Dark Interactions: Perspectives from Theory and Experiment

Report of Contributions

https://indico.bnl.gov/e/di2018

Contribution ID: **0** Type: **not specified**

Recent results and prospects on Dark Interactions from CERN

Kaon experiments at CERN (NA48/2 and NA62) study decays in flight of secondary charged kaons produced by 400 GeV/c protons from the SPS accelerator hitting a Beryllium target. The NA48/2 experiment was exposed to 2x10^{11} kaon decays in 2003-2004, and NA62 is set to surpass this figure by a factor of 50 in 2016-2018. Prospects for the dark photon, heavy neutral lepton and axion-like particle searches via their production (both promptly at the Beryllium target and in secondary kaon decays) and decay with available and future NA62 data are discussed. Results of searches for the dark photon, inflaton and heavy neutral leptons in charged kaon and neutral pion decays with NA48/2 data are presented.

Presenter: LAMANNA, Gianluca

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

Simplified DM models: a case with t-channel colored scalar mediators

The general strategy for dark matter (DM) searches at colliders currently relies on simplified models in order to describe the interactions between the Standard Model (SM) and DM and potential collider signatures at the LHC. A recently proposed UV-complete simplified model with t-channel mediators improves the existing simplified DM models in two important respects: (i) the full SM gauge symmetry is imposed including the fact that the left-handed and the right-handed fermions have two independent mediators with two independent couplings, and (ii) the renormalization group evolution is included in the effective Lagrangian for DM-nucleon scattering when integrating out the t-channel mediators. The first improvement will introduce a few more parameters compared with the existing simplified DM models. The effect this broader set of free parameters has on direct detection and the mono-X + MET (X=jet,W,Z) signatures at 13 TeV LHC are discussed.

Presenter: NATALE, Alexander (KIAS)

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

Dark matter models with two mediators

A reliable comparison of different dark matter searches requires models that satisfy certain consistency conditions like gauge invariance and perturbative unitarity. These conditions can easily be satisfied in U(1)' extensions of the Standard Model, where a fermionic dark matter candidate as well as a new Z' gauge boson obtain their mass from the spontaneous breaking of the U(1)' by a dark Higgs. These dark matter scenarios contain two mediators, the new gauge boson and the dark Higgs, which can also act as final states in dark matter annihilation. I will discuss the general framework of consistent dark matter models with two mediators, and then review a class of dark matter models where baryon number is a local gauge symmetry.

Presenter: DUERR, Michael (DESY)

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

Search for Dark Particles at Belle and Belle II

The dark photon, A′, the dark Higgs boson, h′, and the dark vector gauge boson, U', are hypothetical constituents
featured in a number of recently proposed Dark Sector Models. We will present searches for these particles in the Belle data and discuss prospects in the future Belle II data.

Presenter: JAEGLE, Igal (University of Hawaii at Manoa)

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

Search for Dark Photons at LHCb

Dark photons appear in many well-motivated dark matter scenarios, leading to a worldwide effort to search for them. We propose some novel search methods for dark photons at the LHCb experiment. In this talk, I will focus on the inclusive search for dark photons at the LHCb experiment based on both prompt and displaced di-muon resonances. The dark photon rate can be directly inferred from the off-shell photon rate, making this a fully data-driven search. LHCb is applying this method for the dark photon search in the Run 2 of LHC. For Run 3, LHCb will have sensitivity to large regions of the unexplored dark photon parameter space.

Presenter: XUE, Wei (MIT)

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

Astrophysical Signatures of Dissipative Dark Matter

After nearly a century of searching, the nature of dark matter continues to elude us.While Ockham's razor may at face value want a favor a dark sector with one component, the complexity of the visible sector urges us to consider dark sectors with multiple components, including possibly dissipative interactions. In a galaxy like the Milky Way, these interactions would lead to cooling of the dissipative sector, resulting in a disk of dark matter with enhanced local density. I will briefly review the current bounds on the local dark matter density and explain why they do not apply to a dark disk. I will then explain what the latest astrophysical data truly say about a dark disk, including the bounds we recently determined from Milky Way stellar kinematics and from the distribution of the local interstellar gas, and what we can expect in upcoming the Gaia era.

Presenter: KRAMER, Eric (Harvard University)

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

Updated Bounds on Light Hidden Sectors in Supernovae

Supernova 1987A created an environment of extremely high temperatures and nucleon densities, providing an opportunity to set bounds on a wide range of theories of new physics. We present corrected bounds on hidden sector models, incorporating a wide range of new physical effects on the production, including some novel corrections to the high-mixing-angle calculation. These bounds dramatically alter the landscape of the allowed regions for hidden sector models.

Presenter: MCDERMOTT, Samuel (YITP)

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

”Lattice Gauge Theory insights on Dark Matter

Models of composite dark matter, originating from a new strongly coupled dark sector, have a very interesting phenomenology. To make robust predictions in these models one often need to investigate non-perturbative effects due to the strong self interactions. Lattice field theory methods and numerical simulations are well suited for this task and contribute to a solid uncertainty quantification.
As an example, the Stealth Dark Matter model contains a candidate composite dark matter particle which appears as a bosonic neutral baryon of a new SU(4) strongly coupled gauge sector. The elementary constituents of this composite state carry electroweak charges. This construction provides a mechanism to naturally reduce the strength of dark matter interactions with standard model particles: there is no magnetic moment or charge radius. However such interactions exist and can allow direct detection and collider experiments to put constraints on the model. In order to get predictions from this strongly-coupled model, numerical lattice simulations are employed and give definite results for the cross-section of the dark matter candidate with standard nuclei in detectors, dominated by the electric polarizability interaction. A universal lower bound for the mass of this composite dark matter candidate is reported around 300 GeV.

Presenter: RINALDI, Enrico (BNL)

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

The search for a dark Z boson with Machine Learning

The existence of a dark sector vector boson (Zd) is well motivated by theory and experiment; models add a U(1) gauge symmetry to the standard model which introduces a new gauge field Zd with kinetic mixing epsilon (I'll add the actual symbol) and a Higgs doublet with mass mixing kappa. We can thus use the Higgs as a portal to look for such a particle at the LHC. In particular, we can expand upon the standard ATLAS H->4l analysis to search for and measure the properties of the Zd. I will describe the structure and current status of this analysis, as well as potential applications for using machine learning techniques to increase sensitivity.

Presenter: THAIS, Savannah (Yale University)

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

Respect the ELDERs

We present a novel dark matter candidate, an elastically decoupling relic, which is a cold thermal relic whose present abundance is determined by the cross section of its elastic scattering on standard model particles. The dark matter candidate is predicted to have a mass ranging from a few to a few hundred MeV, and an elastic scattering cross section with electrons, photons and/or neutrinos in the 10^{-3} –1 fb range..

Presenter: TSAI, Yu-Dai (Cornell University)

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

Latest Results from Cosmological probes

Presenter: JAIN, Bhuvnesh (UPenn)

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

Gravitational Wave Signals of Cosmological Phase Transitions

Strong first-order cosmological phase transitions produce a
stochastic gravitational wave background. We discuss the resulting contributions from bubble collisions, magnetohydrodynamic turbulence, and sound waves, and estimate the total corresponding signal predicted in gravitational waves. We demonstrate that LISA is able to probe many well-motivated scenarios beyond the Standard Model of particle physics predicting strong first-order cosmological phase transitions in the early Universe.

Presenter: SERVANT, Geraldine (CERN)

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

Discussion

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

The Status of Primordial Black Holes as Dark Matter

Presenter: KOVETZ, Ely (John Hopkins University)

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

Discussion

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

Future prospects in cosmology

Presenter: FLAUGER, Raphael (University of Texas at Austin)

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

Physics at Future Circular Colliders

The Large Hadron Collider has been a grand success with the discovery of the Higgs boson, with bright prospects for additional discoveries since the recent increase in collider energy and the anticipated large datasets. Big open questions such as the nature of dark matter, the origin of the matter-antimatter asymmetry in the Universe, and the theoretical puzzle of the finely-tuned parameters in the Higgs sector, demand new physics principles that extend the established Standard Model paradigm. Future circular colliders in a substantially larger tunnel can house both a high luminosity electron-positron collider for precision measurements of Higgs and electroweak parameters, as well as a very high energy proton-proton collider which can directly manifest particles associated with these new physics principles. We discuss the physics goals of these future circular colliders, and the prospects for elucidating fundamental new laws of nature that will significantly extend our understanding of the Universe. Detailed studies of the discovery potential in specific benchmark models will be presented, with implications for detector design.

Presenter: Prof. KOTWAL, Ashutosh (Duke University)

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

Discussion

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

Theory + electron beam dumps

Presenter: IZAGUIRRE, Eder (BNL)

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

Proton beam dumps (MiniBoone, Seaquest, SHIP)

Presenters: BATELL, Brian (Chicago); Mr BATELL, Brian (Perimeter Institute)

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

Direct Detection

Presenter: YU, Tien Tien

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

Discussion

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

Theoretical motivation and phenomenology of light dark sectors

Presenter: JAECKEL, Joerg (Heidelberg)

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

Axions and ultralight dark photons: theory+searches

Presenter: DUBOVSKY, Sergei (New York University)

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

Discussion

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

Dark photons at MeV-GeV masses

Presenter: TORO, Natalia (SLAC)

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

Discussion

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

Dark Matter / Dark Interaction

Presenter: MURAYAMA, Hitoshi (Berkeley)

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

Decays to dark sector particles at CMS

Presenter: KOLBERG, Ted

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

Decays to dark sector particles at ATLAS

The postulation of a Hidden Sector to complement the Standard Model offers elegant solutions to one of the most intriguing questions in elementary particle physics, being the particle nature of dark matter. The discovery of a fundamental scalar particle compatible with the Higgs boson paved the way for looking for dark matter with novel methods. In this contribution, I will review recent searches to dark sector particles performed by the ATLAS collaboration. Particular emphasis will be given to results with recent proton-proton data at 13-TeV center-of-mass energy, to improvements in the trigger and reconstruction of physics objects that happened during the LHC long shut-down and to prospects for results with the enlarged dataset being collected by the experiment this year.

Presenter: COCCARO, Andrea

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

Discussion

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

Dark Matter searches at the LHC

Presenter: BOVEIA, Antonio

Contribution ID: **32** Type: **not specified**

Dark sector searches at e+e- colliders

Presenter: KOLOMENSKY, Yury (LBL)

Contribution ID: **33** Type: **not specified**

Discussion

Contribution ID: **34** Type: **not specified**

Status of Dark Matter Direct Detection

Presenter: BROWN, Ethan (RPI)

Contribution ID: **35** Type: **not specified**

Dark Photon Search at the Fermilab SeaQuest Experiment

The SeaQuest E906 experiment is a fixed target Drell-Yan experiment which is aimed at studying the anti-quark distributions in the nucleon and nuclei. 120 GeV protons from the Main Injector at Fermilab could also be used to search for massive dark gauge bosons or dark photons that could be generated when a proton beam dump interacts with a 5m long Fe beam dump. SeaQuest takes advantage of Proton Bremsstrahlung and \eta decay processes to search for dark photons that could provide a portal into the dark sector. Exclusion limit projections for SeaQuest and future prospects for the experiment will be discussed in the talk.

Presenter: TADEPALLI, Arun

Contribution ID: **36** Type: **not specified**

Direct Search for Dark Photon and Dark Higgs in E-1067 at Fermilab

Through kinetic mixing, the postulated dark photon and dark Higgs particles could be produced in the Drell-Yan like q-qbar and gluon-gluon fusion processes in high energy proton + nucleus collisions, respectively. Starting from 2017, the E-1067 experiment at Fermilab will carry out the first direct search for such particle productions in the mass range 0.2 ~ 10 GeV in parasitic with the E906/SeaQuest experiment. LOI of E-1067 was first submitted to PAC in the summer of 2015 and subsequently endorsed by Fermilab director. In the near future, we also plan to install new EM calorimeters recycled from the PHENIX experiment at RHIC to add di-electron capability to the search thus allowing us to access the mass region below the current dimuon limit. To maximize the experimental reach, we are taking on a major upgrade of the SeaQuest DAQ and trigger systems now and will be ready for data taking in early 2017. In this talk, the current status of the upgrade projects and expected experimental reach will be presented.

Presenter: LIU, Ming Xiong (Los Alamos National Laboratory)

Contribution ID: **37** Type: **not specified**

Discussion

Contribution ID: **38** Type: **not specified**

Neutral naturalness

Presenter: CRAIG, Nathaniel

Contribution ID: **39** Type: **not specified**

Searches for Hidden Valleys at the LHC

Presenter: STRASSLER, Matt (Harvard)

Contribution ID: **40** Type: **not specified**

Discussion

Contribution ID: **41** Type: **not specified**

Astrophysical Probes of Neutrinos

Presenter: FRIEDLAND, Alexander (SLAC National Accelerator Laboratory)

Contribution ID: **42** Type: **not specified**

Neutrino anomalies

Presenter: DEGOUVEA, Andre (Northwestern)

Contribution ID: **43** Type: **not specified**

Discussion

Contribution ID: **44** Type: **not specified**

Welcome Address

Tuesday, 2 October 2018 09:00 (10 minutes)

Summary

Presenter: DAWSON, Sally (BNL)

Contribution ID: **45** Type: **not specified**

BSA Distinguished Lecture: ”Illuminating Dark Matter”

Tuesday, 2 October 2018 16:00 (1 hour)

We have understood robustly that the overwhelming majority of matter throughout our galaxy and the universe is something other than what we are made of. We remain profoundly ignorant of what it is. In this talk, Neal Weiner will describe the range of ideas that have arisen as to what this mysterious stuff might be, where it came from, and how to look for it. He will detail the progress made in the search to understand the nature of dark matter, and what questions this era hopes to answer, including perhaps the central one: what does the dark universe have to do with the one we can see?

Summary

Presenter: Prof. WEINER, Neal (NYU)

Contribution ID: **46** Type: **not specified**

Workshop Dinner

Wednesday, 3 October 2018 18:30 (3 hours)

No-host Dinner
Sea Basin Restaurant
642 Route 25A, Rocky Point, NY
631-744-1643
October 3, 2018, 6:30 PM
Cost: $42/pp

Contribution ID: **47** Type: **not specified**

The End of the World As We Know It

Friday, 5 October 2018 11:10 (50 minutes)

Summary

Presenter: STEINHARDT, Paul J. (Princeton University)

Session Classification: Final Session

Contribution ID: **48** Type: **not specified**

Closing Ceremony

Friday, 5 October 2018 12:00 (30 minutes)

Contribution ID: **49** Type: **not specified**

Long lived dark photon searches at ATLAS

Thursday, 4 October 2018 11:00 (20 minutes)

Summary

Presenter: TORRÓ, Emma (University of Washington)

Session Classification: Colliders

Contribution ID: **50** Type: **not specified**

Long lived dark photon searches at CMS

Thursday, 4 October 2018 11:25 (20 minutes)

Summary

Presenter: VARTAK, Adish (CERN)

Session Classification: Colliders

Contribution ID: **51** Type: **not specified**

Dark Matter searches at the LHC

Thursday, 4 October 2018 11:50 (30 minutes)

Summary

Presenter: HARRIS, Philip (MIT)

Session Classification: Colliders

Contribution ID: **52** Type: **not specified**

Prompt dark photons searches at the LHC

Friday, 5 October 2018 09:00 (20 minutes)

Summary

Presenter: JEANTY, Laura (University of Oregon)

Session Classification: Colliders

Contribution ID: **53** Type: **not specified**

Dark sector/dark matter searches at BaBar and outlook for Belle II

Friday, 5 October 2018 09:50 (20 minutes)

I will review BaBar's searches for the direct production of new particles in the context of dark sector and other models. Such searches are a high priority for the early running period of Belle II. I will discuss the status of Belle II and the prospects of these searches.

Summary

Presenter: HEARTY, Christopher (University of British Columbia)

Session Classification: Colliders

Contribution ID: **56** Type: **not specified**

Search for exotic particles at NA62

Friday, 5 October 2018 09:25 (20 minutes)

The high-intensity setup, trigger system flexibility, and detector performance – high-frequency tracking of beam particles, redundant PID, ultra-high-efficiency photon vetoes — make NA62 particularly suitable for searching new-physics effect from different scenarios. Results from a search for invisible dark photons produced from pi0 decays are given. Fixed target experiments are a particularly useful tool in the search of very weakly coupled particles in the MeV-GeV range, which are of interest, e.g. as potential Dark Matter mediators. The NA62 experiment at the CERN SPS is currently taking data to measure rare kaon decays. Owing to the high beam-energy and a hermetic detector coverage, NA62 also has the opportunity to directly search for a plaethora of long-lived beyond-the Standard Model particles, such as Axion-like Particles and Dark Photons. In this talk, we will review the status of this searches and give prospects for future data taking at NA62.

Summary

Presenter: DOBRICH, Babette (CERN)

Session Classification: Colliders

Contribution ID: **57** Type: **not specified**

Novel cosmic probes of dark matter

Wednesday, 3 October 2018 09:35 (30 minutes)

Gravity provides both the evidence for dark matter and all of our present knowledge about its properties. By understanding the detailed structure of gravitationally bound objects in our Universe, we can probe the particle physics of dark matter in a way that is completely orthogonal to the Earth-based high-energy physics searches for dark matter. Such efforts will require close collaboration between astronomers and particle physicists, but have a great deal of potential in the near future. I will describe a useful parameter space to make connections between the two fields, and areas of potential advance.

Summary

Presenter: BUCKLEY, Matthew (Rutgers University)

Session Classification: Cosmological and astrophysical probes of dark sectors

Contribution ID: **58** Type: **not specified**

Indirect detection of dark matter

Wednesday, 3 October 2018 09:00 (30 minutes)

I will review limits on dark matter and dark sectors from indirect searches, with a particular emphasis on what we can learn from probes of the early universe. I will discuss the recent claim of a primordial 21cm absorption signal by the EDGES experiment, and its possible implications for dark-sector physics.

Summary

Presenter: SLAYTER, Tracy (MIT)

Session Classification: Cosmological and astrophysical probes of dark sectors

Contribution ID: **59** Type: **not specified**

Modified gravity after gravitational wave detection

Wednesday, 3 October 2018 14:00 (30 minutes)

Summary

Presenter: SAKSTEIN, Jeremy (UPenn)

Session Classification: Cosmological and astrophysical probes of dark sectors

Contribution ID: **60** Type: **not specified**

SUNny gluonia as DM

Wednesday, 3 October 2018 15:10 (20 minutes)

Presenter: SONI, amarjit (bnl)

Session Classification: Cosmological and astrophysical probes of dark sectors

Contribution ID: **61** Type: **not specified**

Light dark sectors - motivations and signatures

Tuesday, 2 October 2018 09:10 (30 minutes)

Presenter: Prof. RITZ, Adam (University of Victoria)

Session Classification: Theory

Contribution ID: **62** Type: **not specified**

Towards halometry from astrometry

Tuesday, 2 October 2018 09:45 (30 minutes)

Summary

Presenter: Prof. WEINER, Neal (NYU)

Session Classification: Theory

Contribution ID: **63** Type: **not specified**

Fixed-target probes of dark sectors

Tuesday, 2 October 2018 10:50 (30 minutes)

Summary

Presenter: NELSON, Timothy (SLAC)

Session Classification: Experiments

Contribution ID: **64** Type: **not specified**

Direct Detection of Low-Mass Dark Matter

Tuesday, 2 October 2018 11:25 (30 minutes)

Summary

Presenter: Prof. HERTEL, Scott (U Mass Amherst)

Session Classification: Experiments

Contribution ID: **66** Type: **not specified**

Probing sub-GeV Dark Matter with conventional detectors

Tuesday, 2 October 2018 13:30 (30 minutes)

Summary

Presenter: Prof. PRADLER, Josef (Austrian Academy of Sciences)

Session Classification: Light (keV-GeV) Dark Matter

Contribution ID: **67** Type: **not specified**

Direct detection of sub-MeV dark matter with optical phonons

Tuesday, 2 October 2018 14:05 (30 minutes)

I will discuss the direct detection of dark matter (DM) with polar materials, where single production of optical or acoustic phonons gives excellent reach to scattering of sub-MeV DM for both scalar and vector mediators. Using Density Functional Theory (DFT), we calculate the material-specific matrix elements, focusing on GaAs and sapphire, and show that DM scattering in an anisotropic crystal such as sapphire features a strong directional dependence. For example, for a DM candidate with mass 40 keV and relic abundance set by freeze-in, the daily modulation in the interaction rate can be established at 90\% C.L. with a gram-year of exposure. Non-thermal dark photon DM in the meV - eV mass range can also be effectively absorbed in polar materials.

Summary

Presenter: Dr KNAPEN, Simon (Institute of Advanced Study)

Session Classification: Light (keV-GeV) Dark Matter

Contribution ID: **68** Type: **not specified**

Radiating Dark Matter at the LHC

Tuesday, 2 October 2018 14:40 (30 minutes)

Summary

Presenter: Dr BUSCHMANN, Malte (University of Michigan)

Session Classification: Light (keV-GeV) Dark Matter

Contribution ID: **70** Type: **not specified**

Searching for Ultralight Particles with Black Holes and Gravitational Waves

Wednesday, 3 October 2018 10:40 (30 minutes)

The LIGO detection of gravitational waves has opened a new window on the universe. I will discuss how the process of superradiance, combined with gravitational wave measurements, makes black holes into nature's laboratories to search for new light bosons, from axions to dark photons. When a bosonic particle's Compton wavelength is comparable to the horizon size of a black hole, superradiance of these bosons into 'hydrogenic' bound states extracts energy and angular momentum from the black hole. The occupation number of the levels grows exponentially and the black hole spins down. One candidate for such an ultralight boson is the QCD axion with decay constant above the GUT scale. Current black hole spin measurements disfavor a factor of 30 (400) in axion (vector) mass; future measurements can provide evidence of a new boson. Particles transitioning between levels and annihilating to gravitons may produce thousands of monochromatic gravitational wave signals, and turn LIGO into a particle detector.

Summary

Presenter: Dr BARYAKHTAR, Masha (New York University)

Session Classification: Ultralight Dark Matter

Contribution ID: **71** Type: **not specified**

Axion interferometery

Wednesday, 3 October 2018 11:15 (30 minutes)

We propose using interferometry of circularly polarized light as a mechanism by which to test for axion dark matter. These interferometers differ from standard interferometers only by the addition of a few quarter waveplates to preserve the polarization of light upon reflection. We show that using current technology, interferometers can probe new regions of axion parameter space up to a couple orders of magnitude beyond current constraints.

Summary

Presenter: Prof. HOOK, Anson (University of Maryland)

Session Classification: Ultralight Dark Matter

Contribution ID: **72** Type: **not specified**

Indirect detection of axion dark matter with neutron stars

Wednesday, 3 October 2018 11:50 (30 minutes)

I will argue that axion dark matter may be detectable through narrow radio lines emitted from neutron stars. Neutron star magnetospheres host both a strong magnetic field and a plasma frequency that increases towards the neutron star surface. As the axions pass through the magnetosphere, they can resonantly convert into radio photons when the plasma frequency matches the axion mass, making the radio photon signal an analogue of indirect detection for axions. I will show sensitivity projection from a proposal recently submitted to the Green Bank radio telescope, which shows that a few hours of observation may provide sensitivity competitive with future ADMX runs in the mass range near 4 x 10^-6 eV.

Summary

Presenter: Dr KAHN, Yoni (University of Chicago)

Session Classification: Ultralight Dark Matter

Contribution ID: **82** Type: **not specified**

The investigation of the Dark Sector with PADME at the LNF

Wednesday, 3 October 2018 16:00 (20 minutes)

Among the theoretical models addressing the dark matter problem, the category based on a secluded sector is attracting increasing interest. The PADME experiment, at the Laboratori Nazionali di Frascati (LNF) of INFN, is designed to be sensitive to the production of a low mass gauge boson A'of a new U(1) symmetry holding for dark particles. This 'dark photon'is weakly coupled to the photon of the Standard Model, and it provides an experimental signature for one of the simplest implementations of the dark sector paradigm. The DAΦNE Beam-Test Facility of LNF will provide a high intensity, mono-energetic positron beam impacting on a low Z target. The PADME detector will measure with high precision the momentum of a photon, produced along with A'boson in e+e- annihilation in the target, thus allowing to measure the A'mass as the missing mass in the final state. This technique, particularly useful in case of invisible decays of the A'boson, will be exploited for the first time in a fixed target experiment. Simulation studies predict a sensitivity on the interaction strength (ε**2 parameter) down to 10−6, in the mass region 1 MeV<M_A'<22.5 MeV, for one year of data taking with a 550 MeV beam of 6000 positrons in 40 ns long bunches.
In the middle of 2018, the first run will take place, and early data will give the opportunity to compare the detector performance with the design requirements. This talk will review the status of the experiment and the prospects.

Presenter: BOSSI, Fabio (INFN-Frascati)

Session Classification: Contributed Talks I

Contribution ID: **83** Type: **not specified**

Measuring the Small-Scale Matter Power Spectrum with Ultra-High-Resolution CMB Lensing

Wednesday, 3 October 2018 16:25 (20 minutes)

Abstract: I will show how ultra-high-resolution measurements of the gravitational lensing of the Cosmic Microwave Background (CMB) can be used to measure the small-scale matter power spectrum. A robust measurement of structure on scales below 10 kiloparsecs today (M < 10^9 solar masses) with lensing of the CMB requires a telescope with roughly 20 arcsecond resolution or better, and would provide a firm anchor against which to match models of dark matter particle properties and the baryonic influence on the dark matter distribution. For example, a CMB survey at 90 GHz covering 4,000 square degrees of sky, with an instrumental sensitivity of 0.1 microKelvin-arcmin at 10 arcsecond resolution, could distinguish between cold dark matter and an alternative such as 1 keV warm dark matter or 10^−22 eV fuzzy dark matter with about 30-sigma significance, in the absence of baryonic effects; it may also allow one to distinguish between the impact of baryons and the particle nature of dark matter, since each potentially affects the shape of the lensing power spectrum differently. In addition, such a high-resolution, low-noise CMB Dark Matter Survey would also push the boundaries of our knowledge about the early Universe, dark energy, reionization, and galaxy evolution.

Presenter: SEHGAL, Neelima (Stony Brook University)

Session Classification: Contributed Talks I

Contribution ID: **84** Type: **not specified**

Millicharged particles in neutrino experiments

Thursday, 4 October 2018 10:15 (20 minutes)

We set constraints on millicharged particles (mCPs) based on electron scattering data from MiniBooNE and the Liquid Scintillator Neutrino Detector (LSND). Both experiments are found to provide new (and leading) constraints in certain mCP mass windows: 5 – 35 MeV for LSND and 100 – 180 MeV for MiniBooNE. Furthermore, we provide projections for the ongoing Fermilab SBN program, the Deep Underground Neutrino Experiment (DUNE), and the proposed Search for Hidden Particles (SHiP) experiment. In the SBN program, SBND and MicroBooNE have the capacities to provide the leading bounds in the 100-300 MeV mass regime. Both DUNE and SHiP are capable of probing parameter space for mCP masses ranging from 5 MeV – 5 GeV that is significantly beyond the reach of existing bounds, including those from collider searches and SLAC's mQ experiment.

This work is based on arXiv:1806.03310.

Presenter: TSAI, Yu-Dai (Cornell University / Fermilab)

Session Classification: Neutrinos and the dark sectors

Contribution ID: **85** Type: **not specified**

Supernova 1987A Constraints on Low-Mass Dark Sectors

Wednesday, 3 October 2018 16:50 (20 minutes)

Presenter: CHANG, Jae Hyeok (Stony brook University)

Session Classification: Contributed Talks I

Contribution ID: **86** Type: **not specified**

ALPs: What can we learn from neutron stars and X-ray astronomy?

Thursday, 4 October 2018 14:00 (20 minutes)

Axion-like particles (ALPs) produced in the core of a neutron star can convert to photons in the magnetosphere, leading to possible signatures in the soft and hard X-ray emission from these sources. We study these signatures taking the magnetar SGR 1806-20 as an example. In particular, assuming ALP emission rates from the core that are just subdominant to neutrino emission, the parameter space of ALPs can be constrained by the requirement that the luminosity from ALP-to-photon conversion should not exceed the total observed luminosity from the magnetar. Up to astrophysical uncertainties pertaining to the core temperature, these constraints are competitive with constraints from helioscope experiments in the relevant part of ALP parameter space. Another class of signatures in this context are polarized X-rays, since ALPs only mix with the parallel component of the photon. These polarization signals may be observable by IXPE (in the 2-8 keV range) and X-Calibur (in the 15-60 keV range). A better understanding of the astrophysics of the polarization due to the plasma will be necessary to isolate the contribution from ALPs, in case a polarization signal is observed.

Summary

Presenter: SINHA, Kuver (University of Oklahoma)

Session Classification: Contributed Talks II

Contribution ID: **87** Type: **not specified**

Lightish but clumpy: scalar dark matter from inflationary fluctuations

Thursday, 4 October 2018 14:25 (20 minutes)

It is well known that light scalar fields present during inflation are coherently excited. We show that if the field couples to gravity in a non-minimal way, the fluctuations at large scales are suppressed with respect to the small scales ones. This fact allows for the field excitations to make a sizeable contribution to the energy density of the universe without generating too large isocurvature fluctuations at observable scales. We show that this mechanism could generate all the observable dark matter and study the main cosmological implications of this setup.
ArXiv: https://arxiv.org/abs/1807.09785

Presenter: ALONSO ALVAREZ, Gonzalo (Univeristy of Heidelberg)

Session Classification: Contributed Talks II

Contribution ID: **88** Type: **not specified**

Search for light Dark Matter with NEWS-G

Thursday, 4 October 2018 16:00 (20 minutes)

The New Experiments With Spheres-Gas (NEWS-G) is dedicated to the direct search for Dark Matter candidates in the 0.1 −10 GeV range. The experiment uses the novel Spherical Proportional Counter detector, which exhibits a number of key features including: a) low energy thresholds, few tens of eV, owing to low detector capacitance independently of the volume and high gain operation; b) small number of readout channels and potential for directionality; c) background rejection through pulse shape analysis; d) simplicity and use of highly radio-pure materials; e) variety of light target gases, including Hydrogen, Helium, and Neon, allowing optimisation of momentum transfers for low-mass particles in the GeV mass range, significantly increasing the sensitivity to subGeV candidates; and f) possibility to vary the operational pressure and high voltage, providing additional handles to disentangle potential signals from unknown instrumental backgrounds. The first detector SEDINE, a 60cm diameter sphere already operated in the Underground Laboratory of Modane (France), while the full scale detector, with 140cm diameter, will be installed in SNOLab (Canada) later this year. In this talk, the first NEWS-G results based on 9.7kg.days of exposure will be presented, and that status of the project and prospects for the future will be discussed.

Presenter: NIKOLOPOULOS, Konstantinos (University of Birmingham)

Session Classification: Contributed Talks III

Contribution ID: **89** Type: **not specified**

Introducing the SnowBall Chamber, Supercooled Water for Dark Sector

Thursday, 4 October 2018 16:25 (20 minutes)

We have all heard of the cloud and bubble chambers of course, and the latter in the context of direct WIMP dark matter detection even. However, no one has explored a 3rd phase transition, into solid, until now that is. This talk will introduce the snowball chamber, which utilizes a supercooled liquid, just purified water in the prototype. An incoming particle triggers nucleation in the liquid, forming a solid. We will present the world's first definitive evidence that radiation can trigger freezing in metastable cold water, an effect never before observed, and in particular share AmBe and Cf-252 neutron source calibration data, wherein multiple nucleation sites could be observed, another world first, making our device act just like a reverse bubble chamber. Because the reaction is exothermic, not endothermic as in a bubble chamber, the energy threshold should be lower, perfect for dark sector dark matter searches. We will present the measured background gamma-ray discrimination, high as in a bubble chamber, and the projected sensitivity, with a smaller, more cost-effective detector than many of the competing new technologies. The crystallization may even have directionality which we will demonstrate preliminary evidence for: this would mean higher-density directional detectors than in gas.

Presenter: SZYDAGIS, Matthew (SUNY Albany)

Session Classification: Contributed Talks III

Contribution ID: **90** Type: **not specified**

Asymmetric Structure Formation.

Thursday, 4 October 2018 14:50 (20 minutes)

We study the simplest model of a dark sector that forms structure via cooling, in analogy to the baryonic sector.
This dark sector is an asymmetric, sub-dominant component of dark matter, that consists of a dark electron and a dark photon.
The dark-electron perturbations collapse and fragment due to bremsstrahlung cooling, forming astronomical objects of varying size and compactness. These objects may run away into black holes, or be stabilized via kinetic or long-range repulsive Coulomb pressure. Such dark-sector objects may lead to novel signatures at new high-precision astronomical observatories.

Summary

Presenter: EGAÑA, Daniel (Stony Brook University)

Session Classification: Contributed Talks II

Contribution ID: **91** Type: **not specified**

Search for H –> Z(dark)Zdark –> 4l with ATLAS

Thursday, 4 October 2018 15:15 (15 minutes)

Summary

Presenter: BOYE, Diallo (University of Johannesburg)

Session Classification: Contributed Talks II

Contribution ID: **92** Type: **not specified**

Title: Effects of a caustic ring of dark matter on the distribution of stars and interstellar gas

Thursday, 4 October 2018 16:50 (20 minutes)

Authors: Sankha S Chakrabarty and Pierre Sikivie

Caustic rings of dark matter with tricusp cross-section were predicted to lie in the galactic disk. In the self-similar evolution of the dark halo, their radii increase on cosmological time scales at a rate of order 1 kpc/Gyr. When a caustic ring passes through the orbit of a star, the orbit is strongly perturbed. We find that a star moving in a nearly circular orbit is first attracted towards the caustic ring, then moves with and oscillates about the caustic for approximately 1 Gyr before returning to its original orbit. This results in a stellar overdensity around the caustic ring. We predict such overdensities to be of order 120% near the 2nd caustic ring where the Monoceros Ring is observed and of order 45, 30 and 15% near the 3rd, 4th and 5th caustic rings, respectively. We show that the associated bulk velocities of the stars near the caustic rings are less than a few km/s. We also determine the density profile of interstellar gas near the 5th caustic ring assuming it is in thermal equilibrium in the gravitational potential of the caustic and of the gas itself.

Presenter: CHAKRABARTY , Sankha S (Department of Physics, University of Florida)

Session Classification: Contributed Talks III

Contribution ID: **93** Type: **not specified**

Photoproduction of dark particles off electrons in the Compton process

Thursday, 4 October 2018 17:15 (20 minutes)

Summary

Presenter: JAEGLE, Igal (University of Florida at Gainesville)

Session Classification: Contributed Talks III

Contribution ID: **94** Type: **not specified**

Theoretical Constraints on New Interaction

Wednesday, 3 October 2018 14:35 (30 minutes)

Presenter: ROSEN, Rachel A. (Columbia University)

Session Classification: Cosmological and astrophysical probes of dark sectors

Contribution ID: **95** Type: **not specified**

Overview of Neutrinos and Dark Sectors

Thursday, 4 October 2018 09:00 (45 minutes)

Presenter: FRIEDLAND, Alexander (SLAC National Accelerator Laboratory)

Session Classification: Neutrinos and the dark sectors

Contribution ID: **96** Type: **not specified**

Latest Results from MiniBooNE

Thursday, 4 October 2018 09:50 (25 minutes)

Abstract: MiniBooNE has recently updated both their short baseline neutrino oscillation and sub-GeV dark matter analyses. Both results have strong implications for the dark sector. The oscillation analyses suggests the existence of at least one sterile neutrino, while the null results from the sub-GeV dark matter search have placed the most stringent limits to date, on the vector portal dark matter scenario, for dark matter with masses between 5 and 50 MeV. This talk will present both of these analyses, their results, and discuss some of the implications to the dark sector.

Summary

Presenter: THORNTON, Remington Tyler (LANL)

Session Classification: Neutrinos and the dark sectors

Contribution ID: **97** Type: **not specified**

Results of a search for sub-GeV dark matter using 2013 LUX data

Friday, 5 October 2018 10:15 (20 minutes)

Summary

Presenter: TVRZNIKOVA, Lucie (Lawrence Berkeley National Lab)

Session Classification: Direct Detections

Contribution ID: **98** Type: **not specified**

Aspects of Long-Range Interactions Arising from WISPs

Wednesday, 3 October 2018 17:15 (20 minutes)

Abstract: Various theories beyond the Standard Model possess weakly interacting sub-eV particles often referred to as WISPs. Such particles, if they exist, would mediate long-range forces between macroscopic bodies. Strong constraints exist on such ultralight bosons with scalar and vector couplings to fermions from "spin-independent"experiments involving unpolarized test bodies. In contrast, present direct laboratory constraints on exotic spin-dependent forces from pseudoscalar and axial couplings to fermions are many orders of magnitude weaker. Motivated by the disparity between these limits, we investigated whether tighter constraints on pseudoscalar and axial couplings can be extracted using the data from spin-independent searches combined with higher-order perturbation theory calculations. We derive the functional forms for all possible exotic spin-independent interactions arising from two-boson exchange with pseudoscalar and axial couplings between a pair of fermions in the nonrelativistic limit. Some of our results coincide with the results found in the literature calculated a long time ago for pseudo-Goldstone bosons with Yukawa and derivative couplings in the context of nuclear forces: others are completely new. Coupled with the stringent limits from current spin-independent experiments, we have opened up a new opportunity to constrain spin-dependent couplings over new length scales for different fermionic species. We present the first example of the successful use of this approach.

Presenter: ALDAIHAN, Sheakha (Indiana University)

Session Classification: Contributed Talks I