

SCIENCE

Magical equation unites quantum physics, Einstein's general relativity in a first

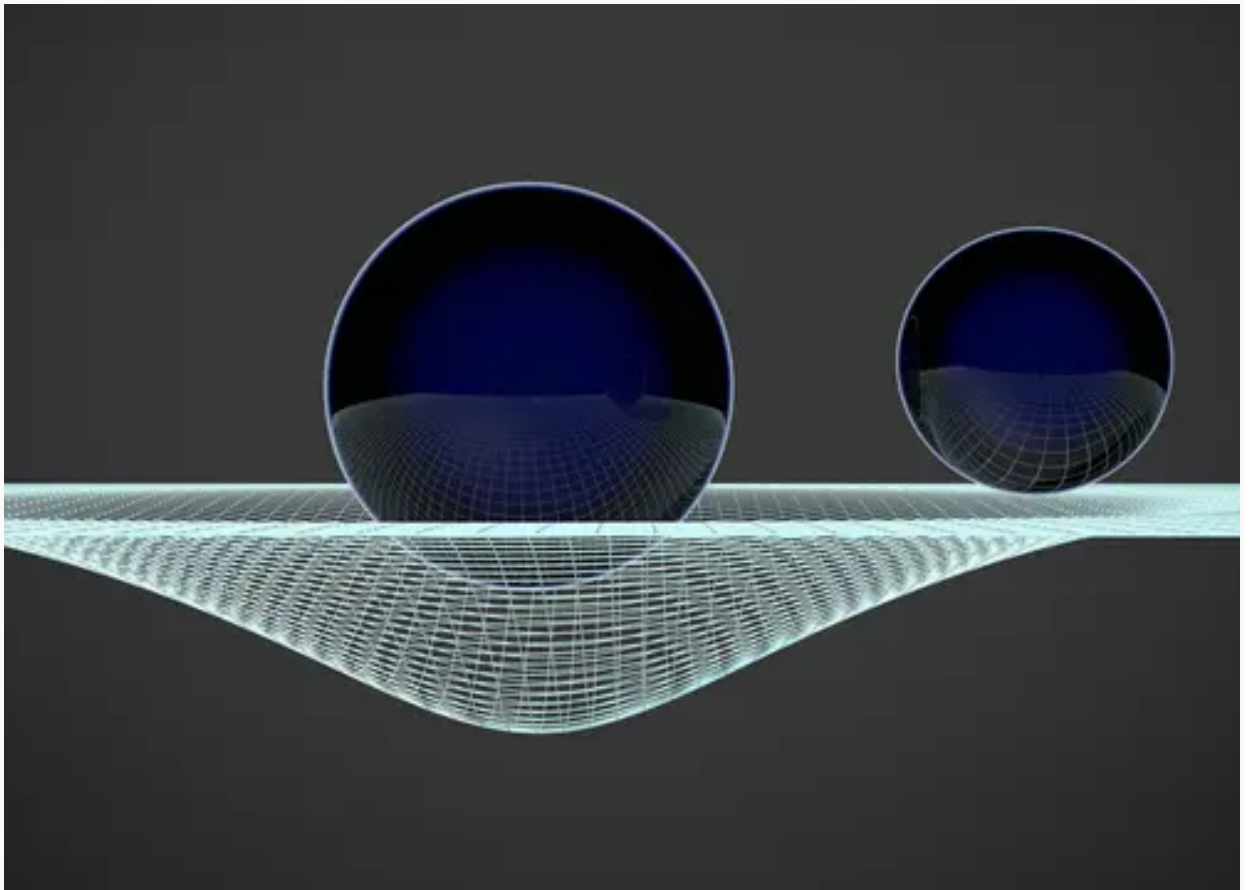
For the first time, we have an equation that connects the cosmic realm with the quantum world in ways never before imagined.

Updated: Sep 07, 2024 08:08 AM EST



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17 hours ago



General relativity works well for large-scale objects, while quantum physics accurately describes microscopic phenomena. (Representational image)

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For the first time, a mathematical framework proves that Einstein's theory of general relativity, which explains the relationship between space, time, and gravity, is in

alignment with quantum physics —- the branch of science that describes the behavior of electrons, photons, and other fundamental particles.

“We proved that the Einstein field equation from general relativity is actually a relativistic quantum mechanical equation,” the researchers note in their study.

In simple words, this new framework [connects the science](#) that governs the macroscopic world with that of the microscopic world.

Therefore, it has the potential to explain every physical phenomenon known to humanity ranging from the [mysterious dark matter](#) in space to the photons emitted by your phone’s flashlight.

“To date, no globally accepted theory has been proposed to explain all physical observations,” the [researchers](#) added. They claim that their theory can challenge the foundations of physics and change our understanding of the universe.

The disconnect between relativity and the quantum world

Einstein’s [theory of general relativity](#) explains how gravity works. It says that massive objects like planets, stars, or galaxies bend the fabric of space and time around them, like a heavy ball on a trampoline. This bending creates what we feel as gravity.

So, instead of thinking of gravity as an invisible force pulling objects together, general relativity shows that objects move along curves in the warped space around them. The more massive the object, the more it bends space, and the stronger the gravitational effect.

Quantum physics, on the other side, is concerned with the study of the [unusual behavior](#) of the tiniest particles in the universe.

For instance, it investigates how particles such as electrons can exist in multiple states or locations at once (superposition) until we measure them. This type of strange behavior is not found in the objects we deal with regularly.

Until now, scientists have failed to reconcile general relativity and quantum physics because the two theories describe the universe in fundamentally different ways. When attempts were made to apply both theories together—such as in the case of black holes, they produced contradictory results, making it difficult to unify them into a single framework.

For example, general relativity predicts a black hole's core is [infinitely dense](#), while quantum physics suggests such infinities can't exist.

Bridging the gap between relativity and quantum physics

General relativity works well for large-scale objects, while quantum physics accurately describes microscopic phenomena, but what's the need to unite them? Well, there are two big reasons for that. First, combining these would provide a complete understanding of the universe across all scales.

This is important because many concepts such as black holes or the Big Bang are probably results of the conditions where both quantum physics and general relativity [played a role](#). Understanding them requires a theory that integrates both.

Second, one can not fully understand the science behind quantum gravity, Hawking radiation, [string theory](#), and various other phenomena without connecting the dots between the theory of general relativity and quantum physics.

To link them, the researchers developed a mathematical framework that "Redefined the mass and charge of leptons (fundamental particles) in terms of the interactions between the energy of the field and the curvature of the spacetime."

"The obtained equation is covariant in space-time and invariant with respect to any Planck scale. Therefore, the constants of the universe can be reduced to only two quantities: Planck length and Planck time," the researchers note.

This equation mathematically proved that the [Einstein Field Equation](#) related to the theory of relativity is equal to the quantum equation. The study authors claim it can provide answers to various questions that have been a mystery.

For instance, it might explain why black holes don't collapse, what were the conditions during the Big Bang, and how space-time entanglement works.

Moreover, "In recent years, the James Webb Space Telescope (JWST) has observed several phenomena, including galaxies that had already existed 300 Myr after the big bang, which have never been thought to exist. Our proposed theory suitably explains this phenomenon," said the researchers.

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The [study](#) is published in the journal *Astroparticle Physics*.