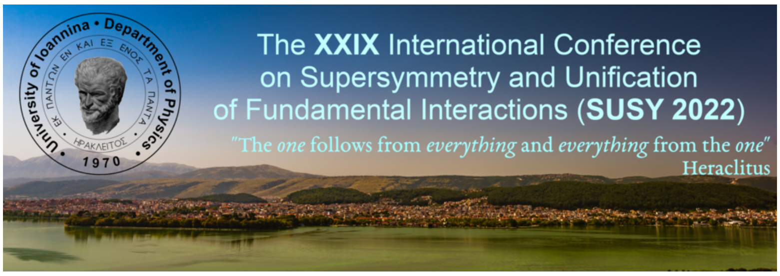

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Capture of DM in Compact Stars

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Neutron stars harbour matter under extreme conditions, providing a unique testing ground for fundamental interactions.
Dark matter can be captured by neutron stars via scattering, where kinetic energy is transferred to the star.
This can have a number of observational consequences, such as theheating of old neutron stars to infra-red temperatures.
Previous treatments of the capture process have employed various approximation or simplifications.
We present here an improved treatment of dark matter capture, valid for a wide dark matter mass range, that correctly incorporates all relevant physical effects.
These include gravitational focusing, a fully relativistic scattering treatment, Pauli blocking, neutron star opacity and multi-scattering effects.
We provide general expressions that enable the exact capture rate to be calculated numerically, and derive simplified expressions that are valid for particular interaction types or mass regimes and that greatly increase the computational efficiency.
Our formalism is applicable to the scattering of dark matter from any neutron star constituents, or to the capture of dark matter in other compact objects.
We apply these results to scattering of dark matter from neutrons, protons, leptonic targets, as well as exotic Baryons.
For leptonic Targets, a relativistic description is essential. Regarding Baryons, we outline two important effects that are missing from most evaluations of the dark matter capture rate in neutron stars.
As dark matter scattering with nucleons in the star involves large momentum transfer, nucleon structure must be taken into account via a momentum dependence of the hadronic form factors.
In addition, due to the high density of neutron star matter, we should account for nucleon interactions rather than modeling the nucleons as an ideal Fermi gas.
Properly incorporating these effects is found to suppress the dark matter capture rate by up to three orders of magnitude.

We find that the potential neutron star sensitivity to DM-lepton scattering cross sections greatly exceeds electron-recoil experiments, particularly in the sub-GeV regime, with a sensitivity to sub-MeV DM well beyond the reach of future terrestrial experiments.
We present preliminary results for DM-Baryons scatterings in Neutron stars, were the sensitivity is expected to greatly exceed current DD experiments for the spin-dependent case in the whole masse range, and for spin-independent in the low and high mass range.
Regarding White Dwarfs, for dark matter-nucleon scattering, we find that white dwarfs can probe the sub-GeV mass range inaccessible to direct detection searches, with the low mass reach limited only by evaporation, and can be competitive with direct detection in the 1 GeV – 10 TeV range.
White dwarf limits on dark matter-electron scattering are found to outperform current electron recoil experiments over the full mass range considered, and extend well beyond the ~ 10 GeV mass regime where the sensitivity of electron recoil experiments is reduced.

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