axions++ 2023

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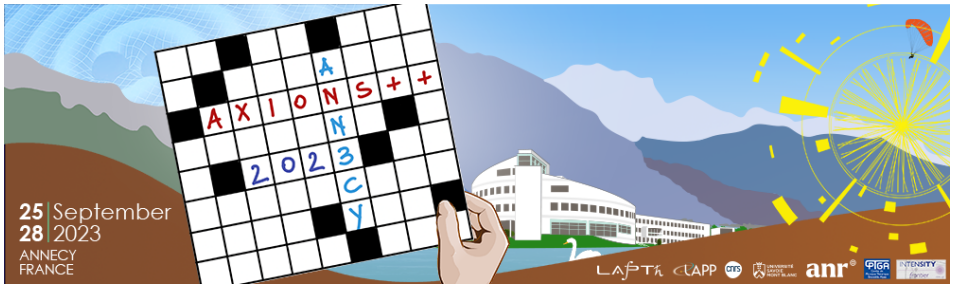

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Auteur: Julia K. Vogel[1]

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Auteur: Maurizio Giannotti[1]

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HEP - Experiment / 11

MADMAX a novel dielectric haloscope experiment

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MADMAX, the MAgnetized Disc and Mirror Axion eXperiment, will use a novel dielectric haloscope concept to detect dark matter axions in a mass range around 100 mueV through axion-photon conversion in the presence of a strong magnetic field. I'll present the status of ongoing R&D on the detector design, in particular on the booster and piezo motors needed to scan the mass range. Preliminary results from prototype boosters, operated at cold or in CERN's 1.6T MORPURGO dipole magnet in Spring 2022 and 2023, will be discussed.

HEP - Experiment / 12

Looking forward to photon-coupled sub-GeV long-lived particles

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Many Dark Sector models contain photon-coupled long-lived particles. An outstanding example is an axion-like particle decaying into two photons. The forward physics detectors at the LHC, e.g., FASER, were shown to be particularly suitable for hunting ~sub-GeV ALPs thanks to numerous photons produced in pp collisions, which in turn are efficiently converted into ALPs by the Primakoff scattering. We consider a few of beyond the SM physics scenarios in which similar processes can occur, in particular *massive spin-2 portal, dark axion portal, and inelastic DM with EM form factors.* We find that FASER2 and SHiP experiments will cover a significant part of the available parameter space for each of them. Moreover, we show that secondary production of LLPs at FASER2 can improve the coverage of parameter spaces in the regime of smaller lifetimes.

Cosmo / **13**

Cosmologically Varying Kinetic Mixing

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The portal connecting the invisible and visible sectors is one of the most natural explanations of the dark world. However, the early-time dark matter production via the portal faces extremely stringent late-time constraints. To solve such tension, in our recent work arXiv:2302.03056, we construct the scalar-controlled kinetic mixing varying with the ultralight ($10^{-33}\text{eV} < m_0 \ll \text{eV}$) CP-even scalar's cosmological evolution. In this talk, I will introduce how do we naturally realize this and eliminate the constant mixing term. Via the time-varying mixing, the keV $-$ MeV dark photon dark matter is produced through the early-time freeze-in when the scalar is misaligned from the origin and free from the late-time exclusions when the scalar does the damped oscillation and dynamically sets the kinetic mixing. We also find that the scalar-photon coupling emerges from the underlying physics, which changes the cosmological history and provides the experimental targets based on the fine-structure constant variation and the equivalence principle violation. To protect the scalar naturalness, we discretely re-establish the broken shift symmetry by embedding the minimal model into the $\mathbb{Z}_N$-protected model.

Astro / **14**

Probing Ultralight Bosons using Supermassive Black Holes and Quantum Sensors

Auteur: Yifan Chen[1]

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Ultralight bosons exhibit coherent wave behavior when their occupation number reaches a significant threshold. If these bosons interact with the Standard Model sector of particle physics, their oscillating background can generate a minute signal. In the vicinity of a rapidly rotating black hole, ultralight bosons falling within a specific mass range can accumulate via superradiance, resulting in a high expected density. I will talk about how the utilization of the Event Horizon Telescope and neutrino detectors can detect and resolve the boson cloud. Additionally, terrestrial experiments employing quantum sensors, such as superconducting cavity and magnetometers, can significantly enhance the search for ultralight boson dark matter. The talk covers both theoretical advancements and experimental findings in this area of research.

Astro / **15**

Axion Star Explosions and the Reionization History of the Universe

Auteurs: Charis Pooni[1]; David Marsh[1]; Diego Blas[2]; Malcolm Fairbairn[1]; Miguel Escudero Abenza[3]; Xiaolong Du[4]

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In axion-like dark matter cosmologies a very dense axion star forms in the center of every dark matter halo. When such axion stars are massive enough they become unstable and quickly decay via parametric resonance into radio photons. In this talk, based on 2302.10206 and 2301.09769, I will highlight the cosmological consequences of such a decay. In particular, the huge number of radio photons produced by axion stars decays can heat up the intergalactic medium and lead to an early period of reionization. Planck CMB constraints on this early reionization yield the most stringent bounds on the coupling between axion dark matter and photons in the sub neV mass range. I will finally show that upcoming 21cm observations will be able to test couplings that are an order of magnitude smaller that those currently tested by Planck.

Astro - HEP Phenomenology / **16**

Light dark matter and its possible probes

Auteur: Sreemanti Chakraborti[1]

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We consider models of light dark matter and light mediator, having mass of the order of a few MeV to a few GeV. In each case, the dark matter achieves relic density through mechanisms beyond the paradigm of typical freeze-in or freeze-out. The light mediators in these models, namely dark scalars, vectors or ALPs, couple to the SM particles. These interactions can be constrained by astrophysical measurements as well as various low-energy terrestrial probes such as proton beam-dumps measuring rare meson decays or electron beam dump experiments measuring mediator decay into leptons. Moreover, indirect searches such as cosmic ray and gamma-ray observations and low-mass direct detections also play an important role to test such models. Systematic analyses of the models are done involving the relevant latest and future constraints.

HEP - Phenomenology / **17**

Constraining ALP couplings using SMEFT-interference

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Axions and axion-like particles (ALPs) are pseudo Nambu-Goldstone bosons interacting with the SM fields via classically shift-invariant operators starting at dimension-5. Loop diagrams where the ALP is present as a virtual particle are generally UV-divergent and require renormalization. Consequently, dimension-6 SMEFT operators are generated as counterterms at the scale of global symmetry breaking via renormalization group evolution, regardless of the mass of the ALP. Since many SMEFT coefficients are experimentally tightly constrained, these bounds can be translated into indirect bounds on the ALP couplings to the SM in a global analysis.

HEP - Phenomenology / **18**

Axion-photon coupling from lattice QCD

Auteurs: Bastian B. Brandt[1]; Francesca Cuteri[2]; Gergely Endrődi[1]; Gergely Markó[1]; José Javier Hernández Hernández[1]

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We present preliminary results for the QCD contribution to the axion-photon coupling obtained via lattice simulations. For sufficiently small background electromagnetic fields, the topological charge exhibits a linear response to the scalar product between E and B, whose slope can be interpreted as the axion-photon coupling. The reasons for this interpretation are explained. In order to extract the coupling, we compute the topological charge with lattice QCD simulations with background electromagnetic fields in the linear response region and perform a numerical derivative.

Astro / **19**

Implications of photon-ALP oscillations in the extragalactic neutrino source TXS 0506+056 at sub-PeV energies

Auteur: Bhanu Prakash Pant[1]

Co-auteurs: Sunanda Sunanda [2]; Reetanjali Moharana [1]; Sarathykannan s [1]

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Photon–axion-like particle (ALP) oscillations result in the survival of gamma rays from distant sources above TeV energies. Studies of events observed by CAST, Fermi-LAT, and IACT have constrained the ALP parameters. We investigate the effect of photon-ALP oscillations on the gamma-ray spectra of the first extragalactic neutrino source, TXS 0506+056, for observations by Fermi-LAT and MAGIC around the IC170922-A alert. We obtain a constraint on the ALP coupling parameter $g_{a\gamma} < 5 \times 10^{-11}$ GeV^{-1} with 95% C.L. when focusing on the ALP mass range 0.1 neV $\leq m_a \leq$ 1000 neV. Importantly, we study the implications of ALP-γ oscillations on the counterpart γ rays of the sub-PeV neutrinos observed from TXS 0506+056. We also show the diffuse γ-ray fluxes and observabilities from FSRQs, HSP sources, and LISP sources, assuming similar gamma-ray emissions as that from TXS 0506+056.

Astro / **20**

Axions as solar thermometers

Auteur: Sebastian Hoof[1]

Co-auteurs: Joerg Jaeckel [2]; Lennert Thormaehlen [2]

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[2] *Ruprecht-Karls-Universität Heidelberg*

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The upcoming helioscope IAXO is sensitive to realistic QCD axion models, making it one of the most exciting future axion searches. In case of a discovery, IAXO will serve as new probe of solar physics, potentially allowing us to study solar metallicities, magnetic fields, and to distinguish different solar or axion models.
To further add to this list, I will show in this talk how an "axion image"of the Sun can be inverted to accurately infer the radial profile of the Sun's temperature using axions. Apart from discussing the necessary computational steps, I will explicitly demonstrate the viability of our approach for benchmark models and simulated IAXO data. I will comment on the relationship of our method with similar techniques, neutrino observatories, and related efforts. [arXiv:2306.00077]

Astro / **21**

Getting the most on supernova bounds on axions

Auteur: Alessandro Lella[1]

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In this talk I will discuss how Supernovae (SN) can be exploited to severely constrain the parameter space of axion-like-particles (ALPs) coupled to nucleons. In particular, I will provide a continuous extension of the ALPs emission rates to the case of strong nuclear couplings, in which they could enter the trapping regime. This approach allowed us to extend the usual cooling bound from the weak coupling regime to the case of strong nuclear couplings. Furthermore, nucleophilic ALPs could have given rise to a signal in the Kamiokande-II water Cherenkov detector. The non observation of this signal allows the introduction of a complementary constraint. Thus, the combination of this two arguments prevents the possibility for future cosmological surveys to detect any signatures of the QCD axion mass.

Astro - HEP Phenomenology / **22**

The Chiral Lagrangian for CP-violating Axion-like particles

Auteur: Gabriele Levati[1]

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CP-violating probes are among the most promising and yet relatively unexplored ways to look for Axion-Like Particles (ALPs) and to investigate their phenomenology. With this work we construct the most general effective Chiral Lagrangian describing the interactions of a light CP-violating ALP ϕ with mesons, baryons, leptons and photons at energies below the QCD confinement scale ($m_\phi < E < \Lambda_{\rm QCD}$), both in a 2-flavors setting and in a 3-flavors one. Starting from the most general dimension-5, $SU(3)_{\rm c} \times U(1)_{\rm em}$ invariant effective Lagrangian for a CP-violating ALP at the electroweak (EW) scale, we provide the running of its Wilson coefficients down to the QCD one, where we discuss the matching conditions onto its chiral counterpart. We then report the minimal set of Jarlskog invariants measuring in a basis-independent way the amount of CP violation introduced by the theory at low energies, which can then be bounded by experiments and directly related to the Wilson coefficients of the EW-scale Lagrangian. The Feynman rules for the low-energy theory can be extracted directly from the FeynRules model we have constructed, which can be employed as well for future dedicated phenomenological analyses.

Astro / **23**

Robust bounds on ALP dark matter from dwarf spheroidal galaxies in the optical MUSE-Faint survey

Auteur: Elisa Maria Todarello[1]

[1] *Turin University*

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Nearby dwarf spheroidal galaxies are ideal targets in the search for indirect dark matter (DM) signals. In this work, we analyze MUSE spectroscopic observations of a sample of five galaxies, composed of both classical and ultra-faint dwarf spheroidals. The goal is to search for radiative decays of axion-like particles (ALPs) in the mass range of 2.7-5.3 eV. After taking into account the uncertainties associated with the DM spatial distribution in the galaxies, we derive robust bounds on the effective ALP-two-photon coupling. They lie well below the QCD axion band and are significantly more constraining than limits from other probes, in the relevant mass range. We also test the possible presence of a positive signal, concluding that none of the channels selected for this analysis, i.e., not affected by large background contamination, is exhibiting such evidence.

HEP - Phenomenology / **24**

King Fits: Global bounds on light new physics from isotope shifts

Auteurs: Fiona Kirk[1]; Fiona Kirk[None]

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Isotope shift frequencies figure among the most precisely measured physical quantities but are highly challenging to predict from first principles. In recent years King plots emerged as powerful data-driven tools that eliminate the theoretical uncertainties on the Standard Model nuclear parameters and can place bounds on new light mediators between neutrons and electrons.
We develop a framework for fits to isotope shift data that allows to take into account more data than conventional King-plot methods and discuss the significance of the King plot bounds for the search for light new physics.

Cosmo / **25**

Axion-like particle dark matter: Beyond the standard paradigm

Auteur: Cem Eröncel[1]

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Axions and axion-like particles (ALPs) are among the most popular candidates that explain the origin of the mysterious dark matter. The most popular ALP production mechanism studied in the literature is the misalignment mechanism, where an ALP field with a quadratic or cosine potential has negligible kinetic energy initially, and it starts oscillating when its mass becomes comparable to the Hubble scale. Recently, there has been an interest in models that go beyond the standard

assumptions. These models extend the ALP dark matter parameter space and provide a rich phenomenology absent in the standard scenario. In particular, the ALP fluctuations grow exponentially via parametric resonance and tachyonic instabilities. In this talk, after giving an overview of the alternative production mechanisms, I will discuss the observational consequences of this exponential growth and show that a sizable region of the ALP parameter space becomes testable even if ALPs have only gravitational interactions.

Astro - HEP Phenomenology / **27**

Axion Dark Matter with Flavor-Violating Couplings to Quarks

Auteur: Alessandro Dondarini[1]

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We discuss simple scenarios where quark flavor-violating couplings generate the observed dark matter abundance through freeze-in of an axion-like particle with mass in the few keV range. We show that these
scenarios are constrained by supernovae, structure formation and collider bounds and can be almost entirely probed by future X-ray telescopes.

Astro - HEP Phenomenology / **28**

A Visible QCD Axion Portal to GeV-Scale Dark Matter

Auteurs: Francesco Paolo Di Meglio[1]; GIOVANNI ARMANDO[2]; Joachim Weiss[3]; Paolo Panci[2]; Robert Ziegler[4]

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We consider a model involving a *visible* QCD axion with mass in the MeV range with flavour non-universal couplings to the Standard Model (SM) first generation quarks and with all the SM leptons. Such a heavy axion must evade a variety of stringent constraints which precisely fix the couplings to the SM fields. While this heavy axion cannot be a Dark Matter (DM) candidate, as it decays promptly, we show that it can act as a portal to a dark sector. By letting the axion couple to a DM fermion χ, we solve the Boltzmann equations to find the regions of the parameter space that yield the correct relic abundance. The coupling of the DM with the electrons is subject to indirect detection constraints from the CMB, while those with the light quarks induce elastic DM-nucleus collisions that are subject to nuclear recoil constraints. This restricts the allowed region of the parameter space that reproduces the correct relic abundance to the GeV mass range and PQ charges of O(0.1).

HEP - Phenomenology / **29**

How to Measure the Spin of Dark Matter in $e^+e^- \to \gamma + X$

Auteur: Sofie Nordahl Erner[1]

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Dark Matter has eluded us for decades and continues to do so. Currently lepton colliders provide exclusion limits on individual dark matter models, but many models may have either identical or indistinguishable signals. Hence there is a need for new methods or observables to determine the nature of the dark matter, especially if more than one candidate is present. Using e^+e^- processes with a mono-photon signal and missing energy, we look into whether the helicities of the incoming beams and the outgoing photon can be used to differentiate between two dark matter models: Dark Photons and Axion-Like-Particles (ALPs). Due to the dark particles' spin and coupling structures, the two models have differing contributions and dependencies on the incoming fermions' spin. Focusing on Belle II and looking at a dark matter mass range of [0.1, 9.75] GeV, we show how the helicities of the incoming beams, together with angular distributions, can be used to discriminate between the dark photon and ALP dark matter.

HEP - Experiment / **30**

WISPFI: WISP Searches on a Fiber Interferometer

Auteur: Josep Maria Batllori Berenguer[1]

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WISP Searches on a Fiber Interferometer (WISPFI) is a novel tabletop experiment using interferometric techniques applied to photonic crystal fibers searching for a resonant photon-axion conversion. It is independent of the local dark matter density which can highly reduce the sensitivity of axion experiments and could as well be the reason behind the null results of dark matter searches so far. The experimental setup consists of a partial fiber, partial free-space Mach-Zehnder-type interferometer. In the sensing arm, the fiber is coiled and can be placed inside the bore of a superconducting solenoid magnet (14T, 140mm
diameter warm bore) or can be attached to electrode strips in order to apply a strong modulated electric field, producing photon-axion mixing. The photon-axion oscillations would then be detected by measuring changes in phase/amplitude. For the detection at resonant mixing, hollow-core photonic crystal fibers (HC-PCF) will be used, while regulation of the gas pressure inside the fiber will allow probing a wide range of axion masses. WISPFI's unique setup focuses on large axion masses around 100meV while reaching the QCD band so far unexplored by other experiments. A scalability of the experiment together with the involvement of state-of-the-art photonic techniques allow even a DFSZ sensitivity while probing dark matter axions in a very wide and unexplored mass range. In addition, The setup can be optimized for working close to vacuum-like conditions by highly pressurizing the fiber to extend the range to lower masses.

Cosmo / **31**

Axiverse Birefringence

Auteur: Silvia Gasparotto[1]

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The cosmic microwave background (CMB) holds intriguing evidence of cosmic birefringence - an isotropic rotation of the polarization direction, manifesting in the CMB's parity odd spectra. This phenomenon finds a compelling explanation within axion physics, where a light scalar field interacts with the electromagnetic field through a Chern-Simons interaction, violating parity.

In this presentation, I will explore the implications of cosmic birefringence detection within the framework of a rich Axiverse. The Axiverse suggests the presence of multiple active axions after the CMB, contributing to the observed signal. By leveraging probability density functions (PDFs) for various axion parameters, such as mass and axion decay constant, I will demonstrate how the cosmic birefringence measurement constrains these PDFs and how the outcomes change for different axion potentials.

Finally, I will discuss the future prospects of "birefringence tomography," which can rule out simpler versions of the Axiverse. These collective findings advance our understanding of axions, cosmic birefringence, and their profound implications.

HEP - Phenomenology / **32**

Shift-Invariant Orders of an Axionlike Particle

Auteurs: Christophe Grojean[1]; Jonathan Kley[2]; Quentin Bonnefoy[None]

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Usually, effective field theories (EFTs) for axion-like particles (ALPs) are built assuming a shift symmetry for the ALP due to the global U(1) Peccei-Quinn (PQ) symmetry that is at the heart of the axion mechanism. However, it is generally believed that global symmetries, in particular axion shift symmetries, can only be approximate. Therefore, it is important to include shift-breaking interactions in the EFT description and find a clear way to implement the different power countings of the shift-conserving and shift-breaking sectors. Focusing on the flavorful effective Yukawa couplings to Standard Model fermions, I will present Jarlskog-like flavor invariants which act as order parameters for shift symmetry breaking of the axion. In this description, shift-breaking couplings are characterized in an explicit and flavor-invariant way and it is straightforward to give different power countings to the shift-conserving and shift-breaking sectors. I will discuss properties of the invariants like their CP parities, enabling us to make non-trivial connections between conservation of CP in the theory and an almost conserved shift-symmetry for the ALP. Finally, I will discuss how they can be used to identify shift-breaking contributions in observables like electric dipole moments.

Astro / **33**

Search for the stochastic axion dark matter signal with the pulsar polarization array

Auteurs: Hoang Nhan Luu[None]; Jing Ren[None]; Jing Shu[None]; Shi Dai[None]; Tao Liu[None]; Xiao Xue[1]; Yue Zhao[None]

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Pulsar polarization arrays have the potential to probe the axion photon coupling up to ~ 10^{-14} – 10^{-17}, with a mass range ~ 10^{-27} – 10^{-21}eV. In this work, we will present the result of using the cross-correlation method to search for the stochastic axion dark matter signal in the Parkes Pulsar Timing Array data.

Cosmo / **34**

Gravitational Waves from Axions

Auteurs: Marco Gorghetto[1]; Marco Gorghetto[None]

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Axions are among the best motivated candidates for new physics. If the Peccei-Quinn symmetry associated with an axion has been ever restored after inflation, axion strings form and inevitably produce a contribution to the stochastic gravitational wave background. In this talk I will discuss the resulting gravitational wave spectrum by combining effective field theory analysis with numerical simulations. I will show that a single ultralight axion-like particle with a decay constant larger than 10^{14} GeV and any mass between 10^{-18} and 10^{-28} eV leads to an observable gravitational wave spectrum, and is compatible with constraints from dark matter overproduction, isocurvature and dark radiation. Since the spectrum extends over a wide range of frequencies, the resulting signal could be detected by multiple experiments. I will also comment on the recent NANOgrav signal in light of these results. Based on: 2101.11007.

HEP - Experiment / **35**

Axion search at the Grenoble Axion Haloscope (GrAHal) platform: Current results and Developments

Auteurs: Arthur Talarmin[1]; Cyril Bruyère[1]; Ohjoon Kwon[2]; Philippe Camus[1]; Pierre Perrier[1]; Pierre Pugnat[3]; Rafik Ballou[1]; Thierry Grenet[1]; Woohyun Chung[2]; Yannis K. Semertzidis[4]

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Current results and developments for the Dark Matter halo axion search in the microwave range at the Grenoble Axion Haloscope platform will be presented.
In particular the possibilities offered by the Grenoble hybrid magnet currently under commissioning will be highlighted. These include the prospects of axion search below 500 MHz at DFSZ sensitivity, in collaboration with CAPP (GraHal-CAPP project). The unique superconducting coil to be used (9T/800mm bore diameter), the special haloscope cryogenic design, and target axion search domain will be presented.

HEP - Phenomenology / **37**

Axion effective action

Auteurs: Jérémie Quevillon[1]; Christopher Smith[2]; Pham Ngoc Hoa Vuong[3]

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We present the construction of Effective Field Theories (EFTs) in which a chiral fermion, charged under both gauge and global symmetries, is integrated out via Path Integral formalism. These symmetries can be spontaneously broken, and the global ones might also be anomalous. This setting is typically served to study the structure of low-energy axion EFTs, where the anomalous global symmetry can be the U(1) Peccei-Quinn and the local symmetries can be the SM electroweak chiral gauge symmetries. We then apply our technique to axion models and compute non-intuitive couplings between axion and the massive SM gauge fields that arise when decoupling massive chiral fermions.

HEP - Experiment / **38**

Ray tracing for BabyIAXO with REST

Auteur: Johanna von Oy[1]

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The helioscope experiment BabyIAXO, which will be the predecessor of IAXO (the International AXion Observatory), poses a lot of physical challenges regarding its components. The mounting precision of magnet, optics and detector as well as physical effects like gravitation and the size of vacuum tight windows have been studied with a ray tracer based on the REST (Rare Event Searches with TPCs) framework.
This Monte Carlo based simulation calculates the production probability of different axion models in the sun and generates the desired amount of events accordingly. For each of those axions, a path is calculated taking into account the coupling probability to photons in the inhomogeneous magnetic field, the reflection on the mirrors of the optics and the absorption in obstacles like flanges or vacuum tight windows.
This talk focuses on the calculations and considerations that went into the ray tracing as well as the acquired knowledge about the expected signal and the efficiency loss due to component displacements.

Astro / **39**

New solar X-ray constraints on keV ALPs and Kaluza-Klein axions

Auteur: Cyprien Beaufort[1]

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The Sun represents a particularly interesting source for keV axions since a fraction of them would be trapped into the solar gravitational field and would then accumulate over cosmic times. The decay of such trapped axions into photons would contribute to the observed X-rays coming from the Sun. The requirement that the axion-induced photons flux should not exceed the solar X-ray measurements is then a powerful way of constraining axion models.

In this talk, we first study the case of Axion-Like Particles (ALPs) in the keV-range. By updating the production mechanisms in the Sun and by accounting for the absorption of the trapped ALPs by the

Sun during their orbits, we derive the most constraining limits on ALPs between 3 keV and 40 keV that are not relying on any assumption about the local dark matter density.

Secondly, we discuss the case of axions propagating in large extra dimensions. In such a framework, besides the QCD axion, the Sun would produce a tower of massive Kaluza-Klein (KK) axions with masses in the keV-range. The KK axions could then be gravitationally trapped around the Sun. By revising the phenomenology and the constraints on such particles, we reduce by six orders of magnitude the axion-decay event rate in a detector on Earth. However, we will also see that the trapped KK axions offer an interpretation for the unexplained non-thermal distribution of the solar X-rays.

This talk is based on https://arxiv.org/pdf/2303.06968.pdf and on https://arxiv.org/pdf/2107.13337.pdf

Astro - HEP Phenomenology / **40**

Axion-mediated Dark Matter beyond freeze-out

Auteur: Aoife Bharucha[1]

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Recent experimental advances further constrain electroweak-scale WIMPs produced via thermal freeze-out, leading to a shift away from this standard paradigm. Here we consider an axion-like particle (ALP), the pseudo-Goldstone boson of an approximate U(1) global symmetry spontaneously broken at a high scale fa, as a mediator between the Standard Model (SM) particles and the dark matter (DM) particles. We explore the case where the couplings are too small to allow for DM generation via freeze-out and the mediator particle and the DM constitute a hidden sector which is thermally decoupled from the SM particles. However, alternative generation mechanisms such as freeze-in and freeze-out from a decoupled dark sector are now appropriate. Having determined the region of parameter space where the correct relic density is obtained, we then revisit experimental constraints on ALPs from electron beam dump experiments, astrophysics and rare B and K decays.

Astro - HEP Phenomenology / **41**

Axions as Thermal DM: A ChPT Approach

Auteur: José Antonio Oller[1]

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Astro - HEP Phenomenology / **42**

Solar Halo of Axions and Implications for Direct Detection

Auteur: Joshua Eby[1]

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Ultralight dark matter (ULDM) is known to form self-gravitating bound states through relaxation of the field, through gravity or self-interactions. The canonical example is a boson star, which is self-gravitating and has been studied for decades. In this talk, I will discuss a related but distinct bound state we call a gravitational atom, which is bound by the gravitational potential of some external astrophysical body (e.g. a star). Strikingly, the direct capture of ULDM from the background haloto such bound states, boosted by Bose enhancement and gravitational focusing, can be fast enough to give rise to large DM overdensities on astrophysically-relevant timescales. As a result, for strong-enough self-interactions we predict the rapid formation of a solar halo of ULDM around our own Sun in the range of axion masses 10^{-15} eV < m < 10^{-13} eV, giving rise to modifications of the local density and DM velocity at the position of Earth and near the Sun. I will conclude by briefly discussing extensions of these ideas, including gravitational atoms bound to other objects and some proposals for astrophysical signals from other star systems.

Cosmo / **43**

The invisible dilaton

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Astro / **44**

Searching for axions with astrophysics

Auteur: Francesca Day[1]

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Astro / **45**

Does the brightest gamma-ray burst of all time provide a hint of axion-like particles?

Auteur: David Marsh[1]

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HEP - Experiment / **47**

Metallic Magnetic Calorimeters for axion and light dark matter searches

Auteur: Loredana Gastaldo[1]

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EFT aspects of axions and other light particles

Auteurs: Maria Ramos[1]; Maria Ramos[None]

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Astro - HEP Phenomenology / **49**

Quadratic Coupling of Axions to Photons

Auteurs: Carl Beadle[1]; Jérémie Quevillon[2]; Pham Ngoc Hoa Vuong[3]; Sebastian Ellis[1]

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In a recent work, using chiral perturbation theory as a guide, we showed that the QCD axion couples to the electromagnetic kinetic term at one loop.
If axions make up dark matter, they should then induce some temporal variation of the fine structure constant α, which is severely constrained.
This argument can be generalised to ALPs and can lead to stringent constraints in ALP parameter space, which I will discuss.

Cosmo / **50**

Domain wall interpretation of the PTA signal confronting black hole overproduction

Auteur: Yann Gouttenoire[1]

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Astro / **51**

Polarized Signatures of Axions at Magnetic White Dwarfs

Auteur: Christopher Dessert[1]

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Searching for ultralight bosons with atomic clocks

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Keynote talk / 54

Outlook keynote talk

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