

Accelerated Reference Frames

Encyclopedia Article

Accelerated Reference Frames

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Accelerated Reference Frames

The coordinate system to which a particular observer refers his or her measurements is called a reference frame. In general, there are two kinds of **reference frames**: inertial and accelerating. Suppose a person is in a small closed room on Earth and drops a ball. The ball will fall to the floor due to the **force of gravity** pulling it down. This is considered an inertial **frame of reference** in a uniform **gravitational field**, meaning the coordinate system is stationary, or, at constant **velocity**. Now suppose this room is instead placed on a spaceship with no gravitational field, but the ship is uniformly accelerating so that an apparent force of one "g" is pushing the person to the floor. If a ball is dropped here in this accelerated reference frame, the ball will seem to fall in exactly the same manner as the inertial frame described on Earth. In reality, the ball is stationary, since there is no gravity and the floor rushes up to hit the ball. The floor's movement upward causes the apparent force that would be mistakenly called gravity.

Einstein's general relativity states that both situations are identical. In fact, general relativity claims you cannot tell the difference between the two reference frames; a uniformly accelerated reference frame is equivalent to an inertial reference frame in a uniform gravitational field. This is known as the equivalence principle.

Perhaps the most interesting example of an accelerated reference frame is an astronaut in a "weightless" environment. If an astronaut drops a ball in this example, the ball will "float" in place. In reality, the astronaut and the ball are both falling towards the Earth and so the ball appears stationary. Being in orbit around Earth (or some other massive object with sufficient gravity) creates this **microgravity** environment. Other examples of accelerating reference frames and the effects associated with them are the **Coriolis Force**, artificial gravity, and centripetal forces.