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Dark Matter Capture in Compact Objects

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The capture of Dark Matter in compact objects has garnered considerable interest over recent years. This renewed interest is driven primarily by the prospect that the energy deposited by the dark matter can heat these objects potentially to infra-red temperatures, which may soon be observed. Such observations can constrain dark matter interactions complementary to modern direct detection experiments. To gain reliable insight into the reach these objects can offer, correctly incorporating the unique physics relevant to these objects into the capture process is necessary. Key among these are the effects of gravitational focusing, relativistic kinematics for targets and dark matter, Pauli blocking due to degenerate targets, and multiple scattering effects. Additionally, we incorporate the internal structure of the objects in a self consistent manner. Specifically for Neutron stars, baryonic targets have additional physics which needs to be accounted for. These are the effects of strong interactions which induce an effective mass, and accounting for their finite size. We can then project realistic sensitivities for dark matter-lepton and nucleon cross sections using dimension-6 effective operators, which are competitive and potentially stronger than those obtained from direct detection searches.

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