"Aspin Bubbles" and gravitational deflection

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Abstract. Based on the "Aspin Bubbles" theory, we propose a velocity function *v(r)* for light that is exclusively dependent on the gravity *g(r)* that exists at each point *P(r)* of space, and with which, by applying the laws of refraction, the gravitational deflections of light measured up to this point are obtained .

Keywords: Aspin Bubbles, anharmonic waves, gravitational lens.

I. Introduction

The "Aspin Bubbles" theory (Lana-Renault 2006)[1], hereinafter **AB**, shows that the gravitational field of a mass *M* is probably the result of the overlap of the anharmonic waves that are emitted by each of its ultimate components (tones), and that the mechanical interaction of all of these waves with each of the ultimate components of another mass *m* is what produces the force of gravity.

In addition, **AB** predicts that the refraction of light in a medium really occurs in the space *"not occupied"* by the ultimate components of the medium. It considers that such space is disturbed by the overlap of anharmonic waves emitted by each one of the components, and that the greater the perturbation of space, the lower the speed the light through it.

Combining both of these concepts, gravitational deflection can be understood simply as the refraction of light caused by gravitational fields.

II. Fundamental Hypotheses

For light to be refracted, it is proposed that its speed varies in space depending on the space perturbation (ether) produced by the anharmonic waves that travel through it and whose value will be quantified by the ‘scalar’ gravity (the sum of the absolute values of the intensities of the gravitational fields existing in such space).

In general, if *P(r)* represents any point in space at a distance *r* from the centre of a space body with a mass *M*, we suppose that:

1. *The speed of light at each point P(r) of its trajectory is given by the fundamental formula*

$$v(r) = \frac{A \cdot c}{\sqrt{A^2 + \chi(r)}} \tag{1}$$

where A is a constant to be determined, $\chi(r)$ *is a dimensionless function quantified by the 'scalar' gravity* $g(r)$ *at each point, and c is the speed of light at infinity, where the space is no longer perturbed by the waves—that is, where gravity is zero.*

In the hypothetical case of a single space body of mass *M,*

$$\chi(r) = g(r) = \frac{GM}{r^2} = \frac{B}{r^2} \tag{2}$$

where $B = GM$, and *G* is the universal gravitational constant. For $r = \infty$, it follows that $\chi(\infty) = g(\infty) = 0$ and $v(\infty) = c$.

2. *The trajectories of light satisfy the laws of refraction.*

Therefore, for each point *P(r)* of the trajectory through which the beam of light travels with velocity *v(r)* at an incident angle *I(r)* with respect to the radius $r = \overline{OP}$ (Figure 1), the law of refraction is expressed by

$$\alpha = \frac{r \sin I}{v} = const. \; , \tag{3}$$

where α is a constant of the trajectory.

III. Trajectories of light

We consider the trajectory of a beam of light $\widetilde{EQPP'T}$ from a distant star *E* that passes near the Sun and that reaches the Earth (Figure 1), as denoted by polar coordinates (r, Δ). The coordinate Δ will be the angular distance travelled by the light. The radius $R = \overline{OQ}$ will be perpendicular to the trajectory and the radius $d = \overline{OT}$ will be the distance from the Sun to the Earth.

In addition, to simplify the calculation of the trajectory, we will neglect Earth's gravity versus the Sun's gravity throughout the trajectory.

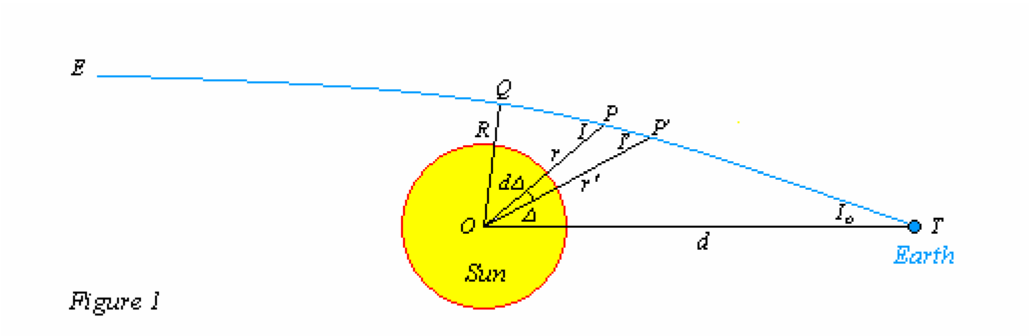


Figure 1

The law of refraction will be followed at all points, especially at points Q, P, P' and T, such that

$$\frac{R\sin 90}{v(R)}=\frac{R}{v(R)}=\frac{r\sin I}{v(r)}=\frac{r'\sin I'}{v(r')}=\frac{d\sin I_0}{v(d)}=\alpha\ , \tag{4}$$

and any arc element $ds=\widehat{PP'}$ of the trajectory shall meet the following differential relation:

$$\tan I=-\frac{r\cdot d\Delta}{dr} \tag{5}$$

To solve this differential equation, the first step is to determine $\tan I$ as a function of the main characteristics of the trajectory: its constant α and its nearest distance R from the Sun. This can be done as follows.

Solve equations (3) or (4) for *v(r),* and set them equal to (1) substituting (2)

$$v(r)=\frac{r\sin I}{\alpha}=\frac{Ac}{\sqrt{A^2+\frac{B}{r^2}}} \tag{6}$$

Square and simplify

$$\sin^2 I=\frac{A^2c^2\alpha^2}{B+A^2r^2} \tag{7}$$

Introducing the characteristics of point Q, $I=90^{\circ}$ and $r=R$, we obtain

$$A^2c^2\alpha^2=B+A^2R^2 \tag{8}$$

Therefore, (7) is expressed as

$$\sin^2 I=\frac{B+A^2R^2}{B+A^2r^2} \tag{9}$$

so that $\tan^2 I=\dfrac{\sin^2 I}{1-\sin^2 I}=\dfrac{\alpha^2c^2}{r^2-R^2}$ and $\tan I=\dfrac{\alpha\cdot c}{\sqrt{r^2-R^2}}$ (10)

Finally, substituting this expression into (5) results in

$$d\Delta=\frac{-\alpha\cdot c}{r\sqrt{r^2-R^2}}dr \tag{11}$$

which can be easily integrated:

$$\Delta = \int \frac{-\alpha \cdot c}{r\sqrt{r^2 - R^2}} dr = \frac{\alpha \cdot c}{R} \arcsin\frac{R}{r} + const. \tag{12}$$

To calculate the constant, it can be observed in the figure that when $r = d$, $\Delta = 0$, such that

$$const. = -\frac{\alpha \cdot c}{R} \arcsin\frac{R}{d} \tag{13}$$

yielding the following angular distance travelled by the light:

$$\Delta(r) = \frac{\alpha \cdot c}{R}\left(\arcsin\frac{R}{r} - \arcsin\frac{R}{d}\right) \tag{14}$$

This angular distance is only valid for distances *r* going from *R* to *d* $(R \le r \le d)$.

For distances *r* beyond the minimum distance to the Sun $(R \le r \le \infty)$, the angular distance (14) must be transformed to

$$\frac{\Delta \cdot R}{\alpha \cdot c} + \arcsin\frac{R}{d} = \arcsin\frac{R}{r} \quad , \tag{15}$$

Applying sine functions and using the property $\sin\phi = \sin(\pi - \phi)$, we obtain

$$\sin\left(\frac{\Delta \cdot R}{\alpha \cdot c} + \arcsin\frac{R}{d}\right) = \frac{R}{r} = \sin\left[\pi - \left(\frac{\Delta \cdot R}{\alpha \cdot c} + \arcsin\frac{R}{d}\right)\right] \tag{16}$$

and by undoing this change, we obtain for distances $R \le r \le \infty$

$$\Delta(r) = \frac{\alpha \cdot c}{R}\left(\pi - \arcsin\frac{R}{d} - \arcsin\frac{R}{r}\right) \tag{17}$$

For point *Q* of the trajectory nearest to the Sun where $r = R$, (14) or (17) will yield

$$\Delta_R = \Delta(R) = \frac{\alpha \cdot c}{R}\left(\frac{\pi}{2} - \arcsin\frac{R}{d}\right) \quad , \tag{18}$$

and for an infinite distance, $r = \infty$, (17) yields

$$\Delta_\infty = \Delta(\infty) = \frac{\alpha \cdot c}{R}\left(\pi - \arcsin\frac{R}{d}\right) \quad . \tag{19}$$

To calculate the distance *r* as a function of any angular distance Δ, we can clear r from (16). The result is

$$r(\Delta) = R\csc\left(\frac{\Delta \cdot R}{\alpha \cdot c} + \arcsin\frac{R}{d}\right) \tag{20}$$

IV. Gravitational deflection

In general, the calculation of a gravitational deflection δ caused by any mass M of a beam of light coming from a distant star at its real position E, visualised on Earth with from a virtual position E' with an observation angle I_0 (Figure 2), follows these steps:

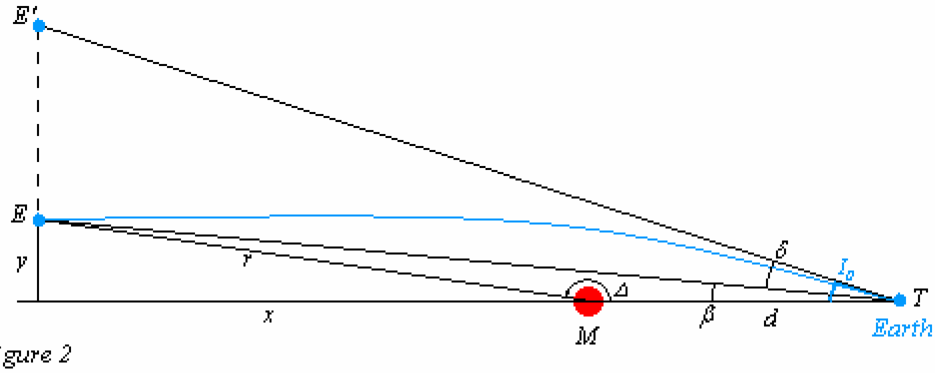


Figure 2

The Cartesian coordinates (x, y) of the real position E of the star are calculated as a function of the polar coordinates (r, Δ), $x = r\cos\Delta$ and $y = r\sin\Delta$. Next, its inclination $\beta = \arctan\frac{y}{|x-d|}$ is calculated for two scenarios:

a) for distances $x - d \leq 0$, the gravitational deflection δ will be:

$$\delta = I_0 - \beta \tag{21}$$

where, according to (4), the observation angle I_0 has the value

$$I_0 = \arcsin\frac{\alpha \cdot c_v}{d} \tag{22}$$

where c_v is the speed of light in a vacuum and on the Earth's surface:

$$c_v = v(d) = 2{,}99792458 \cdot 10^8\, m/s \tag{23}$$

b) for distances $x - d > 0$, the gravitational deflection will have a value of:

$$\delta = I_0 + \beta + \pi \tag{24}$$

V. Determination of the constants *A* and *c*

To determine the values of the constant A and the speed of light at infinity $v(\infty) = c$, we must start from a known fact. We know that the gravitational deflection caused by the Sun on a beam of light from distant stars ($r > 1500$ *light years*) and tangent to it is $1{,}75''$ of arc. With these data, the procedure is as follows:

1. On the Earth's surface, according to (1),

$$v(d-R_T)=c_v=\frac{A\cdot c}{\sqrt{A^2+g_T}} \tag{25}$$

where $g_T=g\left(d-R_T\right)=\frac{GM_T}{R_T^2}+\frac{GM_S}{(d-R_T)^2}$, M_T and M_S are the masses of the Earth and the Sun, respectively, and R_T is the radius of the Earth.

2. Solving (25) for c

$$c=c_v\sqrt{1+\frac{g_T}{A^2}} \tag{26}$$

and inputting values for A such that we can calculate c, $v\left(r\right)$ at each point of the trajectory is

$$v(r)=\frac{A\cdot c}{\sqrt{A^2+\chi(r)}}=\frac{A\cdot c}{\sqrt{A^2+\frac{GM_S}{r^2}+\frac{GM_T}{\left(r-d\right)^2}}}, \tag{27}$$

and the constant α characteristic of each trajectory, $\alpha=\frac{R}{v\left(R\right)}$ according to (4), where R is the radius of the Sun.

3. Next, the angular distance Δ_E of the real position E of the star is found for a distance $r_E=1500$ *light years* using (17).

4. Its Cartesian coordinates $\left(x,y\right)$ are determined, along with its observation angle I_0 and inclination angle β.

5. Finally, the gravitational deflection δ is calculated according to (21).

The process from 2 to 5 is iterative until a value of A is found such that the gravitational deflection is $1,75''$ of arc. The value obtained is the following:

$$A=7121\pm 1 \tag{28}$$

so that the speed of light at infinity is

$$v(\infty)=c=2,9979248706\cdot 10^8\pm 10^{-10}\,m/s \tag{29}$$

such that $c/c_v=1,00000009694\pm 3\cdot 10^{-11}$.

Next, the trajectory $r\left(\Delta\right)$ can be plotted from $\Delta=0$ to $\Delta=\Delta_E$ using equation (20).

Other input data used are:

- Gravitational constant $G = 6,67259 \cdot 10^{-11} N \cdot m^2 \cdot kg^{-2}$
- Radius of the Earth $R_T = 6,371 \cdot 10^6 m$
- Mass of the Earth $M_T = 5,977 \cdot 10^{24} kg$
- Radius of the Sun $R_S = 6,96 \cdot 10^8 m$
- Mass of the Sun $M_S = 1,99 \cdot 10^{30} kg$
- Distance to the Sun $d = 1,5 \cdot 10^{11} m$

Other output data:

- Trajectory constant $\alpha = 2,32161215239192$
- Angular distance $\Delta_E = 179,7346211223093^{\circ}$
- Observation angle $I_0 = 0,265865355953574^{\circ}$
- Inclination angle $\beta = 0,265378874844856^{\circ}$

VI. Differences with Einstein

With these values of *A* and *c*, we can verify that the gravitational deflection of $1,75''$ of arc is the same for stars located between a distance of $r_E = 0.1$ *light years* and infinite r_E. For $r_E < 0.1$ *light years*, the deflection becomes slightly smaller. For example, for $r_E = 10^{-4}$ *light years,* the value obtained is $\delta = 1,51''$ of arc. This constitutes a slight difference from the generic formula established by Einstein for gravitational deflection:

$$\delta_{Einstein} = \frac{4GM}{R \cdot c_v^2} \tag{30}$$

which yields the same result for any distance r_E of the star, since it does not depend on this variable.

Another difference is that while Einstein's theoretical deflection is directly proportional to the mass *M* that causes the deflection, such is not the case with the findings from this study. Only for masses *M*, where $0,1 \cdot M_S < M < 1000 \cdot M_S$, the deflection is also directly proportional to the mass M. Outside of this range, the deflection is slightly smaller than the one obtained with the Einstein equation.

Finally, the greatest difference is that the light beams are not tangent to the space body *M*; that is, they travel at a distance *R* from the centre greater than their radius. Einstein's deflection, according to (30), is inversely proportional to *R* for every space body of mass M. In this case, the deflection obtained is somewhat different. Considering the deflection produced by the Sun, the comparative data are the following.

For $\frac{R}{R_S} = p$, where R_S is the radius of the Sun, we obtain the deflection

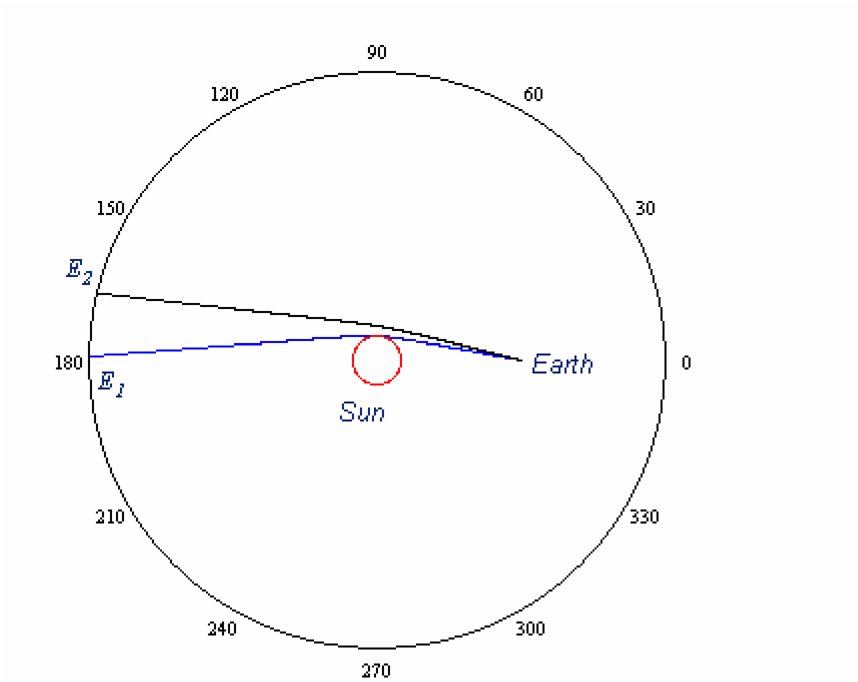
$$\delta \cong \frac{\delta(R_S)}{p^2} \qquad (31)$$

where Einstein's formula yields $\delta = \frac{\delta(R_S)}{p}$. (32)

VII. Trajectories

Since the distances to stars are disproportionate compared those to our solar system, the real trajectories of light cannot be visualised in a graphic. However, with a few modifications—that is, changing the input data and using equation (20)—any light trajectory can be represented, and its path and deflection can be perfectly observed.

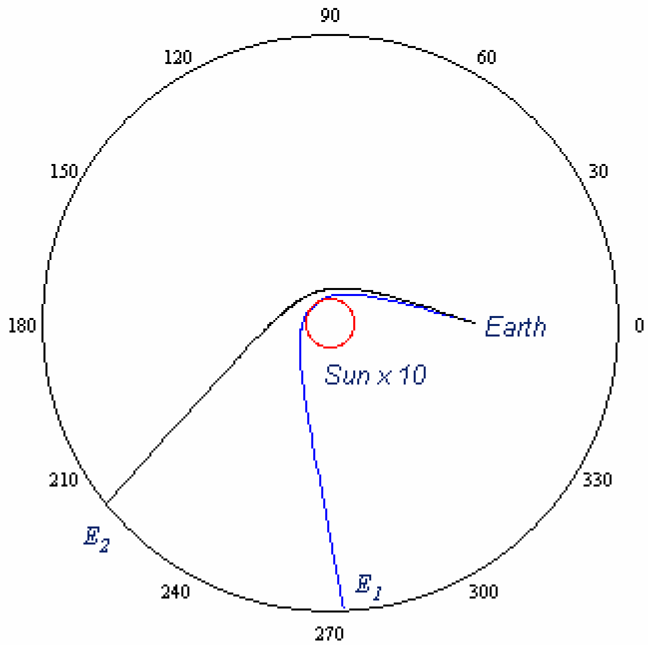
Using the Mathcad software program, several light trajectories are represented.



For light trajectories coming from stars E_1 and E_2 the following input data have been used: $A = 40$, $d = 6R_s$ and $r(E_1) = r(E_2) = 2d$ yielding the following.

- Trajectory E_1 tangent to the Sun: $\alpha_1 = 2{,}499$, $I_0^1 = 10{,}33°$, $\Delta(E_1) = 179{,}25°$, $\beta_1 = 0{,}50°$ resulting in a gravitational deflection value of $\delta_1 = 9{,}83°$.
- Trajectory E_2 away from the Sun such that $p = 1{,}4$: $\alpha_2 = 3{,}371$, $I_0^2 = 14{,}00°$, $\Delta(E_2) = 166{,}64°$, $\beta_1 = 8{,}91°$ resulting in a gravitational deflection of $\delta_2 = 5{,}09°$.

Using the same data input, but assuming that the Sun has a mass 10 times greater, the result would be:



- Trajectory E_1 tangent to the Sun: $\alpha_1 = 3,725$, $I_0^1 = 15,51^{\circ}$, $\Delta(E_1) = 272,81^{\circ}$, $\beta_1 = -65,70^{\circ}$ resulting in a gravitational deflection value of $\delta_1 = 81,21^{\circ}$.
- Trajectory E_2 away from the Sun, such that $p = 1,4$: $\alpha_2 = 4,334$, $I_0^2 = 18,13^{\circ}$, $\Delta(E_2) = 218,77^{\circ}$, $\beta_1 = -26,07^{\circ}$ resulting in a gravitational deflection value of $\delta_2 = 44,20^{\circ}$.

It is possible to observe that the light trajectories are more curved if mass *M*, which causes the deflection, is greater.

VIII. Conclusions

We have demonstrated that gravitational deflection can be treated as a simple refraction of light through space, and that the latter depends, at all times, on the ‘scalar’ gravity present in such space. Consequently, a gravitational index of refraction n_g for each point *P(r)* of the space is considered based on our first hypothesis. From (1) and (2) it can be deduced that

$$n_g = \frac{c}{v(r)} = \sqrt{1 + \frac{g(r)}{A^2}} \tag{33}$$

Phenomena such as ‘gravitational lenses’ and ‘black holes’ can now be easily explained with this tool, based on the gravitational refraction of light.

In addition, according to evidence from this study, we conclude that our space is probably not curved but rather straight or apparently curved by the gravitational fields that refract light.

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REFERENCES

- [1] Lana-Renault, Yoël (2006): *"Aspin" Bubbles: Mechanical Project for the Unification of the Forces of Nature.* Journal online APEIRON, Vol 13, No 3, July, 344-374. http://redshift.vif.com/JournalFiles/V13NO3PDF/V13N3LAN.PDF
- [2] Lana-Renault, Yoël (2006): *Michelson-Morley, Bradley, Fizeau and "Aspin Bubbles"*. Astroseti physics forum http://foros.astroseti.org/viewtopic.php?t=2922

BIBLIOGRAPHY

- Lana-Renault, Yoël (2000): *Exact zero-energy solution for a new family of Anharmonic Potentials*. Journal of the Academy of Sciences Zaragoza. **55**: 103-109. http://www.telefonica.net/web2/yoelclaude/ExactzeroenergyAcadCiencias.pdf http://arxiv.org/abs/physics/0102054

- Lana-Renault, Yoël (1998): *Model of the internal constitution of Earth*. Doctoral Thesis, Dep. of Theoretical Physics, Univ. of Zaragoza, 146 pp. http://www.tesisenred.net/TESIS_UniZar/AVAILABLE/TDR-1103108-085246//TUZ_0029_lana_modelo.pdf