Annihilation of self-interacting dark matter (TIFX04-17-01)

Background
In the standard paradigm of modern astro-particle physics, dark matter is an undetected, unidentified, neutral, massive, cosmologically stable, and at most weakly interacting particle. It is the only coherent physics concept that can explain a variety of otherwise anomalous observations performed on very different physical scales, ranging from the solar neighbourhood to the cosmological horizon. Convincing evidence shows that it makes up about 5/6 of the total matter content of the Universe. And yet, what is dark matter actually, remains a mystery. Particles produced by dark matter annihilation in space, such as photons, positrons, and antiprotons, might hold the key to the dark matter mystery.

Description of the problem
In this project you will calculate the rate of dark matter annihilation in nearby dwarf spheroidal galaxies. The calculation will be performed in a new and relatively unexplored family of dark matter particle models. In this class of models, dark matter is self-interacting. This property has a number of intriguing phenomenological implications, and might reconcile astronomical observations with currently conflicting numerical simulations of galaxy formation. Through this calculation, you will be able to identify correlations between the microscopic properties of dark matter, the velocity distribution of dark matter in dwarf spheroidal galaxies, and the morphology of these astrophysical systems. A successful bachelor project on the proposed topic is expected to lead to a publication in an international scientific journal.

Implementation: The project involves analytic calculations based upon quantum mechanics and scattering theory, and simple numerical computations.

Group structure: The project has been designed for a group of 3-4 students.

Target groups: F, GU-fysik

Literature: