Model describes universe with no big bang, no beginning, and no end

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(PhysOrg.com) -- By suggesting that mass, time, and length can be converted into one another as the universe evolves, Wun-Yi Shu has proposed a new class of cosmological models that may fit observations of the universe better than the current big bang model. What this means specifically is that the new models might explain the increasing acceleration of the universe without relying on a cosmological constant such as dark energy, as well as solve or eliminate other cosmological dilemmas such as the flatness problem and the horizon problem.

Shu, an associate professor at National Tsing Hua University in Taiwan, explains in a study posted at arXiv.org that the new models emerge from a new perspective of some of the most basic entities: time, space, mass, and length. In his proposal, time and space can be converted into one another, with a varying speed of light as the conversion factor. Mass and length are also interchangeable, with the conversion factor depending on both a varying gravitational "constant" and a varying speed of light (G/c^2). Basically, as the universe expands, time is converted into space, and mass is converted into length. As the universe contracts, the opposite occurs.

"We view the speed of light as simply a conversion factor between time and space in spacetime," Shu writes. "It is simply one of the properties of the spacetime geometry. Since the universe is expanding, we speculate that the conversion factor somehow varies in accordance with the evolution of the universe, hence the speed of light varies with cosmic time."

As Shu writes in his paper, the newly proposed models have four distinguishing features:

• The speed of light and the gravitational “constant” are not constant, but vary with the evolution of the universe.
• Time has no beginning and no end; i.e., there is neither a big bang nor a big crunch singularity.
• The spatial section of the universe is a 3-sphere [a higher-dimensional analogue of a sphere], ruling out the possibility of a flat or hyperboloid geometry.
• The universe experiences phases of both acceleration and deceleration.

He tested one of the models against current cosmological observations of Type Ia supernovae that have revealed that the universe appears to be expanding at an accelerating rate. He found that, because acceleration is an inherent part of his model, it fits the redshift data of the observed supernovae quite well. In contrast, the currently accepted big bang model does not fit the data, which has caused scientists to search for other explanations such as dark energy that theoretically makes up 75% of the mass-energy of the universe.

Shu’s models may also account for other problems faced by the standard big bang model. For instance, the flatness problem arises in the big bang model from the observation that a seemingly flat universe such as ours requires finely tuned initial conditions. But because the universe is a 3-sphere in Shu’s models, the flatness problem “disappears automatically.” Similarly, the horizon problem occurs in standard cosmology because it should not be possible for distant places in the universe to share the same physical properties (as they do), since it should require communication faster than the speed of light due to their great distances. However, Shu’s models solve this problem due to their lack of big bang origin and intrinsic acceleration.

“Essentially, this work is a novel theory about how the magnitudes of the three basic physical dimensions, mass, time, and length, are converted into each other, or equivalently, a novel theory about how the geometry of spacetime and the distribution of mass-energy interact,” Shu writes. “The theory resolves problems in cosmology, such as those of the big bang, dark energy, and flatness, in one fell stroke.”

More information: Wun-Yi Shu. "Cosmological Models with No Big Bang." arXiv:1007.1750v1
via: The Physics ArXiv Blog