

EXPLORE 2022 Workshop: Astrophysical Laboratories of Fundamental Physics



Contribution ID: 7

Type: **not specified**

EXPLORE project: "Dark Stars"

Thursday 31 March 2022 17:00 (1 hour)

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Dark matter structures are known to span from dwarf galaxies to the large scale structure of the cosmic web.

But there is an uncharted territory: Do dark matter structures exist on (much) smaller scales?

The research goals are divided in

- Study of dark star properties
- Derive observational constraints on dark stars from tidal streams

Dark stars properties are investigated along these lines:

- What are the properties of dark matter stars?
- Solve the Tolman-Oppenheimer-Volkoff equations and derive mass-radius relations
- Calculate the I-Love-Q relations of dark stars and compare to the one of neutron stars

Dark stars passing through the stream cause dynamical heating.

The gravitational encounters impart random kicks to stream stars.

A limit on dark stars using observed velocity dispersion of GD-1 stream can be derived.

The constraint is not just for dark stars, but for any compact dark object as primordial black holes and MACHOs (Massive Compact Halo Objects).

The goal is to derive (and publish) new general exclusion limit.

Phase 1: Analytic calculation

- Compute dynamical heating of streams from compact objects
 - Point-like objects (black holes), finite objects (dark stars)
- Use mass-radius relation

Phase 2: Numerical simulation

- Simulation of tidal stream + encounters from compact objects
- Goal: numerical validation of analytic results

Phase 3: Data analysis

- Explore Gaia data for calculating GD-1 stream velocity dispersion (reproducing known results)

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