Contribution ID: **1386** Type: **DM**

Neutron stars as Pauli batteries: probing the neutron portal with internal heating of pulsars

Wednesday 26 May 2021 14:00 (15 minutes)

New states that mix with the neutron, such as dark baryons and mirror neutrons, have been proposed to address dark matter, baryogenesis, the long-standing neutron lifetime anomaly, and the recent XENON1T excess. I show that such states are extensively constrained by measurements of neutron star (NS) temperatures. When Fermi-degenerate neutrons in the stellar core convert to these states via scattering and/or decay, the holes left behind in the Fermi sea are refilled by more energetic neutrons, accompanied by explosive liberation of heat. While astronomical measurements of thermal luminosities of NSs are usually motivated by the need to pinpoint cooling models, this effect provides another important incentive: directly probing the properties of the neutron. This could be achieved by imminent telescopes in the optical, ultraviolet and infrared – i.e. by looking for NSs colder than the coldest (< 40,000 K) observed so far.

Summary

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Session Classification: DM VIII