202(5): The Deflection of a Photon of Mass m by the Sun of Mass M.

In note 202(4) it was shown that the deflection of a mass m in a precessing elliptical orbit around a mass M is:

$$\Delta\theta = \frac{2}{x} \sin^{-1}\left(\frac{r-\alpha}{\epsilon |r|}\right)\Bigg|_{R_0}^{\infty} \quad -(1)$$

where R_0 is the distance of closest approach, and where:

$$r = \frac{\alpha}{1+\epsilon\cos(x\theta)} \quad -(2)$$

is a precessing ellipse, with right latitude 2α, eccentricity ϵ and precession constant x, in plane cylindrical coordinates (r, θ).

In eq. (1), as:

$$r \rightarrow \infty \quad -(3)$$

then

$$\sin^{-1}\left(\frac{r-\alpha}{\epsilon|r|}\right) \rightarrow \sin^{-1}\frac{1}{\epsilon} \quad -(4)$$

i.e.

$$\frac{r-\alpha}{\epsilon|r|} \xrightarrow[r\rightarrow\infty]{} \frac{1}{\epsilon}. \quad -(5)$$

for finite α and ϵ. So:

$$\Delta\theta = \frac{2}{x}\left(\sin^{-1}\frac{1}{\epsilon} - \sin^{-1}\left(\frac{R_0-\alpha}{\epsilon|R_0|}\right)\right) \quad -(6)$$

2)

Eq. (6) is the result of:

$$\boxed{\Delta\theta = 2\int_{R_0}^{\infty} \left(\frac{d\theta}{dr}\right) dr} \qquad -(7)$$

with eq. (2) being used directly to define:

$$\frac{d\theta}{dr} = \frac{\epsilon x}{\alpha} r^2 \sin(x\theta) \qquad -(8)$$

so eq. (6) is true for all orbits of type (2).

Note carefully that no theory of any kind has been used. General relativity has not been used at all.

It has been assumed that the photon has a mass m. Light is deflected by the mass of the sun M because of the photon mass m. This is based on the Newtonian idea of m being attracted by M. If this idea is accepted then in the Newtonian theory:

$$x \to 1 \qquad -(9)$$

but by observation eq. (2) is true. In the solar system for a planet

$$x - 1 \sim 10^{-6}. \qquad -(10)$$

To an excellent approximation therefore:

$$r \sim \frac{\alpha}{1 + \epsilon\cos(\theta)} \qquad -(11)$$

The results of NASA Cassini show that:

$$\Delta\theta = \frac{2}{x}\left(\sin^{-1}\frac{1}{\epsilon} - \sin^{-1}\left(\frac{R_0 - d}{\epsilon |R_0|}\right)\right) \sim 0. \quad -(7)$$

The numerical result is as follows:

$$\Delta\theta = 1.75 \text{ arc seconds} = 8.484 \times 10^{-6} \text{ rad.} \quad -(8)$$

The uncertainty is:

$$\Delta\theta = (8.4848 \pm 0.003) \times 10^{-6} \text{ rad.} \quad -(9)$$

In the incorrect Einstein theory it was claimed that this result is:

$$\Delta\theta =? \frac{4MG}{c^2 R_0} \quad -(10)$$

where M is the mass of the sun and R_0 its radius. However, in view of note 202(3), eq. (10) is not true mathematically.

From eqs. (7) and (9) the correct result is:

$$\boxed{\sin^{-1}\frac{1}{\epsilon} - \sin^{-1}\left(\frac{R_0 - d}{\epsilon |R_0|}\right) = \frac{x}{2}\left(8.4848 \pm 0.003\right) \times 10^{-6} \quad -(11)}$$

for the deflection of light by the sun.