Colloquium

Department of Physics - University of Milano Bicocca

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Reionising the Universe: A Brief History of Baryons and the Cosmic Web

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Abstract

The beaded filamentary network of intergalactic gas in which galaxies form and evolve, and which gives origin to a “forest” of hydrogen Lyman-alpha absorption lines in the spectra of distant quasars, encodes information on the physics of structure formation, the nature of the dark matter, the temperature and ionization state of baryons in the Universe. The potential of the Lyman-alpha forest for constraining with percent accuracy the matter density distribution on medium to small cosmological scales has motivated the construction of the Dark Energy Spectroscopic Instrument (DESI) and of the WHT Extended Aperture Velocity Explorer (WEAVE), which are measuring absorption line spectra backlit by nearly a million high-redshift ($z > 2$) quasars. In this talk I will describe the multiple steps needed to connect flux fluctuations in quasar spectra to physical parameters, present an unprecedented suite of thousands of high-resolution hydrodynamical simulations of structure formation with different gas thermal histories along with different free-streaming lengths of (warm) dark matter particles in the early Universe, and use it to perform a statistical comparison of mock spectra with the observed 1D flux power spectrum and other data. A likelihood analysis shows that gas in the cosmic web experienced two main reheating epochs over the last 13 billion years, and yields a lower limit of 3.0 keV (95 percent CL) to the mass of a thermal WDM relic.