XV NExT PhD Workshop: Future Horizons in Particle Physics and Cosmology

Report of Contributions

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

SymTFTs for U(1) symmetries from descent

Wednesday 16 July 2025 17:30 (20 minutes)

Recently, the notion of symmetry descent has been introduced in order to obtain the (d+1)-dimensional Symmetry TFT (SymTFT) of a d-dimensional QFT from the edge mode behaviour of a theory in (d+2)-dimensions. This method has so far been used to obtain SymTFTs for discrete higher-form symmetries of geometrically engineered QFTs. In this note, we extend the symmetry descent procedure to obtain SymTFTs for U(1) higher-form symmetries of geometrically engineered QFTs. We find the resulting SymTFTs match those in the works of Antinucci-Benini and Brennan-Su.

Presenter: GAGLIANO, Finn (Durham University)

Session Classification: Student Talks

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

2l+MET signature from two-component dark matter at the LHC

Monday 14 July 2025 16:30 (20 minutes)

The talk will cover an exploration on the dilepton plus missing transverse energy (MET) signature from LHC to search for two-component scalar Dark Matter (DM). The model discussed in this work is a 3-Higgs Doublet Model (3HDM) where two of the doublets are inert from the Standard Model (SM) and the other one is active and also the SM Higgs doublet, hence a I(2+1)HDM. Each inert sector will provide a scalar DM particle with a discrete symmetry of Z2xZ2 applying on the doublets, and therefore the model will provide two-component DM. The work studies the model parameter space on the masses of two DM particles and the mass differences between the DMs and the next-to-lightest neutral states in each dark sector. Despite the numerical analysis is performed within the I(2+1)HDM for illustrative purposes, this approach makes our essentially largely model-independent and thus suitable for interpretations in other two-component scalar DM scenarios giving rise to the dilepton plus MET signature.

Presenter: CHEN, Shu (University of Southampton)

Session Classification: Student Talks

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

Decay time resolution measurement for the B0 to Dpi decays

Monday 14 July 2025 17:10 (20 minutes)

The decay time resolution is crucial for the determination of CP asymmetries in the time-dependent $B0 \to D\pm\pi\mp$ analysis. In this measurement the decay time resolution was investigated using a sample of reconstructed "fake" B0 candidates selected from the LHCb Run 2 data. A mass fit was performed to suppress the background, and the transverse momentum of the
B0 meson was used to map the data to MC. The final result of the decay time resolution obtained from a second order calibration of the decay time error is $\langle\sigma\rangle = 0.04743 \pm 0.00030$, which is consistent with the MC . And this result will be incorporated in the final decay time fit to unfold the detector effect, thereby improve the sensitivity to
CP variables.

Presenter: SUN, Jinyi (The University of Manchester (GB))

Session Classification: Student Talks

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

The NOvA Test Beam Program Content

Monday 14 July 2025 17:30 (20 minutes)

The NOvA (NuMI Off-Axis electron neutrino Appearance) Experiment is a long-baseline neutrino oscillation experiment composed of two functionally identical detectors, a 300 ton Near Detector, and a 14 kton Far Detector separated by 810 km and placed 14 mrad off the axis of the NuMI neutrino beam created at Fermilab. This configuration enables NOvA's rich neutrino physics program, which includes measuring neutrino mixing parameters, determining the neutrino mass hierarchy, and probing CP violation in the leptonic sector. The NOvA Test Beam experiment deployed at Fermilab between 2018 and 2022 used a scaled-down 30 ton detector to analyse tagged beamline particles. The beamline selected and identified electrons, muons, pions, kaons, and protons with momenta ranging from 0.4 to 1.8 GeV/c, as understanding how the detector responds to these particles found in the final state of neutrino interactions is crucial. This talk describes the components of the beamline and their purpose, showing the highlights and challenges of the NOvA Test Beam program that aims to produce results for particle response in NOvA detectors.

Presenter: BANNISTER, Emerson (University of Sussex)

Session Classification: Student Talks

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

The Black Hole Isospectrality Problem

Wednesday 16 July 2025 17:50 (20 minutes)

In 1983, Chandrasekhar calculated that the ringdown spectrum of a perturbed black hole (BH) is identical regardless of perturbation type (isospectrality). While this 'coincidence' was proven mathematically its physical origin remains mysterious. After the detection of Gravitational waves and BH ringdowns by LIGO (GW150914) this mystery is now directly relevant for BH observations.

In this presentation/ poster I revisit Chandrasekhar's calculation of isospectrality. I will discuss its relation to other areas of BH physics, and super symmetric quantum mechanics. I will also propose a method for making progress by treating spacetime in the fully extended Kruskal-Szekeres coordinates.

Presenter: FRANKLIN, Samuel (Institute of cosmology and gravitation (University of Portsmouth))

Session Classification: Student Talks

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

Dark Matter in X-rays: Revised XMM-Newton Limits and New Constraints from eROSITA

Thursday 17 July 2025 11:35 (20 minutes)

Dark Matter in X-rays: Revised XMM-Newton Limits and New Constraints from eROSITA
We investigate two classes of dark matter (DM) candidates, sub-GeV particles and primordial black holes (PBHs), that can inject low-energy electrons and positrons into the Milky Way and leave observable signatures in the X-ray sky. In the case of sub-GeV DM, annihilation or decay into e+e- contributes to the diffuse sea of cosmic-ray (CR) leptons, which can generate bremsstrahlung and inverse Compton (IC) emission on Galactic photon fields, producing a broad spectrum from X-rays to γ-rays detectable by instruments such as eROSITA and XMM-Newton.

Presenter: CLEAVER, Damon (King's College London)

Session Classification: Student Talks

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

Radiatively generated symmetron mechanism in curved spacetime

Thursday 17 July 2025 11:55 (20 minutes)

Content Scalar-tensor theories of gravity are a class of modified gravity models that extend general relativity by introducing a scalar field coupling to curvature terms in the action. These theories aim to address fundamental problems in cosmology, such as explaining the nature of dark matter and the origin of the Universe's accelerated expansion. The models have been thoroughly tested, and a significant portion of their parameter space has been excluded by observations. In order to avoid these constraints, a screening mechanism can be introduced to the theory that hides the fifth force from detection. In this talk, I will present ongoing work on the extension of the radiatively generated symmetron-like screening mechanism [1] to the curved spacetime. I will discuss the importance of the corrections due to the spacetime's curvature and their consequences for mapping back the observational constraints to the model's parameter space

Presenter: BUNIO, Lukasz (University of Manchester)

Session Classification: Student Talks

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

Impact of external vibrations on long baseline atom interferometers

Thursday 17 July 2025 11:15 (20 minutes)

Long baseline atom interferometers, such as the AION-10 device currently being planned in Oxford, show promise as methods of detecting both unltralight dark matter, gravitational waves and other potential astrophysical signals. However, the readings from these instruments are very noisy due to the impact of gravity gradient noise from the external environment. This work aims to characterise this noise.

Presenter: PARISH, George (King's College London)

Session Classification: Student Talks

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

Top-Quark Pair Production in 1 Higgs-Singlet Model

Monday 14 July 2025 16:50 (20 minutes)

1 Higgs-Singlet Model (1HSM) is a minimal extension of the Standard Model with two physical scalar bosons. Top quark pair production in 1HSM is associated with large interference effects between loop-induced Higgs-mediated amplitudes and the QCD continuum background. I will talk about the research work on top quark pair production in 1HSM at NLO accuracy by Banfi et al. (arXiv: 2309.16759), and outline the main results. I will talk about the computation of the cross section of the top-quark pair production in the Higgs Effective Field Theory framework to make phenomenological predictions at the LHC.

Presenter: LINGADAHALLY, Vishakha

Session Classification: Student Talks

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

Nuclear Pasta and Neutron Star Dynamics

Wednesday 16 July 2025 18:10 (20 minutes)

Neutron stars (NSs) comprise the most extreme matter in the universe, existing on the precipice between ordinary matter and black holes. Their immense density, gravity and magnetic fields offer a unique insight into the nature of matter under extreme conditions that cannot be replicated on Earth.

My PhD and presentation focus on the crust-core transition region of NSs, where neutron-rich nuclei exist in a sea of superfluid neutrons. In this dense region, attractive nuclear forces and Coulomb repulsion compete, preventing the system from minimising its total energy. Matter becomes frustrated, and a complex arrangement emerges featuring many local minima. This results in the formation of mesoscopic structures known as 'nuclear pasta', taking various forms ranging from spaghetti-like strands to lasagne-like sheets, depending on the most energy-efficient configuration at a given density. The material and transport properties of these pasta structures remain poorly understood, yet they play a crucial role in crust-core interactions. These interactions influence several NS observables, such as gravitational wave (GW) i-modes and resonant shattering flares from tidal resonances, expected to be detected by next-generation GW detectors and telescopes. Understanding nuclear pasta is thus key to advancing our knowledge of NSs and dense matter physics.

My research employs a computational technique known as the the Lattice-Bolztmann Method (LBM) to model nuclear pasta. Derived from the Boltzmann equation, the LBM captures the mesoscopic behaviour of fluids, bridging microscopic particle interactions and macroscopic fluid dynamics. While the LBM has been widely used in complex terrestrial fluid simulations, its astrophysical application remains unexplored. Although there are many conceptual similarities between terrestrial applications of the LBM and nuclear pasta, the challenge lies in adapting the method to incorporate the extreme conditions inside NSs. Successful implementation of the LBM to model nuclear pasta will enable predictions of NS observables, improving our interpretation of future GW detections.

Presenter: MATHIAS, Lowri

Session Classification: Student Talks

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

Phenomenology of String/M-Theories - Lecture 1

Monday 14 July 2025 15:00 (1 hour)

Presenter: ACHARYA, Bobby Samir (Abdus Salam Int. Cent. Theor. Phys. (IT))

Session Classification: Phenomenology of String/M-Theories

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

Phenomenology of String/M-Theories - Lecture 2

Tuesday 15 July 2025 09:00 (1 hour)

Presenter: ACHARYA, Bobby Samir (Abdus Salam Int. Cent. Theor. Phys. (IT))

Session Classification: Phenomenology of String/M-Theories

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

Phenomenology of String/M-Theories - Lecture 3

Wednesday 16 July 2025 15:00 (1 hour)

Presenter: ACHARYA, Bobby Samir (Abdus Salam Int. Cent. Theor. Phys. (IT))

Session Classification: Phenomenology of String/M-Theories

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

Beyond WIMPs –Exploring Novel Dark Matter Candidates - Lecture 1

Tuesday 15 July 2025 14:00 (1 hour)

Presenter: SMIRNOV, Juri

Session Classification: Beyond WIMPs –Exploring Novel Dark Matter Candidates

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

Beyond WIMPs –Exploring Novel Dark Matter Candidates - Lecture 2

Wednesday 16 July 2025 09:00 (1 hour)

Presenter: SMIRNOV, Juri

Session Classification: Beyond WIMPs –Exploring Novel Dark Matter Candidates

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

Beyond WIMPs –Exploring Novel Dark Matter Candidates - Lecture 3

Thursday 17 July 2025 09:45 (1 hour)

Presenter: SMIRNOV, Juri

Session Classification: Beyond WIMPs –Exploring Novel Dark Matter Candidates

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

Probing Fundamental Physics with Quantum Sensors - Lecture 1

Tuesday 15 July 2025 15:00 (1 hour)

Presenter: HOWL, Richard

Session Classification: Probing Fundamental Physics with Quantum Sensors

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

Probing Fundamental Physics with Quantum Sensors - Lecture 2

Wednesday 16 July 2025 11:30 (1 hour)

Presenter: HOWL, Richard

Session Classification: Probing Fundamental Physics with Quantum Sensors

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

Probing Fundamental Physics with Quantum Sensors - Lecture 3

Thursday 17 July 2025 13:30 (1 hour)

Presenter: HOWL, Richard

Session Classification: Probing Fundamental Physics with Quantum Sensors

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

Neutrino Experiments –Past, Present and Future - Lecture 1

Tuesday 15 July 2025 10:00 (1 hour)

Presenter: MCCONKEY, Nicola

Session Classification: Neutrino Experiments –Past, Present and Future

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

Neutrino Experiments –Past, Present and Future - Lecture 2

Wednesday 16 July 2025 10:00 (1 hour)

Presenter: MCCONKEY, Nicola

Session Classification: Neutrino Experiments –Past, Present and Future

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

Neutrino Experiments –Past, Present and Future - Lecture 3

Wednesday 16 July 2025 14:00 (1 hour)

Presenter: MCCONKEY, Nicola

Session Classification: Neutrino Experiments –Past, Present and Future

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

Precision Monte Carlo for the Large Hadron Collider - Lecture 1

Monday 14 July 2025 11:30 (1 hour)

Presenters: LINDERT, Jonas (University of Sussex);

Session Classification: Precision Monte Carlo for the Large Hadron Collider

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

Precision Monte Carlo for the Large Hadron Collider - Lecture 2

Monday 14 July 2025 14:00 (1 hour)

Presenters: LINDERT, Jonas (University of Sussex);

Session Classification: Precision Monte Carlo for the Large Hadron Collider

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

Precision Monte Carlo for the Large Hadron Collider - Lecture 3

Tuesday 15 July 2025 11:30 (1 hour)

Presenters: LINDERT, Jonas (University of Sussex);

Session Classification: Precision Monte Carlo for the Large Hadron Collider

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

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Thursday 17 July 2025 12:15 (15 minutes)

Presenter: STOFFERS, Amanda

Session Classification: Student Talks