Model of drop experiment

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Abstract
The equivalence principle has been verified by multiple experiments. Many of these experiments are drop experiments: Balls of different masses fall to the ground. Each experiment yielded the same result: Both objects fall to the ground at the same time. However, we have doubts about this result. Fortunately general relativity provides a tool, It can be used to verify our ideas. It tells us: Mass bends spacetime, and the curvature of spacetime reflects the magnitude of gravity. So, we conducted a thought experiment with this tool, The conclusion is: The experimental results contain a scale problem, Under the existing experimental precision, on a certain scale, We can only get the same result. When this scale is exceeded, the results will be different.

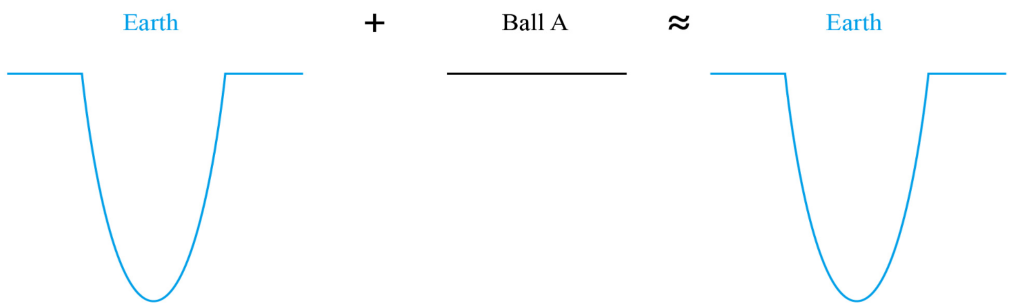
Key words
Gravity, General Relativity, Mass, Space-Time Bending, Acceleration

Introduction
While there have been many successful experiments before, we believe that these experiments are flawed. The flaws come from the mass of the experimental object. To be precise, the mass of the object is always much smaller than that of the earth. We thought that if the mass of the object increased to a certain extent, the experimental results would be different. So, we designed a thought experiment to verify. We said earlier that the experimental tools are provided by general relativity. Why this is a thought experiment and not a real experiment: In this experiment, we need the mass of the object to be close to and above the mass of the Earth.

Experimental design:
Subject of the experiment: Ball (A, B, C, D), Earth.
Experimental environment: a perfect experimental environment, without considering other factors.
Experiment content: drop a ball from a height h above the ground, and analyze the gravitational force on the ball.
Parameter:
Earth mass: 6*10^24 KG
Ball A mass: 1 KG
Ball B mass: 10 KG
Ball C mass: Earth mass
Ball D mass: Neutron star mass = Sun mass*1.4=2.8*10^30 KG

Part 1: Balls A, B fall to the ground
In this part, the mass of the ball is much less than the mass of the Earth. Most of the experiments done in history belong to this scale.
Mass causes space-time curvature, so the gravitational force on ball A can be expressed as:
The gravitational force on the ball A = the curvature of space-time (Earth) + the curvature of space-time (ball A),fig.1

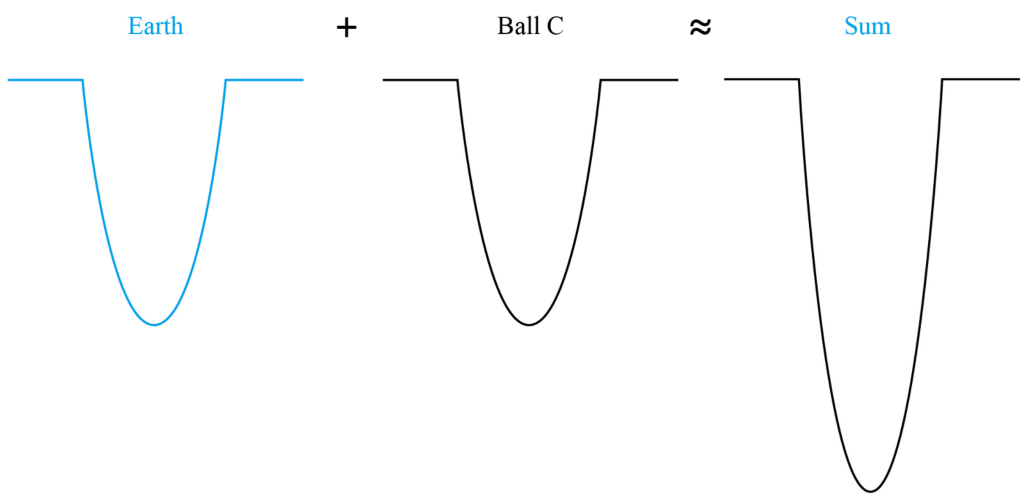
Fig.1 Spacetime Bending: Earth and Ball A



Since the mass of ball A is 24 orders of magnitude different from the mass of Earth, The curvature of space-time (ball A) is represented as a straight line relative to the size of the curvature of space-time (Earth) in the diagram. Obviously, they add up very close to the curvature of spacetime (Earth). The same thing happened with ball B. The result is also very close to the curvature of space-time (Earth).

Part 2: Ball C falls to the ground
In this part, the mass of the ball is similar to that of the Earth.
Similarly：
The gravitational force on the ball C = space-time curvature (Earth) + space-time curvature (Earth),fig.2

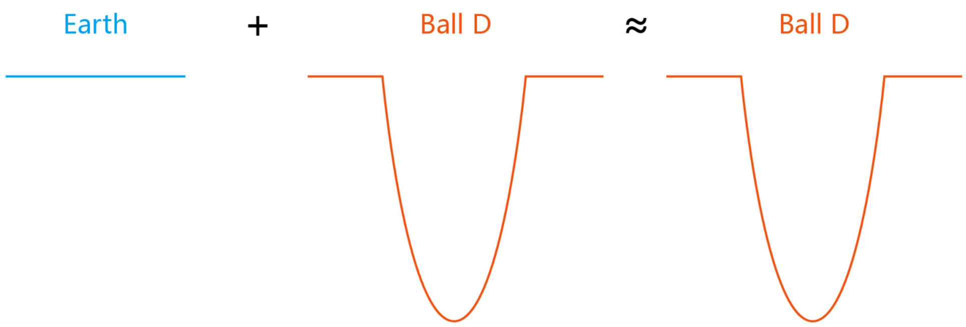
Fig.2 Spacetime Bending: Earth and Ball C



Since ball C mass = Earth mass, the sum of spacetime curvature will be significantly larger than spacetime curvature (Earth). Compared to ball A, it is obvious that ball C will get closer to the ground faster.

Part 3: Ball D falls to the ground
In this part, the mass of the ball is much greater than the mass of the Earth.
Similarly:
Gravitational force on ball D = curvature of spacetime (Earth) + curvature of spacetime (ball D)， fig.3

Fig.3 Spacetime Bending: Earth and Ball D



For the same reason, since the mass of the ball D is much larger than the mass of the earth, the space-time curvature (Earth) in the figure appears as a straight line. The sum is very close to the curvature of spacetime (ball D).

Part 4:
So far, we can see that there is indeed a scale problem in the experiment. There is an upper limit to the accuracy of our current experiments, when the mass of the ball is below a certain scale, we cannot tell the difference between the results.
For example, in the first part of the experiment, the mass of ball A is 24 orders of magnitude different from that of the earth, and the mass of ball B is 23 orders of magnitude different from that of the earth, The current best experimental accuracy is 15 orders of magnitude (1). Therefore, we cannot tell the difference between the experimental results. Unless experimental precision improves by at least 8 orders of magnitude.

Conclusion:
1.A definite object causes a definite curvature of space-time and possesses a definite gravitational field.
2.The curvature of space-time caused by two definite objects is related to both objects, and to the mass of each object.

Reference:
1.PHYSICAL REVIEW LETTERS 129,121102(2022)