COLLOQUIUM

New theories for dark matter: hunting beyond the WIMP

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The nature of dark matter is one of the most important outstanding problems in physics and cosmology. From observing astrophysical objects, we have learned that dark matter represents some 25% of the total energy of the universe, while ordinary matter weighs in at only about 4%. Although they make up a large fraction of the energy of the universe, dark matter particles interact with ordinary matter only very weakly, making their detection via interactions with ordinary matter difficult. We examine some of the constraints and cosmic clues for the nature of the dark matter. These clues and constraints provide the basis for examining new theories of dark matter, beyond the dominant paradigm of weakly interacting massive particles (WIMPs). We consider the most compelling examples of novel dark matter theories, and describe astrophysical signatures, such as in neutron stars and dark matter halo shapes. We also discuss new experimental proposals designed to look for these candidates.