the general science journal

Hipparcos did not measure directly the light bending!

o.serret@free.fr

Abstract: Two different methodologies are used to measure the gravitational light bending: the first one when the light passes close to the Sun, and the second one when the light passes at an angle more or less perpendicular to the Sun. Methodology is at least as important as results. It is exposed here that the second methodology is not necessary equivalent to the first one.

Résumé : Deux méthodologies différentes sont utilisées pour mesurer la déflexion gravitationnelle de la lumière : la première lorsque la lumière passe près du Soleil, la seconde lorsqu'elle passe selon un angle plus ou moins perpendiculaire au Soleil. La méthodologie employée est au moins aussi importante que les résultats. Il est montré ici que la seconde méthode n'est pas nécessairement équivalente à la première.

Keywords: *Gravitational light bending, deflection, PPN Parameter, Relativity, Hipparcos, Gaia, methodology.*

A) Light bending close to the Sun ($\chi < 3°$)

In 1919, Arthur Eddington measured the gravitational light bending passing near the solar corona[1] (*i.e.* at less than 10 solar radii, or less than 3°), thus providing the first proof[2] of the Theory of Relativity. But since the 1990s, Eddington has been publicly suspected[3] of having discarded or modified measurement results, as he was persuaded of the relevance of the Theory of Relativity. Having said this, these deflection measurements of light passing near the sun were redone in the 1970s, comparing directly the measured angles ($\theta_{measurement}$) with the theoretical ones ($\theta_{Relativity}$), and then giving the expected results without correction[4].

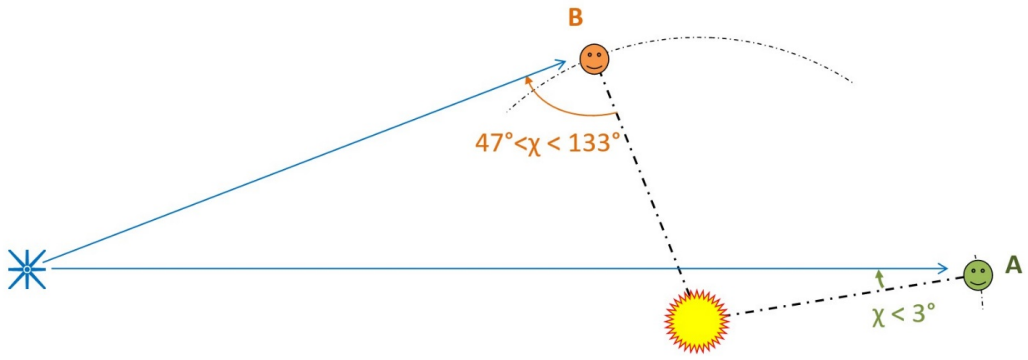

Figure 1: Gravitational light bending measurement
(χ denotes the separation angle)

B) PPN γ with a separation angle χ from 47° to 133°

In the 1990s, more precise measurements were carried out using the Hipparcos satellite over the separation angular range from 47 ° to 133 ° (*see Figure 1*). More precisely, these were parallax measurements of stars[5], pointing the satellite at the different observation times, etc., to determine the curvature factor of space: the PPN γ. To transform parallax measurement results into γ -factor, it is necessary to carry out smart calculations which look like a "black box". It is possible to discard or adjust in good faith some data, in order to conform to the expected result, as Sir Eddington could have done in his time.

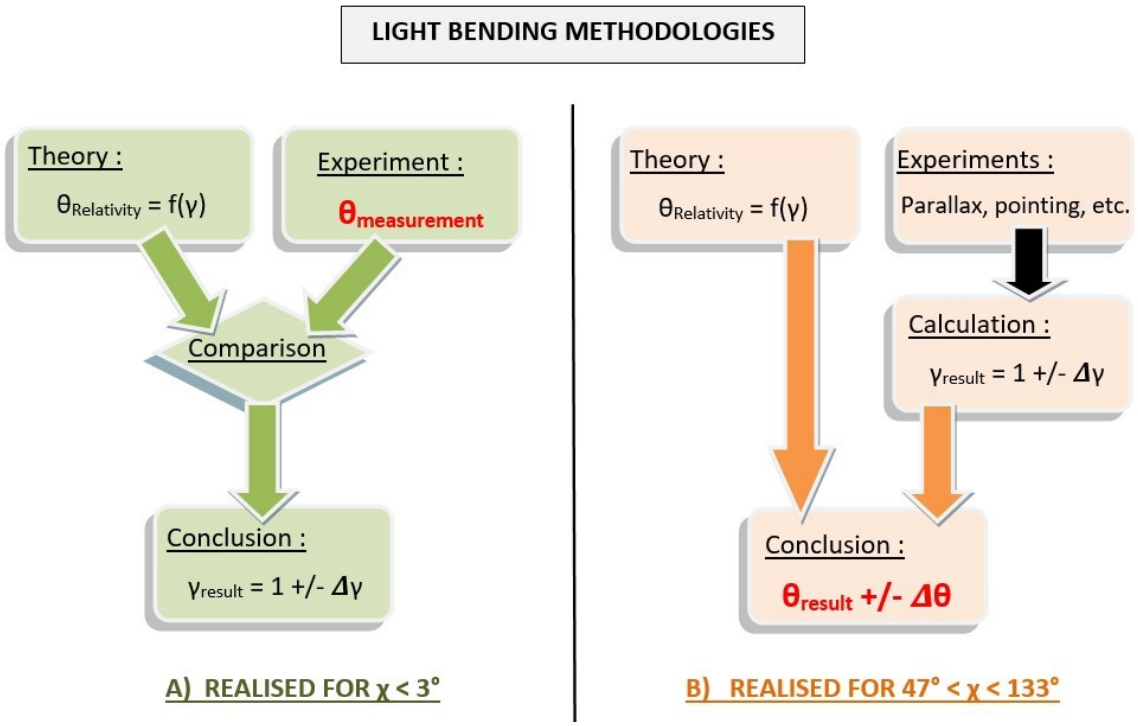

Figure 2: two different methodologies
(θ denotes the light bending angle, χ the separation angle, γ the PPN factor)

Then factor γ is injected into the theoretical formula (*see Figure 2*) to determine the uncertainty on gravitational light bending ($\Delta\theta_{result}$). For example, if the calculation gives a result of γ=1.000 +/-0.003, it is said that the measure of light bending at 90° complies with the theoretical angle with an uncertainty of (4 mas /2 * 0.003 =) +/-0.006 mas. It is then announced « Hipparcos measured the light bending »[6]. This sentence is confusing, this was not the methodology used to directly detect the deflection of light passing near the Sun, ***in fact Hipparcos did not measure 'directly' the light bending.***

C) Proposal for a direct light bending measurement with a separation angle χ from 47° to 133°

"It is better to be roughly right than precisely wrong" the adage says. The Gaia satellite is collecting data and will process measurements according to the same methodology[7] as that used on Hipparcos, and so will necessarily get the same results. To have a level of precision 100 times higher[8] is not a proof of the validity of the results if the methodology is inappropriate or even open to criticism. With the current means, the question is why not to use the first methodology - directly comparing the actual angles with the theoretical ones- to process the collected data on the angular range from 47 ° to 133 °?

References:

1. Dyson F.W., Eddington A.S., Davidson C., "A determination of the deflection of light by the Sun's gravitation field, from Observations Made at the Total Eclipse of May 29, 1919 ", The Royal Society Publishing (1920), http://rsta.royalsocietypublishing.org/content/220/571-581/291
2. Serret O., "About the ovoid orbits in general, and perihelion precession of Mercury in particular", The general science journal (2016), http://www.gsjournal.net/Science-Journals/Research%20Papers-Astrophysics/Download/6607
3. Ball F., "Arthur Eddington was innocent!", Nature (2007), http://www.nature.com/news/2007/070907/full/news070903-20.htm
4. Bonnet-Bidaud J.-M., "Les preuves étaient fausses", Ciel & Espace (2008), http://bonnetbidaud.free.fr/ce/relativite2008/pdf_CE/RELATIVITE-052-456.pdf
5. Perryman M., "Hipparcos: a retrospective", Arxiv (2011), https://arxiv.org/pdf/1109.6769.pdf
6. Andersen J., "Highlights of astronomy" Vol.11 (1999), p.291, https://www.iau.org/publications/iau/highlights/
7. Froeschlé M., Mignard F., Arenou F., "Determination of the PPN parameter γ with the Hipparcos data", ResearchGate (1997), https://www.researchgate.net/publication/2819054_Determination_Of_The_PPN_Parameter_gamma_With_The_Hipparcos_Data
8. Mignard F., Klioner S.A., " Gaia: Relativistic modelling and testing ", SAO/NASA ADS (2010), http://adsabs.harvard.edu/full/2010IAUS..261..306M