Dark Matter in Compact Objects (TBD)

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XXX XXX

Produced on archival quality paper.

Abstract

DM in COs Heat up Maybe See

Publications

Refs. [2, 3, 5, 4, 1] below are the journal publications, and preprints authored or co-authored during my PhD candidature. The authors are listed alphabetically in all of the titles.

Journal papers and preprints

[1] Papers

Declaration

This is to certify that

1. the thesis comprises only my original work towards the PhD except where indicated in the preface;

2. due acknowledgement has been made in the text to all other material used;

3. the thesis is less than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Michael Virgato, XXX XXX

Preface

We don't know what DM is. Can NSs constrain it?

Acknowledgements

Why did I do this?

Contents

List of Figures

List of Tables

1 Introduction

Background on DM and its current status

This is the intro. About DM and its current status

2

Compact Objects for Particle Physics

Introduce COs, formation, structure etc...

3

Dark Matter Capture in Celestion Bodies

Review capture in the Sun, move to what's needed for COs in general, then specify to WDs (ions + electrons) and NS (interacting baryons)

3.1 Capture in the Sun

3.2 Capture in Compact Objects

3.3 White Dwarfs

3.4 Neutron Stars

4

Thermalisation in Compact Objects

Go Over the full thermalisation process for WDs and Neutron Stars

5
Dark Matter Induced Heating

DM kinetic and annihilation heating applied to NSs and WDs

6 Conclusion

Concluding remarks

A
Kinematics

Derivation of $E_f^{'}$ as needed for capture and other kinematics

Definition of Symbols and Abbreviations

$\boldsymbol{C}_{\text{geo}}$ Geometric Capture Rate

DM Dark Matter
$\boldsymbol{K}_{\chi}$ Dark Matter Kinetic Energy
$\boldsymbol{\rho}_{\chi}$ DM halo density
$\boldsymbol{m}_{\chi}$ Dark Matter Mass

EFT Effective Field Theory
EoS Equation of State

$\boldsymbol{f}_{\text{FD}}$ Fermi-Dirac Distribution
$\boldsymbol{\varepsilon}_{F,i}$ Fermi kinetic energy of target species

$\boldsymbol{|\overline{\mathcal{M}}|^2}$ Spin-averaged squared matrix element
$\boldsymbol{\mu}$ DM-Target mass ratio, m_{χ}/m_i

NS Neutron Star

PB Pauli Blocking

QMC Quark-Meson-Coupling EoS

$\boldsymbol{\sigma_{\text{th}}}$ Threshold Cross Section

$\boldsymbol{T}_{\text{eq}}$ Equilibrium Temperature
$\boldsymbol{t}_{\text{eq}}$ Capture-Annihilation equilibrium time
$\boldsymbol{T}_{\star}$ Temperature of the star
$\boldsymbol{t}_{\text{therm}}$ Thermalisation time

$\boldsymbol{v}_d$ DM halo dispersion velocity
$\boldsymbol{v}_{\star}$ Star velocity

Bibliography

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[3] Nicole F. Bell et al. "Improved Treatment of Dark Matter Capture in Neutron Stars II: Leptonic Targets". In: *JCAP* 03 (Mar. 26, 2021), p. 086. DOI: 10.1088/1475-7516/2021/03/086. arXiv: 2010.13257 [hep-ph].

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