Validity of the General Theory of Relativity

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July 20, 1992

The general theory of relativity was strictly based on the principle of equivalence of gravitational and inertial masses. The "principle of equivalence" is not sufficient in itself to establish the equality of gravitational fields and accelerated reference frames. In a gravitational field, the fall of perfectly elastic balls of different masses is synchronous; the balls fall together and bounce back together. We show that the thought experiments used to develop general relativity did not include, ncr consider, the basic "bouncing" motion. We also show that in the Einstein elevator, perfectly elastic balls fall together the first time, but that, subsequently, the motion of the balls is never in synchronous. Our results demonstrate distinct differences between accelerated frames of reference and gravitational fields. In particular, we show that in accelerated frames, the action is a force-pulse, whereas in a gravitational field, the action is a series of uninterrupted force-pulses.

Newton tested and reported the equivalence of the gravitational and inertial masses of a body to an accuracy of a "thousandth part of the whole."[1] During this century, greater accuracies were established; "a few parts" in 10^8 by Eötvös, 10^{11} by Dicke, and 10^{12} by Braginsky.[2] The mass-equivalence was the focal point in the "gedanken" (thought) experiments, of the Einstein elevator, which led to the general theory of relativity. The elevator is a closed chest, pulled by a "being" with a constant force to simulate 1-g gravitational acceleration in isolated space. The primary experiments were Galilean free-fall motion. An observer inside the accelerating chest releases objects and, according to Einstein, will "convince himself that the acceleration ... towards the floor ... is always of the same magnitude, whatever kind of body he may happen to use for the experiment."[1] It is then argued that the chest can be regarded to be at rest in a gravitational field, as if on earth.

A rope is then fixed to the ceiling with a body attached to the free end. The rope hangs "vertically" and stretches. The inside observer considers this to be a gravitational effect. An outside observer, however, determines that the same behavior is the result of acceleration, or the inertial mass of the body. From such observations, a gravitational field and an accelerated frame of reference are made identical.

When a light ray sent across the accelerated chest appears, to the inside observer, to "bend" (Fig. 1), the observer deduces that light rays are bent in gravitational fields. It is concluded that a uniformly accelerated reference frame completely imitates a uniform gravitational field, and gravitation and inertial acceleration become indistinguishable.

Bergman noted that the "principle of equivalence" is basal to general relativity: the "principle cannot be eliminated without destroying the theory as a whole.[3] Einstein himself (and Infeld) emphasized that without the principle, "our ... argument would fail completely."[4] Today, the principle of equivalence and its deductions are stated categorically, e.g., "No experiment whatsoever can distinguish a gravitational field from an accelerated reference frame."[5] We describe such an experiment.

Free fall in a gravitational field requires more than the simultaneous arrival of objects to a floor. When perfectly elastic balls (of whatever mass) are dropped on a perfectly elastic floor, then, in the absence of impediments to motion, the balls bounce back to their original height together, and continue to so bounce. The balls fall together, reach the floor together, and bounce back together with the same downward acceleration and upward deceleration. This, however, does not happen in the Einstein elevator; nor was the condition considered in the development of general relativity.

Suppose that the "being" (or rocket) can keep the chest in constant 1-g acceleration. We equip the chest with elastic plates on the floor, and let the inside observer release balls of different masses (Fig. 2), say, from a height of 4.9 meters. From conservation of momentum and conservation of energy, we can calculate the recoil velocity of each ball, v_2, using,

$$v_2 = \left(\frac{2m_1}{m_1 + m_2}\right) u_1 + \left(\frac{m_2 - m_1}{m_1 + m_2}\right) u_2 \qquad (1)$$

where, m_1 is the mass of the chest and its contents, u_1 is the initial velocity of the chest, and u_2 is the initial velocity of each ball. After 1 second, the floor, traveling at 9.8 m/s, impacts the balls. The inside observer will then be challenged by the following results:

object	m_{21}	m_{22}	m_{23}
Absolute velocity (m/s)	9.8	17.8	19.4
Apparent velocity (m/s)	0	8.0	9.6

The large ball (m_{21}) remains stuck to the floor, while the other two balls fly off at different speeds. The two smaller balls will bounce to different (relative) heights, specifically, because the effect is not produced by a gravitational field.

The inside observer must conclude that several gravitational fields are acting simultaneously in his lab, which is absurd. Alternatively, he, or she, must discover that the chest is undergoing non-gravitational acceleration. It should then be evident to the inside, outside, and independent (us) observers that gravitational fields and accelerated frames of reference are not identical, nor analogous.

Our reasoning is not limited to thought experiments. The mass of a Space Shuttle Orbiter is approximately 90,000 kg. If the thrusters provide 1-g acceleration in orbit, then a floating 1-kg elastic ball will appear to fall freely in the opposite direction. On impact with a solid surface (from a distance of 4.9 meters), the ball will bounce back with an apparent velocity of 9.79978 m/s, and not 9.8 m/s. Such a difference is easily measured with available instruments today, and the astronauts will immediately know that they are in an accelerating frame, and not in a gravitational field.

Of course, if constant acceleration cannot be maintained, because of impact with the balls, then the inside observer will equally discover that he, or she, is not in a gravitational field. The bending of a light ray, a water jet, or machine gun bullets propelled from one wall to the other in the Einstein elevator is then purely the result of acceleration, and not the result of a gravitational field.

By Einstein's own criterion and gedanken experiment, the bouncing test invalidates the basal postulate of general relativity. We ask why?

When the chest floor impacts the balls, the balls fly away as if hit by a baseball bat, i.e., by the action of an impulse of short duration. In a force field, the balls move under the influence of a series of force pulses, the sum of which adds up to a unit-step-function (Fig. 3). It is the action of the series of pulses in a gravitational field that makes synchronous bouncing harmonic motion of elastic balls of different masses possible. In the absence of correct, harmonic, and synchronous bouncing motion, there is simply no gravitational field, nor even an analogy to it.

There are classical explanations to the results reported from general relativity, including, the bending of light and the advance of Mercury's perihelion.[6] We recently described three concepts and models for motion which include, (1) bouncing harmonic motion, (2) oscillations in force fields, i.e., under the action of a series of force-pulses, and (3) the dynamic overshoot effect. These models provide direct mathematical correlations and incredibly "easy to imagine" descriptions to several quantum effects.[7] One example of the utility of one of these concepts, the bouncing harmonic motion, can be seen from this article. The "principle of equivalence" of gravitational and inertial masses has a profound significance. We believe that our concepts and models of motion can lead to the explanation of the perplexing observation, as well as other outstanding scientific issues.

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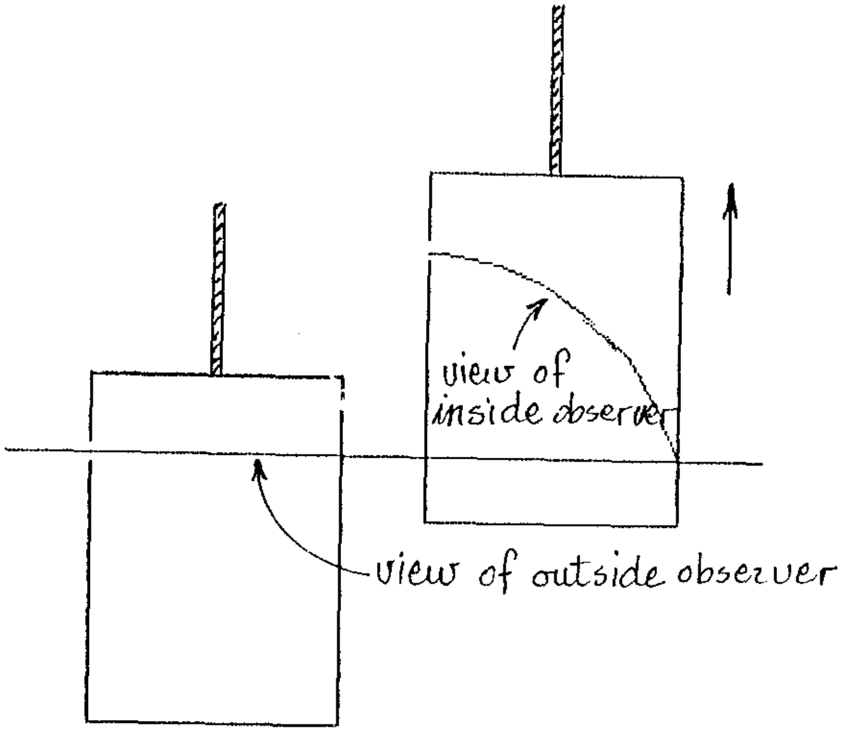
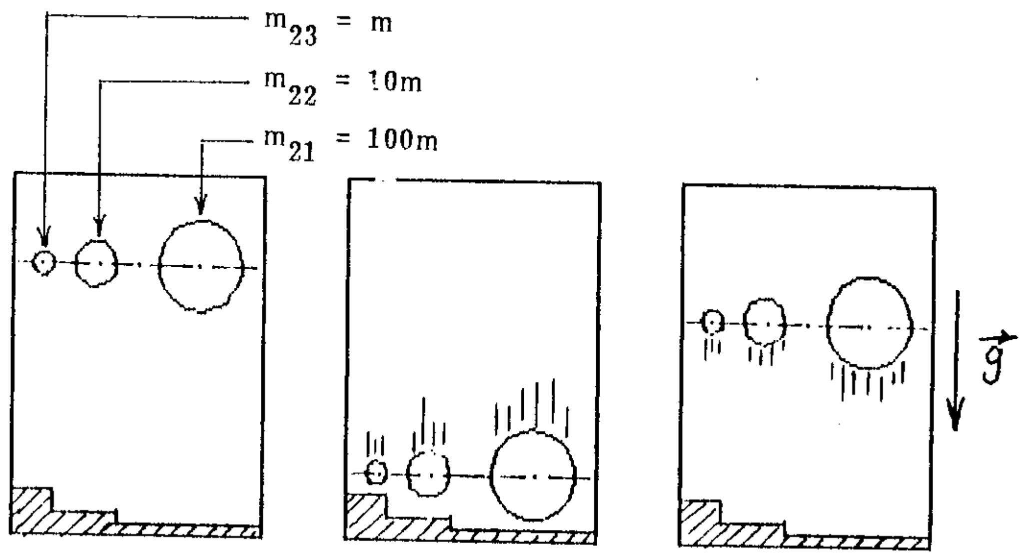
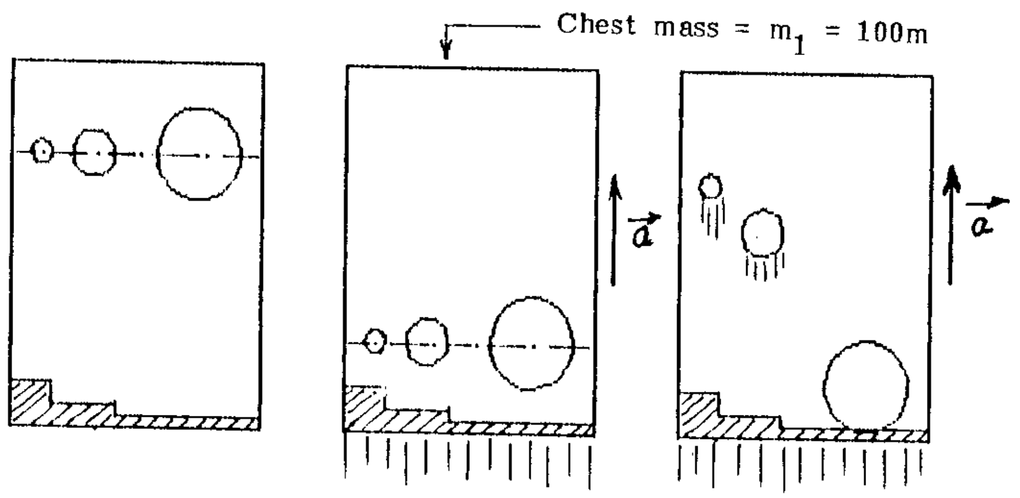


Fig. 1 A light ray as seen by outside and inside observers in an accelerated frame

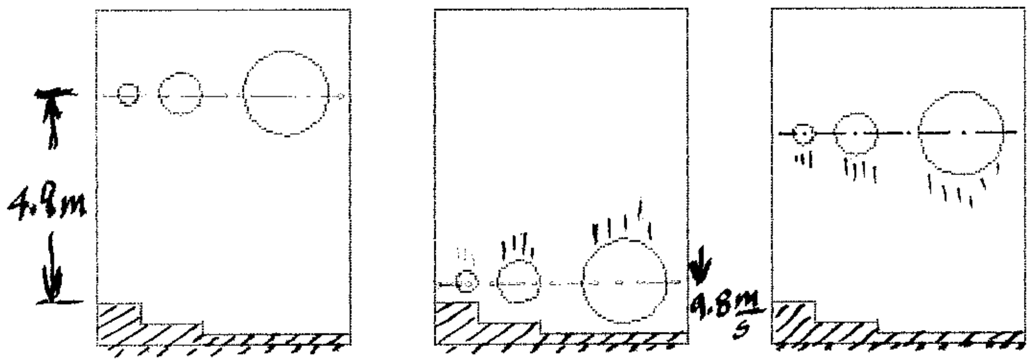


(a) In a gravitational field, elastic bodies fall together and bounce together - continuously, independent of their masses.

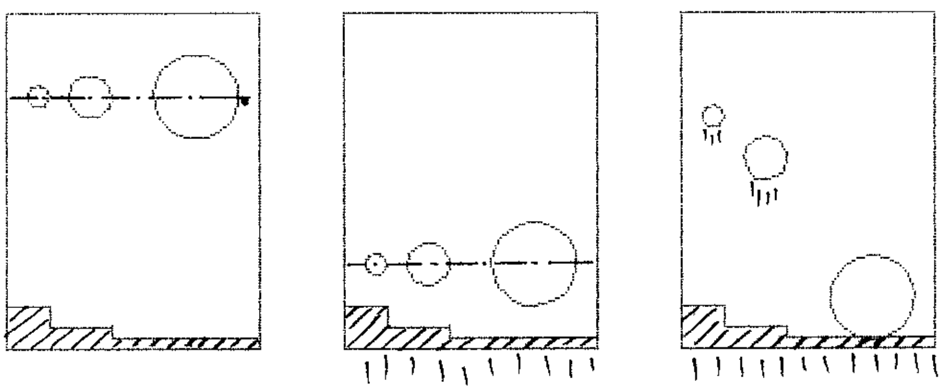


(b) In Einstein elevator, only initially do elastic bodies fall together, but then bodies bounce back randomly - according to their inertial masses.

Fig. 2 The fundamental difference between gravitational fields and accelerated frames of reference



(a) In a gravitational field, elastic bodies fall together and bounce back together – continuosly.



(b) In Einstein elevator, elastic bodies fall together initially, but bounce back haphazardly. A large body gets stuck to the floor. Lighter bodies fly off faster.

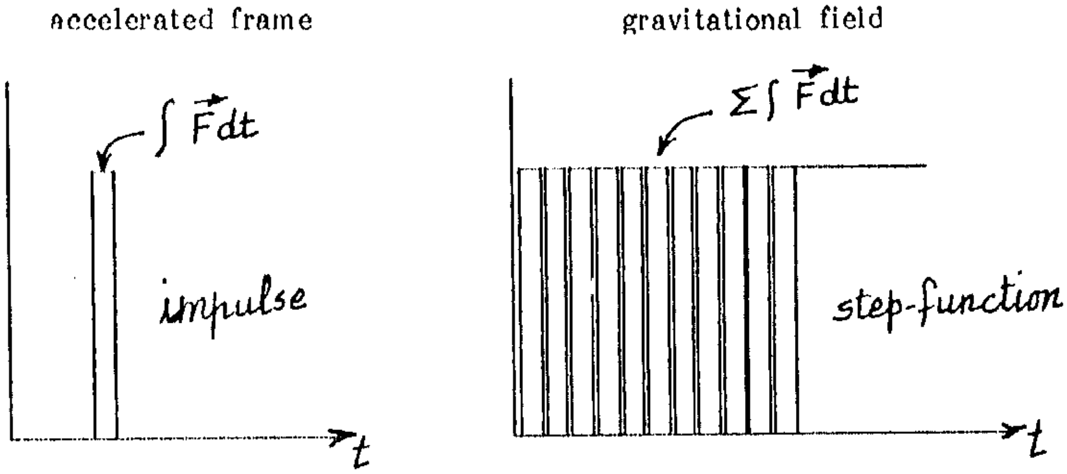


Fig. 3 The fundamental difference between the forcing functions in gravitational fields and accelerated frames