Sydney Spring School 2022

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University of Sydney

Book of Abstracts

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Phenomenology of the companion-axion model

Author: Giovanni Pierobon[None]

We study the phenomenology of the 'companion-axion model' consisting of two coupled QCD axions. The second axion is required to rescue the Peccei-Quinn solution to the strong-CP problem from the effects of colored gravitational instantons. We investigate here the combined phenomenology of axion-axion and axionphoton interactions, recasting present and future single-axion bounds onto the companion-axion parameter
space. Most remarkably, we predict that future axion searches with haloscopes and helioscopes may well discover two QCD axions, perhaps even within the same experiment

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Decaying warm dark matter

Authors: Emil Brinch Holm[None]; Steen Hannestad[1]; Thomas Tram Bulow[2]

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During the recent years, decaying dark matter models have received renewed interest as proposed solutions to the current cosmological tensions, mainly due to their flexible expansion histories and clustering properties. While much focus has been on decaying cold dark matter, in this talk, I will present our recent work on decaying warm dark matter based on our recent preprint arXiv:2205.13628. Decaying warm dark matter generalises its cold counterpart, and interpolates between a wide range of cosmological models, admitting considerable customisability with few model parameters. Among other things, I will present results from a comprehensive MCMC analysis, evaluating the consequence of the model on the Hubble and �8 tensions. Lastly, I emphasise the power of agnosticism with respect to the underlying particle physics realisation and discuss applications to majorons and neutrino decays, both of which can be described as decaying warm dark matter.

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Sensitivity of Dark Matter-Nucleus Interactions to Nuclear Structure

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Non-relativistic effective field theory (NREFT) is one approach used for describing the interaction of WIMPS with ordinary matter. Among other factors, these interactions are expected to be affected by the structure of the atomic nuclei in the target. The sensitivity of the nuclear response components of the WIMP-nucleus scattering amplitude is investigated using shell model calculations for ^{19}F, ^{23}Na, ^{28,29,30}Si, ^{40}Ar, ^{127}I, ^{70,72,73,74,76}Ge and ^{128,129,130,131,132,134,136}Xe. Resulting integrated nuclear response values are shown to be sensitive to some specifics of the nuclear structure calculations. The potential uncertainties that may arise from the nuclear components of WIMP-nucleus scattering amplitudes due to nuclear structure theory and modelling are thus highlighted.

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Primordial black holes

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