections in the results; it was another "Case 4" alignment occurrence which likely showed similar skewing. The aforestated samples represent the four possible cases of deflection that provide further evidence of the causality for the deflection as the galactic equipotential surface. The fixed-curvature orbit around the galaxy by the Sun establishes the equipotential surface at a predictable position through time, but Earth observation is subject to the Sun barycenter movements. The implication is that the eclipse observations made from Earth strongly suggest a galactic source for the deflection of photons near the limb of the Sun. The oblique alignments cases deflection and their variability actually call into question their ability to support or substantiate GR.

Diffusion Gravity maintains that the important factor discovered is the orientation and alignment of the Sun-Galaxy equipotential surface with respect to the Earth during solar eclipses. We have reviewed the previous total solar eclipse events that were recorded since 1919 (supposedly the observational "proof" of deflection due to GR). Since the DG theory does not dispute the 1.75" deflection, but only its cause, we compared the different possible Earth-Sun-Galaxy orientations from historical eclipses, and correlate those to our model orientation with respect to the equipotential surface, to demonstrate how the observations may have indicated the *galactic orbit curvature* origin of the deflections. The following Section 3 will interpret the eclipse deflection results from events in 1919, 1922, and 1973. The rationale for selecting these specific events is due to the quality of the data, the availability of data from skilled observatories, and our requirement to represent the different possible case alignments of the Earth-Sun-Galaxy and how they support the DG model. These examples were reviewed against the DG model for deflection and based upon quality of the results from known credible sources (institutional astronomers). NASA lists ten total solar eclipses since 1919, so the data set is tractable, but limited. This analysis also considered the eclipse data from the February 25, 1952 solar eclipse, by Yerkes Observatory that occurred in Africa, but it was not of sufficient quality to substantiate GR. From Van Biesbroeck's own published paper, we quote (exact from Astronomical Journal):

> "The large scattering of these figures shows how uncertain the final result remains on account of the poor quality and the small number of measurable star-images. Giving half weight to the shorter first exposure which shows the poorer images and the smaller number of stars the average of I"70 4= ".10 (m.e.) comes out close to the theoretical prediction i"75." [13]

The results are suspect from that eclipse, and the brevity of the report in Astronomical Journal confirms this conclusion. Therefore, our research paper will not include that particular eclipse event; that is unfortunate, since it would have been a Case 3-4 of alignment with the Earth perpendicular to galactic radius, similar to 1922. In summary, using the available "good" results, we were able to demonstrate that the eclipse data explains that more likely the deflection of light is caused by galactic geometry, in concordance with DG, rather than by GR. The deflections and their geometry show the influence of the galactic equipotential surface as the key factor in the symmetry and direction of deflection.

Section 3 The Original Solar Eclipse "Proof" from Historical Records The observation in 1919 and the analysis were included in a full report by Arthur Eddington and his associates. There are long-standing questions as to the observing conditions and the quality of the results; however, we examined them for the critical factors of geometry that shed new light on the results. The discussion that follows will show how that observation and measurement was a fortuitous *coincidence* of alignment of the Earth-Sun observation line of sight and the radius line of the Milky Way Galaxy (see Figure 6-5). This coincidence is not the *typical*, but rather the *exceptional* of the possible eclipse alignments, depending on the position of Earth in its orbit around the Sun. Subsequent observations in 1922 and afterward have shown different, skewed, and even unusable results due to asymmetry of the Earth observation points around the Sun relative to the galactic radius during those solar eclipse viewing events. If GR were correct, these observations would therefore logically lead to a symmetric distribution of star deflections in ALL the photographic records. We contrasted the 1922 result, which was recorded by skilled Lick Observatory astronomers, to the 1919 observation; the Earth position in its orbit around the Sun was NOT in alignment with the MWG radius as it was in 1919, but was perpendicular to that MWG radius, and thereby tangent to the Sun's orbit in the MWG. This is shown in Figure 6-6, which clearly shows an *asymmetry*, or skew, to the star deflections, and the correlation to its different (perpendicular) alignment to the galactic radius. The skew in the star deflections toward the equipotential surface is very likely caused by the geometry of deflection and DG as discussed in

Section 1. The near absence of star deflections to the right of the Sun in Figure 6-6 is obvious; this is indicative of the true origin of the post-Newtonian gravitational deflection of the starlight. This stark contrast between 1922 and 1919 shows clearly that GR cannot explain the asymmetry of the starlight deflections in the 1922 results. Apparently, no questions were raised or explanations offered in the report [9] by Campbell and Trumpler on the asymmetry of the deflections. Objections raised in subsequent analyses by competent scientists like Charles Lane Poor [6] did not discuss this skew factor, but expressed doubt in the conclusions for other valid technical reasons, including the asymmetry of deflections. If we look further into more recent eclipse results, there is scarcer data to review; there seems to have been a lack of repeatability historically to re-confirm GR; if we look at the results and report for the 1973 eclipse, we find a similar skew in starlight deflections, again likely due to the non-coincidence of the Earth-Sun-Galactic center. The DG model is a simpler explanation, since it does not depend on complex metrics and curved space, to show the deflection of light phenomenon as anything other than a *galactic curvature* gravitational effect at the equipotential interface with the Sun. Moreover, it is of the exact magnitude, 1.75 arcseconds to explain the post-Newtonian deflection. Eclipse data since 1919 supports the alternative explanation of deflection near the Sun as the DG model has presented. When similar radio astronomy results are reviewed, the deflection near the Sun of those radio signals can also be explained by the DG theory and the proximate equipotential interface between the Sun and the MWG. Regardless of which direction the radio wave deflection experiments are configured, they still *must traverse* the equipotential surface, and will be deflected or lensed accordingly by that interface; please see Figure 6-8 which shows how all observation-from-Earth alignments will be influenced by the Sun-Galaxy equipotential interface, with one exception being the deflection on the opposite side of the Sun (red line shown). The 1987 observation by Lebach, Shapiro, et al. [19] would necessarily have traversed the EP surface (see: Planets Today.com for October 1987).

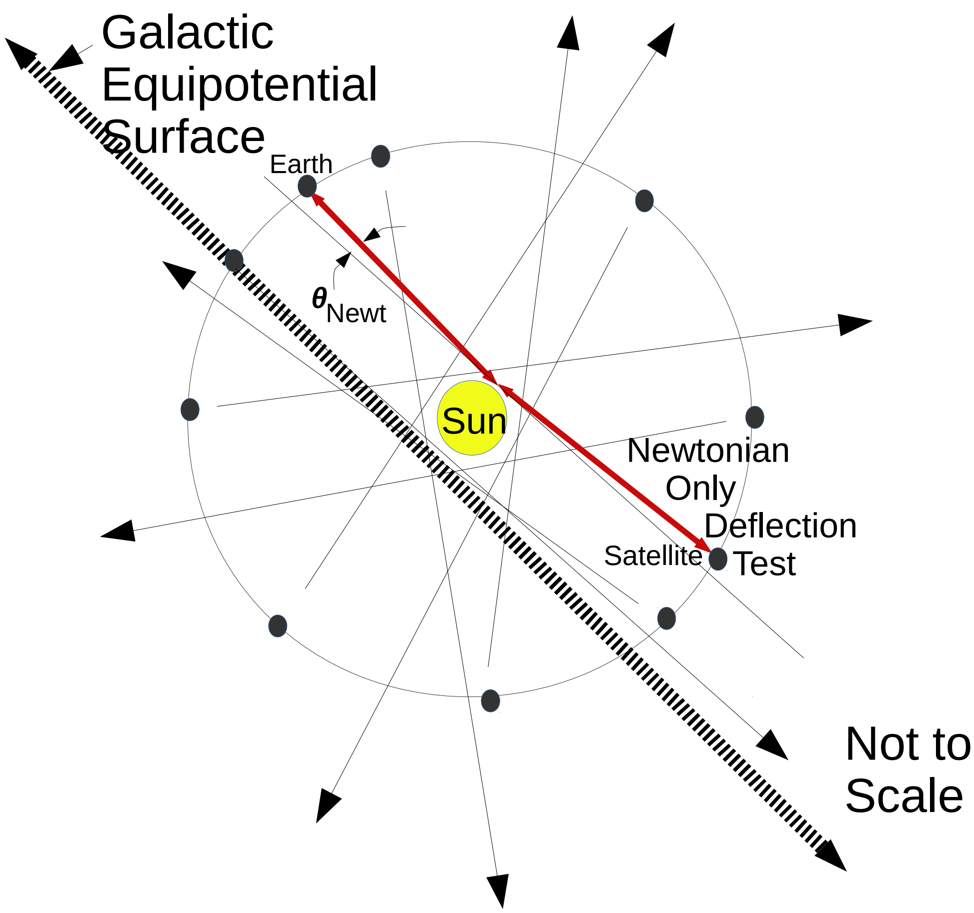


Figure 6-8 All Alignments Traverse EP Interface Except Red Case Shown

We also reviewed some radio astronomy deflection GR observations that have been attempted with Jupiter as the gravitational deflection source, instead of the Sun, but again, the Sun-Galaxy equipotential interface would likely also be in the radio signal path, so the experiment would need to *exclude* that traversal, to verify GR, as in the example setup in Figure 6-8. Additionally, those Jovian deflections have been openly questioned by various physicists, including Samuel [14], and Carlip [15], who asserted that the experiment measured the speed of light, and nothing more. More detailed research should verify any and all radio astronomy results as deflection measurements, independent of timing inaccuracies. The Shapiro time delay may also be due to the signal deflection by the galactic equipotential interface. Time delays, as compared to deflections, are suspect as confirmations of anything. Further research should answer these questions, which heretofore have not considered the alternative explanation presented by DG.

Section 4 Diffusion Gravity Theory Summary to Date

The current research paper has expanded the overall DG model to include the deflection of light near the Sun as a Sun-Galaxy interface effect. This adds to the overall theory of DG, which can be summarized in the following points:

(1) DG provides the mechanism for gravity as virtual particle streams from masses interacting and annihilating to cause attraction by diffusion from those VP streams. This was introduced in "DG, an Heuristic Model", and then developed more completely in "DG 3: Attraction Mechanism" [11].

(2) The DG model satisfies basic physics including dynamics and the equivalence principle without a metric theory, wherein acceleration and other kinematics can be explained, as presented in the DG 2 installment paper [16].

(3) DG model provides the mechanism due to the virtual particle vacuum as the primary medium and carrier of gravity (mass) information; we add now to that model the carrying of the photon information (wavelength and direction) as introduced in this current paper.

(4) DG and the Equipotential Surface between the Sun and the MWG provide the correct physics for the advance of the perihelion of Mercury, due to galactic torque, not GR, and for the constant velocity rotation curves of galaxies due to the minimum energy (principle of least action) orbits. These models were included in installment reports 4 and 5 of the DG Theory [2,3].

(5) GR is not needed in the DG model since it shows that the deflection of light near the Sun is an artifact of the geometry between the galaxy and the Sun, which manifests as an equipotential surface very near the sun, at about 1.72×10^9 meters radius. The behavior expressed by the DG model matches the galactic orbital curvature of the sun, which is far more likely the source of "curvature" than that theorized by GR; the DG deflection due to the galactic interface provides *exactly* 1.75 arcseconds, as observed, and as calculated in Section 1 of this report.

This has been a summary of the research and reports to date for DG Theory. The final section will provide the conclusion and directions for further research. The objective of this current effort has been to show that deflection of light near the Sun is actually caused by galactic curvature and behaviors at and within the equipotential surface according to Diffusion Gravity models for attraction and deflection; that objective has been met.

Conclusion

This current presentation of DG research has shown that non-Newtonian deflection of light near the Sun is explained clearly and simply by the DG model in conjunction with in the Galac<u>tic</u> Gravitational Scaling Ratio (GGSR) of 1.32×10^{-6} and the circular galactic curvature ratio of $\frac{1}{2} \sqrt{r/R} = \boldsymbol{\delta_C} = 1.75$ arcseconds per full circle orbit; we can explain the Sun's light deflection as a geometric linkage effect between the Milky Way Galaxy and the Sun. Review of eclipse data strongly suggests the premise that the Sun-Galaxy equipotential interface is the primary cause and influence for the post-Newtonian light deflection effects around the Sun during eclipses, in congruence with the geometry and direction from the MWG center relative to the Earth position (alignment lateral, perpendicular, or oblique). We also showed that the varying alignments of reflection and refraction by the Sun-Galaxy interface has commensurate effects on the quality and verifiability of eclipse deflection experiments, raising questions as to the eclipse results and the conclusions thereof. Since the equipotential surface is the *primary* interface for the Sun to the Galaxy, it has commensurate deflection effects observed during eclipses; therefore, we further argue that recent attempts by radio astronomers to confirm GR [18, 19] actually confirm the deflection effect of the Sun-Galaxy interface, since their tests require the same traversal and deflection by the equipotential surface near the Sun.

In the total set of six research papers to date, DG theory has thus shown how galactic effects can explain both the advance of the perihelion of Mercury precession through galactic torque, and now the deflection of light near the Sun via the Sun-Galaxy equipotential interface surface near the sun. We have demonstrated that accepted proofs of GR are not necessarily what the perception has been for the last century, and have proposed experiments that are configured to test the presence or absence of radio wave deflection, and that could be exactly set up to exclude the Sun-Galaxy equipotential surface by testing on the opposite side of the Sun, away, but parallel to the equipotential surface, to demonstrate Newtonian-only deflection when the EP interface is not traversed or otherwise encountered, as shown in Figure 6-8. This would require a unique alignment and setup of a satellite to Earth. This concept will be developed more fully in subsequent papers, along with experimental proposals for further DG confirmation.

Subsequent research will pursue the gravitational *wave-lengthening*, or “redshift” by additional Diffusion Gravity component models. The future research effort will also continue the expansion of the DG model in the galactic scaling relations to include the baryonic-to-light scaling that is related to the mystery of the constant velocity curves of stars in galaxies. The ratio that was introduced in previous papers [3] as the “potential ratio”; $M/m = R/r$ for the sun to galaxy equipotential interface will be similarly applied in the galactic constant rotation curve anomaly, as in the derivation provided herein for the Galactic Gravitational Scaling Ratio, in equation 3-6, and for the curvature factor $\boldsymbol{\delta}$. That ratio will be investigated relative to the accelerations involved in the sun-galaxy orbit.

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