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We live in a time-distorted world

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Today, we live in a world where we all share the same time. We define a standard clock, and by matching our clocks to it, we all share the same precise time. Thanks to this, I can board trains and airplanes without being late for the scheduled departure time. Likewise, you can turn on the TV in advance and wait for your favorite program to start. So to speak, we live in a "time-flattened" world.

Since ancient times, we have made clocks using the cycles of objects around us to determine the time standard. The time it takes for the sand in an hourglass to run out or the time it takes for the sun to rise one day and rise again the next are examples of clocks used in the past.

The current standard of time around the world is the cesium atom clock which utilizes a "pendulum" of the cesium atom. This clock is accurate to within 1 second in 300 million years. Since the pendulum of the cesium atom swings so quickly and accurately, the world shares exact time by determining that when the cesium pendulum swings 91 billion times, the time is one second.

Recently, something that swings even faster and more accurately has been attracting attention. It is the strontium atom, which swings 429 trillion times per second, making it possible to create a more accurate clock. A clock that uses strontium atoms is called an optical lattice clock. It is off by only one second in 30 billion years. This is 100 times better accuracy than that of a cesium atom clock. As a candidate for a new standard clock, it is attracting attention from all over the world.

With this kind of accurate clock, we can observe time distortions. A famous scientist, Einstein, theorized that time at higher elevations on earth should move faster than at lower elevations. We all thought we lived in a world where we all ticked the same time, but he began to say that this world is time distorted. Is that really?

An experiment was conducted to confirm whether his claim was correct at the Tokyo Skytree, Japan's tallest structure. In this experiment, two optical lattice clocks are placed on the "Tenku-Kairo" (at the height of 450 m) of the Tokyo Sky Tree and on the ground (0 m). The result showed a difference in time, equivalent to one second in 600,000 years. His strange claim was valid!

Until now, we have not been aware that we live in a time-distorted world. An optical lattice is a significant invention that makes this possible.

You may think that what the merit is of knowing the time distortion. But wouldn't it seem helpful to replace knowing the distortion of time with knowing the difference in height?

It is now known that an optical lattice clock can measure a difference in time to the nearest 1 cm in about 1 hour. This is a significant advance considering that even the latest GPS-based surveying technology is limited to an accuracy of 10 m. Therefore, we can say that optical lattice clocks are precise sensors to measure height differences by measuring time distortion.

What would happen if optical lattice clocks were placed underground in Japan, for example, a country prone to earthquakes and volcanic eruptions? Before an earthquake occurs, the earth's bedrock may begin to rise or fall as it collides. Detecting the movement of the earth's bedrock as soon as possible with optical lattice clocks, we would forecast earthquakes. Also, before there is a volcanic eruption, the expansion of magma pools occurs. If there is a rise in height on an optical lattice clock near a magma pool, An eruption may happen soon.

Not only by the height, it is also expected that time is distorted by heavy objects nearby. If you find a place where the time of a clock is moving slower or conversely faster, it might be interesting to dig into the ground. You may find gold, silver, oil, or diamonds buried there.

Let's imagine further. What if everyone started carrying optical lattice watches around their wrist like the Apple watch? "I went hiking yesterday, and when I came home, I compared my watch with the one at home and found that it went a little faster!" "He

always leaves me behind with his fast walking, and time seems to move faster than mine." You may hear such conversations in the city.

We live in a time-distorted world. From such a point of view, the world looks very different. Salvador Dali is said to have been shocked by Einstein's theory and painted a picture of a distorted clock. What kind of world do you see? What kind of picture do you draw?