Alternative Reflections on Gravitational Anomalies during Solar Eclipses

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ABSTRACT

Since the first reports by Allais about gravitational anomalies during solar eclipses, a large number of papers appeared until now which assume that these anomalies are due to a shielding or an absorption of the attracting force of the Sun by the mass of the Moon. In the meantime it became more and more clear that this is not the case. Instead of a single maximum of the anomaly at totality, as expected from a shielding effect, due to several recent observations, a quite different effect seems to exist: The appearance of two maxima of the gravitational anomalies, one near the first and a second near the fourth contact. This curious behavior can hardly be explained by classical theories of gravitation. On the basis of the "Alternative Reflections on Gravitation" (ARG), however, just such a behavior of the anomalous gravitational effects can very well be expected. This can be derived quite straightforward from the principles of the ARG, considering the interaction of ALPs from the Sun with the unusual spatial arrangement of the magnetic field of the Moon.

1. INTRODUCTION

Already in 1954 Allais observed anomalous gravitational effects during a solar eclipse by using a paraconical pendulum. Since then until now, a lot of further experiments were conducted, also by using different other equipments, torsion pendula, Foucault pendula, gravitational pendula, or gravimeters. Despite a huge amount of observations with very different results, it seems, however, not to be clear what really happens. As a good overlook of the matter a review-paper by Duif [1] may be cited here, where he states in the abstract "It is concluded that all the proposed conventional explanations either qualitatively or quantitatively fail to explain the observations". This own paper is not intended to present a broad overview of this controversial field. In contrary it is focussed onto very special details. The reasons for these selections can be found in the following chapters.

3. TWO-VALLEY-OBSERVATIONS

In the abstract of a paper about gravitational anomalies during solar eclipses [2] Hector A. Munera refers to the reports of a chinese group which observed in May 1997 the so called "two gravity anomaly valleys" [3a], [3b]. Later in the abstract, Munera writes: "...the residual gravity curve may exhibit two lateral valleys, as effectively observed in at least six solar eclipses from 1954 to 1999, described in the text. Therefore, gravity attenuation during solar eclipses is dominated by scattering instead of absorption as conventionally believed". Two reports of such observations of two anomaly values will be discussed later: The above cited observations of the chinese group at MOHA in 1997, and another one described by Duval [4].

4. RELEVANT PRINCIPLES OF THE ARG

If one excludes an absorption effect as the reason of the obviously existing gravitational anomalies during solar eclipses, the question arises whether the ARG may offer an alternative explanation of this mystery. This requires an explanation of the relevant principles of the ARG, as they are presented in chapter 7 in an update of the ARG [5] and four following papers on vixra.org, especially in chapter 2 in [6].

In short: ALPs (axion like particles) are produced at some places by some mechanism, traverse baryonic matter without almost any interaction, transform to gravitons (not to photons as assumed in the case of Axions) which interact with baryonic matter and produce repulsive gravitational forces. The transformation to gravitons seems to be increased by the interaction with magnetic fields.

This rises the question: Where do such relevant sources of ALPs and the involved interacting magnetic fields exist, in connection with the above mentioned anomalies?

5. SOURCES OF ALPS

Axions, and thus also the so called ALPs, are assumed to be produced especially in the hot interior of stars. Of interest are therefore data in connection with the core of the Sun. From Wikipedia [7] the following interesting data can be obtained: "The core of the Sun is considered to extend from the center to about 0.2 to 0.25 of solar radius. It is the hottest part of the Sun and of the Solar System. It has ... a temperature of 27 million degrees Fahrenheit (15 million degrees Celsius, 15 million Kelvin)". And furthermore: "Inside 0.24 solar radius, the core generates 99% of the fusion power of the Sun."

This region of the core of the Sun is assumed as the first source of the production of ALPs which travel towards Earth. But there may be a second region from which ALPs travel from the Sun towards Earth.

Far outside the photosphere of the Sun, with temperatures around 6000K, there exist the so called corona with temperatures up to 10 million K [8]. Already in 1995 [5] it was assumed by the author of this paper, that this curious effect is produced by ALPs from the core of the Sun. Due to these high temperatures up to 10 million Kelvin inside the corona, almost as high as inside the core of the Sun, it may well be assumed that also from this region ALPs travel towards Earth. This region is therefore seen as the second source of ALPs from the Sun.

In connection with these considerations and the own paper [5] in 2015, a very recent publication in 2018 [9] may be mentioned here, which strongly supports the own concepts. In this paper one can read:

"This extra energy released in corona represents a resolution, within AQN framework, a long standing puzzle known in the literature as the “solar corona heating mystery". The same annihilation events also produce the axions. The flux of these axions is unambiguously fixed in this model and expressed in terms of the EUV luminosity from corona."

Due to data in WIKIPEDIA-articles, the first picture in [8] and two pictures in [10], one may assume that the most active region for the production of radiation in the corona may be described as a calotte with a radius reaching from the radius R_{Sun} of the visible Sun till $1.8 * R_{Sun}$. The center of this calotte may therefore be localized at a radius of about $1.4 * R_{Sun}$, thus well outside the visible surface of the Sun.

6. MAGNETIC FIELDS OF THE MOON

Besides the evidence of suited sources of ALPs, as described in the foregoing chapter, according to the statements in chapter 4., one must look whether also the second contributor of this process exists near the Moon, magnetic fields which increase the transformation of ALPs from the Sun to gravitons, which travel towards Earth. Data from WIKIPEDIA may be cited here [11]:

"The magnetic field of the Moon is very weak in comparison to that of the Earth. Other major differences are that the Moon does not currently have a dipolar magnetic field (as would be generated by a geodynamo in its core) and the varying magnetization that is present is almost entirely crustal in origin." And another interesting point is mentioned there:

"In support of this, it has been noted that the largest crustal magnetizations appear to be located near the antipodes of the giant impact basins. It has been proposed that such a phenomenon could result from the free expansion of an impact-generated plasma cloud around the Moon in the presence of an ambient magnetic field.[..] For example, the Chandrayaan-1 spacecraft mapped a "mini-magnetosphere" at the Crisium antipode on the moon's far side, using its Sub-keV Atom Reflecting Analyzer (SARA) instrument. The mini-magnetosphere is 360 km across at the surface and is surrounded by a 300-km-thick region of enhanced plasma flux that results from the solar wind flowing around the mini-magnetosphere.[..]".

Of interest are the magnetized regions with dimensions between 300 to 360 km, which correspond to about 20 % of the Moons radius, but also data about the crustal region and the amplitude of the magnetic fields are of interest here.

The crustal region of the Moon is reported to exhibit thicknesses between 60 to 100 km [12]. The magnetic fields in different regions range from zero to about 300 nT, as can be seen in the pictures from the near and the far side of the Moon in [11].

Thus, one may assume that magnetic fields of the moon can be expected inside a spherical shell with a thickness of .2 times the radius of the Moon, R_{Moon}. This thickness obviously includes the region of the crust, but may probably extend also into regions above the visible surface of the Moon.

7. TRAVEL OF ALPS THROUGH THE MAGNETIZED SPHERICAL SHELL OF THE MOON

The regions with increased magnetic fields near the surface of the Moon and their amplitudes can hardly be used here to calculate a realistic picture of their influence on gravitational anomalies, because both the regions and the amplitudes are distributed highly irregular, as can be seen from the figures in [11].

But what can be calculated, is the statistical probability that ALPs are transferred to gravitons, if one assumes that this probability is proportional to the length of their way through the magnetized regions of the Moon towards the gravimeter.

In order to illustrate this situation, the following arrangement may be observed: ALPs from the centre of the Sun travel towards the gravimeter on Earth and traverse the magnetized spherical shell of the Moon, which expands from $R_1=1$ to $R_2=1.2$. The real value of radius of the Moon, R_{Moon}, may be compared with a value somewhere between the relative values of R_1 and R_2.

The length L of the way of the ALPs through the magnetized spherical shell can easily be calculated for different regions of R:

In the regions $R<-R_2$ and $R>R_2$: L=0.

In both regions, from - R_2 to $-R_1$ and from R_1 to R_2: $L = 2*(Sqr(R_2^2-R^2)-Sqr(R_1^2-R^2))$.

At R=0 the length L is $2*(R_2-R_1)$, with a value of .4.

These data can be seen in Fig. 1, in the dotted line, containing values of L at R-Values increasing by .02, a tenth of (R_2-R_1). The solid line in Fig.1 describes the mean value of 10 such data around the center position of R. The data in this figure clearly show, what type of gravitational anomalies can be expected on the basis of the ARG during solar eclipses: Two anomalies, positioned near the first and the fourth contact, in agreement with recently reported observations.

8. MOHE OBSERVATIONS

Of high interest in connection with the own considerations are the Mohe observations, mentioned in chapter 3. Details of these observations can be seen in Fig. 2 in [12]. Of interest are especially the times of the first and the fourth contact, C_1 and C_4, scaled there in minutes. Also of interest are the positions of the two gravitational anomalies, A_1 and A_2, whose centers can be determined roughly at half height of their amplitude on digitized pictures of this figure. Then two details become evident, which, however, can be seen easily by eyes already in the figure. First: The distance between A_1 and A_2 is about 25% higher than the distance between C_1 and C_4. Second: The midpoint C_M of the optical observations ($C_M = 1/2*(C_4-C_1)$) appears about 7.5 or 10 minutes later than the midpoint A_M of the gravitational anomalies, A_M, ($A_M = 1/2*(A_2-A_1)$. The different two values of C_M-A_M result from the fact that the positions of the two arrows at C_1 and C_2 in Fig. 2 are obviously more than 2 minutes later than they can be calculated from corresponding data in the text of this paper.

9. TIME LAG BETWEEN OPTICAL AND GRAVITATIONAL DATA

In the foregoing chapter a curious effect was evaluated: a time lag between the optical observations and the gravitational ones, although one may expect that the midpoints of both effects, C_M and A_M, should appear at the same time. Is this perhaps a measurement error or may there be a reasonable explanation?

On the basis of the principles of the ARG the following considerations may be helpful: The centers of the two gravitational anomalies A_1 and A_2, and thus also of the midpoint A_M, are determined by the interaction of two involved components, the magnetic fields at the moon's surface and the incoming ALPs, which appear at just the same time when the gravitational effects are observed on Earth (neglecting the small time difference of 1.3 sec due to the distance between Moon and Earth). Thus, the actual time may be assumed as basis.

The optical determinations of the first and the fourth contact, C_1 and C_4, are also based on the observations on two involved components: The surface of the Moon and the surface of the Sun. However, the actual surface of the Moon is combined with a picture of the surface of the Sun, that corresponds to a position which the Sun reached already 8.3 minutes before, due to the limited speed of light. These 8.3 minutes correspond very well with both data of the observed time lag, calculated in the foregoing chapter. If one shifts C_1, C_4 and C_M by just these 8 minutes to lower values, the new values C_1', C_4' and C_M', as well as A_1, A_2, and A_M are all positioned symmetrically around the center $C_M' = A_M$.

10. MOHE-ANOMALIES BEFORE C1 AND BEHIND C4

There exists still another open question: In chapter 8 it was stated that time difference A_2-A_1 is about 25% higher than that between C_1 and C_4. Can that be explained on the basis of the ARG?

For a rough estimation it may be assumed that the apparent diameter of the Sun and the Moon are equal, corresponding to a radius R_0 of about a quarter of a degree. In the case of observations including total or annular eclipses, the value of C_4-C_1 then equals $4*R_0$. In chapter 5 it was estimated that both centers of the calotte of the corona, near C_1 and C_4, are located outside the surface of the Sun by an amount of about $.4*R_0$. Therefore the distance between the ALPs-emitting regions is by $.8*R_0$ larger than the $4*R_0$-value of C_4-C_1. This increase by 20% corresponds rather well with the above mentioned 25% higher value of A_2-A_1. So it seems quite obvious, that the anomalous gravitational signals are not due to ALPs from the center of the Sun, but from ALPs, emitted from the corona.

11. ANOMALIES DUE TO ALPS FROM THE CENTER OF THE SUN?

Data from another paper, published by M. Duval [4], are of interest in connection with this paper. The first point of interest: The gravitational attraction is seen by the author as a shielding effect, similar to the ideas of the ARG. But that will not be at the centre of discussion here. The relevant point of interest are the data in figure 4 of his paper. Indicated are the times of C_1 and C_4, the first and the fourth contact. Furthermore the data indicate an anomaly, just behind C_1. The center of this anomaly can easily be determined from the lines drawn between the date points, at a height of 2 microgal. Thus this center can be located easily at a distance of .23 times the distance (C_4-C_1) behind C_1. If one recognizes a time shift of 8 minutes, as discussed in chapter 9, one gets a position of the anomaly which is .27 times (C_4-C_1) behind C1'. May there be an explanation of this value on the basis of the ARG?

An anomaly at distance of about .25 times the distance of (C_4-C_1) behind C1' is on the basis of the ARG highly indicative to a process, where ALPs from the center of the Sun produce the gravitons at the surface on the Moon which travel in the same direction and activate the sensors on Earth.

In the case of an annular eclipse, as described by Duval [4], a delay of .25 times the distance of (C_4-C_1) is a minimal value, occurring if the apparent radius of the Moon equals that of the Sun. The highest value of this delay can reach a value of .263 instead of .25. This situation appears if the highest apparent radius of the Sun is about 11 percent higher than the smallest radius of the Moon [13], $(R_{Sun}/(2R_{Sun}+2R_{Moon})$ $=(1.11/4.22) = .263$.

A second anomaly, A_2, just before C_4, can't be determined, mainly due to the fact that in the corresponding region there exists only a single data-point with an increased value. Despite a missing evidence of A_2, the observations reported by Duval favour the assumption that the anomalous gravitational effects in this case are created by ALPs from the center of the Sun.

12. COMPLICATED SCENARIO DUE TO MANY INTERACTING PARAMETERS

Due to the until now quite usually accepted assumption, that the gravitational anomalies during solar eclipses are produced by the absorption of the attractive force from the Sun, one can easily calculate the result: Gravimeters must show an increase of the gravitation towards earth with its maximum at totality. This effect, however, is usually not observed.

Unfortunately, the scenario discussed in this paper as an explanation of the gravitational anomalies is much more complicated. Two regions inside and around the Sun may contribute as sources of ALPs. The regions with magnetic fields near the surface of the Moon are rather irregularly distributed. The libration of the Moon delivers additional problems.

Even in the case of total or annular eclipses, where ALPs from the center of the Sun transmit the center of the moon on their way to the gravimeter, these ALPs thus must not produce equal amplitudes of the anomalous effects at both maxima positions of the "two valley observations". This situation may be responsible for the results in Fig. 4 in [4], where the first maximum is well developed, the second one, however, is hardly discernible. Furthermore it should be regarded, that even in the cases of total or annular eclipses, the path along which these ALPs traverse the Moon changes, leading to different results.

13. POSSIBLE NEW EVALUATIONS OF STORED OBSERVATIONS

Previous observations of gravitational anomalies during solar eclipses are strongly focused on measurements during totality. Based on the considerations of the foregoing chapters, measurements of gravimeters in the area of partial solar eclipses should also be considered. That would significantly increase the number of analyzable observations. This is due to the fact that "Typically, the umbra is 100–160 km wide, while the penumbral diameter is in excess of 6400 km." [14].

Because one may expect that only a part of the new gravitons from the Moon are absorbed by the Earth, anomalous gravitational effects should also be observable in the region on the backside of the Earth, which is defined by the prolongation of the penumbra towards this region. This increases the number of stations with interesting observations furthermore. And observations by gravimeters at these stations may be of highest value, because they are hardly affected by atmospheric disturbances. Most suitable for such observations seem to be Superconducting Gravimeters, due to their low noise level and high sensitivity. Data from such gravimeters, especially on Level2, are freely available and can be easily corrected by programs like ETERNA3 to Level3, which allows the detection of the relevant anomalies.

Thus it seems that new knowledge concerning gravity can easily be obtained. No millions of dollars are necessary to plan and build new equipment during typically a decade, nor must some more years pass by until usable data are gathered. The data already exist and there exists an enormous number of qualified people, able to handle these data without the need of additional financial resources. So it may happen that a lot of observational data, which on the basis of conventional theories of gravitation seem to be unexplainable noise, will mutate to valuable supports of new concepts like the ARG.

The explanation of the existence of the small gravitational anomalies during solar eclipses by the above described process may be seen as a valuable new insight. But of even higher value should be appreciated the fact, that this process probably is the same, that according to the ARG produces effects around the Sun and far away in the universe: Solar wind, coronal heating, coronal mass emission, coronal flares, and bipolar jets.

14. REFERENCES

[1] Duif, C. P. (2004), arXiv:gr-qc/0408023
[2] Munera, H. A. (2011), http://physicsessays.org/my-orders/product/235-13-pdf-hector-a-munera-gravity-attenuation-and-consistency-with-observed-solar-eclipse-gravitational-anomalies.html
[3a] Wang, Q. S et al. (2000), Phys. Rev. D 62, 041101R
[3b] Yang, X. S. and Wang, Q. S. (2002), https://www.researchgate.net/publication/225262849
[4] Duval, M. (2007), arXiv:0705.2581 [physics.gen-ph]
[5] Albers, J. (2015) , http://vixra.org/pdf/1509.0224v1.pdf
[6] Albers, J. (2017), http://vixra.org/pdf/1703.0266v1.pdf
[7] https://en.wikipedia.org/wiki/Solar_core
[8] https://en.wikipedia.org/wiki/Corona
[9] Fischer, H. et al. (2018), arXiv:1805.05184v1 [hep-ph]
[10] https://de.wikipedia.org/wiki/Korona_(Sonne)
[11] https://en.wikipedia.org/wiki/Magnetic_field_of_the_Moon

[12] http://www.planetenkunde.de/p012/p01203/p0120302001.htm
[13] https://en.wikipedia.org/wiki/Solar_eclipse#Geometry
[14] https://en.wikipedia.org/wiki/Solar_eclipse#Path

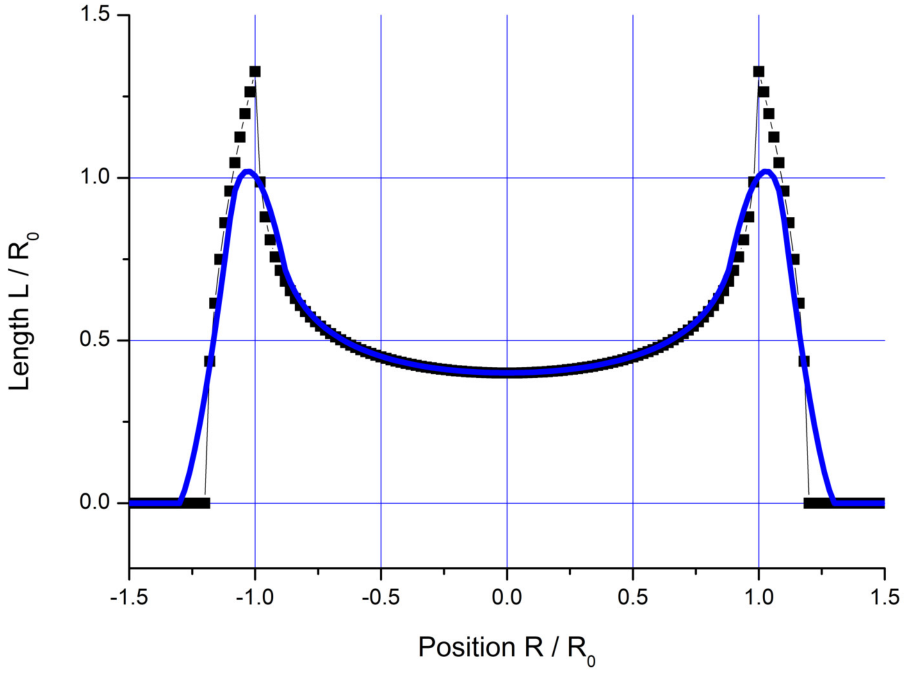

Fig. 1. Dependence of the length L on the distance R. L is the length of the path of a ray through the volume of a spherical calotte which extends between the radii $R_1 = R_0$ and $R_2 = 1.2{*}R_0$. R is the distance between the path and the center. The filled squares represent single paths, separated by $.02{*}R_0$. The solid line represents the mean value of ten such paths symmetrically around R.