Multiple Refutations of Einsteinian General Relativity

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3 Computational methods and graphical results

In section 2 was shown that equating the solution for a Newtonian precessing ellipse and the EGR solution leads to Eq.(8). This is a quadratic equation in $r$, that means this equality is only fulfilled for two values of $r$. This shows that both theories deliver qualitatively different results, albeit they may not differ much for planets in the solar system where precession of orbits is very small. Eq.(8) has the solution (9), here rewritten to

$$\frac{1}{r_{1,2}} = \pm \sqrt{x-1} \frac{\sqrt{x+1} \sqrt{\alpha x^2 + 4 \delta - \alpha}}{2 \sqrt{\alpha \delta}} \frac{x^2 + 1}{2 \delta}$$

(58)

with $\delta$ and $\alpha$ defined by Eq.(7). Inserting the values for the earth orbit

$$G = 6.67385 \cdot 10^{-11} m^3/(kg s^2)$$
$$M = 1.9891 \cdot 10^{30} kg$$
$$c = 2.99792 \cdot 10^8 m/s$$
$$\epsilon = 0.0167$$
$$r_{\text{min}} = 1.4709 \cdot 10^{12} m$$
$$r_{\text{max}} = 1.521 \cdot 10^{12} m$$
$$a = \frac{r_{\text{min}}}{1-\epsilon} = 1.49588 \cdot 10^{12} m$$

(66)

leads to values

$$\alpha = a(1-\epsilon^2) = 1.49546 \cdot 10^{12} m$$
$$\delta = \frac{3GM}{c^2} = 4431.1 m$$
$$r_{\text{av}} = 1.49595 \cdot 10^{12} m$$

(69)
One sees that \( \delta \) is very small, compared to the average orbital radius \( r_{av} \). Correspondingly, the term \( \delta/r^2 \), appearing in Eq.(6), is of order \( 10^{-21}/m \). The solutions of Eq.(58) are

\[
\begin{align*}
  r_1 &= 1.49546 \cdot 10^{12} \, m, \\
  r_2 &= 4431.1 \, m.
\end{align*}
\]

(70) (71)

Obviously the first value is near to the average radius and the second is equal to \( \delta \) so that only one result is a valid orbit value, i.e. Eq.(58) holds only for one radius value of the orbit.

If \( x \) is evaluated instead of \( r \) from Eq.(8), the result is Eq.(10) which can be inserted into the true solution of the precessing ellipse (2). The result can be resolved for \( \theta \) which gives Eq.(11) for EGR:

\[
\theta_{\text{EGR}} = \cos^{-1} \left( \frac{\frac{1}{2} (\frac{2}{x} - 1)}{1 - \frac{1}{2} (1 - \frac{x}{\alpha})^{-1}} \right). \tag{72}
\]

The result for the exact precessing ellipse is

\[
\theta = \frac{1}{x} \cos^{-1} \left( \frac{1}{\epsilon} \left( \frac{\alpha}{r} - 1 \right) \right). \tag{73}
\]

Both are compared in Figs. 1 and 2. For small \( \delta \), the EGR solution approaches the exact solution, with exception of a pole appearing for the radius \( r = \alpha \) whose appearance can easily be seen from Eq.(72). This is a deficiency of EGR. For a larger \( \delta \) (Fig. 2), the EGR orbit is not an ellipse anymore although the the angle for the right end radius could be adjusted between \( x \) and \( \delta \) (in this case \( x = 1.1 \) meets \( \delta = 0.05 \)).

For illustrating the behaviour of small distortions of ellipticity, we have investigated Eq.(13) numerically in the form

\[
\frac{\partial^2 u}{\partial \theta^2} + u - A - Bu^2 = 0 \tag{74}
\]

with the inverse \( r \) coordinate

\[
u = \frac{1}{r}. \tag{75}
\]

If \( A \) is chosen large enough, \( u \) takes negative values which is shown in the polar plot of Fig. 3. Since no negative values are representable in such a plot, such values are displayed by their absolute values and a rotation of 180 degrees, resulting in the “loop” structure. By reducing the initial velocity of \( u \) (parameters given in the figure captions), the negative \( u \) range can be avoided and a highly elliptical precessing curve appears (Fig. 4). In the \( r \) representation of this result (Fig. 5) it can be seen that the maximum radius of the orbit changes, this is obviously not a precessing ellipse. This radius change can be remedied by adding higher order terms to Eq.(74). An addition of \( -0.001 u^3 \) can stop the radius change but results in extremely enhanced precession. Terms of even higher order have similar effects.

Next we give examples of the solution (23) according to ref. [12]. As a result, the perihelion and aphelion radius depends on the precession parameter \( \delta \) which
contradicts the behaviour of $x$ for a true precessing ellipse. Even worse, these radii change over time. For very large $\delta$'s an unphysical pole appears (see Fig. 5), making this solution unphysical.

The last graphical example is for Eq.(56) which can be rewritten to

$$x_1 = \frac{1}{\theta} \cos^{-1} \left( \frac{2(\epsilon^2 - 1) \cos(x\theta) - 3\epsilon}{4\epsilon^2 - 1} \right). \quad (76)$$

This describes a kind of effective $x$ for mass deflection with $\epsilon \geq 1$. The curve $x_1(\theta)$ is plotted for different $\epsilon$ and $x$ values in Fig. 7. For $\epsilon = 1$ the result is independent of $x$ and is simply

$$x_1 = \frac{\pi}{\theta}. \quad (77)$$

For $\epsilon > 1$ the variation of $x$ leads to a modulation of the $1/\theta$ like curve.

Figure 1: Orbits $\theta(r)$ for $x$ (precessing ellipse) and $\delta$ (EGR) with $\alpha = 1, \epsilon = 0.3$.  

![Figure 1: Orbits $\theta(r)$ for $x$ (precessing ellipse) and $\delta$ (EGR) with $\alpha = 1, \epsilon = 0.3$.](image)
Figure 2: Orbits $\theta(r)$ for $x$ (precessing ellipse) and $\delta$ (EGR) with $\alpha = 1, \epsilon = 0.3$.

Figure 3: EGR-like parametrized orbit with negative $u$ values. $A = 5, B = 1 \cdot 10^{-3}, u(0) = 10, u'(0) = 4$. 
Figure 4: EGR-like parametrized orbit with high ellipticity. $A = 5$, $B = 1 \cdot 10^{-3}$, $u(0) = 10$, $u'(0) = 0.3$.

Figure 5: Representation $r(\theta)$ for same orbit as in Fig. 4.
Figure 6: Solution $r_t(\theta)$ of ref. [12] with $\alpha = 1$, $\epsilon = 0.3$.

Figure 7: Redefined precession parameter $x_1(\theta)$ for different $\epsilon$ and $x$ values.