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Book of Abstracts

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Search for a leptophibic B-boson via eta decay at Jlab

Prof. GAN, Liping[1]

[1] *University of North Carolina Wilmington*

Corresponding Author(s): ganl@uncw.edu

A leptophibic B-boson couples predominantly to quarks and arises from a new U(1) baryon number gauge symmetry [1]. Its leading decay is B→πˆ0+γ for the mass range of 140-620 MeV [2]. This offers a great experimental opportunity to search for such weakly-coupled gauge boson in the sub-GeV mass range through eta doubly-radiative decay η→Bγ→πˆ0γγ. Jlab Eta Factory (JEF) experiment [3] has been recently developed to search for B through this decay channel, with sensitivity to the baryonic fine structure constant as low as 10E−7, indirectly constraining the existence of anomaly cancelling fermions at the TeV-scale. Proposed experiment to search for B in three-photon final states (B→πˆ0γ→3γ) is complementary to a world wide effort searching for a dark photon A' at the high-intensity frontiers.
Reference: [1] B. Batell et. al., Phys. ReV., D90, 115014 (2014). [2] S. Tulin, Phys. Rev., D89, 14008 (2014). [3] L. Gan et. al., https://www.jlab.org/exp_prog/proposals/14/PR12-14-004.pdf.

2

Hidden photon CDM search at Tokyo

Author(s): Mr. SUZUKI, Jun'ya[1]
Co-author(s): Mr. INOUE, Yoshizumi [2] ; Prof. MINOWA, Makoto [1] ; Mr. HORIE, Tomoki [1]

[1] *Department of Physics, School of Science, The University of Tokyo*

[2] *International Center for Elementary Particle Physics, The University of Tokyo*

Corresponding Author(s): jsuzuki@icepp.s.u-tokyo.ac.jp

We report on a search for hidden photon cold dark matter (HP CDM) using a novel technique with a dish antenna. We constructed two independent apparatus: one is aiming at the detection of the HP with a mass of $\sim 5 \times 10^{-5}$ eV utilizing a commercially available parabolic antenna facing on a plane reflector, and the other is for a mass of $\sim$ eV which employs optical instruments. From the result of the measurement, we found no evidence for the existence of HP CDM and set upper limits on the photon-HP mixing parameter χ.

3

Direct detection of dark matter with XENON

Mr. RAUCH, Ludwig[1]

[1] *Max-Planck-Institut für Kernphysik*

Corresponding Author(s): rauch@mpi-hd.mpg.de

The XENON100 experiment was designed to test the particle nature of dark matter by directly detecting their interactions with a target nuclei. The detector is a dual-phase time projection chamber, containing a total mass of 161kg liquid-xenon. It is located at the Laboratori Nazionali del Gran Sasso in Italy and optimized to search for Weakly Interacting Massive Particles (WIMPs). To this date, there is no conclusive evidence for a direct detection of dark matter. In this talk, the highlights of the science results derived by the XENON100 detector will be presented. In addition to the WIMP search results, bounds on galactic as well as solar axions will be presented. Finally, the construction status of the next generation detector XENON1T will be briefly reviewed and its scientific potential summarized.

4

Cosmological search for ultra-light axions

GRIN, Daniel[1]

[1] *University of Chicago, Kavli Institute for Cosmological Physics*

Corresponding Author(s): dgrin@kicp.uchicago.edu

In today's era of precision cosmology, we can go beyond cosmic accounting to actually testing various ideas for the identity of the dark matter and dark energy. One such idea is that the dark matter or even the dark energy is an ultra-light particle like an axion, the Goldstone boson of a new high-energy symmetry, motivated by the mystery of why charge-parity symmetry violation in the strong sector is so small. After reviewing the properties of the cosmic microwave background, I will discuss how we have tested the ultra-light axion idea using both cosmic microwave background fluctuations and the large-scale clustering of galaxies, putting constraints on ˜7 orders of magnitude in axion mass. I will then discuss the prospects for future cosmological probes of axions and other light particles.

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Atomic Methods for Axion and WIMP Detection

Author(s): Mr. ROBERTS, Benjamin[1]
Co-author(s): Mr. STADNIK, Yevgeny [1] ; Dr. DZUBA, Vladimir [1] ; Prof. FLAMBAUM, Victor [1] ; Mr. LEEFER, Nathan [2] ; Prof. BUDKER, Dmitry [2]

[1] *University of New South Wales*

[2] *Helmholtz Institute, JGU, Mainz*

Corresponding Author(s): b.roberts@unsw.edu.au

We present our recent proposals to exploit the parity and time-reversal violating effects in atoms, nuclei, and molecules to search for evidence of various background cosmic fields, and to constrain the interaction strengths of these fields with fermions.
Candidates for such background fields include dark matter (e.g. axions) and dark energy, and also are motivated by various Standard Model extensions. Certain interactions of static and dynamic background cosmic fields would lead to the mixing of opposite parity states in atoms and molecules. This would, in turn, give rise to observable parity and time-invariance violating effects. The measurement of such effects would shed light on the interactions that gave rise to them.
Of particular interest is the interaction of a dynamic pseudoscalar field with atomic/molecular electrons and nuclei. Such a field could describe axions, a hypothetical pseudoscalar particle invoked to solve the strong CP problem from QCD, now also a leading cold dark matter candidate. We perform calculations of the parity and time-invariance violating effects that such a field would induce in atoms [1,2], and demonstrate a potential very large enhancement of the effects in diatomic molecules.
Crucially, the effects we consider here are linear in the small parameter that quantifies the interaction strength between the dark matter particles and ordinary matter particles; most current dark matter and axion searches rely on effects that are proportional to quadratic and higher powers of this parameter.
Oscillating electric dipole moments have the potential to be measured with very high accuracy, and experimental techniques in this field are evolving fast, making this a particularly exciting area for potential discovery in the near future. Pairs of closely spaced opposite parity levels that are found in diatomic molecules may also lead to a significant enhancement in these effects [2,3].
We are also investigating a possible explanation for the DAMA annual modulation result - a 9 sigma result claimed to be a detection of WIMP dark matter. This result is controversial, however, because of null results of several other experiments. The DAMA experiment is sensitive to scattering off both electrons and nuclei. Most other DM detection experiments, however, reject pure electron events, meaning that DM particles that interact favorably with electrons could potentially explain the DAMA modulation without being ruled out by the other null results. We perform accurate relativistic Hartree-Fock atomic calculations to determine model-independent cross-sections and event rates for the atomic ionization induced by the interaction with dark matter for xenon, iodine, and sodium. Our results have implications for the interpretation of the DAMA annual modulation signal in terms of WIMP–electron scattering.

1. B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer, and D. Budker. Limiting P-Odd Interactions of Cosmic Fields with Electrons, Protons, and Neutrons. Phys. Rev. Lett. 113, 081601 (2014).

2. B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer, and D. Budker. Parity-violating interactions of cosmic fields with atoms, molecules, and nuclei: Concepts and calculations for laboratory searches and extracting limits [Editors' Suggestion]. Phys. Rev. D 90, 096005 (2014).

3. Y. V. Stadnik, and V. V. Flambaum. Axion-induced effects in atoms, molecules, and nuclei: Parity nonconservation, anapole moments, electric dipole moments, and spin-gravity and spin-axion momentum couplings. Phys. Rev. D, 89, 043522 (2014).

6

Violations of Symmetries in Atoms: Cosmic Fields and Limits on Extensions to the Standard Model

Author(s): Mr. ROBERTS, Benjamin[1]
Co-author(s): Mr. STADNIK, Yevgeny [1] ; Dr. DZUBA, Vladimir [1] ; Prof. VICTOR, Flambaum [1] ; Dr. LEEFER, Nathan [2] ; Prof. BUDKER, Dmitry [2]

[1] *University of New South Wales*

[2] *JGU, Mainz*

Corresponding Author(s): b.roberts@unsw.edu.au

The success of the standard model is extraordinary; however, it is widely believed to be a low-energy manifestation of a more complete unified theory. Theories and models for physics beyond the standard model make varying predictions, and tests must be performed to distinguish between them. Signatures of various types of "new physics" can be parameterised into a form useful for making tests and comparing results of different experiments. One such parameterisation is the so-called "Standard Model Extension" of Kostelecky et al.
We propose methods for extracting limits on the strength of various background cosmic fields. We consider the parity-violating interactions of pseudoscalar, pseudovector, and tensor cosmic fields with electrons, protons, and neutrons. Candidates for such fields are dark matter (including axions) and dark energy, as well as several more exotic sources described by standard model extensions.
Certain interactions of static and dynamic background cosmic fields would lead to the mixing of opposite parity states in atoms and molecules. This would, in turn, give rise to observable parity and time-invariance violating effects. The measurement of such effects would shed light on the interactions that gave rise to them. Calculations of parity nonconserving amplitudes and atomic electric dipole moments induced by these fields are performed for several atomic systems. From these calculations, and existing measurements in Dy, Cs, and Tl, we place the first direct constraints on the interaction strengths of electrons, protons, and neutrons with the temporal component of the static pseudovector cosmic field [1,2]. We also derived the relativistic factor for splitting of the g-factors of a fermion and its anti-fermion partner, which is important for placing constraints on dimension-five, CPT-odd interactions. We extract stringent limits on the coupling strengths of this background field to electrons, protons, and muons [3].

1. B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer, and D. Budker. Limiting P-Odd Interactions of Cosmic Fields with Electrons, Protons, and Neutrons. Phys. Rev. Lett. 113, 081601 (2014).

2. B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer, and D. Budker. Parity-violating interactions of cosmic fields with atoms, molecules, and nuclei: Concepts and calculations for laboratory searches and extracting limits [Editors' Suggestion]. Phys. Rev. D 90, 096005 (2014).

3. Y. V. Stadnik, B. M. Roberts, and V. V. Flambaum. Tests of CPT and Lorentz symmetry from muon anomalous magnetic dipole moment. Phys. Rev. D 90, 045035 (2014).

7

AMELIE: An Axion Modulation hELIoscope Experiment

Dr. GALAN, Javier[1]

[1] *University of Zaragoza*

Corresponding Author(s): javier.galan.lacarra@cern.ch

In this work, I will present an innovative idea to search for solar axions using a large volume low background TPC immersed in a magnetic field. This technique will be sensitive to axion masses above few meV in the theoretically favoured QCD-axion parameter space. The detector geometry will be such that will allow to monitor the Solar axion flux during full day. A stationary detector would produce a daily and annual modulation signal pattern given by the angle of the incident axion flux and the TPC magnetic field which is driven by earth rotation. Recent progress on large volume low background TPC's for rare event searches motivates the development of such helioscope technique. The principle of detection and prospects on the sensitivity of such experiment will be shown.

8

A proposal to search for a "dark-omega" vector boson in direct electro-production processes using intense high energy electron beams

Prof. GASPARIAN, Ashot[1]

[1] *NC A&T State University*

Corresponding Author(s): gasparan@jlab.org

We propose to perform new experiments to search for a new vector boson coupled via baryonic current ("dark-omega") in the mass range of [150-600] MeV. This particle, if it exists in nature, will be produced on large-A fixed targets in the forward direction using electron beams with energies up to 11.5 GeV. High intensity and high energy electron beams are well suited for this type of search experiments. The multi-gamma decay of this, yet unknown, particle (VB$\to\pi 0\gamma\to\gamma\gamma\gamma$) can be detected by a high resolution and large acceptance crystal calorimeter (like the existing PrimEx HyCal PbWO4 calorimeter at Jefferson Lab). That will provide a few MeV level resolutions in the proposed multi-photon invariant mass reconstruction process. In this talk the motivation, feasibility studies of the setup and estimation of the realistic parameter space of the proposed experiment will be presented and discussed.

9

Status of preparations for the Phase II of the GERDA experiment aimed for the $0\nu\beta\beta$ decay search

Dr. LUBASHEVSKIY, Alexey[1]

[1] *Max-Planck-Institut für Kernphysik*

Corresponding Author(s): alexey.lubashevskiy@mpi-hd.mpg.de

GERDA is a low background experiment aimed for the neutrinoless double beta-decay search. It is located at the LNGS underground laboratory of INFN in Italy. The search is performed using high purity germanium detectors operated in liquid argon (LAr) that are enriched enriched in 76Ge to 86%. The backgrounds from the detector's surrounding are reduced to a background index of 10ˆ−2 cts/(keV•kg•yr). This is about one order of magnitude better than in predecessor experiments with HPGe detectors. Accumulated statistics allows to derive the most stringent lower limit on the half-life for neutrinoless double beta-decay decay of 76Ge: 2.1•10ˆ25 yr. Currently the preparations for Phase II are ongoing. A LAr scintillation veto has been installed in GERDA. 20 kg of new type BEGe detectors with powerful pulse shape discrimination ability and better energy resolution will be incorporated in the setup soon. We expect that the use of the new active background reduction techniques and cleaner materials would allow us to achieve background

index of 10ˆ−3 cts/(keV•kg•yr) and significantly increase the sensitivity of the experiment. The actual status of the experiment will be presented.

10

Exploring dark matter with AMS through electroweak corrections

Author(s): PELLEN, Mathieu[1]
Co-author(s): ALI CAVASONZA, Leila [1] ; KRÄMER, Michael [1]

[1] *RWTH Aachen*

Corresponding Author(s): pellen@physik.rwth-aachen.de

The AMS experiment is now measuring charged cosmic rays fluxes with an unprecedented precision. It is thus necessary to provide appropriate predictions for dark matter signals. To that end, computing electroweak corrections is an important task. It is particularly relevant for leptophilic models where anti-protons can be produced through the decay of massive gauge bosons. In this talk, we present a new calculation of electroweak radiation for vector dark matter annihilation. From the lack of particular spectral features in the AMS positron flux, we derive upper limits on the annihilation cross section. We furthermore provide predictions for the flux of anti-protons from electroweak radiation, which will be probed by AMS in the future.

11

First results of the CASCADE light shining through a wall experiment

Mr. WOOLLETT, Nathan[1]

[1] *Lancaster University and The Cockcroft Institute*

Corresponding Author(s): n.woollett@lancaster.ac.uk

Light shining through a wall experiments can be used to make measurements of photon-WISP couplings. The first stage of the CASCADE experiment at the Cockcroft Institute of Accelerator Science and Technology is intended to be a proof-of-principle experiment utilising standard microwave technologies to make a modular, cryogenic HSP detector to take advantage of future high-power superconducting cavity tests. In this presentation I will be presenting the first results of the CASCADE LSW experiment showing a best in mass range exclusion.

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New effects of dark matter which are linear in the interaction strength

Prof. FLAMBAUM, Victor[1] ; Mr. STADNIK, Yevgeny[1]

[1] *University of New South Wales*

Corresponding Author(s): v.flambaum@unsw.edu.au

The boson dark matter particles produced after Big Bang may form a Bose condensate and/or topological defects. In contrast to traditional dark matter searches, effects produced by interaction of an ordinary matter with this condensate and defects may be first power in the underlying interaction strength, which is extremely small, rather than the second power or higher.
We discuss new effects and schemes for the direct detection of dark matter, including axions, axion-like pseudoscalar particles (ALPs) and scalar particles, as well as topological defects. Specific effects produced by the particle condensates include: space-time variation of the fundamental constants (fine structure constant alpha, particle masses, etc) including both slow variation (on the cosmological scale) and fast oscillations, oscillating atomic electric dipole moments, precession of electron and nuclear spins about the direction of Earth's motion through an axion/ALP condensate

(the axion wind effect), axion-mediated spin-gravity couplings, and oscillating variations in phase shifts produced in laser/maser interferometers (such as LIGO, Virgo, GEO600 and TAMA300) by a scalar particle condensate. Topological defects (which may also be a part of dark matter) may produce changes in pulsar rotational frequencies (which may have been observed already in pulsar glitches), non-gravitational lensing of cosmic radiation and the time-delay of pulsar signals. Topological defects may also produce transient and correlated observable effects in a global network of atomic clocks, magnetometers (spin precession effects and transient electric dipole moments) and laser/maser interferometers, as well as alter the rate of Earth rotation. The proposed detection methods offer sensitive probes into important, unconstrained regions of dark matter parameter spaces.
References: [1] Y. V. Stadnik and V. V. Flambaum. Phys. Rev. D 89, 043522 (2014). [2] B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer and D. Budker. Phys. Rev. Lett. 113, 081601 (2014). [3] Y. V. Stadnik and V. V. Flambaum. Phys. Rev. Lett. 113, 151301 (2014). [4] B. M. Roberts, Y. V. Stadnik, V. A. Dzuba, V. V. Flambaum, N. Leefer and D. Budker. Phys. Rev. D 90, 096005 (2014). [5] M. Pospelov, S. Pustelny, M. P. Ledbetter, D. F. Jackson Kimball, W. Gawlik, and D. Budker. Phys. Rev. Lett. 110, 021803 (2013). [6] A. Derevianko and M. Pospelov. Nature Physics 10, 933 (2014). [7] Y. V. Stadnik and V. V. Flambaum. arXiv:1412.7801 [8] P.W. Graham, S. Rajendran. Phys. Rev. D84,055013 (2011); D88,035023 (2013).

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Light Dark Matter in the NOvA Near Detector, a first look at the new data.

Dr. HATZIKOUTELIS, Athanasios[1]

[1] *University of Tennessee*

Corresponding Author(s): a.hatzikoutelis@utk.edu

The neutrino oscillations experiment NOvA is the flagship of Fermi National Laboratory. The neutrino source NuMI is delivering record numbers of protons-on-target surpassing the most stringent dark matter production upper limits of current models in the under-10 GeV mass range. We take advantage of the sophisticated particle identification algorithms of the experiment to interrogate the data from the 300-ton, off-axis, low-Z, Near Detector of NOvA during the experiment's first physics runs. We search for signatures of Dark Matter, Axion-like-particles, and Heavy or Sterile Neutrino that may scatter or decay in the volume of the detector.

14

A simplified model interpretation of searches for dark matter at the LHC and with the IceCube Neutrino Observatory

Dr. HEISIG, Jan[1] ; Prof. KRÄMER, Michael[1] ; Prof. WIEBUSCH, Christopher[1] ; Mr. PELLEN, Mathieu[1]

[1] *RWTH Aachen University*

Corresponding Author(s): jan.heisig@desy.de

We present an interpretation of searches for dark matter in a simplified model approach. Considering Majorana fermion dark matter and neutral vector mediators with axial-vector interaction we compare the limits obtained in mono-jet searches at the LHC with limits on the spin-dependent scattering cross-section set by the IceCube collaboration. We discuss the dependence of the search sensitivity to the mediator mass and place new limits on the parameter space of this model.

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New axion and hidden photon constraints from a solar data global fit

Author(s): Mrs. VINYOLES VERGÉS, Núria[1]

Co-author(s): Dr. SERENELLI, Aldo [1] ; Dr. VILLANTE, Francesco [2] ; Dr. BASU, Sarbani [3] ; Dr. REDONDO, Javier [4] ; Dr. ISERN, Jordi [1]

[1] *Institute of Space Sciences (CSIC-IEEC)*

[2] *Istituto Nazionale di Fisica Nucleare (INFN), Laboratori N azionali del Gran Sasso (LNGS)*

[3] *Department of Astronomy, Yale University*

[4] *Departamento de F ´ısica Te ´orica, Facultad de Ciencias, Universidad de Zaragoza*

Corresponding Author(s): vinyoles@ice.cat

I will present the results of a our last paper that presents a new statistical analysis that combines helioseismology sound speed,surface helium and convective radius) and solar neutrino observations (boron and beryllium fluxes) to place upper limits to the properties of non standard weakly interacting particles. Our analysis includes theoretical and observational errors, accounts for tensions between input parameters of solar models and can be easily extended to include other observational constraints. We present two applications to test the method: the well studied case of axions and axion-like particles and the more novel case of low mass hidden photons. For axions we obtain an upper limit at 3σ for the axion-photon coupling constant of gaγ<4·10−10 GeV−1. For hidden photons we obtain the most restrictive upper limit for the product of the kinetic mixing and mass of χm < 1.82·10−12 eV at 3σ. Both cases improve the previous solar constraints based on the Standard Solar Models showing the power of our global statistical approach.

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A prototype detector for axion in space in X-rays

Author(s): Mr. ZHAO, Hao[1]
Co-author(s): Dr. CUI, Xingzhu [1] ; Prof. HUANYU, Wang [1]

[1] *Particle Astrophysics Division,Institute of High Energy Physics,CAS*

Corresponding Author(s): zhaohao@ihep.ac.cn

To describe spontaneous breaking of continuous Peccei-Quinn symmetry, axion has been brought up for several decades. Also it has been established as a prominent cold dark matter candidate. Much effort has been done on ground base to detect the regenerated photons lies in the soft X-ray region associated with this mysterious particle, such as CAST, IXAO etc. It is generally understood that axion can be produced inside the sun via Primakoff effect. The solar outstreaming axion would experience the conversion in the solar magnetic fields, which makes it possible to detect the axion indirectly in space. Here we present a prototype instrument with three detectors with energy range of 0.4˜20 keV onboard a Chinese Cube-satellite. These three detectors are aligned in 32' interval, with the middle one pointing to the sun and the other two are collimated to the limb of the sun.

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Parameters of the astrophysically motivated axion-like particle.

Prof. TROITSKY, Sergey[1]

[1] *INR, Moscow*

Corresponding Author(s): st@ms2.inr.ac.ru

Recent astrophysical results suggest that axion-like particles (ALPs) may be favored by the observational data. We give a quantitative comparison of various ALP scenarios, in view of astrophysical data, determine favored regions in the ALP parameter space and outline future observations which may help to distinguish between scenarios.

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Status of the ANAIS dark matter project at the Canfranc underground laboratory

Dr. CEBRIAN, Susana[1]

[1] *University of Zaragoza*

Corresponding Author(s): scebrian@unizar.es

The ANAIS (Annual Modulation with NaI(Tl) Scintillators) experiment aims at the confirmation of the DAMA/LIBRA signal using the same target and technique at the Canfranc Underground Laboratory. Two NaI(Tl) crystals of 12.5 kg each, grown by Alpha Spectra from a powder having a potassium level under the limit of the analytical techniques, form the ANAIS-25 set-up. A detailed analysis of ANAIS-25 data will be presented: MC simulations reproduce very satisfactorily the measured background, effective threshold at 1 keVee is at reach, robust PMT noise filtering protocols have been developed, the bulk content in the crystals of potassium as well as of uranium and thorium radioactive chains has been quantified and cosmogenic activation of NaI(Tl) has been evaluated for the first time. Very preliminary results of a new 12.5 kg NaI(Tl) detector, received at LSC in the first week of March 2015, and installed together with the two previous modules forming the ANAIS37 set-up, will be presented. Finally, background prospects and expected sensitivity for the set-up with 250 kg will be shown and the status of the full ANAIS experiment will be reviewed.

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Light collection in the prototypes of the ANAIS dark matter project

Dr. CEBRIAN, Susana[1]

[1] *University of Zaragoza*

Corresponding Author(s): scebrian@unizar.es

The ANAIS (Annual Modulation with NaI(Tl) Scintillators) experiment aims at the confirmation of the DAMA/LIBRA signal using the same target and technique at the Canfranc Underground Laboratory. The ANAIS-25 set-up consisted of two NaI(Tl) crystals of 12.5 kg each. It has been taking data since 2012 in order to measure the internal contamination of the NaI(Tl) crystal and assess the performance of the detectors. A new crystal with expected better internal background was received in 2015, forming the ANAIS-37 set-up. The Single Electron Response (SER) data extracted from both set-ups on underground site and along normal operation have been compared with the SER characterization of the photomultipliers previously performed at Zaragoza and the total light collection has been computed for all modules. An excellent result of ˜15 phe/keV can be reported for the three modules, having this figure a good impact in both resolution and energy threshold. An energy threshold at 1 keVee is at reach, which would significantly improve the sensitivity of the ANAIS Project in the search for the annual modulation effect in the WIMPs signal.

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Background model of NaI(Tl) detectors for the ANAIS dark matter project

Dr. CEBRIAN, Susana[1]

[1] *University of Zaragoza*

Corresponding Author(s): scebrian@unizar.es

A thorough understanding of the background sources is mandatory in any experiment searching for rare events like the direct interaction of dark matter. The ANAIS (Annual Modulation with NaI(Tl) Scintillators) experiment intends to confirm the DAMA/LIBRA signal using the same target and technique at the Canfranc Underground Laboratory. Data have been taken for more than two years with two NaI(Tl) crystals of 12.5 kg each produced by Alpha Spectra in the so-called ANAIS-25 set-up. The construction of the complete background model of these detectors will be described; it is based on the analysis of all the collected data together with Monte Carlo simulations and the results of the radioassay of components. The background in the region of interest is dominated by crystal contributions; corresponding activities from 40K, 232Th and

238U chains, including an important amount of 210Pb out of equilibrium, and cosmogenic isotopes have been precisely quantified thanks to the combination of different techniques (Pulse Shape Discrimination, coincidence techniques, ...). Although the measured potassium content (at a level of 40 ppb) is significantly lower than in previous prototypes of ANAIS, a further reduction has been attempted together with the suppression of the 210Pb contamination, in a new 12.5 kg crystal received at Canfranc in March, 2015. First background analysis of the new detector (ANAIS-37 set-up) will be shown too. Finally, the expected background in the whole ANAIS set-up using 250 kg of NaI(Tl) will be presented, according to Monte Carlo simulation considering as input the background components quantified in the prototypes.

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Proposal to detect axionic dark matter via their coherent interaction with intrinsic spin

Author(s): Dr. ORTOLAN, Antonello[1]
Co-author(s): Prof. CARUGNO, Giovanni [2] ; Dr. RUOSO, Giuseppe [3] ; Prof. SPEAKE, Clive [4]

[1] *INFN- Nat. Labs of Legnaro*

[2] *University of Padova and INFN*

[3] *INFN Nat. Labs of Legnaro*

[4] *University of Birmingham*

Corresponding Author(s): ortolan@lnl.infn.it

We present the research and development program that is underway at National Laboratories of Legnaro and University of Padova which aims to search for axionic dark matter in the range around 100 micro eV. The work is currently funded by INFN. We are investigating the possibility of exploiting the interaction of dark matter axions with the polarized spins in ferromagnetic or paramagnetic resonant systems. We briefly discuss the theoretical basis of this approach, the expected signal to noise ratio and the potential for detection of such a scheme. We hope to be able to present our preliminary experimental work at the time of the conference.

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Indirect dark matter searches with MAGIC telescopes

SATALECKA, Konstancja[1]

[1] *UCM, Spain*

Corresponding Author(s): satalk@gae.ucm.es

A major open question for modern physics is the nature of dark matter: strong experimental evidences suggest the presence of this elusive component in the energy budget of the Universe, without, however, being able to provide conclusive results about its nature. In the last few years the indirect DM searches became a hot topic, with several experimental results (e.g. Fermi, PAMELA) showing hints of DM signal. The Major Atmospheric Gamma Imaging Cherenkov (MAGIC) telescopes are two 17 m diameter Cherenkov telescopes, located on the Canary island La Palma (Spain), with an optimal view on the Northern sky. It is nowadays one of the few ground-based instruments able to measure high-energy gamma-rays below 100 GeV. MAGIC carries out a broad DM search program, including observations of dwarf galaxies, galaxy clusters and other DM dominated objects. In this talk we will present recent MAGIC results in this field. We will discuss them in a broader context, giving an brief overwiev of the present and future of DM searches with Cherenkov telescopes.

23

Searches for resonant absorption of solar axions by ^{169}Tm and ^{83}Kr nuclei.

Author(s): Prof. DERBIN, Alexander[1] ; Dr. MURATOVA, Valentina[1]

Co-author(s): Dr. GANGAPSHEV, Albert [2] ; Dr. NAGORNY, Sergey [3] ; Prof. PIRRO, Stefano [4] ; Dr. PATTAVINA, Luca [4]

[1] *Petersburg Nuclear Physics Institute*

[2] *Institute of Nuclear Research, RAS*

[3] *Gran Sasso Science Institute*

[4] *Laboratori Nazionali del Gran Sasso*

Corresponding Author(s): derbin@pnpi.spb.ru

A search for resonant absorption of the solar axion by ^{83}Kr nuclei was continued using the proportional counter installed inside the low-background setup at the Baksan Neutrino Observatory. The obtained model independent upper limit on the combination of isoscalar and isovector axion-nucleon couplings $|g_3 - g_0| \leq 1.29 \times 10^{-6}$ allowed us to set the new upper limit on the KSVZ axion mass of $m_A \leq 100$ eV (95\% C.L.) with the generally accepted values S=0.5 and z=0.56. An experiment on search for resonant absorption of solar axions by ^{169}Tm-containing crystal have been started. The crystals were grown in the Novosibirsk State University. Testing of bolometric properties of the crystals are performing at LNGS. If the scheme of experiment – detector + target - will be replaced by Tm- bolometer, the sensitivity of experiment can be increased in 10^5 times in comparison with the existing results.

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Cavity-based Axion and WISP experiments at the University of Western Australia

Author(s): Prof. TOBAR, Michael[1]
Co-author(s): Dr. PARKER, Stephen [1] ; Mr. MCALLISTER, Ben [1] ; Prof. IVANOV, Eugene [1]

[1] *The University of Western Australia*

Corresponding Author(s): michael.tobar@uwa.edu.au

We report on the progress of attempting to verify recent claims of a possible 0.11 meV axion signal (˜26 GHz) and discuss the feasibility of using readily available tools to perform a very narrowband Haloscope-style experiment to check for such an axion signal.
Also, we outline the principles of the cross-spectrum measurement technique whereby two spectrums are cross-correlated together, allowing for rejection of uncorrelated noise processes. We apply these concepts to microwave cavity-based searches for axions, such as the Haloscope style experiment, and WISPs, such as hidden sector photon light-shining-through-a-wall. We discuss how such techniques can be used to enhance these experiments.

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New results from the Yale Microwave Cavity Experiment

Author(s): BAKER, Oliver Keith[1]
Co-author(s): HIRSHFIELD, Jay [1] ; JIANG, Y. [1] ; MALAGON, Ana [2] ; MARTIN, Andrew [1] ; SHCHELKUNOV, S [1] ; SLOCUM, Penny [1] ; SZYMKOWIAK, Andrew [1]

[1] *Yale University*

[2] *University of Washington*

Corresponding Author(s): oliver.baker@yale.edu

We have performed a sensitive search for axions and axion-like particles near one-tenth of an meV mass (34 GHz) using a cryogenic microwave cavity immersed in a seven Tesla magnetic field, and a sensitive triple-heterodyne receiver. Results of this pilot experiment will be presented, along with future plans.

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Hints of ALPs from the sky?

Dr. GIANNOTTI, maurizio[1]

[1] *Barry Universtiy*

Corresponding Author(s): mgiannotti@barry.edu

I will review some of the recent bounds on axion-like particles (ALPs) from stellar evolution. In most cases, these bounds improved only marginally on the previous results, showing instead a little preference for new physics with couplings accessible by proposed experiments, particularly IAXO. I will briefly discuss the statistical significance of these hints and the need to understand better the source of possible systematics. Though individually each single hint is statistically weak, globally these results point to some particularly interesting regions in the ALP parameter space which could be accessed by the next generation ALP detectors.

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Axions and CMB spectral distortions in cosmic magnetic field

Dr. EJLLI, Damian[1]

[1] *Laboratori Nazionali del Gran Sasso*

Corresponding Author(s): damian.ejlli@lngs.infn.it

I will discuss the impact of photon-axion mixing on distorting the CMB spectrum. Limits on the axion mass and stochastic magnetic fields are discussed.

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Low background single photon detection with a transition edge sensor for ALPS II

Author(s): Ms. BASTIDON, Noëmie[1]
Co-author(s): Prof. HORNS, Dieter [1] ; Dr. LINDNER, Axel [2]

[1] *Hamburg University*

[2] *DESY*

Corresponding Author(s): noemie.bastidon@desy.de

The ALPS II experiment, Any Light Particle Search II at DESY in Hamburg, will look for light (m < 10−4 eV) new fundamental bosons (e.g., axion-like particles, hidden photons and other WISPs) in the next years by the means of a light-shining-through the wall setup. A few years ago, its predecessor had constrained the coupling to photons of axion-like particles (ALPS) to gaγ ≤ 7 • 10−8 GeV − 1, m ≤ 10−4 eV. Several improvements are foreseen to reach much better sensitivities (gaγ ≤ 7 • 10 −11 GeV −1). One of the main modifications which has been done is the substitution of the CCD camera by two microcalorimetric W-TESs (Transition Edge Sensors with tungsten chips). These TESs, operated at 80 mK have already allowed single infrared photons detections as well as non-dispersive spectroscopy with very low background rates. The detection efficiency for such TES is > 95 % and the dark count rate < 10-2 s-1 for 1064 nm photons. At this wavelength, the intrinsic dark count rate is of 10-4 sec-1. The relative energy resolution for 1064 nm signals is < 8%. In order to bias accurately the device and for reading purposes, TESs are inductively coupled to a SQUID (Superconducting Quantum Interference Device). In the near future, complete characterization, calibration and optimization (e.g., background suppression) need to be finalized. The latest progress in this task will be presented as well as next steps planned for future developments.

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Spin-axion interactions

Dr. POPOV, Vladimir[1]

[1] *Kazan Federal University*

Corresponding Author(s): vladipopov@mail.ru

Spontaneous breaking of Peccei-Quinn symmetry provides axion interactions with photons, gluons and fermions. Searching for the axions is primarily based on an axion-photon interaction. The last two interactions lead to the axion coupling with an electric dipole moment and a magnetic moment of the ordinary particles. We simulate this coupling in a phenomenological way using a relativistic covariance. The spin-axion interaction include compositions of the spin four-vector with the axion field and its gradient. Evidences of the spin-axion coupling are discussed in the astrophysical context. Possible terrestrial experiments based on a spin precession induced by the axions are considered.

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Running in the Dark Sector

Author(s): Dr. DAVOUDIASL, Hooman[1]
Co-author(s): Dr. MARCIANO, William [1]

[1] *BNL*

Corresponding Author(s): hooman@bnl.gov

The dark photon can become effectively invisible if it primarily decays into light dark matter states. Such a scenario may allow for production and detection of these states at fixed target experiments. We point out that in the presence of the light states, the dark U(1) coupling constant may exhibit significant running, as a function of momentum transfer, over the kinematic range of the experiments. In typical models, an associated running is also induced in the kinetic mixing parameter that connects the dark and the visible sectors. The combined running of these parameters could probe the spectrum of light dark particles and also substantially modify some existing predictions for the above experiments. We also outline theoretical considerations that can imply upper bounds on the low energy value of the dark U(1) coupling.

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Second Stage of WISPDMX Measurements

Author(s): Dr. LOBANOV, Andrei[1]
Co-author(s): Prof. HORNS, Dieter [1] ; Dr. LINDNER, Axel [2] ; NGUYEN, Le Hoang [1] ; Dr. RINGWALD, Andreas [2]

[1] *University of Hamburg*

[2] *DESY, Hamburg*

Corresponding Author(s): andrei.lobanov@desy.de

Weakly interactive slim particles (WISP), including the QCD axion, axion-like particles (ALP), and hidden photon, are considered to be strong candidates for the dark matter carrier particle. The microwave cavity experiment WISPDMX is the first direct WISP dark matter search experiment probing the particle masses in the 0.8-2.0 micro-eV range. The first stage of WISPDMX measurements made at nominal resonant frequencies of the cavity constrains the kinetic mixing angle of hidden photons well inside the region of the parameter space where hidden photons can constitute the dark matter. The second and third stages of WISPDMX are presently being prepared. At these stages, WISPDMX will employ cavity tuning and a strong magnet to probe up to 80% of the 0.8–2 micro-eV range and to extend the searches also to axions. The results from the first stage of WISPDMX measurements and the preparations for the successive stages will be described.

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Status of the CRESST-II Experiment for Direct Dark Matter Search

Ms. MUENSTER, Andrea[1]

[1] *TU Muenchen*

Corresponding Author(s): andrea.muenster@ph.tum.de

The direct dark matter search experiment CRESST-II uses scintillating CaWO4 single crystals as targets for possible scattering of Weakly Interacting Massive Particles (WIMPs). The simultaneous measurement of scintillation light and phonons produced in the crystal by a particle interaction allows a suppression of most of the background. Most of the remaining background in the previous phase 1 (2009-2012, G. Angloher et al., Eur. Phys. J. C v.72 nr4 (2012)) originated from alpha-decays in non-scintillating materials in the vicinity of the CaWO4 crystals. Therefore, in the currently ongoing phase 2 six detector modules equipped with an active veto for such events are installed. In this contribution we will present the results achieved by one of these fully scintillating detector modules using 29 kg days of data taken in 2013 (G. Angloher et al., Eur. Phys. J. C v.74 nr.12 (2014)). A new limit on the elastic WIMP-nucleon scattering cross-section for WIMPs lighter than 3GeV/c^2 could be set. The upcoming experiment CRESST-III will focus on the investigation of the low-mass WIMP regime. The status of the preparations and prospects for CRESST-III will be presented.

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ALPs explain the unphysical redshift-dependence of blazar spectra

Author(s): Dr. RONCADELLI, Marco[1]
Co-author(s): Dr. GALANTI, Giorgio [2] ; Prof. DE ANGELIS, Alessandro [3] ; Prof. BIGNAMI, Giovanni [4]

[1] *INFN - Pavia*

[2] *Universita' dell'Insubria*

[3] *INFN - Padova*

[4] *INAF*

Corresponding Author(s): marco.roncadelli@pv.infn.it

So far about 41 blazars have been detected with the IACTs and their emitted energy spectra analyzed. They differ from the observed ones because of photon absorption due to the EBL. It turns out that the most energetic emitted spectra belong to the most distant blazars, and so their lack at smaller distances looks unphysical, since no conventional explanation works. Yet, the existence of ALPs yields a simple way out of this conundrum for realistic values of the model parameters, provided they oscillate to photons in extragalactic magnetic fields in the 0.1 nG range. As a consequence, blazars with very energetic emitted spectra are present at any distance, as naturally expected. Remarkably, for the same choice of the ALP properties also two other puzzling astrophysical effects are naturally explained. Both ALPS II and the CTA will be able to check our prediction.

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Any Light Particle Search II

Ms. BASTIDON, Noëmie[1]

[1] *Hamburg University*

Corresponding Author(s): noemie.bastidon@desy.de

Any Light Particle Search II (ALPS II) experiment (DESY, Hamburg) searches for photon oscillations into WISPs. This second generation of the ALPS light-shining-through-a-wall (LSW) experiment approaches the finalization of the preparation phase before ALPS IIa (search for hidden photons).
In the last years, efforts have been put for the setting up of two optical cavities as well as characterization of a single-photon transition-edge sensor (TES) detector. Such detectors have showed excellent results in infrared single-photon detections with a detection efficiency higher than 95% and an intrinsic dark count rate of 1.0·10-4 sec-1 for 1064 nm photons.

In parallel, the setting up of ALPS IIc (search for axion-like particles), including the unbending of 20 HERA dipoles, have been pursued.
The latest progress in these tasks will be presented.

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The DEAP-3600 Search for Dark Matter

Mr. BUTCHER, Alistair[1]

[1] *Royal Holloway - University of London*

Corresponding Author(s): alistair.butcher.2010@live.rhul.ac.uk

DEAP-3600 is a single phase dark matter direct detection experiment at SNOLAB, Ontario, Canada. DEAP-3600 has been designed to achieve extremely low background rates, including those from 39Ar β decays, neutron scatters, and surface ∝ contamination, with the goal of measuring the spin-independent WIMP-nucleon cross section down to 1E−46 cmˆ2 for a 100 GeV WIMP. An overview of the experiment will be presented with updates on the current status of calibration and data taking.

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Comissioning of TREX-DM, a low background Micromegas-based TPC for low mass WIMP detection

Author(s): Dr. IGUAZ GUTIERREZ, Francisco Jose[1]
Co-author(s): Mr. GRACIA GARZA, Javier [1] ; Dr. GARCIA IRASTORZA, Igor [1]

[1] *University of Zaragoza*

Corresponding Author(s): iguaz@unizar.es

Dark Matter experiments are recently focusing their detection techniques in low-mass WIMPs, which requires the use of light elements and low energy threshold. In this context, we describe the TREX-DM experiment, a low background Micromegas-based TPC for low-mass WIMP detection. Its main goal is the operation of an active detection mass ∼0.300 kg, with an energy threshold below 0.4 keVee and fully built with previously selected radiopure materials. This work focus on the commissioning of the actual setup situated in a laboratory on surface. We also describe the updates needed for a possible physics run at the Canfranc Underground Laboratory in 2016. A preliminary background model of TREX-DM is also presented, based on Geant4 simulations and two discrimination methods: a conservative muon/electron and one based on a 252Cf source. Based on this background model, TREX-DM could be competitive in the search for low mass WIMPs. In particular it could be sensitive, e.g., to the low mass WIMP interpretation of the DAMA/LIBRA and other hints in a conservative scenario.

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Recent results from the EDELWEISS-III WIMP search experiment

Dr. DE JESUS, Maryvonne[1]

[1] *IPNL*

Corresponding Author(s): j.gascon@ipnl.in2p3.fr

The EDELWEISS experiment is dedicated to the direct detection of Dark Matter. The current setup – EDELWEISS-III – aims at exploring a spin-independent WIMP-nucleon cross section down to the 10ˆ-9 pb range, and extend the coverage for masses below 20 GeV. Since July 2014, the collaboration is taking data with 24 state-of-the-art cryogenic FID800 Germanium detectors installed in the radio pure environment of the Modane underground laboratory - the deepest of its kind in Europe. In this talk I will present the current status of the EDELWEISS-III experiment and show first preliminary results highlighting our new low WIMP mass analysis and the current background budget.

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Laboratory Search for New Spin-Dependent Interaction : Axion Resonant Interaction Detection Experiment (ARIADNE)

Dr. SHIN, YUNCHANG[1]

[1] *CENTER FOR AXION AND PRECISION PHYSICS RESEARCH (CAPP) /INSTITUTE FOR BASIC SICENCE (IBS)*

Corresponding Author(s): yunshin@ibs.re.kr

Axions are light pseudoscalar particles originally proposed by Peccei and Quinn (PQ) to explain the strong CP problem in QCD [1]. Axions could be a possible component of cold dark matter if their mass is in very light regime. Direct search of axions dark matter is the object of current experiment at the Center for Axion and Precision Physics (CAPP), Institute for Basic Science (IBS). This experiment involves axion to photon conversion in a resonant cavity [2]. In addition, Axions and other axion-like particles (ALP) would mediate spin-dependent interactions in macroscopic scale [3]. A precision experiment that can detect axions by measuring spin-dependent interactions in very short range has been recently proposed from ARIADNE collaboration [4]. The experiment includes high sensitivity SQUID NMR with polarized ^{3}He nuclei using the metastability-exchange optical pumping (MEOP) method and a radially slotted tungsten as unpolarized source mass to induce a resonant monopole-dipole interaction. With proper magnetic shielding, it will resonantly enhance the effective magnetic field signal from the spin-dependent interaction mediated by axion. The proposed experiment can look into axions in their mass range between 10^{-5} eV to 10^{-2} eV which is very complementary with our experimental search of axions with resonant cavity. We describe the experimental plan including ^{3}He optical pumping system at CAPP, IBS.
[1] R. D. Peccei and H. R. Quinn, Phys. Rev. Lett. 38, 1440 (1977). [2] P. Sikivie, Phys. Rev. Lett, 51,1415, (1983). [3] J. E. Moody and F. Wilczek, Phys. Rev. D 30, 130 (1984). [4] A. Arvanitaki and A. Geraci, Phys. Rev. Lett. 113, 161801 (2014).

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Receiver electronics for axion experiment at CAPP/IBS

Mr. CHANG, Seung Pyo[1]

[1] *CAPP/KAIST*

Corresponding Author(s): koreanbr1@kaist.ac.kr

The Center for Axion and Precision Physics (CAPP), in the Republic of Korea, aims to do an axion search by detecting the extremely weak signal generated by the axion in a magnetic field using a resonant cavity. The output of the cavity will go to a preamplifier inside the cryostat in as close a proximity to the cavity as possible. Once the signal exits the cryostat it is then sent to room temperature signal processing electronics, which is basically a direct conversion RF receiver. The RF receiver electronics consist of filters, mixers, amplifiers and couplers. The characterization of each component of the RF receiver electronics is essential for identifying the sources of unexpected features that might appear in the signal and determining how the design can be altered to mitigate them. The measurement efforts for understanding the RF properties of each component will be summarized and presented, as well as the discussion on their effects on cavity axion experiments.

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The Coldest Axion Experiment at CAPP/IBS/KAIST in Korea

Dr. CHUNG, Woohyun[1]

[1] *CAPP/IBS*

Corresponding Author(s): gnuhcw@ibs.re.kr

The axion, a hypothetical elementary particle arising from Peccei-Quinn solution to the strong-CP problem, is a well-motivated dark matter candidate. The IBS Center for Axion and Precision Physics (CAPP) in Korea will explore the dark matter axion using a method suggested by P. Sikivie, converting the axions into microwave photons in a resonant cavity permeated by a strong magnetic field. CAPP's first microwave axion experiment in an ultra-low temperature setup is being launched at KAIST (Korea Advanced Institute of Science and Technology) campus this summer, utilizing top of the line equipment and technology. I will discuss the progress and future plans of the axion experiment.

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Cylindrical cavity simulation for searching axions

Mr. LEE, Doyu[1]

[1] *KAIST/CAPP*

Corresponding Author(s): du568@kaist.ac.kr

Axion is an excellent candidate for cold dark matter. In 1983, Sikivie proposed the scheme to detect axions using resonant cavity inside high magnetic field [1]. In order to detect axions in his scheme, we need to scan a range of resonant frequencies of the cavity where the converted photon signal gets enhanced. This poster presents the ways to design a frequency tuning system with conducting and dielectric materials inside the cavity. The simulation software package, COMSOL Multiphysics was used to evaluate the effects on Q-factor and form factor with different configurations and materials.

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The CAST-CAPP Experiment: Haloscope Axion Searches with the CAST Dipole Magnet.

Dr. MICELI, Lino[1]

[1] *IBS Center for Axion and Precision Physics*

Corresponding Author(s): lmiceli@kaist.ac.kr

The CAST-CAPP Experiment: Haloscope Axion Searches with the CAST Dipole Magnet. Lino Miceli IBS Center for Axion and Precision Physics Research (CAPP) Korea Advanced Institute of Science andTechnology Daejeon, Republic of Korea
The CAST-CAPP experiment is a joint effort between the CERN Axion Solar Telescope (CAST) collaboration [1] and the Center for Axion and Precision Physics Research (CAPP). The CAPP, located at the Korea Advanced Institute of Science and Technology (Daejeon, South Korea), focuses on two key issues of contemporary physics: the nature of dark matter [DM], and the origin of the matter anti-matter asymmetry of our universe. The nature of DM is investigated through a comprehensive QCD-axion search program including this experiment. Tunable rectangular cavities will be inserted in the 43 mm twin-bore, 9T, CAST dipole magnet. This will be the first time in which the traditional haloscope technique [2] will be applied in rectangular, rather than cylindrical, geometry. The cavity operational frequency will be in the ˜5 to 6 GHz range, corresponding to an axion mass of ˜21 to 25 [U+F06D]eV. The CAST-CAPP experiment sensitivity could reach into the QCD axion parameter space in this yet unexplored mass region.
[1] CAST Collaboration, K. Zioutas et al., Phy. Rev. Lett. 94 (2005) 121301. [2] P. Sikivie, Phys. Rev. Lett. 51, 1415 (1983).

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The Optimization of Uniform Magnetic Field for an Experimental Search for Axion-mediated Spin-Dependent Interaction

Mr. KIM, Dong-Ok[1]

[1] *CAPP/KAIST*

Corresponding Author(s): physicist@kaist.ac.kr

Possible interaction between unpolarized and polarized nuclei in short range may provide a new source for parity (P) and time-reversal (T) symmetry violation [1]. Moody and Wilczek proposed that such forces might be mediated by pseudoscalar bosons like Peccei-Quinn (PQ) axion or axion-like particle (ALP) [2]. A new idea of tabletop experiment searching for such spin-dependent interaction has been recently proposed from ARIADNE collaboration. This experiment includes high sensitivity SQUID NMR with Helium-3 nuclei polarized using the metastability-exchange optical pumping (MEOP) method. MEOP allows the polarization of Helium-3 nuclei in low pressure using a uniform magnetic field and circularly polarized light [3]. We describe semi-analytical approach to generate uniform magnetic field to preserve polarization with a number of Helmholtz Coils compared with a simulation result from the finite element method (FEM).
References [1] J. E. Moody and Frank Wilczek, Phys. Rev. D 30, 130 (1984) [2] R. D. Peccei and Helen R. Quinn, Phys. Rev. Lett. 38, 1440 (1977) [3] Asimina Arvanitaki and Andrew A. Geraci, Phys. Rev. Lett. 113, 161801 (2014)

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Search for axion-like particle signatures in the gamma-ray spectrum of NGC 1275

MEYER, Manuel[1]

[1] *Stockholm University*

Corresponding Author(s): manuel.meyer@fysik.su.se

Axion-like particles (ALPs) occur in a variety of extensions of the Standard Model and are a viable candidate for a constituent of dark matter. ALPs are predicted to couple to photons in external magnetic fields and thus could leave an imprint on gamma-ray spectra. Around the critical energy for photon-ALP conversions, oscillatory features together with a decrease of the photon flux are expected. Especially sources located in galaxy clusters are well suited for searches of these spectral features as galaxy clusters are known to harbor magnetic fields over large spatial extensions. One particular example is the radio galaxy NGC1275 at the center of the Perseus cluster: the value of the central cluster magnetic field is high (of the order of 10μG) and the source is bright in the energy range covered with the Large Area Telescope (LAT) on board the Fermi satellite.
Here, we present the expected sensitivity of the Fermi LAT to the detection of the spectral features. The analysis makes use of the latest instrumental response functions and a detailed modelling of the turbulent cluster magnetic field. For ALP masses between 1 and 10 neV, the Fermi-LAT measurements are expected to be more sensitive than future laboratory searches and might be able to probe optimistic models of ALP dark matter.

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Last results from the OSQAR experiment for the search of Axion like particle and short term perspective for Chameleons

Dr. SULC, Miroslav[1]

[1] *Technical University of Liberec*

Corresponding Author(s): miroslav.sulc@tul.cz

The last results and near future plans of the OSQAR experiment at the low energy frontier, i.e. sub-eV range, will be presented. The OSQAR-LSW experiment dedicated to axion like particle search from Light Shining through Wall have been run in 2014 with an unprecedented sensitivity

using two spare LHC dipole. The number of incident photons as well as the photon detection efficiency has been increased by using an 18.5 W DC laser and a state-of-the art CCD, respectively. Moreover a new statistical data analysis has been developed. All these improvements have led to new exclusion limits for the di-photon couplings for both scalar and pseudo-scalar particles. The OSQAR-CHASE experiment will look for chameleons, i.e. particles with environment-dependent mass, from the search of a magnetic afterglow effect due to the possible coupling of chameleons to photons. Simulation results from the preparatory phase as well as preliminary data will be presented.

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Experimental efforts at CAPP related to the axion issues and the strong CP problem

Prof. SEMERTZIDIS, Yannis[1]

[1] *CAPP/IBS and KAIST*

Corresponding Author(s): yannis@kaist.ac.kr

The Center for Axion and Precision Physics research (CAPP) of the Institute for Basic Science (IBS) at the KAIST campus of South Korea is making a comprehensive effort towards resolving the issues related to axions and the strong CP-problem. Already a number of projects are either in the construction phase or in the design phase, promising an exciting decade in axion physics. I will provide an overview of the experiments under preparation by CAPP scientists.

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Composite Dark Sectors

Author(s): Dr. CARMONA, Adrian[1]
Co-author(s): Dr. CHALA, Mikael [2]

[1] *ETH Zürich*

[2] *DESY Hamburg*

Corresponding Author(s): carmona@itp.phys.ethz.ch

We introduce a new paradigm in Composite Dark Sectors, where the full Standard Model (including the Higgs boson) is extended with a strongly-interacting composite sector with global symmetry group G spontaneously broken to H⊂G. We show that, under well-motivated conditions, the lightest neutral pseudo Nambu-Goldstone bosons are natural dark matter candidates for they are protected by a parity symmetry not even broken in the electroweak phase. These models are characterized by only two free parameters, namely the typical coupling gD and the scale fD of the composite sector, and are therefore very predictive. We consider in detail two minimal scenarios, SU(3)/[SU(2)×U(1)] and [SU(2)×SU(2)xU(1)]/[SU(2)×U(1)], which provide a dynamical realization of the Inert Doublet and Triplet models, respectively. We show that the radiatively-induced potential can be computed in a five-dimensional description with modified boundary conditions with respect to Composite Higgs models. Finally, the dark matter candidates are shown to be compatible, in a large region of the parameter space, with current bounds from dark matter searches as well as electroweak and collider constraints on new resonances.

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Mixed axion/axino dark matter in R-parity violating Supersymmetry and X-ray lines

Dr. UBALDI, Lorenzo[1] ; Prof. DREINER, Herbert[2] ; Mr. COLUCCI, Stefano[2] ; Dr. FLORIAN, Staub[3]

[1] *Raymond and Beverly Sackler School of Physics and Astronomy, Tel-Aviv University*

[2] *Universität Bonn*

[3] *Theory Division, CERN*

Corresponding Author(s): colucci@th.physik.uni-bonn.de

The axion is a well-known cold dark matter (CDM) candidate. Its fermionic partner in supersymmetry, the axino, can also be stable on cosmological times and if its mass is of order keV, if it is a warm dark matter (WDM) candidate. Assuming that the Peccei-Quinn (PQ) phase transition happens after the end of inflation, the mixed axion CDM / axino WDM scenario can only be realized for $10^{10} < f_a/\mathrm{GeV} < 10^{11}$, with f_a the PQ scale. This combination is particularly interesting in the context of R-parity violating (RPV) supersymmetric models for two reasons: (a) they would otherwise lack a dark matter candidate, and (b) the keV axino can decay, with a lifetime much longer than the age of the universe, into a photon and a neutrino and produce an X-ray signal. In this work, we study a supersymmetric model with a baryon triality discrete symmetry, in which we introduce a DFSZ axion superfield. We embed the model in supergravity, parametrize supersymmetry breaking with soft terms, determine under which conditions the model is cosmologically acceptable and provide three benchmark points which would result in potentially detectable X-ray lines from axino decays.

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Data Analysing and Preliminary Result From The Second Stage of WISPDMX

Mr. NGUYEN, Le Hoang[1]

[1] *Uni Hamburg*

Corresponding Author(s): le.hoang.nguyen@desy.de

Weakly interactive slim particles (WISP), including the QCD axion, axion-like particles (ALP), and hidden photon, are considered to be strong candidates for the dark matter carrier particle. The microwave cavity experiment WISPDMX is the first direct WISP dark matter search experiment probing the particle masses in the 0.8-2.0 micro-eV range. The first stage of WISPDMX measurements made at nominal resonant frequencies of the cavity constrains the kinetic mixing angle of hidden photons well inside the region of the parameter space where hidden photons can constitute the dark matter. The second and third stages of WISPDMX are presently being prepared. At the second stages, WISPDMX will employ cavity tuning and a strong magnet to probe up to 80% of the 0.8–2 micro-eV range. The data transfer and analysing are having an upgrade from the first stage with the frequency calibration to ensure the high quality data sufficient for the goal of second stage. The results from the first stage of WISPDMX and preliminary result of the second stage will be described.
Authors:
Dieter Horns (1), Axel Lindner (2), Andrei Lobanov (1,3), Le Hoang Nguyen (1), Andreas Ringwald (2)
1 - University of Hamburg, Luruper Chausee 149, 22761 Hamburg, DE 2 - Deutches Elektronen Synchrotron (DESY), Notkestrasse 85, 22607 Hamburg, DE 3 - Max-Planck-Insitute for Radioastronomy, Auf dem Huegel 69, 53121, Bonn, DE
Presenter: Le Hoang Nguyen

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Primordial Chiral Gravitational Waves from the Axiverse

Author(s): Mr. OBATA, Ippei[1]
Co-author(s): Prof. SODA, Jiro [2]

[1] *Department of Physics, Kyoto University*

[2] *Department of Physics, Kobe University*

Corresponding Author(s): obata@tap.scphys.kyoto-u.ac.jp

It is known that, the “axion”, the pseudo NG boson of a broken chiral sym- metry, is a favorable candidate for an inflaton; it preserves an inflaton’s potential against quantum loop corrections due to its shift symmetry. The presence of ax- ions in the early universe is strongly suggested by string theory. On the contrary, string theory suggests the presence of a plenitude of axions

through a compactifi- cation in an extra-dimensional complex manifold. It is expected that these many axions with a wide mass range affect various cosmological phenomena, just like an inflationary universe. Under such a description, dubbed "axiverse", we study the possibility of realizing an axionic inflation consistent with the observation of CMB polarization. We focus on the property of primordial gravitational waves derived from such an axionic inflation. String axions generally couple to Chern-Simons terms of gauge fields due to the anomaly cancellation, and remarkably, this interaction sources the tensor components of metric perturbations and can enhance one helic- ity mode of gravitational waves, producing primordial chiral gravitational waves. In this talk, we verify the possibility of detecting such an interesting signal from the axiverse in future experiments, without contradicting CMB observations. This presentation is based on the following our work (arXiv:1412.7620 [hep-ph]).

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Axion search and research with low background Micromegas

Mr. GARCÍA PASCUAL, Juan Antonio[1]

[1] *Universidad de zaragoza*

Corresponding Author(s): juanan318@gmail.com

Helioscopes are one of the most promising techniques for axion discovery in which low background x-ray detectors are mandatory. We report the latest developments of the Micromegas detectors for the CERN Axion Solar Telescope (CAST). The use of low background techniques has led to background levels below 10^{-6} counts/keV/cm^2/s, more than a factor 100 lower than the first generation of Micromegas detectors at CAST. The helioscope technique can be enhanced by the use of an x-ray focusing device, increasing the signal-to-background ratio. A new dedicated x-ray optic was installed at CAST during 2014 with a low background Micromegas in its focal plane. On top of increasing CAST's sensitivity, the system has been conceived as a technological pathfinder for the International Axion Observatory IAXO.

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Astrophysical constraints to axion-photon coupling

Prof. STRANIERO, Oscar[1]

[1] *INA*

Corresponding Author(s): redondo@mpp.mpg.de

We revise the astrophysical bound to the axion-photon coupling, as obtained by comparing R=N_HB/N_RGB (1) measured in a sample of 39 Galactic Globular Clusters with up-to-date theoretical predictions. First results, already published in a PRL paper in 2014, show that the derived bound significantly depends on the assumed He mass fraction. To remove this degeneracy, accurate measurements of the early He content of our Galaxy are required.
More recently, we have developed a new and more accurate method to calculate the theoretical R, which makes use of synthetic Colour-Magnitude diagrams to be directly compared to the observed (real) diagrams. It required the calculation of a few hundreds evolutionary sequences of stellar models with the typical mass of the evolved stars in Globular Clusters, under various assumptions for the original He content and mass loss history. Uncertainties in the relevant nuclear reaction rates, as well as those related to the development of convection during the core He burning phase, have been carefully considered and combined by means of a Monte Carlo procedure. Methods and results of this new analysis will be here presented.

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Using an InGrid-Detector to search for solar axions and chameleons

Author(s): DESCH, Klaus[1]

Co-author(s): KAMINSKI, Jochen [1] ; KRIEGER, Christoph [1]

[1] *University of Bonn*

Corresponding Author(s): desch@uni-bonn.de

We report on recent results from the application of InGrids in the CAST experiment at CERN searching for solar axions and solar chameleons. InGrids employ Micromegas-like gas amplification using a highly pixellated CMOS readout chip as charge-collecting anode. An InGrid detector has successfully taken data in the CAST setup using the Abrixas X-ray telescope in late 2014. Operation experience and first results from this data taking period will be presented. A multivariate technique for background reduction will be shown. An outlook will be given towards further improvements of the setup in terms of X-ray efficiency and active background suppression. Also, potential application of InGrids as X-ray detectors in IAXO will be discussed.

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Dark matter searches with the LUX detector

BELTRAME, Paolo[1]

[1] *University of Edinburgh*

Corresponding Author(s): paolo.beltrame@ed.ac.uk

The Large Underground Xenon (LUX) experiment is a 350kg liquid xenon time projection chamber (TPC) designed to directly detect galactic dark matter. Currently deployed 1 mile underground in the Sanford Underground Research Facility in Lead, South Dakota, LUX completed its first physics run in 2013 collecting 85.3 live-days of science data. The profile-likelihood based analysis has shown no evidence for signal, setting the best limit on spin independent WIMP-nucleon cross section with a minimum of 7.6 × 10ˆ-46 cm2 for WIMP mass of 33 GeV/cˆ2 at 90% CL. LUX is presently conducting a 300-day data set. We will present the present run status together with details of new calibrations and improvements to data analysis. Although optimised to detect weakly interacting massive particles, this Xe based TPC is particularly suitable for exploration of alternative dark matter scenarios - for example spin-dependent WIMP interaction, effective field theory approaches, axions and axion-like particles. The present status of these searches will also be presented.

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Theoretical prospects for directional dark matter detection

Mr. O'HARE, Ciaran[1]

[1] *University of Nottingham*

Corresponding Author(s): ciaran.ohare@nottingham.ac.uk

Direct detection of WIMPs where the direction of nuclear recoils is measured presents an exciting opportunity for studying the physics and astrophysics of WIMPs. Additionally, directionality offers crucial information that distinguishes a WIMP signal from the irreducible background to direct detection, neutrinos. I will describe work assessing the theoretical capabilities of future generations of directional detectors including searching for non-standard velocity distributions of WIMPs in the Milky Way and how directional detectors can help circumvent the encroaching neutrino floor.

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Hidden photon constraints from red giant branch luminosity functions

Author(s): Mr. AYALA, Adrian[1]
Co-author(s): Dr. STRANIERO, Oscar [2] ; Mr. GIANNOTTI, Maurizio [3] ; Dr. MIRIZZI, Alessandro [4] ; Dr. DOMINGUEZ, Inma [1]

[1] *University of Granada*

[2] *INAF (Instituto Nazionale di Astrofisica)*

[3] *Physical Sciences.Barry University(USA)*

[4] *DESY*

Corresponding Author(s): aayala@ugr.es

Features in globular cluster luminosity functions (LF) of post-main sequence stars have been used to investigate modifications of standard stellar models and to look for new physics fingerprints, like axions or hidden photons. Simulated luminosity functions are sensitive to the effect of the inclusion in stellar evolution codes of hidden photon production longitudinal mode mechanism, especially during red giant branch (RGB) phase. In this poster communication we present first attempts to constrain hidden photon from the comparison of both simulated and observed globular cluster LF.

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Status of the Axion Dark Matter Experiment (ADMX)

Dr. RYBKA, Gray[1]

[1] *University of Washington*

Corresponding Author(s): redondo@mpp.mpg.de

The Axion Dark Matter Experiment (ADMX) is a search for QCD axion dark matter using axion-photon conversion in a resonant cavity. The "Gen 2" version of ADMX, presently in commissioning, improves upon previous versions using a dilution refrigerator, enhancing sensitivity to be sensitive to even pessimistically coupled DFSZ axions. I will present the status of the commissioning, plans for the upcoming data run plan, our strategy to expand the search to higher masses, and ongoing R&D to improve sensitivity.

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Gamma-ray spectra of Galactic pulsars and the signature of photon-ALPs mixing

Ms. MAJUMDAR, Jhilik[1]

[1] *DESY*

Corresponding Author(s): redondo@mpp.mpg.de

In many approaches to describe physics beyond the standard model, light Nambu-Goldstone bosons (named axion-like particles or ALPS for their similarity with the axion) are predicted to exist. For ALPs with a mass of neV, photon-ALPs oscillation takes place in extra-galactic magnetic fields during the propagation of very high energy gamma-ray photons leading to excess radiation observed for optically thick sources. In order to verify this effect, gamma-ray spectra from strong Galactic sources can be used. Here the photon-ALPs mixing would lead to an energy dependent suppression of the observed gamma-ray spectra. Here, we have used Fermi-LAT observations of a sample of gamma-ray pulsars located at different line-of-sights to search for spectral signatures and compare the result with the predictions using particular models for the Galactic magnetic field.

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Review Indirect DM

Corresponding Author(s): weniger@mppmu.mpg.de

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IAXO

Corresponding Author(s): biljana.lakic@cern.ch

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CASPER

Corresponding Author(s): alex@physics.harvard.edu

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Vector DM

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FUNK

Corresponding Author(s): babette.doebrich@desy.de

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Review DM at colliders

Corresponding Author(s): jalal.abdallah@cern.ch

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WIMP Review

Corresponding Author(s): davidg.cerdeno@gmail.com

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SuperCDMS

Corresponding Author(s): pbrink@slac.stanford.edu

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ADMX-HF

Corresponding Author(s): karl.van.bibber@nuc.berkeley.edu

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Solar Chamelons searches with the KWISP force sensor

CANTATORE, Giovanni[1]

[1] *INFN Trieste*

Corresponding Author(s): redondo@mpp.mpg.de

The KWISP opto-mechanical force sensor has been built and calibrated in the Trieste optics laboratory and is now under off-beam commissioning in CAST. It is designed to detect the pressure exerted by a flux of solar Chameleons on a thin (50 nm) silicon nitride micromembrane thanks to their direct coupling to matter. The membrane is placed inside a Fabry-Perot optical resonator excited at 1064 nm, and its displacements are monitored through the resonator characteristic frequencies. Displacements as little as 1e-15 m can be detected in 1 s, corresponding to a force sensitivity of $<$ 1e-14 N. This sensitivity opens access to unexplored regions in the Chameleon parameter space, and may allow a first experimental glimpse at the nature of Dark Energy. Once installed on CAST, the KWISP force sensor will immediately exploit the flux focusing action of an X-Ray Telescope and the tracking capability to increase its sensitivity by a factor more than 100. We will present the preliminary measurements done in Trieste, the current status and the near and long term perspectives for further extending the physics reach in the Dark Energy sector.

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Conecting the Inverse Seesaw Mechanism to a Symmetry Breakdown with Axion Like Particles

GOMES DIAS, Alex[1]

[1] *Universidade Federal do ABC*

Corresponding Author(s): redondo@mpp.mpg.de

We present a model in which the breakdown of a global U(1) symmetry, leading to a axion like particle, trigger the inverse seesaw mechanism. The mass scale parameters required in such a mechanism are generated through gravity induced nonrenormalizable operators and the vacuum expectation value of a scalar field hosting the axion like particle, which may be behind physical phenomena like the Universe transparency to ultra-energetic photons, the soft \gamma -ray excess from the Coma cluster, and the 3.5 keV line. Strong gravitational effects that destabilize the axion like particle and the inverse seesaw mechanism are shown to be suppressed by anomaly free discrete symmetries.

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Dark matter halos as particle colliders

TULLIN, Sean[1]

[1] *York U*

Corresponding Author(s): redondo@mpp.mpg.de

Astrophysical observations of the structure of galaxies and clusters are no longer simply proving the existence of DM, but have sharpened into a discovery tool probing the particle physics of DM. I discuss small scale structure anomalies for CDM and their possible implications for DM physics, such as the existence of forces in the dark sector. New results on cluster scales provide a new important handle for constraining DM's interactions, its mass, and the mass of dark mediator particles.

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Bose-Einstein Condensation of Dark Matter Axions

Prof. SIKIVIE, Pierre[1]

[1] *University of Florida*

Corresponding Author(s): sikivie@phys.ufl.edu

It has long been known that axions produced by vacuum realignment during the QCD phase transition in the early universe form a cold degenerate Bose gas and are a candidate for the dark matter. More recently it was found that dark matter axions thermalize through their gravitational self-interactions and form a Bose-Einstein condensate (BEC). On time scales long compared to their rethermalization time scale, almost all the axions go to the lowest energy state available to them. In this behaviour they differ from the other dark matter candidates. Axions accreting onto a galactic halo fall in with net overall rotation because almost all go to the lowest energy available state for given angular momentum. In contrast, the other proposed forms of dark matter accrete onto galactic halos with an irrotational velocity field. The inner caustics are different in the two cases. I'll argue that the dark matter is axions because there is observational evidence for the type of inner caustic produced by, and only by, an axion BEC.

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Self interacting DM review

Corresponding Author(s): stulin@yorku.ca

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Supernovae WISP bounds

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Axion miniclusters

Corresponding Author(s): tkachev@ms2.inr.ac.ru

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Unconventional ideas for axion and DM experiments

CASPERS, Fritz[None]
Corresponding Author(s): fritz.caspers@cern.ch

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