

Tuesday, April 6, 2:30 pm

Speaker: Prof. Nikita Blinov

Institution: FNAL

Title: The Early Universe as a Laboratory for Particle Physics

Abstract:

Precise observations of the early Universe can offer insight into particle physics beyond the Standard Model. At the same time, terrestrial experiments guide our interpretation of this cosmological data. I will illustrate this interplay of cosmology and particle physics in two contexts: an exciting tension in recent cosmological data, and the long-standing mystery of dark matter, a fundamental ingredient of our Universe, whose nature remains unknown.

Different measurements of the (Hubble) expansion rate of the Universe appear to be in severe tension with each other. One possible explanation of this discrepancy involves new neutrino interactions when the universe was a few tens of thousands of years old. I will argue that particle physics experiments rule out this possibility. I will then show how the same cosmological data underlying the tension can be used to constrain the existence of particles beyond the Standard Model that are incredibly challenging to observe otherwise. Unfortunately, the earliest direct observations only test the era of nucleosynthesis when the Universe was about a second old.

In the second part of this talk, I will show that the spatial distribution of dark matter at small scales can carry the imprints of the pre-nucleosynthesis Universe. For example, if dark matter density perturbations grow much faster at early times than expected, dense clumps (called minihalos) could have formed. These small-scale structures can be searched for with observations of pulsars and photometric monitoring of highly-magnified stars. Detection of minihalos can shed light on the nature of dark matter, the existence of new particles, and inflation.