

# EINSTEIN'S THEORY OF RELATIVITY

There are two Theories of Relativity: the Special and the General. The Special Theory shows that movement over a straight line at a constant speed is always relative to any observer. The General Theory extends the Special Theory from uniform to accelerated motion, movement at a changing speed or over a non-straight path.

## SPECIAL THEORY OF RELATIVITY

Based in a basic assumption: the speed of light is always the same regardless of the speed of the light source or observer. This fact has unexpected and astonishing ramifications.

### RELATIVITY OF TIME



1 A man is riding on a moving train. He is shining a ray of light that travels from a source in the ceiling to a mirror in the floor and back to the ceiling. From his point of view the light source and the mirror are stationary, so the light travels directly down and up in perfectly vertical lines.

2 From the point of view of a stationary observer standing outside the train, the light source and the mirror are moving, so the light follows a path in the shape of a V. This path is longer than the one observed by the man on the train. Since light travels at the same speed for any observer, from the stationary point of view the ray takes longer than from the perspective of the man on the train. Or, in other words, time passes slower for the man in the train than for the stationary observer. So, there is no meaning to the concept of absolute time. Time is relative to the observer.



### RELATIVITY OF LENGTH



3 The man in the train is now trying to measure the length of the car by sending a ray of light from one end to the other, knowing the speed of light and the time the ray takes to reach the other and he can calculate the length of the car.



4 From the point of view of the stationary observer the end of the train is moving to meet the ray of light, so it has to travel a shorter distance. The stationary observer will calculate a shorter length for the car than the man in the train. So, there is no meaning to the concept of absolute length. Length is relative to the observer.

### HISTORY'S FAMOUS EQUATION

Another important idea of the Special Theory of Relativity is the equivalence of mass and energy: mass can be converted into energy and vice versa. This relationship is expressed in the equation:

$$E=mc^2$$

The energy ( $E$ ) contained in any quantity of mass ( $m$ ) is finite, that quantity of mass ( $m$ ) multiplied by the speed of light ( $c$ ) multiplied by itself. Since  $c^2$  is an enormous number, almost 30 billion billion, the formula shows that even tiny amounts of matter contain a tremendous amount of energy. A dramatic example of the power of mass and energy is provided in the atomic bomb, which converts into energy a tiny mass of uranium.

## GENERAL THEORY OF RELATIVITY

The theory asserts that accelerated motion is relative to the observer, as the Special theory did for the uniform motion. It shows that inertia (the force that presses you against the back of your seat when your car accelerates) and gravity are equivalent forces, two sides of the same phenomenon.

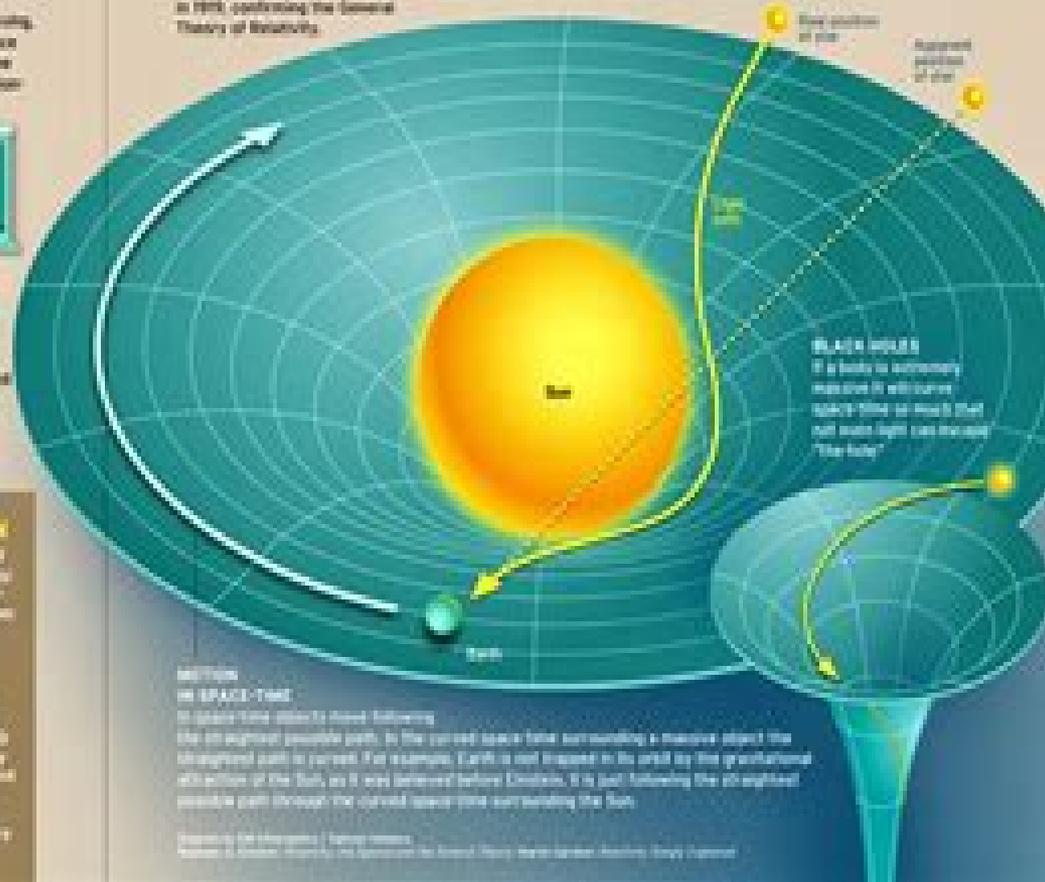
### THE EQUIVALENCE OF ACCELERATION AND GRAVITY

A man is inside an elevator that is accelerating upwards at a constant rate. The forces he experiences (that pressing on the floor) and the way objects fall are indistinguishable from those produced by gravity.



### THE CURVED SPACE-TIME OF GRAVITY

According to Einstein gravity is not a force at all. It is a distortion or curvature of the space-time (a four-dimensional compound of the three dimensions of space plus time) that occurs around any massive body (for example, the Sun). It's like a rubber sheet being bent by a weight placed in its center. Even light curves when passing close to a massive body. Thus the position of a star appears displaced if its light passes close to the Sun. This effect was observed in 1919, confirming the General Theory of Relativity.



**BLACK HOLES**  
If a body is extremely massive it will curve space-time so much that not even light can escape "the hole".

### TRAJECTORIES IN SPACE-TIME

In space-time objects don't travel following the straight possible path, in the curved space-time surrounding a massive object the straightest path is curved. For example, Earth is not trapped in its orbit by the gravitational attraction of the Sun, as it was believed before Einstein. It is just following the straightest possible path through the curved space-time surrounding the Sun.

# Theory Of Relativity In Contemporary

**Xiaolong Qi**



## **Theory Of Relativity In Contemporary:**

## Whispering the Techniques of Language: An Emotional Quest through **Theory Of Relativity In Contemporary**

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