

# Dark energy hides behind phantom fields

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Observations of Planck and other satellites help to solve the equation of the state of dark energy. Credit: ESA et al.

Quintessence and phantom fields, two hypotheses formulated using data from satellites, such as Planck and WMAP, are among the many theories that try to explain the nature of dark energy. Now researchers from Barcelona and Athens suggest that both possibilities are only a mirage in the observations and it is the quantum vacuum which could be behind this energy that moves our universe.

Cosmologists believe that some three quarters of the universe are made

up of a mysterious [dark energy](#) which would explain its accelerated expansion. The truth is that they do not know what it could be, therefore they put forward possible solutions.

One is the existence of quintessence, an invisible gravitating agent that instead of attracting, repels and accelerates the expansion of the cosmos. From the Classical World until the Middle Ages, this term has referred to the ether or fifth element of nature, together with earth, fire, water and air.

Another possibility is the presence of an energy or phantom field whose density increases with time, causing an exponential cosmic acceleration. This would reach such speed that it could break the nuclear forces in the atoms and end the universe in some 20,000 million years, in what is called the Big Rip.

The experimental data that underlie these two hypotheses comes from satellites such as Planck of the European Space Agency (ESA) and Wilkinson Microwave Anisotropy Probe (WMAP) of NASA. Observations from the two probes are essential for solving the so-called equation of the state of dark energy, a characterising mathematical formula, the same as that possessed by solid, liquid and gaseous states.

Now researchers from the University of Barcelona (Spain) and the Academy of Athens (Greece) have used the same satellite data to demonstrate that the behaviour of dark energy does not need to resort to either quintessence or phantom energy in order to be explained. The details have been published in the *Monthly Notices of the Royal Astronomical Society* journal.

"Our theoretical study demonstrates that the equation of the state of dark energy can simulate a quintessence field, or even a phantom field, without being one in reality, thus when we see these effects in the

observations from WMAP, Planck and other instruments, what we are seeing is an mirage," told SINC Joan Solà, one of the authors from University of Barcelona.

## Nothing fuller than the quantum vacuum

"What we think is happening is a dynamic effect of the quantum vacuum, a parameter that we can calculate," explained the researcher. The concept of the quantum vacuum has nothing to do with the classic notion of absolute nothingness. "Nothing is more 'full' than the quantum vacuum since it is full of fluctuations that contribute fundamentally to the values that we observe and measure," Solà pointed out.

These scientists propose that dark energy is a type of dynamical quantum vacuum energy that acts in the accelerated expansion of our universe. This is in contrast to the traditional static vacuum energy or cosmological constant.

The drawback with this strange vacuum is that it is the source of problems such as the cosmological constant, a discrepancy between the theoretical data and the predictions of the quantum theory that drives physicists mad.

"However, quintessence and phantom fields are still more problematic, therefore the explanation based on the dynamic [quantum vacuum](#) could be the more simple and natural one," concluded Solà.

**More information:** Spyros Basilakos, Joan Sola. "Effective equation of state for running vacuum: "mirage" quintessence and phantom dark energy". *Monthly Notices of the Royal Astronomical Society* 437(4), February 2014. [DOI: 10.1093/mnras/stt2135](https://doi.org/10.1093/mnras/stt2135)

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