PHYSICS DEPARTMENT COLLOQUIUM

"Astrophysical probes of dark matter"

BY

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The last ten years in astrophysics has seen the birth of precision cosmology. Pioneering studies of the cosmic microwave background radiation combined with data from large astronomical surveys have demonstrated that most of the Universe is dark: dark energy ~72%, cold dark matter (CDM) ~22%, and dark baryons ~4%. In this talk, I show how much we can learn about dark matter by combining observations of the Universe with state of the art computer simulations. In the first part of the talk, I show how we can directly image dark matter in galaxies and clusters of galaxies using strong gravitational lensing. Comparing these data with the results of computer simulations allows us to test a variety of dark matter models. In the second part of the talk, I show how astrophysics has a vital role to play in attempts to detect dark matter in the laboratory. Such experiments require detailed predictions of the dark matter distribution in the Solar system, both to motivate experimental design and to interpret future signals. I show that such predictions require high resolution simulations of our Galaxy that model both the dark matter and the baryons -- the stars and gas. If the dark matter is modelled alone, the simulations predict an extended dark matter halo that surrounds our Galaxy, with a local velocity distribution that is near-Gaussian and isotropic. However, once the baryons are included, the simulations predict an additional dark matter component: a dark matter disk. I discuss the implications of this dark disk for direct and indirect dark matter detection experiments and show that it significantly increases the chance that we will detect dark matter in the next 5-10 years.

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