# The Atomic Clocks and Time Dilation

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**Abstract**
The atomic clocks on-board each satellite tick faster than identical clocks on the ground by about 38 microseconds per day. People like to use this fact to prove Relativity and call it time dilation. With no doubt, Relativity is one of the explanations of the atomic clocks phenomenon, but is it the only one?

**How Atomic Clocks Work**
The principle of operation of an atomic clock is based on atomic physics: it measures the electromagnetic signal that electrons in atoms emit when they change energy levels. Since 1968, the International System of Units (SI) has defined the second as the duration of 9192631770 cycles of radiation corresponding to the transition between two energy levels of the ground state of the caesium-133 atom. When an electron jumps from an energy level to a lower energy level, it releases electromagnetic waves. The atomic clock counts these electromagnetic waves to click time.

**Is there any chance an electron jumps into another nucleus?**
In reality, it's more like layers of clouds wrapped around the nucleus, with the electrons being somewhere in the layers of the cloud. One way to think of it is as a probability cloud, with a high probability that the electron is somewhere in a particular layer. Due to the quirks of quantum physics, we can't directly determine where an electron is located in space at any given time without breaking things, but we can infer where it is by indirect measurements. In other words, an electron may move anywhere, only depending on the difference in probability. It is possible for an electron to jump into a nearby nucleus.

**When an electron jumps into another nucleus, we will lose a count**
An electron jumps up to a higher energy level, then jumps to a lower energy level and releases a wave. The wave is the keypoint the atomic clock counts on. Electrons keep jumping like flipping coins. When an electron jumps into a nucleus, the result will become difficult to estimate. It could cause a Beta decay, or mostly the electron would be kicked out as a normal electron. It is probably to lose a wave. This probability is very low, still, a count is lost. Such loss of counting will not affect the accuracy of the atomic clock on the surface of the earth. Because that number 9192631770 is calculated through repeated comparisons by many scientists on the surface of the earth. It contains the loss of counting, even though they did not notice it. On the earth, the number 9192631770 can make the atomic clocks very precise, even if people ignore the missed counting of electrons.

**Density affect the chance of jumping**
The jumping distance of electrons is limited. Within the effective jumping distance of electrons, if there are more nuclei, the electrons have greater the chance to jump into other nuclei. If the density of caesium becomes larger, the space it occupies will become smaller, the number of nuclei per unit space will increase, and the loss of counting will increase. Conversely, if the density of caesium becomes smaller,

the space it occupies will become larger, the number of nucleus per unit space will decrease, and the loss of counting will also decrease.

**The atomic clocks on the satellite.**

On the surface of the earth, the atomic clock runs well with 9192631770 counting. After the atomic clock is sent to the weightless space, the density of caesium will be decreased, the loss of counting will be decreased as well. The waves will be a little more than on the earth. If we still use the 9192631770 to count the second, the atomic clock will become inaccurate but go faster. That gives people an illusion: the time on the satellite is faster than the time on the earth, which is the time dilation which people wishfully believe in.

**An experiment can prove it or not**

A simple experiment can prove it or not: setup two small atomic clocks and a centrifuge. Put one clock in the centrifuge, keep it under high centrifugal force, the density will increase. This atomic clock's miscounting will go up, and it will run slower than the stay one. Then compare two clocks. If this density theory is right, the atomic clock on the centrifuge will be slower than the other one. That can prove the time dilation is not caused by gravity, but by an increase of density.

**Conclusion**

The "time dilation" is caused by the density increase of caesium, but not by change of gravity. The "time dilation" can not prove GR but can prove GR wrong.