ON EINSTEINIAN ORBITS OF CELESTIAL BODIES

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Abstract. It can be demonstrated that no motion of masses can generate gravitational waves. Accordingly: i) the time decrease of the orbital period of the famous binary PSR1913+16 cannot yield an experimental proof of the emission of gravitational waves; ii) measurements of the propagation of the quasar J0842+1835 radio-signals past Jupiter cannot reveal the propagation of gravitational waves sent forth by the planet in its motion around the Sun: indeed, this motion does not generate any gravitational radiation; iii) the binary RX J0806.3+1527 has the shortest known revolution period (only 321 s): however, it cannot be a candidate for the detection of gravitational waves because no kind of motion of a mass can give origin to a gravitational wave.

Introduction

Innumerable papers have been written on the Einsteinian orbits of the celestial bodies. For clear reasons, the overwhelming majority of them are of a perturbative character. In the present Note I consider the above orbits only so far as the hypothesized emission of gravitational waves is concerned. Now, we shall see that from this standpoint it is possible to develop some very simple and general considerations from which one can conclude that no motion of the celestial bodies gives origin to a gravitational radiation.

1. Theory

Several arguments prove that no motion of masses can generate gravitational waves [1]. An essential demonstration may be resumed in the following way.

Consider a continuous medium characterized by whatever mass tensor $T_{jk}(x)$, $(j, k = 0, 1, 2, 3)$, and let $g_{jk}(x)$ be the solution of the Einstein field equations corresponding to a generic motion with respect to a given reference system $x \equiv (x^0, x^1, x^2, x^3)$. Suppose to follow ideally the motion of a given mass element describing a world line $L$, and suppose that at a given time this element begins to emit a gravitational wave. Now, if we refer its motion to some Riemann-Fermi coordinates $z \equiv (z^0, z^1, z^2, z^3)$ [2], the components $h_{jk}(z)$ of the metric tensor will be equal to some constants for all points of $L$. This means that the gravitational field on $L$ can be obliterated: consequently, no gravitational wave can be actually sent forth by the considered mass element. But line $L$ is quite generic, and therefore no motion of the medium gives origin to a gravitational wave.

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It is implicit in the above reasoning that no gravitational damping force has influenced the motion of our mass element.

2. On the binary PSR1913+16

According to many authors, an indirect experimental proof of the physical existence of the gravitational waves is given by the time decrease of the orbital period $P_b$ of the binary radiopulsar PSR1913+16 \[3\]. The measured value of $dP_b/dt$ is $-(2.30 \pm 0.22) \cdot 10^{-12}$, while the quadrupole formula of the linearized relativity gives a $dP_b/dt$ due to a hypothesized emission of gravitational radiation equal to $-2.4 \cdot 10^{-12}$. An excellent agreement with the observational data has been also obtained by computations at third order of the gravitational constant and fifth order in $v/c$. However, this agreement is rather suspect owing to the unreliability of the adopted perturbative treatments (cf.\[4\]).

As a matter of fact, we know from the theoretical proof of sect. 1 that no motion of the stars of the above binary system can generate gravitational waves. Accordingly, it would be necessary to re-examine carefully the influence on $dP_b/dt$ of those realistic effects that Damour and Taylor have discarded as scarcely significant \[5\].

On the other hand, the computations of Taylor et alii are based on the assumption that the two stars of the system PSR1913+16 can be treated as point masses so far as their motions are concerned: now, point masses interacting only gravitationally describe geodesic lines (cf. the first paper cited in \[1\]), i.e. their motions are "free", "inertial" motions with no radiation damping.

The conclusion is obvious: the binary PSR1913+16 gives no experimental proof of the real existence of the gravity waves.

3. On the motion of Jupiter

As is well known, as a consequence of the quadrupole formula of the linearized relativity, the power of the gravitational radiation sent out by Jupiter in its motion around the Sun is \(\approx 450\) watt. (The power of the solar electromagnetic radiation is about \(10^{24}\) times greater). From the standpoint of the exact theory, this result is a pure nonsense because – cf. sect. 1 – no motion of a body generates gravitational waves. However, the present astrophysical community gives an excessive credit to the linearized version of general relativity and to perturbative computations starting from it. Thus, in recent times we have seen a proclamation according to which an indirect experimental detection of the gravitational waves emitted by Jupiter in its motion would be quite possible, see Kopeikin and Fomalont \[6\]. These authors declare that, owing to a rare alignment of Jupiter’s motion against the quasar J0842+1835, measurements of the propagation of the quasar radio-signals past Jupiter must be sensitive to the propagation of the gravitational radiation emitted by the planet. However, Asada \[7\] and subsequently Will \[8\], by means of more reasonable perturbative treatments, have proved the non-existence of the Kopeikin-Fomalont effect.
Of course, this result is obvious from the rigorous point of view of the exact formulation of general relativity.

4. On the binary RX J0806.3+1527

This binary system is composed of two white dwarfs revolving around each other at a distance of only $8 \cdot 10^4$ km. The speed of the orbital motion is over $10^3$ km/s, the orbital period amounts to 321 s: it is the shortest known revolution period, see Israel et alii [9]. These authors believe that the above binary is an excellent candidate for the detection of the gravitational waves, owing to the shortness of its period. According to them, the space experiment LISA (Laser Interferometer Space Antenna), that will be launched within 2020, will be able to reveal the gravitational waves emitted by RX J0806.3+1527. Of course, this is a pure wishful thinking, see sect. 1.

In conclusion, I desire also to emphasize that the astrophysical community ”ignores” that the so-called gravitational waves are mere mathematical undulations devoid of a real energy and a real momentum [10].

“Sir, I have found you an argument:
I am not obliged to find you an understanding.”

Samuel Johnson

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