Signal from Annihilating Dark Matter

The distribution of dark matter in the Milky Way may be described by a spherically symmetric density profile with the density increasing towards the Galactic Center. Thus, a flux of messenger particles, like gamma ray photons or neutrinos from the direction of the Galactic Center or a large-scale anisotropy in the Galactic halo, can be interpreted as indirect evidence of dark matter. The inherent advantage, and ensuing challenge, of neutrinos is the low interaction probability. Neutrinos can escape the production site unimpeded by potentially complex absorption processes but require large detectors. Results from two searches for dark matter in the Galactic Center and halo are presented.

Dark Matter in the Galactic Center

The kinematics of dwarf galaxies imply that these objects have a large mass-to-light ratio and are thus considered to be strongly dark matter dominated. Other promising types of distant dark matter accumulations are large galaxies and galaxy clusters. A neutrino flux resulting from annihilating dark matter particles in these halos could be detected as an excess above the background of atmospheric neutrinos. An analysis using data collected by IceCube in 2009/2010 with the 59-string configuration searching for a dark matter signal from five dwarf galaxies, two galaxy clusters, and the galaxy M31 is performed.

Dwarf Galaxies and Extragalactic Dark Matter Halos

We present limits for:
- IceCube-22 (Galactic halo) [2]
- IceCube-40 (Galactic Center)
Further, we present sensitivities for:
- IceCube-59 (dwarf galaxies/clusters)

These are compared to phenomenological models based on DM-interpretations of the PAMELA/Fermi excess [3], as well as recent limits from Fermi, based on observation of dwarf galaxies [4].

Results

Limits from the Galactic halo and Center analyses (IceCube), compared to a search for gamma rays from annihilating dark matter by Fermi. The thickness of the blue-shaded lines corresponds to the uncertainty on the halo profile. The IC40 limits were obtained assuming the NFW profile. The variation of limits due to halo uncertainties for the Galactic Center spans up to two orders of magnitude.

References: