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Capture, thermalisation and annihilation of Dark Matter in Compact Objects

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It is well-established that Dark Matter can be captured and accumulate in celestial objects. While this phenomenon has been extensively studied for the Sun and Earth, recent interest has shifted towards compact objects such as White Dwarfs and Neutron Stars. In this presentation, I will discuss two recent results related to these objects.

For Neutron Stars, we consider Dark Matter candidates that are capable of annihilation. The capture of Dark Matter and its subsequent annihilation can lead to the heating of old, isolated Neutron Stars. For kinetic heating to occur, the captured Dark Matter must undergo sufficient scattering to transfer its kinetic energy to the star. Our findings show that this energy transfer typically happens rapidly, and that capture-annihilation equilibrium —and hence maximal annihilation heating —can be reached without the complete thermalization of the captured Dark Matter.

For White Dwarfs, we explore a scenario where the Dark Matter is very heavy and cannot annihilate. In the heavy Dark Matter regime, multiple collisions are required for the Dark Matter to become gravitationally bound. We present an improved approach to calculate the scattering rates for these collisions, particularly when the Dark Matter interacts with the ion constituents of a White Dwarf.

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