Abstract

The bulk of the matter in our Universe is expected to be in the form of hitherto unobserved particles called dark matter. These particles are supposedly responsible for stabilizing galaxies and for much of the structure observed in astrophysics. Still, all experimental attempts at discerning the properties of these particles have failed. In this thesis, I will consider the behavior of dark matter particles in stellar environments. Stars offer extreme conditions that cannot be replicated in terrestrial experiments and may become crucial for a future discovery of dark matter. I will mainly cover two distinct physical scenarios. First, I investigate dark matter particles that interact with regular baryonic stars. Stellar nuclei heated by fusion processes can accelerate light dark matter particles or decelerate and thermalize heavy ones - both cases can potentially lead to observational signatures. In particular, the accelerated particles may be observed in direct detectors, whereas thermalized dark matter may annihilate/decay into particles that can be seen in indirect detectors. I further investigate how dark matter in stars can be produced from neutron decay without destabilizing neutron stars. The second part of the thesis concerns cold stars that are themselves made of dark matter. Here, I focus on the structure of such stars depending on the particles' interactions and spin. The last part of the thesis concerns two additional topics related to dark matter and stars. One concerns the structure of white dwarf stars in the presence of certain types of modified gravity. The other concerns an idea for observable effects in the most pessimistic dark matter scenario, namely one where dark matter particles are super-heavy and *only* gravitationally interacting.