

# “Aspin Bubbles” and Gravitational Deflection

Yoël Lana-Renault\*

**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.

## I. Introduction

The “Aspin Bubbles” theory<sup>1</sup> (ABT) 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, ABT 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 center 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

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

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  $M$ ,

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

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

$$\alpha = \frac{r \sin I}{v} = \text{const.} , \quad (3)$$

where  $\alpha$  is a constant of the trajectory.

## III. Trajectories of Light

We consider the trajectory of a beam of light  $\widehat{EQPP'T}$  from a distant star  $E$  that passes near the Sun and that reaches the Earth (Figure 1), as denoted by polar coordinates  $(r, \Delta)$ . The coordinate  $\Delta$  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.

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

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

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

$$\tan I = - \frac{r \cdot d\Delta}{dr} \quad (5)$$

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  $\alpha$  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 Equation 1 substituting Equation 2

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

Square and simplify

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

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

$$A^2 c^2 \alpha^2 = B + A^2 R^2 \quad (8)$$

Therefore, Equation 7 is expressed as

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

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

Finally, substituting this expression into Equation 5 results in

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

which can be easily integrated:

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

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

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

yielding the following angular distance travelled by the light:

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

This angular distance is only valid for distances  $r$  going from  $R$  to  $d$  ( $R \leq r \leq d$ ). For distances  $r$  beyond the minimum distance to the Sun ( $R \leq r \leq \infty$ ), the angular distance (Equation 14) must be transformed to

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

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

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

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

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

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

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

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

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

To calculate the distance  $r$  as a function of any angular distance  $\Delta$ , we can clear  $r$  from Equation 16. The result is

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

## IV. Gravitational Deflection

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

The Cartesian coordinates  $(x, y)$  of the real position  $E$  of the star are calculated as a function of the polar coordinates  $(r, \Delta)$ ,  $x = r \cos \Delta$  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  $\delta$  will be:

$$\delta = I_0 - \beta \quad (21)$$

where, according to Equation 4, the observation angle  $I_0$  has the value

$$I_0 = \arcsin \frac{\alpha \cdot c_v}{d} \quad (22)$$

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

$$c_v = v(d) = 2.99792458 \cdot 10^8 \text{ m/s} \quad (23)$$

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

$$\delta = I_0 + \beta + \pi \quad (24)$$

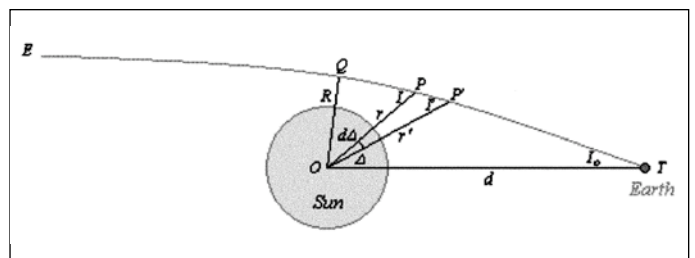


Figure 1. Trajectory of a beam of light from a distant star  $E$  that passes near the Sun and reaches the Earth.

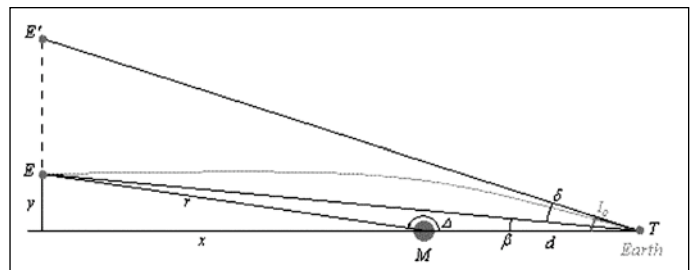


Figure 2. Gravitational deflection  $\delta$  caused by any mass  $M$  of a beam of light coming from a distant star at its real position  $E$ , visualized on Earth with from a virtual position  $E'$ .

## 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 Equation 1,

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

$$\text{where } g_T = g(d - R_T) = \frac{GM_T}{R_T^2} + \frac{GM_S}{(d - R_T)^2},$$

$M_T$  and  $M_S$  are the masses of the Earth and the Sun, respectively, and  $R_T$  is the radius of the Earth.

2. Solving Equation 25 for c

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

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

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

and the constant  $\alpha$  characteristic of each trajectory,  $\alpha = \frac{R}{v(R)}$

according to Equation 4, where R is the radius of the Sun.

3. Next, the angular distance  $\Delta_E$  of the real position E of the star is found for a distance  $r_E = 1500$  light years using Equation 17.

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

5. Finally, the gravitational deflection  $\delta$  is calculated according to Equation 21.

The process from Steps 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:

$$A = 7121 \pm 1 \quad (28)$$

so that the speed of light at infinity is

$$v(\infty) = c = 2.9979248706 \cdot 10^8 \pm 10^{-10} \text{ m/s} \quad (29)$$

such that  $c/c_v = 1.00000009694 \pm 3 \cdot 10^{-11}$ .

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

Other input data used are: gravitational constant  $G = 6.67259 \cdot 10^{-11} \text{ N} \cdot \text{m}^2 \cdot \text{kg}^{-2}$ ; radius of the Earth  $R_T = 6.371 \cdot 10^6 \text{ m}$ ; mass of the Earth  $M_T = 5.977 \cdot 10^{24} \text{ kg}$ ; radius of the Sun  $R_S = 6.96 \cdot 10^8 \text{ m}$ ; mass of the Sun  $M_S = 1.99 \cdot 10^{30} \text{ kg}$ ; distance to the Sun  $d = 1.5 \cdot 10^{11} \text{ m}$ .

Other output data are: 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:

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

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 center greater than their radius. Einstein's deflection, according to Equation 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

$$\delta \approx \frac{\delta(R_S)}{p^2} \quad (31)$$

where Einstein's formula yields

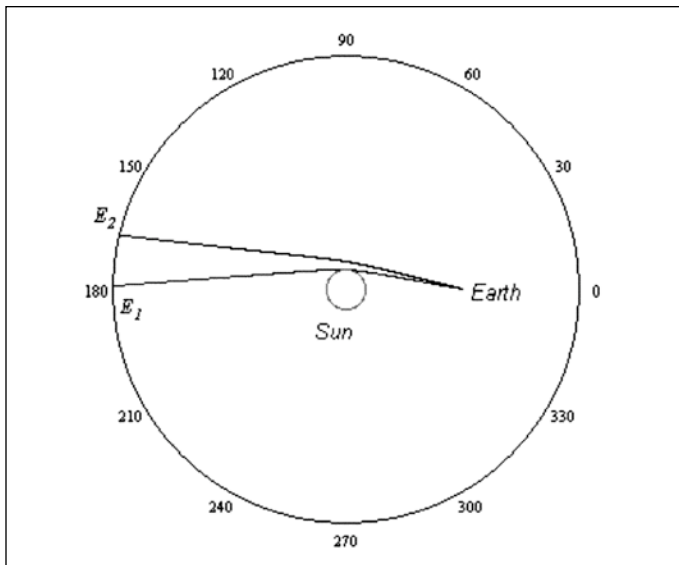
$$\delta = \frac{\delta(R_S)}{p} \quad (32)$$

## VII. Trajectories

Since the distances to stars are disproportionate compared 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. See Figure 3. 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:  $\alpha_1 = 2.499$ ,  $I_0^1 = 10.33^\circ$ ,  $\Delta(E_1) = 179.25^\circ$ ,  $\beta_1 = 0.50^\circ$ , resulting in a gravitational deflection value of  $\delta_1 = 9.83''$ .
- Trajectory  $E_2$  away from the Sun such that  $p = 1.4$ :  $\alpha_2 =$



**Figure 3.** Changing the input data and using Equation 20, any light trajectory can be represented, and its path and deflection can be perfectly observed.

$3.371, I_0^2 = 14.00^\circ, \Delta(E_2) = 166.64^\circ, \beta_1 = 8.91^\circ$ , resulting in a gravitational deflection of  $\delta_2 = 5.09^\circ$ .

Using the same data input, but assuming that the Sun has a mass ten times greater, the result would be (Figure 4):

- 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

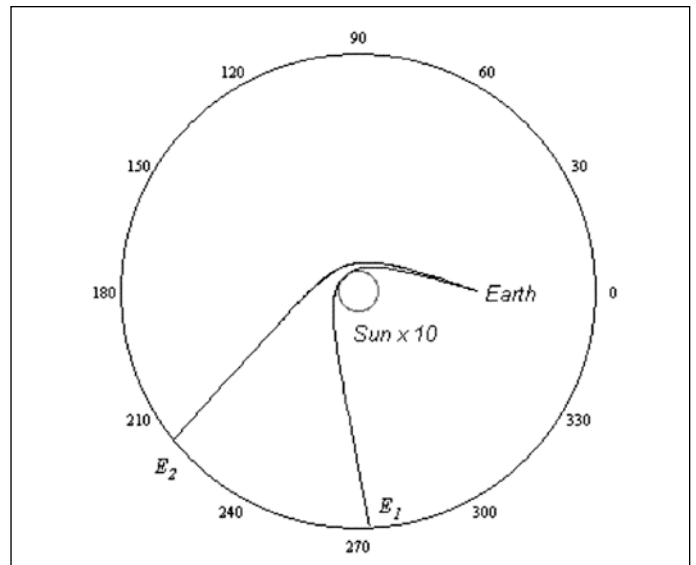
We have demonstrated that gravitational deflection can be treated as a simple refraction of light through space, and that the latter depends, at all times, on the “scalar” gravity present in such space. Consequently, a gravitational index of refraction  $n_g$  for each point  $P(r)$  of the space is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

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

### About the Author

Dr. Yoël Lana-Renault has a Ph.D. in the physical sciences from the University of Saragossa (Spain). He is currently a high school mathematics teacher. He previously was an assistant professor at both the University of Saragossa and La Rioja University. Dr. Lana-Renault has published numerous papers in scientific journals.

\*Email: [yoelclaude@telefonica.net](mailto:yoelclaude@telefonica.net)  
 Website: [www.yoel-lana-renault.es](http://www.yoel-lana-renault.es)



**Figure 4.** Using the same data input, but assuming that the Sun has a mass ten times greater, we observe that the light trajectories are more curved.

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.

## ACKNOWLEDGEMENTS

I would like to acknowledge the time and friendship of Dr. Juan José Gascón Wingenbach<sup>2</sup> and Dr. Miguel Ángel González Rodrigo<sup>2</sup>, who have always been participants, encouragers and excellent critics of this work through their contributions to the Astroseti astrophysics forum.

## REFERENCES

1. Lana-Renault, Y. 2006. “‘Aspin’ Bubbles: Mechanical Project for the Unification of the Forces of Nature,” *Apeiron*, 13, 3, July, 344-374, <http://redshift.vif.com/JournalFiles/V13NO3PDF/V13N3LAN.PDF>
2. Lana-Renault, Y. 2006. “Michelson-Morley, Bradley, Fizeau and ‘Aspin Bubbles,’” *Astroseti Physics Forum*, <http://foros.astroseti.org/viewtopic.php?t=2922>