How a rotating universe makes time travel possible

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It turns out that time travel into the past is actually relatively easy. All you need to do is make the universe rotate.

The famous mathematician Kurt Gödel was a friend and neighbor of

Albert Einstein at Princeton. He became incredibly curious about Einstein's general theory of relativity, which was and continues to be our modern formulation of the gravitational force. That theory connects the presence of matter and energy to the bending and warping of space and time, and then connects that bending and warping to the behavior of matter and energy.

Gödel was curious as to whether relativity could allow time travel into the past. Einstein's theory purported to be an ultimate framework for the nature of space and time, and as far as we know time travel into the past is forbidden. So Gödel reckoned that general relativity should automatically disallow it.

And Gödel discovered that actually general relativity is perfectly fine with time travel into the past. The trick is to set the universe in motion.

Gödel constructed a relatively simple and artificial model universe to prove his point. This universe is rotating and contains only one ingredient. That ingredient is a negative cosmological constant that resists the centrifugal force of the rotation to keep the universe static.

Gödel found that if you follow a particular path in this rotating universe you can end up in your own past. You would have to travel incredibly far, billions of light years long, to do it, but it can be done. As you travel, you would get caught up in the rotation of the universe. That isn't just a rotation of the stuff in the cosmos, but of both space and time themselves. In essence, the rotation of the universe would so strongly alter your potential paths forward that those paths loop back around to where you started.

You would set off on your journey and never travel faster than the speed of light, and you would find yourself back where you started but in your own past.

The possibility of backwards time travel creates paradoxes and violates our understanding of causality. Thankfully, all observations indicate that the universe is not rotating, so we are protected from Gödel's problem of backwards time travel. But it remains to this day a mystery why general relativity is OK with this seemingly impossible phenomenon. Gödel used the example of the rotating universe to argue that general relativity is incomplete, and he may yet be right.

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