Philosophy of Dark Energy Workshop
March 8 – 10, 2019
University of California, Irvine
Social & Behavioral Sciences Gateway, SBSG 1321

Luca Amendola (Heidelberg)

The ever-changing dark energy

In this talk I first review (a part of) the illuminating history of the cosmological constant and discuss its impact on cosmology. Then I discuss the main hurdles in assessing the properties of the cosmological constant through observations, and in distinguishing it from other cosmological models.

Robert Brandenberger (McGill)

Dynamical Relaxation of the Cosmological Constant and Dark Energy

The back-reaction of long wavelength cosmological perturbations leads to a negative contribution to the cosmological constant whose absolute value is increasing in time. I will discuss the possibility that there is a dynamical fixed point of the equations which explains Dark Energy.

Robert Caldwell (Dartmouth)

Dark Energy Needs Dark Radiation

(abstract forthcoming)

Sean Carroll (Caltech)

Holography, Hilbert Space, and the Cosmological Constant

The cosmological constant problem can be couched in terms of effective field theory: given a Planck-scale ultraviolet cutoff, the "natural" value for a constant operator in the Lagrangian is the Planck energy to the fourth power, which is 120 orders of magnitude larger than the observed dark energy density. Holography suggests a very different conception. The entropy of a de Sitter patch is the area of its event horizon in Planck units, which is inversely proportional to the cosmological constant, and the dimensionality of the Hilbert space describing that patch is the exponential of that entropy. If we take that Hilbert space as a fundamental aspect of nature, the problem is not why the cosmological constant is so small, but why Hilbert space is so big. This isn't a solution to the problem, but a change of perspective. I will discuss some implications of this view.

Anne-Christine Davis (Cambridge)

Recent developments in Modified Gravity and Chameleons

(abstract forthcoming)

Paul Hamilton (UCLA)

Searches for new forces with atom interferometry

Many models of beyond the Standard Model physics predict forces from interactions of new fields with ordinary matter. Atom interferometry, a technique using the wave nature of laser-cooled matter, enables precise measurements of forces in ultra-high vacuum chambers in table-top experiments. In this talk, I will briefly introduce matter wave interferometry and discuss its application in searches for new forces from screened scalar field models such as chameleons and symmetrons.

Lavinia Heisenberg (Zurich)

The landscape of effective field theories of gravity and their consistency

After giving a systematical overview about consistent-looking constructions of effective field theories of gravity, I will discuss different ways of assessing them by means of theoretical and cosmological consistency. In the former case I will pay special attention to the recently suggested Swampland criteria and their cosmological implications.

Dragan Huterer (Michigan)

Dark Energy Two Decades After: Cosmological Probes and Consistency Tests

I will give a data-centric but broad overview of the past, present, and future constraints on dark energy. I will briefly review how much we have learned over the past two decades, and then focus on what aspects of the accelerating universe we have a chance -- or not -- to learn about in the near future. I will broadly outline how we can maximize the information coming from the great variety of present-day observations to 1. find any departures from the standard cosmological-constant model, and 2. separate between the dark-energy and modified-gravity scenarios for the accelerating universe.

Jim Peebles (Princeton)

Finding LambdaCDM

We could have arrived at the established LambdaCDM cosmology or something like it by a variety of paths, and it seems difficult to imagine how we might have missed it given what else was happening in science and society. I will offer examples of what happened and what could have happened, and assess the revolutionary developments at the turn of the century that established to the satisfaction of most this remarkable extension of the reach of well-tested natural science.

Daniela Saadeh (Nottingham)

Dark energy: can the fifth force be screened?

The phenomenology of dark energy may be explained by an extra scalar particle mediating a fifth force at cosmological scales. However, stringent limits on the existence of extra forces have been placed by solar-system experiments: viable models must therefore be able to screen (i.e. suppress) the fifth force in environments where it is known to be small.

Several screening mechanisms have been proposed, which predictions can be tested against data. Atom interferometry experiments have recently revolutionised the landscape of screening constraints, allowing precise tests with table-top experiments. I will discuss the working principle of these tests, and present the latest constraints on the chameleon and symmetron models.

In the second part of the talk, I will focus on the Vainshtein screening mechanism, where the fifth force is suppressed by large higher-order derivatives of the scalar field. Progress in tests of this mechanism has been hindered by the complexity of the field equations. I will present a numerical approach based on the finite element method that overcomes this problem, and use it to assess whether Vainsthein screening can effectively take place within the limits of validity of the theories that invoke it.

Shinji Tsujikawa (Tokyo)

Dark energy in scalar-tensor versus vector-tensor theories