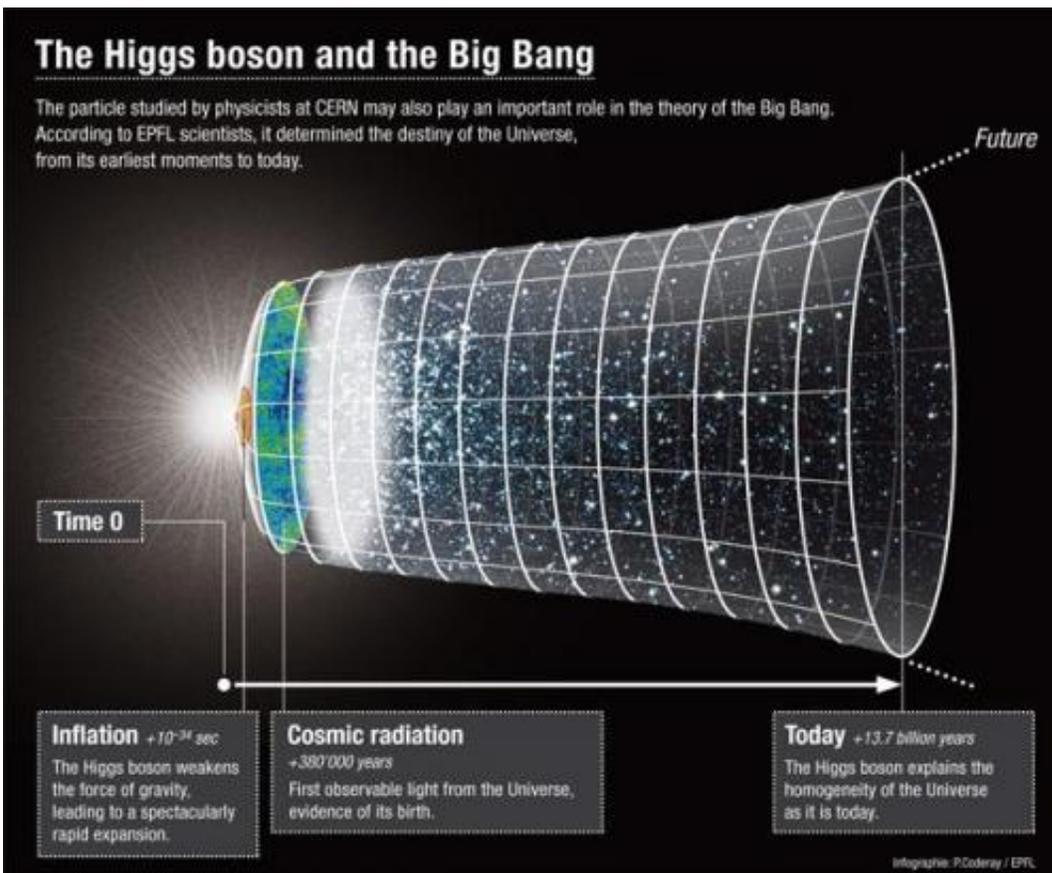


Could the Higgs boson explain the size of the Universe?

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(PhysOrg.com) -- The Universe wouldn't be the same without the Higgs boson. This legendary particle plays a role in cosmology and reveals the possible existence of another closely related particle.

The race to identify the [Higgs boson](#) is on at CERN. This Holy Grail of particle physics would help explain why the majority of [elementary particles](#) possess mass. The mysterious particle would also help us understand the evolution of the Universe from the moment of its birth, according to a group of EPFL physicists. If their theory is verified with data from the Planck satellite, it would clear up several questions about the Universe, past and future.

An expanding Universe

The Universe, which today extends over billions of light-years, was incredibly minuscule at its birth. To simultaneously explain this dichotomy of scale and the fact that matter is seemingly distributed in a homogeneous fashion throughout the Universe, physicists have had to resort to a theoretical trick: they added an inflationary phase to the [Big Bang](#), an initial phenomenal expansion in which the Universe grew by a factor of 10^{26} in a very short time. Physicists have a hard time, though, accounting for this rapid growth.

In its first moments, the Universe was unimaginably dense. Under these conditions, why wouldn't gravity have slowed down its initial expansion? Here's where the Higgs boson enters the game – it can explain the speed and magnitude of the expansion, says Mikhail Shaposhnikov and his team from EPFL's Laboratory of [Particle Physics](#) and [Cosmology](#). In this infant Universe, the Higgs, in a condensate phase, would have behaved in a very special way – and in so doing changed the laws of physics. The force of gravity would have been reduced. In this way, physicists can explain how the Universe expanded at such an incredible rate.

What's in store for the Universe?

The theory may clear up the first moments of the Universe, but what about the Universe as it is today? “We have determined that when the Higgs condensate disappeared to make way for the particles that exist today, the equations permitted the existence of a new, massless particle, the dilaton,” explains EPFL physicist Daniel Zenhäusern.

To arrive at this conclusion, the [physicists](#) applied a mathematical principle known as scale invariance – starting with the Higgs boson, they were able to determine the existence of the dilaton, a close cousin, as well as its properties. And it turns out that this new and as yet purely theoretical particle happens to have the exact characteristics to explain the existence of dark energy. This energy explains why the expansion of the current Universe is once again accelerating, but its origins are not understood. This theoretical advance – a completely unexpected result – is reassuring the scientists that they may be on the right track.

Astrophysicists are measuring the state of the [Universe](#) today using data from the Planck [satellite](#). They are observing the light echo from the Big Bang, which reveals the large scale properties of the cosmos. In 2013, the measurement campaign will provide results that will be precise enough to compare with the EPFL scientists’ theoretical predictions – and they’ll be able to see if their Higgs theory holds up. The boson isn’t just hidden in the bowels of [CERN](#)’s accelerator.

More information: Higgs-Dilaton Cosmology: From the Early to the Late Universe, Juan García-Bellido, Javier Rubio, Mikhail Shaposhnikov, Daniel Zenhäusern, High Energy Physics - Phenomenology, arxiv.org/abs/1107.2163

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