Active Galactic Nuclei: the Shape of Material Around Black Holes and the Witch of Agnesi Function. Asymmetry of Neutrino Particle Density

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A mathematical representation is given and physically described for the shape of the very hot material that immediately surrounds a black hole and the warm material located at a greater distance from the black hole, as related to active galactic nuclei. The shape of the material surrounding the black hole is interpreted in terms of asymmetry of the neutrino flux. Detailed experimental measurements on radioactive decay influenced by astrophysical events are given to support this interpretation.

1 Introduction

Recent work [1] that examined over 200 active galactic nuclei has shown that all have a common shape of the material surrounding the black hole core, and that this shape seems to be independent of the size of the black hole. The Active galactic nuclei (AGN) are cores of galaxies that are energized by disks of hot material that act as ingress/feeder to supermassive black holes. the shape of the hot material that surrounds the black hole was inferred from the observation of x-rays that emanate from very hot material that is close to the black hole, and from infra-red radiation that derives from warm material much further from the core of the black hole.

Through comparing the ratio of x-rays to infrared radiation, the contour shape of the black hole is indirectly mapped [1]. The results are shown in Fig. 1. Inspection of the inferred topology of the surrounding material indicates that although approximate symmetry is shown across the vertical axis, the horizontal axis shows no indication whatsoever of mirror plane symmetry, and thus the upper and lower regions of the 2-d projection must derive from very different functional representations. Stars, planets, and moons do not show a significant asymmetry, other than equatorial bulge. The non-symmetry of the material surrounding the black hole appears thus at first surprising, however, when considered in terms of a collision-induced gravity model [2], the asymmetry could be hypothesized to be a consequence of observing the black hole from a location closer to the centre of the universe where the neutrino flux density is far greater than at position coordinates that are associated with the expansion of the periphery region of the universe, even though that locus of positions is considered unbounded. Asymmetries, such as shown in Fig. 1 are generally thought to be associated with tidal effects — and in the case at hand, this would mean gravitational interactions, such as a form of lensing. Although there is a consideration of the red shift associated with the receding of the galaxies, the cores of which are powered by disks of very hot material "feeding" the supper massive black hole, I do not think that the asymmetry shown in Fig. 1 arises purely from considerations of Relativity, but instead arises at least to some significant level from collision criteria [2].

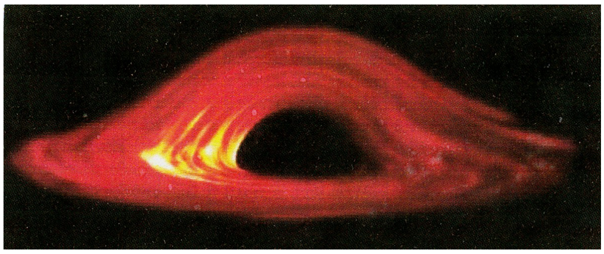

Fig. 1: Material shape near black hole. Courtesy of Anna Morton, moderator of 4D WorldX Yahoo Science Groups. See [1].

2 Analysis and interpretation

The event horizon associated with a black hole refers to the surface that surrounds the black hole, having the property that any visible light cannot escape from the super dense mass because of the strength of the gravitational field [3]. In terms of collision-induced gravity, the term "field" is *not* employed because gravity is considered to be particle-based and the escape-inability of photons at energies less than x-rays is due the increase in collision cross-section between neutrinos and photons that accompanies the super dense packing of mass in a black hole that has developed from a neutron star. The accretion disc of a black hole refers to how accretion onto a neutron star takes place from from a matter input from the Roche lobe of a primary star in the binary system. This passing of matter when occurring from the primary to the secondary star through a Lagrangian point [4] establishes a non-symmetry, but of a different form than that of the black hole shown in Fig. 1, yet these asymmetries may be ultimately related through the physical processes associated with the involvement of the black hole. The vertical asymmetry of the material that surrounds the black hole may also arise from the phenomena that are associated with the periodic ejecta of

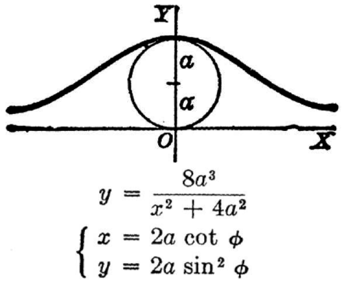

Fig. 2: The Witch of Agnesi function.

material from the black hole, which may be influenced by the magnetic properties of the super dense collapsed star. The comparatively slight asymmetry in the horizontal direction must relate to inhomogeneous temperatures and non-isotropic mass distributions of the black hole because of specific local conditions at the $xyzt$ spatial-temporal location of the highly dense aggregating of matter.

The 2-d geometry shown in Fig. 1 above the horizontal axis that passes through the extrema of the inferred contoured distribution of mass, shows the appearance of the mathematical function known as the Witch of Agnesi. (The term "witch" is an involvement of a misnomer, caused by an incorrect translation of the work of Maria Agnesi who developed the function geometrically in 1768). The Agnesi function (Fig. 2) is generally given by, $y = [(8a^3)/(x^2 + 4a^2)]$, where a is the radius of the circle that is utilized to geometrically form the functional curve. In polar coordinates the Agnesi function is given by $x = 2a \cot \phi$, and $y = 2 \sin^2 \phi$. The function can be generated geometrically by rotating the radius of the circle whereby the y-coordinate of the function is the y-value of the radial vector as it sweeps the associated circle, and the x-coordinate is the x-value of the ordered pair that represents the intersection of the extrapolation of the radial vector with the line, $y = a$. Although many world class mathematicians explored the geometric development of this function, including Fermat, no application in astrophysics to the author's knowledge was established for what became known as the Witch of Agnesi function, until now — general applications of the function being confined to probability theory.

Some properties of the Agnesi function are associated with gravitational criteria, such as the x-squared term appearing in the denominator, and suggestive of an inverse square relationship, which in Newtonian gravity derives from Newton's postulate of a central force, which he interpreted from Kepler's First Law of Planetary Action-namely that the orbits of the planet must be elliptical from consideration of years of visual data of Tycho Brahe. The inverse square relationship in the collision-induced gravity model/theory derives from the properties of a flux, as in the photon inverse-square light intensity fall-off, or the equivalent for the distance dependency of the amplitude/intensity of magnetic or electrostatic properties. The relationship of the sweeping rotating radius of the function-forming circle, and its extension to intersect the line $y = a$ can be arguably topologically associated with the notion of accretion and event horizon, and *continuous* processes. The asymptotes of the function (the positive and negative x-axes) relate to the convergence of the shape of the constituent material as temperature decreases because of distance from the "donut" core of the black hole.

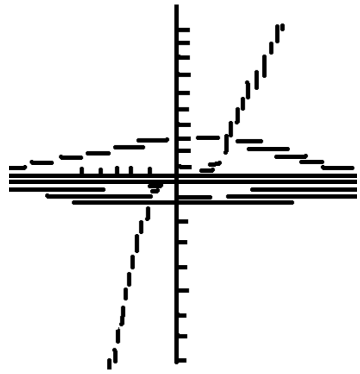

Fig. 3: Representation of the shape of material near a black hole using Agnesi function contours and quadratic function.

The region of Fig. 1 below the horizontal axis can in 2-d projection be well represented by a wide parabola that opens upward. Thus the combined representation of the 2-d geometry shown in Fig. 1 requires the use of a two-function coalescence, and implies the involvement of two different physical phenomena, whereby the quadratic is typically associated with gravitational interactions but the Agnesi function is not.

Using the Agnesi function, and varying the value of the radius, a, combined with the parabola, $y = ax^2 - k$, where a is a very small positive constant $\ll 1$, the contoured representation shown in Fig. 3 is readily developed. The knee shaped curve given also in Fig. 3 represents the calculation of volume of integration of the region surrounding the black hole as a function of the position coordinate, x, showing a threshold effect above which the volume increases rapidly with high slope. The volume function involves an arc tangent term which which is consistent with involvement of an event horizon.

It has been proposed [5] that when emission from an inner accretion disk around a black hole is occulted by a companion star, the observed light curve becomes asymmetric at ingress and egress on a time scale of 0.1–1 sec. The light-curve analysis is claimed [5] to provide a means of verifying the relativistic properties of the accretion flow which is based on both the Special Relativity and General Relativity that is associated with black holes. It is reported [5] that the "skewness" for the eclipsing light curve is approximately zero for what are called slim disks because the innermost part is self-occulted by the outer rim of the disk. This self occulting is a very important property of the black hole, yet these criteria do not uniquely and exclusively seem capable of explaining the major asymmetry shown in the geometry inferred from the x-ray and infra-red data [1] given in Fig. 1.

1	425
2	415
2	390
4	462
5	420
6	420
7	405
8	406
9	421
10	429
11	410
12	415
13	392
14	420
15	430
16	412
17	411
18	418
19	420
20	410
21	391
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31	404
32	402
33	430

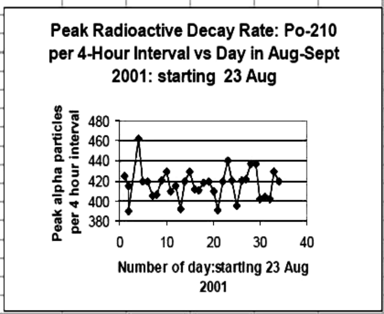

Fig. 4: Radioactive decay data for Po-210 during August-September 2001 measured at Harvard University using the Rad-7 solid-state detector.

On the other hand, it has been reported [6] that propagation of fermions in curved space-time generates gravitational interaction due to the coupling of its spin with space time curvature connection, and causes a CPT violating term in the Lagrangian, generating an asymmetry between the left-handed and the right-handed partners under the CPT transformation. (CPT refers to charge conjugation, space reversal, and time interval, and thus deals with parity). It is interpreted [6] that in the case of neutrinos this property can generate neutrino asymmetry in the Universe, causing the dispersion energy relation for the neutrino and its anti-neutrino to be different giving rise to differences in their number density, and associated with the left-hand helicity of the neutrino. These effects may have an influence in contributing to the asymmetry shown in Fig. 1. It has also been shown [7] that particle interactions in the black-hole accretion disks cause an excess production of positrons as compared to electrons, however, this disparity alone, without emission directionality considerations, does not constitute a non-conservation of parity.

Although the behaviour of each type of galaxy or AGN is *dependent* upon the angle of observation relative to the accretion plane of the black hole core, the asymmetry shown in Fig. 1 is common to all 200 AGN's that were studied in [1], yet the angles of observation relative to the accretion zones had to be different, and the azimuths from the observation coordinates also had to be different.

Our own work [8] has suggested that near the periphery of the current universe, gravitational interactions must have a net repulsive, rather than attractive, dependence — this owing to the far lower neutrino flux in the far distant regions of the universe ($\sim 10^{50}$ km). Thus, though arguably at very small length scales ($\ll 0.1$ mm), gravitational interactions may be described by an inverse fourth dependence [9], and at typical solar system and galactic length scales by inverse square dependence, yet at length scales of 10^n km (where $n > 40$), the dependence is likely *not* to be attractive at all, and instead repulsive near the outer zones of the universe. Thus, relative to the line of centres (a curved Riemannian arc) of the earth born measurement laboratory and the very distant black holes, the neutrino flux that is emanating from the outer regions of the universe, and opposing the escape of both x-rays and infra-red radiation toward the observer, has a higher particle density, than the neutrino flux that is *opposing* (due to collisions and associated net exchange of total momenta) the escape of electromagnetic radiation in the direction of the periphery of the universe. This higher level of particles per square centimetre per second escaping toward the periphery of the universe diffuses in curved directions because of the collision basis of gravity, and the net result contributes to the asymmetry detected by the observer, as in Fig. 1, and shown functionally in Figs. 2 and 3.

3 Supporting evidence for the significance of the neutrino flux

In a work previously published in this journal [10] I presented the explanation of the physical cause of the decades of radioactive decay data histograms determined by Shnoll et al. [11–13] which reported characteristic histograms for the decay of Pu-239 which were periodic over a 24 h interval (the solar day, thus the spin of the Earth), a $\sim$28 day interval (the lunar month, thus the period of the Moon), and the sidereal year, and also reported characteristic histograms of radioactive decay rate associated with a New Moon and a total solar eclipse. My explanation [10] was based on the Moon and/or the Earth periodically interrupting through scattering and capture some of the neutrinos that emanated from the Sun, and which would have otherwise transferred their momentum to the radioactive source, the decay rate of which was being studied in the experiments (taking place in Moscow, and aboard two research ships that travelled all over the world, including the polar regions). Also, the Sun and Moon intercept neutrinos emanating from deep space.

The Shnoll work [11–13] prompted me to lease a Rad-7 solid-state detector through Dr. Derek Lane-Smith at Durridge Corporation (Bedford, MA) for the purpose of exploring further the Shnoll conclusions. The Rad-7 detector is utilized worldwide as the principle detector of alpha particles decaying from radon gas, and as such is ideally suited also to study the daughter isotopes of Radon. Amongst these, Po-210 has the ideal half life compatible with the purposes of my work. The detector was set up for a 4 week period at the Farlow Herbarium at Harvard University, where I was a research affiliate at the time, conducting work at the Arnold Ar-

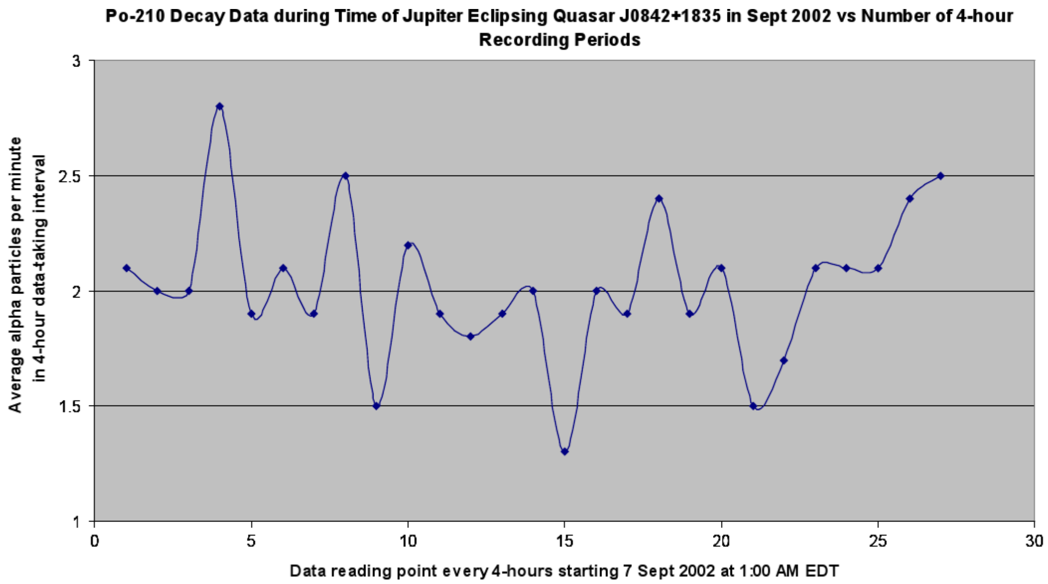

Fig. 5: Data showing three decreases in radioactive decay data of Po-210, 24 hours apart, corresponding to period of 6–10 AM Sept. 7–10 during time interval of Jupiter eclipsing quasar JO842+1835. Reproduced from [16].

boretum, studying the negative geotropism of a heavy vine, Aristolochia macrophylla. Although, conclusions could not be definitely established regarding a diurnal variation of the radioactive decay, a clear peak was observed in the 12:00–4:00 PM time interval on 26 August 2001, far exceeding two-sigma in alpha particles per 4 hour interval. These data are given in Fig. 4, and are digitally reproduced from [14]. It was not until over a year later that I learned that on 26–27 August 2001, radiation from the explosion of supernova SN 2001 dz (in UGC 47) reached the Earth [15]. A supernova explosion is associated with a very significant release of neutrinos, and I interpret that the radioactive alpha particle decay rate peak, shown in Fig. 4, is a consequence of the impingement of the neutrinos, associated with the supernova explosion burst, upon the radioactive isotope source which then pertubed and further de-stabilized a nucleus that was already unstable due to the ratio of neutrons to protons.

During the period September 7–11, 2002, the planet Jupiter eclipsed the deep space quasar JO842+1835, and measurements of alpha particle decay rate were conducted by Dr. Lane-Smith in the Boston area at my request. The averaged data are given in Fig. 5 (digitally reproduced from [16]), showing a decrease in decay rate from approximately 6:00AM to 10:00 AM every 24 hours during the 3-day time interval of the eclipsing event. This variation is attributed to the rotation of the Earth such that once per day Jupiter, interrupted the particle-path from the deep-space quasar to the earth laboratory where the radioactive source was located for the experiment. This interruption of neutrinos, due to the nucleons of Jupiter scattering and inelastically capturing some small, but non-trivial, proportion of particles and/or radiation causes a decrease in radioactive decay rate because of the consequent decrease in the particle flux transferring momentum to the nuclei of Po-210. The x-axis scale is the number of four-hour periods in to the experiment starting at 1:00 AM EDT Sept 7, 2002, and showing decreases at abscissa values of 9, 15, and 21 — these being six 4-hr intervals (24 h) apart.

On 4 Dec 2002, a total solar eclipse occurred, during which the radioactive decay rate of Co-60 was measured at Pittsburg State University in southeastern Kansas [17], and the radioactive decay rate of Po-210 [18] was measured in the Boston area, both at/near the time of totality in southern Australia. The decay data [14] are plotted in Fig. 6, and show dips in decay rate at the time when the umbra of the eclipse was closest to the location of the source isotopes (on the opposite side of the Earth from totality). The inset shows very recent data [19] on the decay of Cs-137 during the annular solar eclipse of 26 January 2009, also in southeast Kansas, at the time when the eclipse was at peak darkness in Australia, also showing a dip in decay rate when the umbra passed closest to the source isotope (time = 4.06 days into the experiment). The 2009 data plot (inset) shows also the envelope of the negative percent changes. The circled data points are analogous to the leading-edge signal and the trailing-edge signal that corresponded to dips in gravity upon first contact and upon last contact associated with the total solar eclipse in China in March 1997 (see [20, 20]). These consistent decreases in decay rate (using three different isotopes) during two different solar eclipses can only be explained by the mass of the Moon and the mass of the Earth interupting the flux of neutrinos coming from the Sun, and thus some of the neutrinos associated with the flux, never reaching the source isotope. Hence these scattered and captured neutrinos do *not* cause any further de-stabilization of the weak cohesive interaction of mesons and of gluons that hold the nucleus intact/together, normally ascribed to the weak force — an internal interaction

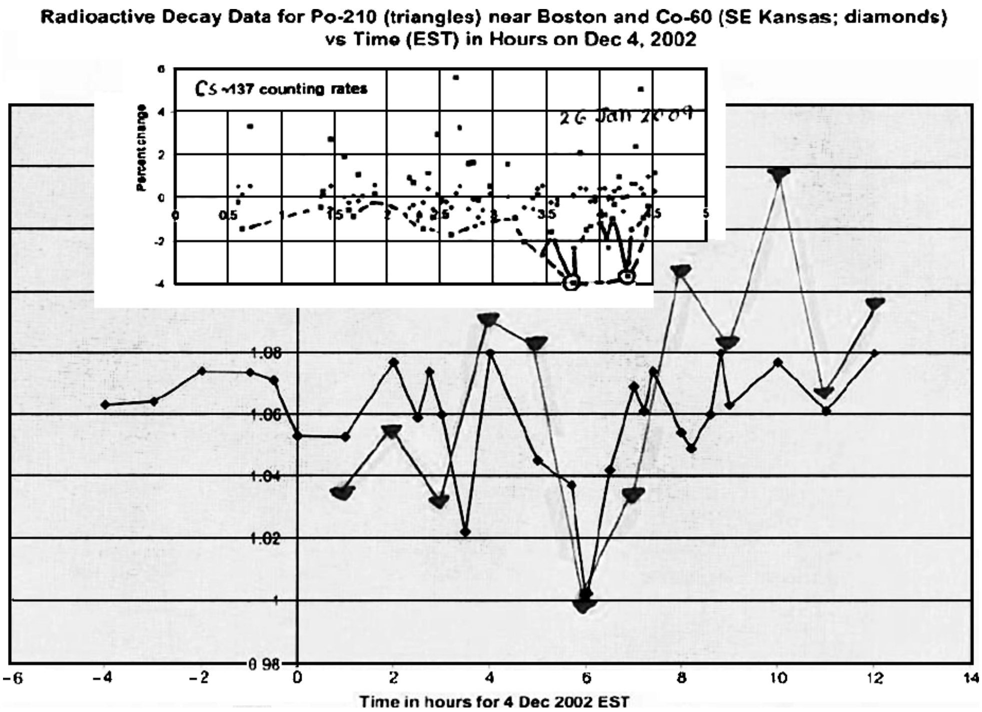

Fig. 6: Decrease in radioactive decay rate for Co-60 and for Po-210 during total eclipse of 4 Dec. 2002, and decrease in radioactive decay rate for Cs-137 during annular solar eclipse of 26 Jan. 2009.

— but now shown to depend upon momenta transfer from externally impinging particles including primarily the muon neutrino and the electron neutrino.

Additional supporting data regarding the significance of the neutrino flux on radioactivity, and highly supportive of my own work and interpretations given herein, are as follows:

1. A major multi-year study by Purdue University researchers at Brookhaven National Laboratory clearly show that the radioactive decay rates of many isotopes correlate very well with the distance of the source isotope from the Sun, as well as changes in radioactive decay rate correlated with major solar flares [22].
2. Positron annihilation measurements [23] that show periodic variation with the phases of the Moon, yielding peaks associated with the New Moon (which approximates a solar eclipse), and troughs correlated with the presence of the Full Moon. The source of positrons in this study was Na-22, and the dependent variable of the experiment measured the yield of molecular iodine (I_2). Thus the peaks in I_2% correlated with the presence of the New Moon, and hence the interference by the Moon of a flow of particles from the Sun and from space. The data also showed a general trend increase in I_2 production over the course of the months of the experiment (November through February), that the authors tentatively attribute to seasonal changes of the distance between the Earth and the Sun. The exact phenomena causing the peaks is not yet established since in this case an interruption of neutrino flow by the Moon enhances positronium production. It is possible that the peaks are due to more molecular iodine being produced associated with a different collision crosssection caused by change-in-flavor of the neutrino due to collision with nucleons of the Moon.
3. Periodic oscillations have been reported [24] in Pm-142 which show an oscillating sinusoidal decay for electron capture (as contrasted to a conventionally established exponential decay) which the authors attribute to modulations caused by the oscillation of neutrinos between two different mass states (flavors), that of the electron neutrino emitted in the original decay, and that of the muon neutrino which is observed in decays of the muon (a particle 200 times more massive than the electron).
4. The standard deviation of decay rate of radioactive isotopes is periodic with respect to the phases of the Moon, being maximum at Full Moon (whereby external particle impingement from the Sun is unobstructed) and minimum at New Moon (whereby external particle impingement is obstructed by the Moon [25]), akin an eclipse condition.

4 Conclusion

Thus based on all of the above considerations, in the current work, the asymmetry in neutrino flux is identified as the principal cause of the non-symmetry shown in Fig. 1, owing to neutrino-photon collisions in the AGN or black hole regimes where the collision cross-sections of neutrinos and photons is many orders of magnitude higher than in the solar system regime. This conclusion is supported by our previous experimental work using both very-close-proximity gravitational pendula, and a magnetic pendulum system, interrogated by laser scattering, showing asymmetry in gravitational particle/wave impinging flux in the X-Y plane as compared to the zed (Z) direction [16].

Note added in proof

Recent work by G. C. Vezzoli and R. Morgan has shown that the 1444 minute annually periodic histogram reported by Shnol and Rubenstein in this journal for the period 24 July 2005 into August correlates with the NASA report of the Sun beginning the occulting of Saturn on that date; and thus also correlates with the work of Vezzoli reporting a dip in gravity on 18 May 2001 when earth, Sun, and Saturn were in syzygy [15]. The Morgan-Vezzoli work will be reported in a Letter-to-the-Editor of this journal authored by Morgan.

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18. Po-210 study was conducted by Dr. Derek Lane-Smith of Durridge Corporation in Bedford, MA, during time interval of total solar eclipse of 4 Dec 2002 showing a decrease in radioactive decay rate at the time of totality in southern Australia.
19. Cs-137 decay study was conducted by Professor C. Blatchley at Pittsburg State University during the time interval of the annular solar eclipse of 26 January 2009, indicating a small decrease in decay rate at the time of totality in Australia, corresponding to 4.06 days since the beginning of the experimental measurements. Dr. Blatchley does not share the same opinion as the author regarding the significance of the Cs-137 radioactive decay data as related to the total physics of a solar eclipse, partly because the detected signal does not show a variation exceding two-sigma. However, it must be pointed out that the variation in the measuring of a property such as radioactive decay, or gravity, during totality of a solar eclipse must indeed necessarily

be extremely small. Regarding gravity, this variation was measured to be about 10 microgal (see Refs. 21 and 22).

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