

## Research team reconstructs gravity to find a more robust way of understanding the cosmos

November 4 2022



The impact on cosmological tensions. Credit: *Nature Astronomy* (2022). DOI: 10.1038/s41550-022-01808-7

Scientists from around the world have reconstructed the laws of gravity,



to help get a more precise picture of the universe and its constitution.

The standard model of <u>cosmology</u> is based on General Relativity, which describes gravity as the curving or warping of space and time. While the Einstein equations have been proven to work very well in our solar system, they had not been observationally confirmed to work over the entire <u>universe</u>.

An international team of cosmologists, including scientists from the University of Portsmouth in England, has now been able to test Einstein's theory of gravity in the outer-reaches of space.

They did this by examining new observational data from space and <u>ground-based telescopes</u> that measure the expansion of the universe, as well as the shapes and the distribution of distant galaxies.

The study, published in *Nature Astronomy*, explored whether modifying General Relativity could help resolve some of the open problems faced by the standard model of cosmology.

Professor Kazuya Koyama, from the Institute of Cosmology and Gravitation at the University of Portsmouth, says, "We know the expansion of the universe is accelerating, but for Einstein's theory to work we need this mysterious cosmological constant."

"Different measurements of the rate of cosmic expansion give us different answers, also known as the Hubble tension. To try and combat this, we altered the relationship between matter and spacetime, and studied how well we can constrain deviations from the prediction of General Relativity. The results were promising, but we're still a long way off a solution."

Possible modifications to the General Relativity equation are encased in



three phenomenological functions describing the <u>expansion of the</u> <u>universe</u>, the effects of gravity on light, and the effects on matter. Using a statistical method known as the Bayesian inference, the team reconstructed the three functions simultaneously for the first time.

"Partial reconstructions of these functions have been done in the last 5 to 10 years, but we didn't have enough data to accurately reconstruct all three at the same time," adds Professor Koyama.

"What we found was that current observations are getting good enough to get a limit on deviations from General Relativity. But at the same time, we find it's very difficult to solve this problem we have in the standard model even by extending our theory of gravity.

"One exciting prospect is that in a few years' time we'll have a lot more data from new probes. This means that we will be able to continue improving the limits on modifications to General Relativity using these statistical methods."

Up and coming missions will deliver a highly accurate 3D map of the clustered matter in the universe, which cosmologists call large scale structure. These will offer an unprecedented insight into gravity at large distances.

Professor Levon Pogosian, from Simon Fraser University in Canada, says that "as the era of precision cosmology is unfolding, we are on the brink of learning about <u>gravity</u> on cosmological scales with high precision. Current data already draws an interesting picture, which, if confirmed with higher constraining power, could pave the way to resolving some of the open challenges in cosmology."

**More information:** Levon Pogosian et al, Imprints of cosmological tensions in reconstructed gravity, *Nature Astronomy* (2022). <u>DOI:</u>



## 10.1038/s41550-022-01808-7

## Provided by University of Portsmouth

Citation: Research team reconstructs gravity to find a more robust way of understanding the cosmos (2022, November 4) retrieved 26 April 2024 from <u>https://phys.org/news/2022-11-team-reconstructs-gravity-robust-cosmos.html</u>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.