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Rotating and Expanding Universe in the Light of Flyby Anomaly and Path Distribution

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The Flyby Anomaly- The flyby anomaly is an unexpected energy change during Earth flybys of spacecraft which causes a significant speed change of over 0,013 m/s [1].The difference of speed Δv is given by Anderson's empirical prediction formula [1]:

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Rotating and Expanding Universe in the Light of Flyby Anomaly and Path Distribution

Janez Špringer

In this paper one tries to explain the rotation and expansion of the Universe in the light of Anderson's flyby-anomaly prediction formula. The result of the effort is a prediction that the Universe rotates with the equatorial speed of half the speed of light and we land at the Pole of that Universe with the speed of expansion of the Universe which is apparently zero since in such circumstances the inbound speed equals the maximal decrement of speed. The maximal speed of expansion of the future Universe $100\frac{\text{km}}{\text{s}} < \text{v}_{\text{maximal}}^{\text{future Universe}} < 123\frac{\text{km}}{\text{s}}$ is predicted on the basis of a comparison of the flyby and path distribution energy.

I. The Flyby Anomaly

The flyby anomaly is an unexpected energy change during Earth flybys of spacecraft which causes a significant speed change of over 0,013 m/s [1].The difference of speed Δv is given by Anderson's empirical prediction formula [1]:

$$\Delta \text{v} = \frac{2v_{ekuatorial}}{c} v_{inbound}\ (\cos\delta_{inbound} - \cos\delta_{outbound}\ ). \quad (1)$$

Here $v_{ekuatorial}$ is the equatorial speed of Earth, and $\delta_{inbound}$ and $\delta_{outbound}$ are the equatorial angles of the spacecraft. The maximal difference of speed Δv_{max} is given by the simplified Anderson's formula in the case where the inbound and outbound equatorial angles are 0 and $\frac{\pi}{2}$, respectively:

$$\Delta v_{max} = \frac{2v_{ekuatorial}}{c} v_{inbound}. \quad (2)$$

Since the maximal inbound speed is the escape speed the maximal difference of Earth-flyby speed yields:

$$\Delta v_{max}^{Earth} = 0.035\frac{m}{s} \quad (3)$$

If the mentioned anomaly has a physical background then it is reasonable to expect to take place in the gravity field of a rotating massive body in general. Neglecting the insignificant relativistic effects the maximal difference of kinetic energy of the mass body with mass m in any gravity field can be written as:

$$\Delta W_{kinetic} = m\frac{(v_{inbound}\ )^2}{2} - m\frac{(v_{inbound} - \Delta v_{max}\ )^2}{2}. \quad (4)$$

Due to conservation law the negative kinetic energy increment of mass body should equal the same positive energy increment of that body, let us denote it E_{flyby} so that the whole energy of mass body remains unchanged:

$$-\Delta \text{W}_{\text{kinetic}} + \text{E}_{\text{flyby}} = 0. \quad (5)$$

Then taking into account the equations (2), and (5) we have:

$$\frac{E_{flyby}}{m} = v_{inbound}\ .\Delta v_{max} - \frac{\Delta v_{max}{}^2}{2} \quad (6a)$$

$$\frac{\text{E}_{\text{flyby}}}{\text{mc}^2} = \frac{2\text{v}_{\text{inbound}}^2}{\text{c}^2}\left(\frac{\text{v}_{\text{equatorial}}}{\text{c}} - \frac{\text{v}_{\text{equatorial}}^2}{\text{c}^2}\right). \quad (6b)$$

The expression on the $\frac{E_{flyby}}{mc^2}$ is the flyby energy share resulting from the negative kinetic energy increment after the perpendicular change of the direction of motion of the mass body m in the gravity field at the $\frac{\pi}{2}$– latitude of the rotating massive body. It can be written in the more transparent form using the ratio of speeds $\text{a} = \text{v}/\text{c}$

$$\frac{\text{E}_{\text{flyby}}}{\text{mc}^2} = 2\text{a}_{\text{inbound}}^2\left(\text{a}_{\text{equatorial}} - \text{a}_{\text{equatorial}}^2\right). \quad (6c)$$

It is evident from the equations (6*b*), and (6*c*) that the flyby energy share is zero at the zero equatorial speed as well as that one of the speed of light. Both of them are the equatorial speeds enabling the minimal flyby energy share where no flyby anomaly is expected. On the other hand the optimal equatorial speed and flyby anomaly exists at the given inbound speed where the energy share of the flyby energy occupies the maximal value. The latter is found with the help of the derivation of the function (6*c*):

$$\left(\frac{\text{E}_{\text{flyby}}}{\text{mc}^2}\right)' = 2\text{a}_{\text{inbound}}^2\left(1 - 2\text{a}_{\text{equatorial}}\right).$$

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$$2a_{\text{inbound}}^{2}\left(1-2a_{\text{equatorial}}^{\text{optimal}}\right)=0$$
$$a_{\text{equatorial}}^{\text{optimal}}=\frac{1}{2}\quad\text{or}\quad v_{\text{equatorial}}^{\text{optimal}}=\frac{1}{2}c. \tag{7}$$

The optimal equatorial speed for all inbound speeds equals half of the speed of light. The maximal flyby energy share belonging to this speed is given by the equation (6c):

$$\left(\frac{E_{\text{flyby}}}{mc^{2}}\right)_{\text{maximal}}=\frac{1}{2}a_{\text{inbound}}^{2}. \tag{8}$$

The maximal flyby energy share is only of the inbound speed dependent and equals half of the square of the inbound speed expressed in the units of the speed of light. Possessing the maximal flyby energy share the mass body apparently stops moving according to the equations (2) and (7) since the maximal difference of flyby speed Δv_{max} equals the inbound speed $v_{inbound}$:

$$\Delta v_{max}=\frac{2v_{ekuatorial}}{c}v_{inbound}=\frac{2}{c}\frac{c}{2}v_{inbound}=v_{inbound}. \tag{9}$$

The mass body slows down the speed so much that it stays at apparent zero speed.

$$v_{apparent}=-\Delta v_{max}+v_{inbound}=0. \tag{10}$$

At maximal flyby energy share of the mass body where the massive body rotates with the equatorial speed $\frac{c}{2}$ the whole kinetic energy is transformed into the flyby energy. Its value is given using the equation (6*b*):

$$E_{\text{flyby}}^{\max}=E_{\text{flyby}}\left(v_{\text{equatorial}}=\frac{c}{2}\right)=\frac{m.v_{\text{inbound}}^{2}}{2}. \tag{11}$$

At the first sub-maximal flyby energy share of the mass body where the massive body rotates with the equatorial speed lower than $\frac{c}{2}$ only a part of kinetic energy is transformed into the flyby energy:

$$E_{\text{flyby}}\left(v_{\text{equatorial}}<\frac{c}{2}\right)<\frac{m.v_{\text{inbound}}^{2}}{2}. \tag{12}$$

The mass body slows down the speed but keeps the same apparent direction as the inbound speed:

$$v_{apparent}=-\Delta v_{max}+v_{inbound}>0. \tag{13}$$

At the second sub-maximal flyby energy share the mass body where the massive body rotates with the the equatorial speed higher than $\frac{c}{2}$ again only a part of the kinetic energy is transformed into the flyby energy:

$$E_{\text{flyby}}\left(v_{\text{equatorial}}>\frac{c}{2}\right)<\frac{m.v_{\text{inbound}}^{2}}{2}. \tag{14}$$

The mass body slows down the speed so much that it takes the opposite apparent direction than the inbound speed:

$$v_{apparent}=-\Delta v_{max}+v_{inbound}<0. \tag{15}$$

At the equatorial speed of light the apparent speed has also the opposite value than the inbound speed:

$$v_{apparent}=-2v_{inbound}+v_{inbound}=-v_{inbound}. \tag{16}$$

II. The Rotating and Expanding Universe

The Universe expands with the apparent zero speed:

$$v_{\text{apparent}}=-v_{\text{expansion}}+v_{\text{expansion}}=0. \tag{17}$$

The equation (17) resembles to the equation (10), so we can propose that the maximal flyby decrement of speed $-\Delta v_{max}$ and the inbound speed $+v_{inbound}$ equal the speed of the expansion of Universe in the negative direction $-v_{\text{expansion}}$ and positive direction $+v_{\text{expansion}}$, respectively. If the flyby concept holds true for the whole Universe, one can consider we are making right now the pure flyby at apparent zero speed in the circumstances of our maximal flyby energy share. In such case we are landing at the Pole of the Universe which rotates with the equatorial speed of half of the speed of light $\frac{1}{2}c$. The inbound and outbound equatorial angles are 0 and $\frac{\pi}{2}$, respectively, and the inbound speed is the speed of the expansion of Universe [2]:

$$v_{\text{inbound}}^{\text{Universe}}=v_{\text{expansion}}^{\text{Universe}}\approx 70\ \frac{\text{km}}{\text{s}}. \tag{18}$$

With the help of the equation (8) the maximal present Universe-flyby energy share is given:

$$\left(\frac{E_{\text{flyby}}}{mc^{2}}\right)_{\text{maximal}}^{\text{present Universe}}\approx 3\text{ x }10^{-8}. \tag{19}$$

It increases with time since the expansion of Universe is speeding up. [3],[4] The maximal possible future Universe-flyby energy share could be limited with the path distribution energy share of the electron in the ground state of Hydrogen atom [5][6] ,of course, if the latter appears as a true physical phenomenon since with the greater energy share no path distribution would be possible:

$$\left(\frac{E_{flyby}}{mc^2}\right)_{maximal}^{future\ Universe} < \frac{E_{distribution}^{2-sided}}{mc^2} \approx 5.6\,x\,10^{-8} \leq \frac{E_{distribution}^{\infty-sided}}{mc^2} \approx 8.4\,x\,10^{-8}. \qquad (20)$$

Then with the help of the equation (8) and regarding the sidedness of the path distribution of the electron in the ground state of Hydrogen atom the maximal speed of the expansion of the future Universe is predicted:

$$100\frac{\mathrm{km}}{\mathrm{s}} < v_{\mathrm{maximal}}^{\mathrm{future\ Universe}} < 123\frac{\mathrm{km}}{\mathrm{s}}. \qquad (21)$$

III. Conclusions

We analyzed Anderson's flyby-anomaly prediction formula in the case where the inbound and outbound equatorial angles are 0 and $\frac{\pi}{2}$, respectively. Extending the validity of the discussed concept to the flybys in the gravity field of a rotating massive body in general, including that one of the whole Universe, the flyby inbound speed and the speed of expansion of the Universe were related in the circumstances of the maximal flyby-energy share increment and the latter compared with the path distribution energy share of the electron in the ground state of Hydrogen atom.

The next the critical reader needs to consider:"The speculation of the maximal speed of the future Universe-expansion $100\frac{\mathrm{km}}{\mathrm{s}} < v_{\mathrm{maximal}}^{\mathrm{future\ Universe}} < 123\frac{\mathrm{km}}{\mathrm{s}}$ was made on the proposal of the general validity of Anderson's flyby prediction formula which has been otherwise verified only at the relatively low equatorial speed of the Earth as well as on the basis of a comparison of the Universe-flyby energy share with the path distribution energy share of the electron which is not a proven physical phenomenon."

The physical reality is the twin sister of good imagination. (Author)

IV. Acknowledgment

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Dedication

This fragment is dedicated to my birthplace Maribor and place of childhood Selnica ob Dravi.

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