An Open Letter On Gravity Part 2

Free fall in gravitational theory

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Abstract: Einstein's explanation of Mercury's perihelion motion has been verified by astronomical observations. His formula could also be obtained in Schwarzschild metric and was published already in 1898. Motion along a straight geodesic, however, namely, free fall into a gravitational center with vanishing angular momentum, is incorrectly described both by Einstein's and by Schwarzschild's equation of motion. A physical solution for free fall may be obtained by taking into account the dependence of mass on velocity in Newton's gravitational law as adopted in the physics of accelerators. © *2017 Physics Essays Publication.*
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Résumé: Résumé: L'explication que donne Einstein sur le mouvement du périhélie de Mercure a été vérifiée grâce à des observations astronomiques. L'on pourrait également obtenir en métrique de Schwarzschild sa formule qui fut déjà publiée en 1898. Cependant, le mouvement tout au long d'une géodésie en ligne droite, à savoir en chute libre vers un centre gravitationnel sans moment cinétique, est décrit de manière incorrecte dans les deux cas: par l'équation de mouvement d'Einstein et par celle de Schwarzschild. Une solution physique pour la chute libre peut s'obtenir en tenant compte du fait que la masse dépend de la vélocité dans la loi sur la gravitation de Newton comme elle est adoptée dans la physique des accélérateurs.

Key words: General Relativity; Schwarzschild Metric; Perihelion Motion; Space-Time Geodesics.

I. INTRODUCTION

In 1915, Einstein published his famous paper on the explanation of Mercury's perihelion motion[1] as a first application of his new gravitational theory. He arrived at the identical formula for the advance of the perihelion which Gerber had derived in 1898 (Ref. 2) on the basis of a velocity dependent gravitational potential. The velocity dependence chosen by Einstein was somewhat different, but in the approximation considered his result agreed with Gerber's. Since then the accordance between the Gerber formula and the astronomical observations on Mercury's orbit is considered as a corner stone confirming Einstein's geometrized theory of gravitation (GR) that was published in 1916 (Ref. 3) quoting the foregoing paper of 1915.

In this paper, we will show in Sec. II that Einstein actually did not use his GR equation of motion, but used Newton's equation with a slight modification of the gravitational potential when he calculated Mercury's anomalous orbit. Thus, his theory suffers from the same deficiency as Newton's, namely, free-falling mass points may attain superluminal velocities depending on their initial velocity at infinity.

This problem does not arise in the Schwarzschild solution of 1916 (Ref. 4) which we discuss in Sec. III. It results in an equation of motion which is different from Einstein's, but it leads also to the Gerber formula. In two letters to Einstein[5] and to Sommerfeld,[6] Schwarzschild called it a "miracle" that his abstract idea leads to the same practical result published by Gerber in 1898 and by Einstein in 1915.

If one applies, however, Schwarzschild's equation of motion to the free fall of a mass point with vanishing angular momentum, one finds that the kinetic energy of the mass point decreases and the particle comes to a halt at the Schwarzschild radius. This solution avoids superluminality, but it is not physical either.

In Sec. IV, we modify Newton's equation of motion by introducing the velocity dependent mass that proved appropriate in particle accelerators and prevents superluminality in free fall. The particle's kinetic energy increases unlimited when it falls into the assumed singularity at $r = 0$. The consequences for closed orbits are discussed. One obtains a perihelion advance which is one third of the Gerber-Einstein formula.

II. EINSTEIN'S PERIHELION FORMULA OF 1915

In Sec. II of his perihelion paper,[1,b)] Einstein derived the equations of motion (7 E) of a mass point in the gravitational field. In lowest order, the equations are identical with Newton's, but in higher order Einstein finds from his theory the equations of motion

$$\frac{d^2x_\nu}{ds^2} = -\frac{\alpha}{2}\frac{x_\nu}{r^3}\left(1 + \frac{\alpha}{r} + 2u^2 - 3\left(\frac{dr}{ds}\right)^2\right). \qquad (7b\ E)$$

[b)] The title of this paper reads: *Erklärung der Perihelbewegung des Merkur aus der allgemeinen Relativitätstheorie (Explanation of the Perihelion Motion of Mercury from General Relativity Theory).* As will be shown in Sec. II and in the Appendix, this title is inappropriate, since Einstein's derivation of Gerber's formula is flawed. His "explanation" is not valid.

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