Paris-Amsterdam-London-Stockholm 9th meeting

Report of Contributions

https://indico.cern.ch/e/PALS9

Contribution ID: **1** Type: **not specified**

Paleo-Detectors for Galactic Supernova Neutrinos

Thursday, September 26, 2019 2:00 PM (20 minutes)

Paleo-detectors are a proposed experimental technique in which one would search for traces of recoiling nuclei in ancient minerals. Natural minerals on Earth are as old as $\mathcal{O}(1)$ Gyr and, in many minerals, the damage tracks left by recoiling nuclei are also preserved for time scales long compared to 1 Gyr once created. Thus, even reading out relatively small target samples of order 100 g, paleo-detectors would allow one to search for very rare events thanks to the large exposure, $\varepsilon \sim 100\,\mathrm{g\,Gyr} = 10^5\,\mathrm{t\,yr}$. Here, we explore the potential of paleo-detectors to measure nuclear recoils induced by neutrinos from galactic core collapse supernovae. We find that they would not only allow for a direct measurement of the average core collapse supernova rate in the Milky Way, but would also contain information about the time-dependence of the local supernova rate over the past ~ 1 Gyr. Since the supernova rate is thought to be directly proportional to the star formation rate, such a measurement would provide a determination of the local star formation history. We investigate the sensitivity of paleo-detectors to both a smooth time evolution and an enhancement of the core collapse supernova rate on relatively short time scales, as would be expected for a starburst period in the local group.

Primary author: Dr STENGEL, Patrick (Stockholm University)

Presenter: Dr STENGEL, Patrick (Stockholm University)

Session Classification: Thursday evening talks

Contribution ID: **2** Type: **not specified**

Effect of Fluctuating Fuzzy Dark Matter Haloes on Stellar Dynamics

Friday, September 27, 2019 11:55 AM (20 minutes)

Ultra light axion fuzzy dark matter (FDM) has recently risen as a topical alternative that solves some of the galactic scale problems associated CDM-based structure formation. The long de Broglie wavelength leads for example to constant density cores replacing the density cups at the centres of CDM haloes.
This same property however also leads to interference patterns and accompanying fluctuations that can have observable effects on classical galactic components,
such as the disk and bulge, 'heating' them beyond observationally acceptable levels.

I develop and explain a detailed analytical model evaluating the effect of such fluctuations and apply it to the Milky Way disk and bulge to obtain a lower limit of m 2* 10ˆ-22 and 8 10ˆ-22 eV respectively for the axion mass. Application to the central cluster of Eridamus II leads to stronger constraints, which may entirely rule out FDM as a solution to galactic problems associated with CDM structure formation

.

Primary author: Prof. EL-ZANT, Amr (Centre for Theoretical Physics, British University in Egypt)

Presenter: Prof. EL-ZANT, Amr (Centre for Theoretical Physics, British University in Egypt)

Session Classification: Friday morning talks

Contribution ID: **3** Type: **not specified**

21 cm cosmology and spin temperature reduction via spin-dependent dark matter interactions

Thursday, September 26, 2019 3:00 PM (20 minutes)

The EDGES low-band experiment has measured an absorption feature in the cosmic microwave background radiation (CMB), corresponding to the 21 cm hyperfine transition of hydrogen at redshift z simeq 17, before the era of cosmic reionization. The amplitude of this absorption is connected to the ratio of singlet and triplet hyperfine states in the hydrogen gas, which can be parametrized by a spin temperature. The EDGES result suggests that the spin temperature is lower than the expected temperatures of both the CMB and the hydrogen gas. A variety of mechanisms have been proposed in order to explain this signal, for example by lowering the kinetic temperature of the hydrogen gas via dark matter interactions. We introduce an alternative mechanism, by which a sub-GeV dark matter particle with spin-dependent coupling to nucleons or electrons can cause hyperfine transitions and lower the spin temperature directly, with negligible reduction of the kinetic temperature of the hydrogen gas. We consider a model with an asymmetric dark matter fermion and a light pseudo-vector mediator. Significant reduction of the spin temperature by this simple model is excluded, most strongly by coupling constant bounds coming from stellar cooling. Perhaps an alternative dark sector model, subject to different sets of constraints, can lower the spin temperature by the same mechanism.

Primary author: WIDMARK, Axel (Stockholm University)

Presenter: WIDMARK, Axel (Stockholm University)

Session Classification: Thursday evening talks

Contribution ID: **4** Type: **not specified**

A Unique Multi-Messenger Signal of QCD Axion Dark Matter

Thursday, September 26, 2019 11:00 AM (20 minutes)

We propose a multi-messenger probe of the natural parameter space of QCD axion dark matter (DM) based on observations of black hole-neutron star binary inspirals. It is suggested that a dense DM spike may grow around intermediate mass black holes. The presence of such a spike produces two unique effects: a distinct phase shift in the gravitational wave strain during the inspiral period and an enhancement of the radio emission from the resonant axion-photon conversion occurring in the neutron star magnetosphere. Remarkably, the observation of the gravitational wave signal can be used to infer the DM density and, consequently, to predict the radio emission. Given a sufficiently nearby detection with the LISA interferometer and next-generation radio telescope Square Kilometre Array, I will show that such observations can explore the QCD axion in the mass range 10^{-7}eV to 10^{-5}eV, potentially providing a striking multi-messenger signature of QCD axion DM.

Primary authors: EDWARDS, Thomas (University of Amsterdam); Dr CHIANESE, Marco (GRAPPA, University of Amsterdam); Dr KAVANAGH, Bradley (GRAPPA, University of Amsterdam); NISSANKE, Samaya (University of Amsterdam); WENIGER, Christoph (University of Amsterdam)

Presenter: Dr CHIANESE, Marco (GRAPPA, University of Amsterdam)

Session Classification: Thursday morning talks

Contribution ID: **5** Type: **not specified**

Stochastic gravitational-wave background

Friday, September 27, 2019 11:00 AM (35 minutes)

The stochastic gravitational-wave background (SGWB) is formed from the incoherent superposition of many GW sources throughout cosmic history. I will briefly summarise the astrophysical and cosmological sources that contribute to the SGWB and the ongoing searches by cross-correlating data between multiple GW detectors. I will review the current limits on the SGWB and the consequences for theoretical models. I will then discuss the anisotropies in the astrophysical GW background, and their relevance in providing new information about galaxy clustering and large-scale structure. Finally, I will emphasise that this information is obscured by shot noise, caused by the finite number of GW sources that contribute to the background at any given time and then present a new method for estimating the angular spectrum of anisotropies, based on the principle of combining statistically-independent data segments.

Primary author: Prof. SAKELLARIADOU, Mairi (King's College London)

Presenter: Prof. SAKELLARIADOU, Mairi (King's College London)

Session Classification: Friday morning talks

Contribution ID: **6** Type: **not specified**

Detecting Dark Matter in the LISA era: Gravitational Waves from Intermediate Mass Ratio Inspirals

Friday, September 27, 2019 11:35 AM (20 minutes)

The observation of Gravitational Waves (GWs) has opened up a whole new avenue for constraining and detecting particle Dark Matter (DM). One of the most promising systems to study is the Intermediate Mass Ratio Inspiral (IMRI): a stellar-mass compact object such as a black hole or neutron star inspiraling towards an intermediate mass black hole, thousands of times more massive than the Sun. Sub-hertz GWs emitted during the inspiral should be detectable by future space-based observatories such as LISA. But the presence of DM in the system can have subtle dynamical effects on the inspiral, altering the waveform and allowing for a detection of DM almost independently of its particle properties. I will discuss ongoing work to study these systems carefully and self-consistently, incorporating the effects of feedback on the DM halo, in order to determine whether such a signal can be detected and what we can learn about Dark Matter if it is.

Primary author: Dr KAVANAGH, Bradley (GRAPPA, University of Amsterdam)

Presenter: Dr KAVANAGH, Bradley (GRAPPA, University of Amsterdam)

Session Classification: Friday morning talks

Contribution ID: **7** Type: **not specified**

Neutrinos and gamma rays from long-lived mediator decays in the Sun

Wednesday, September 25, 2019 4:10 PM (35 minutes)

We investigate a scenario where dark matter (DM) particles can be captured and accumulate in the Sun, and subsequently annihilate into a pair of long-lived mediators. These mediators can decay further out in the Sun or outside of the Sun. Compared to the standard scenario where DM particles annihilate directly into Standard Model particles close to the solar core, here we also obtain fluxes of gamma rays and charged cosmic rays. We simulate this scenario using a full three-dimensional model of the Sun, and include interactions and neutrino oscillations. In particular, we perform a model-independent study of the complementarity between neutrino and gamma ray fluxes by comparing the recent searches from IceCube, Super-Kamiokande, Fermi-LAT, ARGO and HAWC. We find that the resulting neutrino fluxes are significantly higher at high energy when the mediators decay further out in the Sun. We also find that gamma ray searches place stronger constraints than neutrino searches on these models even in cases where the mediators decay mainly inside the Sun, except in the approximately inner 10% of the Sun where neutrino searches are more powerful. We present our results in a model-independent manner and release a new version of the WimpSim code that can be used to simulate this scenario for arbitrary mediator models.

Primary authors: Prof. EDSJO, Joakim; NIBLAEUS, Carl (Stockholm University); Dr BENIWAL, Ankit (CP3, Université catholique de Louvain)

Presenter: Prof. EDSJO, Joakim

Session Classification: Wednesday evening talks

Contribution ID: **8** Type: **not specified**

Dark matter searches with the DAMIC detector

Thursday, September 26, 2019 2:20 PM (20 minutes)

DAMIC (for Dark Matter In CCD) seeks for DM interaction in thick fully depleted CCDs. Thanks to the precise energy estimation, the granularity and the very low noise of these detectors, DAMIC is sensitive to low mass WIMP (below 10GeV/cˆ2) through nuclear recoil but also to hidden sector model through interaction of DM particles with electrons. DAMIC at Snolab, a version of DAMIC experiment with 42 grams of active detector installed at Snolab, has ended its phase of science run accumulating 13kg.day - more than a 20 fold increase compared to the previous publication. We present the latest results of DM searches with this increased exposure combined with an improved background model and give the status of the next generation of this experiment, DAMIC-M, currently in development.

Primary author: Dr GAIOR, Romain (Chiba University)

Presenter: Dr GAIOR, Romain (Chiba University)

Session Classification: Thursday evening talks

Contribution ID: **9** Type: **not specified**

Angular power spectrum analysis on current and future high-energy neutrino data

Thursday, September 26, 2019 10:00 AM (20 minutes)

To constrain the contribution of source populations to the observed neutrino sky, we consider isotropic and anisotropic components of the diffuse neutrino data. We simulate through-going muon neutrino events by applying statistical distributions for the fluxes of extra-galactic sources and investigate the sensitivities of current (IceCube) and future (IceCube-Gen2 and KM3NeT) experiments. I will show that the angular power spectrum is a powerful probe to assess the angular characteristics of neutrino data and demonstrate that we are already constraining rare and bright sources with current IceCube data.
In addition, I will investigate the decay and annihilation of very heavy dark matter as a potential neutrino source, as suggested by the observed excess in the High-Energy Starting Event dataset. We apply our angular power spectrum analysis to this HESE data for different channels, allowing us to interpret the observed neutrino sky and perform a sensitivity forecast.

Primary author: DEKKER, Ariane (University of Amsterdam)

Co-authors: ANDO, Shin'ichiro (University of Amsterdam); CHIANESE, Marco (GRAPPA, University of Amsterdam)

Presenter: DEKKER, Ariane (University of Amsterdam)

Session Classification: Thursday morning talks

Contribution ID: **10** Type: **not specified**

Searching for dark matter with X-ray lines

Thursday, September 26, 2019 9:20 AM (20 minutes)

X-ray line searches are sensitive probes for many dark matter models, such as sterile neutrino dark matter in the nuMSM. I will discuss the current status of the experimental efforts, including that of the tentative signal at 3.5 keV. Then I will discuss some recent progress with NuSTAR and its prospects in the near future. Finally, I will talk about the idea of dark matter velocity spectroscopy, a powerful diagnostic tool for tentative dark matter line signals, which is achievable with high-resolution spectrometers, such as XRISM and Athena.

Primary author: Dr NG, Kenny Chun Yu (University of Amsterdam)

Presenter: Dr NG, Kenny Chun Yu (University of Amsterdam)

Session Classification: Thursday morning talks

Contribution ID: **11** Type: **not specified**

AMS-02 antiprotons are consistent with a secondary astrophysical origin

Thursday, September 26, 2019 9:00 AM (20 minutes)

Cosmic ray antiprotons are among the best channels to constrain WIMP dark matter particle candidates. The compatibility of AMS-02 data with a pure secondary origin is currently actively debated. Using the USINE code and an improved methodology to extract the cosmic ray transport parameters from the B/C data, we derive a robust range of predictions for the secondary antiproton flux. We list and update the various sources of uncertainties, and further account for their correlations. We also introduce a correlation matrix of errors for the AMS-02 data. We show that AMS-02 antiproton data are consistent with a secondary origin within this framework.

Primary author: Dr BOUDAUD, Mathieu (LPTHE Paris)

Presenter: Dr BOUDAUD, Mathieu (LPTHE Paris)

Session Classification: Thursday morning talks

Contribution ID: **12** Type: **not specified**

Effective electroweak baryogenesis

Thursday, September 26, 2019 3:45 PM (35 minutes)

In electroweak baryogenesis the baryon asymmetry of the universe is created during a first-order electroweak phase transtion. The scenario requires new physics at the electroweak scale, in particular an extended Higgs sector and new sources of CP violation, which can be tested experimentally. It would be advantageous if the crucial aspects of the various models can be tested in a single framework. In this talk I will discuss what ingredients are needed for an effective production of baryons, and whether this can be tested in a model-independent way using effective field theory methods.

Primary author: Dr POSTMA, Marieke (nikhef)

Co-authors: DE VRIES, Jordy (Nikhef); WHITE, Graham (Monash University); VAN DE VIS, jorinde (nikhef)

Presenter: Dr POSTMA, Marieke (nikhef)

Session Classification: Thursday evening talks

Contribution ID: **13** Type: **not specified**

The Higgs instability during inflation

Friday, September 27, 2019 9:55 AM (20 minutes)

The central measured Standard Model parameters indicate that, at large scale, the Higgs potential develops a second minimum at energy lower than the current Electroweak vacuum.
This has important consequence for cosmology. For instance, the dynamics of the Higgs during inflation could have triggered the decay of the EW vacuum with fatal consequences for our Universe. By requiring that this did not happen we can relate (and constraint) the Standard Model parameter with the energy scale of inflation.

Primary author: Dr FUMAGALLI, Jacopo (IAP)

Presenter: Dr FUMAGALLI, Jacopo (IAP)

Session Classification: Friday morning talks

Contribution ID: **14** Type: **not specified**

Direct Dark Matter Search wih the DarkSide Liquid Argon TPC

Thursday, September 26, 2019 2:40 PM (20 minutes)

The DarkSide experiment is designed for the direct detection of WIMPs by means of a double phase liquid argon TPC, inserted inside a double system of active vetoes. The current detector, DarkSide-50, is running with a 50 kg fiducial mass underground argon fill.
The results of DarkSide-50 will be discussed before presenting the larger 20 tonnes project, DarkSide-20k.

Primary author: NAVRER-AGASSON, Anyssa (LPNHE)

Presenter: NAVRER-AGASSON, Anyssa (LPNHE)

Session Classification: Thursday evening talks

Contribution ID: **15** Type: **not specified**

GUM: GAMBIT Universal Models

Thursday, September 26, 2019 11:40 AM (20 minutes)

GUM is a new feature of the GAMBIT global fitting software framework, which provides a direct interface between Lagrangian level tools and GAMBIT. GUM automatically writes GAMBIT routines to compute observables and likelihoods for physics beyond the Standard Model. I will describe the structure of GUM, the tools (within GAMBIT) it is able to create interfaces to, and the observables it is able to compute.

Primary author: BLOOR, Sanjay (Imperial College London)

Presenter: BLOOR, Sanjay (Imperial College London)

Session Classification: Thursday morning talks

Contribution ID: **16** Type: **not specified**

Baryogenesis from Modulus Decay

Thursday, September 26, 2019 4:20 PM (20 minutes)

Many string compactifications predict the existence of a scalar field (modulus) with a mass of 100-10000 TeV. In the early universe its decay (at MeV-temperatures) generates large amounts of entropy and washes out any previously produced baryon asymmetry. I describe how the baryon asymmetry can be (re)generated by the modulus decay. The mechanism relates the smallness of the asymmetry to the hierarchy between the Planck- and the Fermi-scale.

Primary author: Dr WINKLER, Martin (Stockholm University)

Presenter: Dr WINKLER, Martin (Stockholm University)

Session Classification: Thursday evening talks

Contribution ID: **17** Type: **not specified**

Dark matter in our galaxy

Wednesday, September 25, 2019 2:00 PM (35 minutes)

Presenter: Prof. SILK, Joseph (IAP)

Session Classification: Wednesday evening talks

Contribution ID: **18** Type: **not specified**

Machine learning techniques for strong lensing image analysis

Wednesday, September 25, 2019 2:35 PM (35 minutes)

Presenter: Dr WENIGER, Christoph (University of Amsterdam)

Session Classification: Wednesday evening talks

Contribution ID: **19** Type: **not specified**

The Atmosphere as a Beam Dump

Wednesday, September 25, 2019 3:10 PM (35 minutes)

Presenter: Prof. FAIRBAIRN, Malcolm (Physics, King's College London)

Session Classification: Wednesday evening talks

Contribution ID: **20** Type: **not specified**

Emergent gravity

Wednesday, September 25, 2019 4:45 PM (35 minutes)

Presenter: Prof. VERLINDE, Erik (Amsterdam, Netherlands)

Session Classification: Wednesday evening talks

Contribution ID: **21** Type: **not specified**

The Trouble with Hubble: signs of new physics?

Friday, September 27, 2019 9:00 AM (35 minutes)

Presenter: Dr POULIN, Vivian (LUPM, CNRS, France)

Session Classification: Friday morning talks

Contribution ID: **22** Type: **not specified**

CANCELED - Can primordial black holes constrain sub-millimeter gravity?

Friday, September 27, 2019 10:15 AM (20 minutes)

Presenter: Dr AKRAMI, Yashar

Session Classification: Friday morning talks

Contribution ID: **23** Type: **not specified**

New cosmological tests of fundamental physics

Friday, September 27, 2019 12:15 PM (35 minutes)

Presenter: Prof. WANDELT, Benjamin

Session Classification: Friday morning talks

Contribution ID: **24** Type: **not specified**

Discussion

Session Classification: Thursday morning talks

Contribution ID: **25** Type: **not specified**

Discussion

Session Classification: Thursday evening talks

Contribution ID: **26** Type: **not specified**

Free discussion and group work

Friday, September 27, 2019 2:30 PM (2h 30m)

Contribution ID: **27** Type: **not specified**

Primordial Black Holes as Silver Bullets for New Physics at the Weak Scale

Thursday, September 26, 2019 9:40 AM (20 minutes)

Observational constraints on gamma rays produced by the annihilation of weakly interacting massive particles around primordial black holes (PBHs) imply that these two classes of Dark Matter candidates cannot coexist. In this talk, I will show that the successful detection of one or more PBHs by radio searches (with the Square Kilometer Array) and gravitational waves searches (with LIGO/Virgo and the upcoming Einstein Telescope) would set extraordinarily stringent constraints on virtually all weak-scale extensions of the Standard Model with stable relics, including those predicting a WIMP abundance much smaller than that of Dark Matter. Upcoming PBHs searches have in particular the potential to rule out almost all of the favorable parameter space of popular theories such as the minimal supersymmetric standard model and scalar singlet Dark Matter.

Presenter: Dr COOGAN, Adam (University of Amsterdam)

Session Classification: Thursday morning talks

Contribution ID: **28** Type: **not specified**

Machine Learning in Jet Physics

Thursday, September 26, 2019 12:00 PM (20 minutes)

Machine Learning techniques have been widely used in different applications in high energy physics. In this talk I would like to speak about two different machine learning algorithms used to classify signal and background jets. We compare the performance of a convolutional neural network (CNN) trained on jet images with dense neural networks (DNNs) trained on n-subjettiness variables to study the distinguishing power of these two separate techniques applied to top quark decays. We obtain a comparable results from both techniques which suggest that the underlying physics learned using these neural networks are the same.

Presenter: VARMA, Sreedevi

Session Classification: Thursday morning talks

Contribution ID: **29** Type: **not specified**

Gravitational waves from hot and cold hidden sectors

Thursday, September 26, 2019 4:40 PM (20 minutes)

We study the spectrum of gravitational waves produced by a first order phase transition in a hidden sector that is colder than the visible sector. In this scenario, bubbles of the hidden sector vacuum can be nucleated through either thermal fluctuations or quantum tunnelling. If a cold hidden sector undergoes a thermally induced transition, the amplitude of the gravitational wave signal produced will be suppressed and its peak frequency shifted compared to if the hidden and visible sector temperatures were equal. This could lead to signals in a frequency range that would otherwise be ruled out by constraints from big bang nucleosynthesis. Alternatively, a sufficiently cold hidden sector could fail to undergo a thermal transition and subsequently transition through the nucleation of bubbles by quantum tunnelling. In this case the bubble walls might accelerate with completely negligible friction. The resulting gravitational wave spectrum has a characteristic frequency dependence, which may allow such cold hidden sectors to be distinguished from models in which the hidden and visible sector temperatures are similar. We compare our results to the sensitivity of the future gravitational wave experimental programme.

Presenter: WICKENS, Alastair (King's College London)

Session Classification: Thursday evening talks

Contribution ID: **30** Type: **not specified**

Could the H0 Tension be Pointing Toward the Neutrino Mass Mechanism?

Friday, September 27, 2019 9:35 AM (20 minutes)

Within the framework of ΛCDM, the local determination of the Hubble constant disagrees – at the 4.4 sigma level – with that inferred from the very accurate CMB observations by the Planck satellite. This clearly motivates the study of extensions of the standard cosmological model that could reduce such tension. Proposed extensions of ΛCDM that reduce this so-called Hubble tension require an additional component of the energy density in the Universe to contribute to radiation at a time close to recombination.

In this talk, I will show that pseudo-Goldstone bosons – associated with the spontaneous breaking of global lepton number – lead to a non-standard early Universe evolution that can help to reduce the Hubble tension. I will show that current CMB observations can constraint scalar-neutrino couplings as small as 10-13, which within the type-I seesaw mechanism correspond to scales of lepton number breaking as high as ˜ 1 TeV. Finally, I will argue that future CMB observations will test wide and relevant regions of parameter space of scenarios in which the spontaneous breaking of global lepton number is the mechanism behind the observed neutrino masses.

Presenter: ESCUDERO, Miguel (IFIC-University of Valencia)

Session Classification: Friday morning talks

Contribution ID: **31** Type: **not specified**

Axion-photon conversion in the magnetosphere of a neutron star

Thursday, September 26, 2019 11:20 AM (20 minutes)

Presenter: LEROY, Mikael

Session Classification: Thursday morning talks