

# Swampland and our Universe

April 15 – 16, 2026

Wednesday, April 15, 2026

Time	Session Details
8:00 am – 9:00 am	<b>Breakfast</b>
9:00 am – 10:00 am	<b>Marc Kamionkowski, Johns Hopkins: Dark-matter dynamics and new physics.</b> <b>Abstract:</b> Galactic halos that are spherical, stationary, and composed of collisionless dark matter are easy to describe mathematically. If dark matter decays or interacts or there is some departure from equilibrium or time evolution of the system, all bets are off. In this case costly N-body simulations are required. If, however, one retains the assumption of spherical symmetry, these systems can be evolved numerically with a far simpler algorithm that is easily coded run in a matter of minutes on a laptop, rather than a day on a supercomputer. I will describe this approach and illustrate with simulations of self-interacting dark matter, decaying dark matter (with and without anisotropic velocity distributions, supermassive-black-hole growth, tidal stripping, mixed SIDM/CDM models. Come prepared with your own non-standard dark-matter model; we'll see if we can simulate it during the talk!
10:00 am – 10:30 am	<b>Coffee Break</b>
10:30 am – 11:30 am	<b>Tracy Slatyer, MIT: What (more) the CMB can teach us about dark matter.</b> <b>Abstract:</b> Observations of the cosmic microwave background have already provided critical evidence for dark matter, but can also stringently constrain a range of dark matter properties. I will outline CMB constraints on dark matter properties based on purely gravitational effects, and then discuss in more detail how both CMB anisotropies and the blackbody spectrum can be used to test dark matter interactions with the Standard Model.
11:30 am – 1:00 pm	<b>Lunch Break (catered)</b>
1:00 pm – 2:00 pm	<b>Alek Bedroya, Princeton: How Quantum Gravity Constrains Physics on the Largest Length Scales.</b> <b>Abstract:</b> I will review the hierarchy of energy scales in quantum gravity, from the Hubble scale in the IR to the quantum-gravity cutoff and the Planck scale in the UV, and emphasize the nontrivial UV/IR relations that connect them. I will discuss conjectures constraining scalar potentials and explain how they are related to the behavior of the other energy scales, together with bottom-up arguments based on general principles of quantum gravity such as holography. In particular, I will explain how well-motivated holographic assumptions lead to strong restrictions on scalar potentials, ruling out parametrically prolonged accelerated expansion for positive potentials and obstructing parametric scale separation for negative potentials associated with AdS vacua.
2:00 pm – 2:30 pm	<b>Coffee Break</b>
2:30 pm – 3:30 pm	<b>Mustapha Ishak-Boushaki, UT Dallas: Persistent and serious challenge to the <math>\Lambda</math>CDM throne: Evidence for dynamical dark energy rising from combinations of different types of datasets.</b> <b>Abstract:</b> We derive multiple constraints on dark energy and compare dynamical dark energy models with a time-varying equation of state ( $w_0w_a$ CDM) versus a cosmological constant model (LCDM). We use Baryon Acoustic Oscillation (BAO) from DESI and DES, Cosmic Microwave Background from Planck with and without lensing from Planck and ACT (noted CMBL and CMB, respectively), supernovae(SN), and cross-correlations between galaxy positions and galaxy lensing from DES. We use pairs or triplets of datasets where we exclude one type of dataset each time and categorize them as “NO SN”, “NO CMB” and “NO BAO” combinations. In all cases, we find that the combinations favor the $w_0w_a$ CDM model over LCDM, with significance ranging from 2.0 to 3.0-sigma. The persistence of this pattern across various dataset combinations even when any of the datasets is excluded supports an overall validation of this trending result regardless of any specific dataset. Next, we use larger combinations of these datasets after verifying their mutual consistency within the $w_0w_a$ CDM model. We find combinations that give robust significance levels, with DESI+DESY6BAO+CMBL+SN giving 3.4-sigma. In sum, while we need to remain cautious, the trend and pattern of these results beyond any single type of dataset and their associated systematics presents a compelling overall portrait not in favor of the LCDM and constitutes a serious challenge to the model's reign. A few other cosmological results will be provided.

<b>3:30 pm – 4:00 pm</b>	<b>Coffee Break</b>
<b>4:00 pm – 5:00 pm</b>	<p><b>Georges Obied, U Chicago: The Dark Dimension and its interplay with DESI data.</b></p> <p><b>Abstract:</b> In this talk, I will discuss the motivation for considering an extra mesoscopic Dark Dimension of length <math>l \sim 1 - 10</math> microns, taking into account theoretical and observational arguments. I will then talk about cosmological aspects of the Dark Dimension. In particular this scenario leads, by the universal coupling of the Standard Model sector to bulk gravitons, to massive spin 2 KK excitations of the graviton in the Dark Dimension (the “dark gravitons”) as an unavoidable dark matter candidate. Observations allow such an extra dimension of size in the micron range. Finally, I will discuss how this scenario can naturally accommodate features recently observed by the DESI survey such as an effective dark energy equation of state that is smaller than -1.</p>

## Thursday, April 16, 2026

Time	Session Details
<b>8:00 am – 8:30 am</b>	<b>Breakfast</b>
<b>8:30 am – 9:30 am</b>	<p><b>MC Gonzalez-Garcia, ICREA U. Barcelona, YITP Stony Brook: Massive Neutrinos in 2026: What we know, what we do not know (yet?), and what we do not understand.</b></p> <p><b>Abstract:</b> In this talk I will present an update of the current understanding (and some not understanding) of the neutrino masses and the lepton mixing and some other minimal SM extensions as derived from direct scrutiny of the results of neutrino flavour oscillation experiments, some other laboratory probes, and the cosmos.</p>
<b>9:30 am – 10:00 am</b>	<b>Coffee Break</b>
<b>10:00 am – 11:00 am</b>	<p><b>Miguel Montero, IFT, Madrid: Neutrinos and B-L symmetry in the Dark Dimension scenario.</b></p> <p><b>Abstract:</b> The Dark Dimension proposes the existence of a micrometer-sized large extra dimension, whose size is tied to the observed small vacuum energy. I will review the scenario, and then discuss how to embed the B-L global symmetry of the SM, focusing on one possibility which leads to an explanation of the observed coincidence between neutrino mass scale and the vacuum energy scale, while leading to 3 light species of right-handed neutrinos. I will also briefly discuss potential opportunities for detection of the resulting neutrino oscillations.</p>
<b>11:00 am – 11:30 am</b>	<b>Coffee Break</b>
<b>11:30 am – 12:30 pm</b>	<p><b>Ignatios Antoniadis, IAS, Princeton: Searching for the dark dimension in neutrino experiments.</b></p> <p><b>Abstract:</b> Micron size extra dimensions offer a possibility to explain the smallness of neutrino masses if the right-handed neutrino propagates in the higher dimensional bulk. I will discuss the theoretical framework and the experimental signatures of this proposal in present and future experiments of KATRIN prototype, aiming to measure the magnitude of neutrino masses and to search for extra sterile-type species.</p>
<b>12:30 pm – 1:30 pm</b>	<b>Lunch Break (catered)</b>
<b>1:30 pm – 2:30 pm</b>	<p><b>Mike Boylan-Kolchin, UT Austin: Galaxies as Tracers of the Matter Density Field.</b></p> <p><b>Abstract:</b> Galaxy formation is often (rightly) thought of as involving a complex interplay of messy astrophysical processes, but it also traces the nonlinear evolution of the matter density in the Universe. Remarkably, it appears that properties of this nonlinear field are intimately connected to properties of the initial linear fluctuations and some basic physics of dark matter interactions. I will explore some of these connections, with applications that include the surprisingly fast evolution of early galaxy formation as revealed by JWST and properties of the lowest-mass dark matter clumps capable of hosting galaxies in the local Universe.</p>
<b>2:30 pm – 3:00 pm</b>	<b>Coffee Break</b>
<b>3:00 pm – 4:00 pm</b>	<p><b>Matt Reece, Harvard: Axions from String Theory, and String Theory from Axions.</b></p> <p><b>Abstract:</b> String theory compactifications contain the right ingredients to produce axion fields that might solve the Strong CP problem or contribute to dark matter or dynamical dark energy in our universe. After briefly reviewing some of these ingredients, I will frame the inverse question: suppose that an axion is discovered, and its decay constant is measured in an experiment. Could this help us to locate ourselves in the string landscape? In particular, I will discuss how an axion could give us clues about the fundamental string scale and the scale of supersymmetry breaking.</p>