

Towards a New Model of the Universe

Monday, 22 October 2018 15:40 (150)

We present the astonishing astrophysical and cosmological consequences of the following hypotheses:

1. The Standard Model matter (i.e. matter made from quarks and leptons interacting through the exchange of gauge bosons) is the only content of the Universe.
2. Quantum vacuum fluctuations are virtual gravitational dipoles (i.e. systems composed from one positive and one negative gravitational charge)

The first hypothesis excludes dark matter and dark energy from astrophysics and cosmology, while the second hypothesis postulates quantum vacuum as a cosmological fluid free of the cosmological constant problem.

The phenomena usually attributed to hypothetical dark matter, may be considered as a consequence of the local gravitational polarization of the quantum vacuum by the immersed Standard Model matter; i.e. the galactic halo of dark matter can be replaced by the halo of the polarized quantum vacuum. Globally “quantum vacuum” may be viewed as a cosmological fluid, which during expansion of the Universe converts from a fluid with negative pressure - allowing an accelerated expansion of the Universe - to a fluid with zero pressure, which physically means the end of the accelerated expansion. This, for the first time, suggests that quantum vacuum may explain both phenomena; phenomena for which we have invoked dark matter and phenomena for which we have invoked dark energy.

Furthermore, as a consequence of the hypothesis of virtual gravitational dipoles, together with the gravitational version of the Schwinger mechanism, the possibility exists that we live in a cyclic universe with cycles alternatively dominated by matter and antimatter. Consequently, at least mathematically, there is no initial singularity, there is no need for cosmic inflation and there is an elegant explanation of the matter-antimatter asymmetry in the universe: our universe is dominated by matter because the previous cycle was dominated by antimatter (and the next cycle would be dominated by antimatter again).

The eventual evidence of gravitational effects from the quantum vacuum “enriched” with virtual gravitational dipoles can be revealed, among other ways, through the gravitational experiments with antihydrogen at CERN and by the study of orbits of tiny satellites in trans-Neptunian binaries, for instance UX 25.

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Session Classification : Poster session and coffee-buffet