New Frontiers in Theoretical Physics - XXXVIII Convegno Nazionale di Fisica Teorica

Report of Contributions

https://agenda.infn.it/e/cortona2025

Contribution ID: **125** Type: **not specified**

N=1 supergravity Lagrangian from the Double Copy

Wednesday, 21 May 2025 10:25 (15 minutes)

The Double Copy relations are a set of correspondences between (super) gravitational and (super) Yang-Mills theories which allow one to compute tree-level n-graviton scattering amplitudes from tree-level n-gluon ones. We try to extend this paradigm to the off-shell case by attempting the construction of the Lagrangian of N=1 Supergravity using an N=1 Yang-Mills theory and a non-supersymmetric Yang -Mills theory as building blocks. This is done by constructing Double Copy fields as suitable convolution products of the fields of the two Yang-Mills Theories. We also try to generalize the Double Copy to the case of higher-spin fields by means of the same construction.

Primary authors: Dr FRANCIA, Dario (Università degli Studi Roma Tre, INFN Rome Tre Section); Dr FERRERO, Pietro (Stony Brook U., New York, SCGP); DESCONTUS, Valerio (Istituto Nazionale di Fisica Nucleare)

Presenter: DESCONTUS, Valerio (Istituto Nazionale di Fisica Nucleare)

Session Classification: Formal aspects

Contribution ID: **126** Type: **not specified**

Foundational aspects of Supersymmetry via the Dressing Field Method

Wednesday, 21 May 2025 09:40 (15 minutes)

I will explore some foundational aspects of supersymmetric field theories under the perspective of the Dressing Field Method (DFM), a new systematic tool to exhibit the gauge-invariant content of general-relativistic gauge field theories.
First, I will show that the gauge-fixing conditions typically used to extract the degrees of freedom of the Rarita-Schwinger spinor-vector and gravitino fields are actually instances of the DFM. Since the latter has a natural relational interpretation, solving the dressing functional constraints actually realises the Rarita-Schwinger spinor-vector and gravitino fields as *relational variables*.
I will then discuss the *unconventional supersymmetry* proposal by Alvarez, Valenzuela, and Zanelli, aiming to use the framework of supersymmetric field theory to describe fermionic matter fields and bosonic gauge fields as parts of a single superconnection, showing that the so-called *matter ansatz* underlying the theory is a special case of the DFM.

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Co-author: Dr FRANÇOIS, Jordan (University of Graz, Austria)

Presenter: RAVERA, Lucrezia (Istituto Nazionale di Fisica Nucleare)

Session Classification: Formal aspects

Contribution ID: **127** Type: **not specified**

Atoms as electron accelerators

Wednesday, 21 May 2025 16:55 (15 minutes)

Resonant positron annihilation on atomic electrons is a powerful technique for searching for light new particles that couple to e^+e^-. Precise estimates of production rates require a detailed characterisation of atomic electron momentum distributions. I will present a general method that leverages the Compton profile of the target material to accurately account for electron velocity effects in resonant annihilation cross-sections. Additionally, I will discuss the implications of this precise computation for new physics searches and explore how high Z atoms can effectively serve as electron accelerators, significantly extending the experimental mass reach. Finally, I will demonstrate that by harnessing the relativistic velocities of electrons in the inner atomic shells, a high-intensity 12 GeV positron beam —such as the one planned at JLab —can enable precise measurements of the hadronic cross section, from the two-pion threshold to a center-of-mass energy exceeding 1 GeV.

Primary authors: NARDI, Enrico (Istituto Nazionale di Fisica Nucleare); ARIAS ARAGON, Fernando (Istituto Nazionale di Fisica Nucleare); GRILLI DI CORTONA, Giovanni (Istituto Nazionale di Fisica Nucleare); DARME, Luc (IP2I - Lyon 1 University)

Presenter: GRILLI DI CORTONA, Giovanni (Istituto Nazionale di Fisica Nucleare)

Session Classification: Applied theory

Contribution ID: **128** Type: **not specified**

Dissipative electrically driven fluids

Wednesday, 21 May 2025 15:45 (15 minutes)

Hydrodynamics is the effective field theory description of many-body systems close to thermal equilibrium at large distances and late times. The dynamics of these systems are governed by the conservation of energy, momentum and charge. However, in certain cases, e.g., when spatial translation invariance is broken, these hydrodynamic currents decay slowly rather than remain conserved, necessitating a modification to the standard hydrodynamic framework, known as relaxed hydrodynamics.

In this talk, I will explore how to incorporate relaxations into the description of entropy generating flows for fluids that reach a steady state under an applied electric field. Specifically, we aimed to construct a hydrodynamic theory that aligns with Drude's model of electron transport. In the conventional hydrodynamic formulation of a charged fluid under an external electric field, the stationary state arises when the electric field is balanced by the gradient of the chemical potential. This approach treats the electric field and the fluid velocity as independent degrees of freedom, which contrasts with Drude's model.

To resolve this discrepancy, I discuss a boost-agnostic hydrodynamic model with modified hydrostatic constraints. After pointing out the relation between the energy and momentum relaxation in the presence of dissipation in our model, I will present the computed thermo-electric conductivities. We find that imposing Onsager reciprocity leads to a zero incoherent conductivity. Furthermore, the AC thermo-electric conductivities exhibit a Drude-like form. This model thus provides a refined hydrodynamic description that includes Drude's theory within a hydrodynamic formalism.

Primary author: Mr RONGEN, Jonas (University of Genoa & Istituto Nazionale di Fisica Nucleare)

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Presenter: Mr RONGEN, Jonas (University of Genoa & Istituto Nazionale di Fisica Nucleare)

Session Classification: Applied theory

Contribution ID: **129** Type: **not specified**

Current constraints on cosmological scenarios with very low reheating temperatures

Tuesday, 20 May 2025 16:50 (15 minutes)

If reheating occurs at sufficiently low temperatures (below $20\,\mathrm{MeV}$), neutrinosmdash;assuming they are populated only through weak interactionsmdash;do not have enough time to reach thermal equilibrium before decoupling. We present an updated analysis of cosmological models with very low reheating scenarios, including a more precise computation of neutrino distribution functions, leveraging the latest datasets from cosmological surveys. At the 95% confidence level, we establish a lower bound on the reheating temperature of $T_{\mathrm{RH}} > 5.96\,\mathrm{MeV}$, representing the most stringent constraint to date.

Primary author: BARBIERI, Nicola (Istituto Nazionale di Fisica Nucleare)

Presenter: BARBIERI, Nicola (Istituto Nazionale di Fisica Nucleare)

Session Classification: Astro/Cosmo

Contribution ID: **130** Type: **not specified**

Nonlinearities in black hole ringdown

Tuesday, 20 May 2025 15:05 (15 minutes)

We study the quadratic quasi-normal modes of a Schwarzschild black hole, which are perturbations originating from the coupling of two linear quasi-normal modes. As recent studies suggest, nonlinear effects in black hole perturbation theory may be crucial for accurately describing a black hole ringdown. We present a new class of "quadratic" quasi-normal modes at second order in perturbation theory, where both the frequency and amplitude are entirely determined by the linear modes. Assuming the amplitude of the two linear modes is known, we compute the amplitude of the resulting quadratic mode across a wide range of possible angular momenta using Leaver's algorithm. Finally, we reconstruct the waveform in the radiation gauge. These quadratic modes could enhance black hole ringdown models by incorporating nonlinear features without adding extra free parameters for data analysis, or serve as a tool to test General Relativity in the nonlinear regime.

Primary authors: KUNTZ, Adrien (SISSA); BUCCIOTTI, Bruno (Scuola Normale Superiore, INFN); TRINCHERINI, Enrico (SNS); JULIANO, Leonardo (Istituto Nazionale di Fisica Nucleare)

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Session Classification: Astro/Cosmo

Contribution ID: **131** Type: **not specified**

On the Atomki nuclear anomaly after the MEG-II result

Thursday, 22 May 2025 11:40 (15 minutes)

Recent experimental results from the Atomki collaboration have reported the observation of anomalous effects in Beryllium, Helium and Carbon nuclear transitions that could hint at physics beyond the Standard Model. However, the MEG-II experiment has recently found no significant anomalous signal in the Beryllium transition $^8\text{Be} \longrightarrow {}^8\text{Be} + e^+e^-$. In view of this result, we critically re-examine the possible theoretical interpretations of the anomalies observed by the Atomki experiment in terms of a new boson X with mass around 17 MeV. The present work aims to study the phenomenology of a spin-2 state and revisit the possibility of a pure CP-even scalar, which was initially dismissed due to its inability to explain the Beryllium anomalous signal. Our analysis shows that a spin-2 state is highly disfavoured by the SINDRUM constraint while a scalar boson could explain the Helium and Carbon anomalies while being compatible with other experimental constraints.

Primary authors: BARDUCCI, Daniele (Istituto Nazionale di Fisica Nucleare); NARDECCHIA, Marco (Istituto Nazionale di Fisica Nucleare); TONI, Claudio (Istituto Nazionale di Fisica Nucleare); GERMANI, Davide (Istituto Nazionale di Fisica Nucleare); SCACCO, Stefano (Istituto Nazionale di Fisica Nucleare)

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Session Classification: QCD/EW/BSM pheno

Contribution ID: **132** Type: **not specified**

Light spin-3/2 particles need gravity (and broken SUSY)

Wednesday, 21 May 2025 09:55 (15 minutes)

We study the EFT of a Majorana massive spin-$\frac{3}{2}$ particle through consistency conditions derived from unitarity, causality and Lorentz invariance. We show that its mass cannot be parametrically lighter than the UV cutoff, unless all the interactions, both in the transverse and longitudinal sector, are tuned to gravity. Then we focus on the decoupling limit, which effectively projects out the longitudinal modes and gives a theory of goldstinos. We study the allowed parameter space, identifying relevant UV completions, with both finite and infinite towers of higher-spin states. The necessity of gravity for consistency and the tuning of the couplings point to theories with spontaneously broken supersymmetry as the only consistent UV completions for a parametrically light spin-$\frac{3}{2}$ particle.

Primary author: ROMANO, Marcello (IPhT, Saclay)

Presenter: ROMANO, Marcello (IPhT, Saclay)

Session Classification: Formal aspects

Contribution ID: **133** Type: **not specified**

Fractons from covariant higher-rank Chern-Simons and BF theories

Wednesday, 21 May 2025 17:10 (15 minutes)

Fracton phases of matter constitute an interesting point of contact between condensed matter and high-energy physics. The limited mobility of subdimensional quasiparticles finds applications in different areas of theoretical physics, including quantum information, quantum field theory, elasticity, hydrodynamics and gravity. In our works we adopt a field theoretical approach to investigate three dimensional (3D) actions involving a rank-2 symmetric tensor gauge field $a_{\mu\nu}(x)$ invariant under the covariant fracton symmetry. First of all we study the most general 3D action of $a_{\mu\nu}(x)$ with mass dimension one and the theory appears as a traceless non-topological higher-rank generalisation of the ordinary Chern-Simons model. Once matter is introduced, our model shows a Hall-like dipole current together with a vectorial "flux-attachment"relation for dipoles. Subsequently, we studied the 3D field theory of two tensor gauge fields with mass dimension one: $a_{\mu\nu}(x)$, transforming under the covariant fracton symmetry, and $B_{\mu\nu}(x)$, with no symmetry on its indices. The corresponding invariant action is a non-topological higher-rank BF-like model, first considered from a purely field theoretical point of view, and the propagators with their poles and the degrees of freedom are studied. Once matter is introduced, a subdimensional behaviour emerges, with both fractons and lineons. Moreover our theory can be mapped to the low-energy effective field theory describing the Rank-2 Toric Code. Finally we analyze the case in which $B_{\mu\nu}(x)$ is a symmetric tensor, where it turns out that the action can be cast into the sum of two rank-2 Chern-Simons actions, thus generalizing the ordinary abelian case.

Primary authors: Dr BERTOLINI, Erica (Dublin Institute for Advanced Studies); BLASI, Alberto (GE); Dr CARREGA, Matteo (CNR-SPIN Genova); MAGGIORE, Nicola (GE); SACCO SHAIKH, Daniel (Università di Genova and INFN Genova)

Presenter: SACCO SHAIKH, Daniel (Università di Genova and INFN Genova)

Session Classification: Applied theory

Contribution ID: **134** Type: **not specified**

Work Fluctuations for Active Particles: singularities, dynamical phase transitions and big jumps

Wednesday, 21 May 2025 17:25 (15 minutes)

Active Particles are physical entities able to transform energy from the environment or internal reservoirs into directed self-propelled motion. From a theoretical standpoint, in recent years this class of systems generated great interest in statistical mechanics due to the display of intriguing new properties as motility-induced phase separation [1], an inherent out of equilibrium character [2] and the occurrence of singularities in distributions of integrated observables. The latter are in turn are associated to Dynamical Phase Transitions (DPTs) [3], i.e changes in the dynamical behavior of the system in different fluctuation regimes separated by singularities. In this respect, Active Work, i.e. the work performed by the self-propulsion force, emerged as a key observable to monitor in active systems as at the same time it quantifies how efficiently energy is transformed into self propulsion [4], it is strictly related to entropy production [2] and its singular distribution signals DPTs [5].

In this talk we will present a summary of our results on this subject. After briefly reviewing the case of a single free Active Ornstein-Uhlenbeck Particle (AOUP) from [4], in which DPTs do not occur, we will consider the case of a single AOUP under the effect of a confining harmonic potential from [6]. The simple but non-trivial framework of a single particle allowed us to tackle the problem analytically for both stationary and generic uncorrelated initial states. In particular, we adopted the general Large Deviations approach we developed in [7] for quadratic functionals of Gauss-Markov chains. Our results showed that harmonic confinement can indeed induce singularities in the Active Work Rate Function, with linear tails at large positive and negative values appearing for sufficiently large self-propulsion force, harmonic confinement and/or initial values. In addition, by looking at the system trajectories, we discovered these singularities to be associated to DPTs, which in turn are originated by concentrated large values, or big jumps, in the displacement and the self-propulsion force at the initial or ending points of trajectories. In order to show that these big jumps represent a general mechanism for Brownian particles, we will show that analogous results are obtained also for the work injected by the random noise on a passive underdamped Brownian particle studied in [8]. Overall, our results provide a connection between DPTs and a condensation-like physical mechanism and clarify the relevance of boundary terms in the problem at hand.

[1] Motility-Induced Phase Separation, M. E. Cates and J. Tailleur, Annual Review of Condensed Matter Physics (6) 2015
[2] Irreversibility and Biased Ensembles in Active Matter: Insights from Stochastic Thermodynamics, E. Fodor, R. L. Jack, and M. E. Cates, Annual Review of Condensed Matter Physics (13) 2022
[3] A first-order dynamical transition in the displacement distribution of a driven run-and-tumble particle, G. Gradenigo and S. N. Majumdar, Journal of Statistical Mechanics: Theory and Experiment (5) 2019
[4] Work fluctuations in the active Ornstein–Uhlenbeck particle model, M. Semeraro, A. Suma, I. Petrelli, F. Cagnetta, and G. Gonnella, Journal of Statistical Mechanics: Theory and Experiment (12) 2021
[5] Large fluctuations and dynamic phase transition in a system of self-propelled particles, F. Cagnetta, F. Corberi, G. Gonnella, and A. Suma, Physical review letters (119) 2017
[6] Work Fluctuations for a Harmonically Confined Active Ornstein-Uhlenbeck Particle, M. Semeraro, G. Gonnella, A. Suma, and M. Zamparo, Physical Review Letters (131) 2023
[7] Large deviations for quadratic functionals of stable Gauss–Markov chains and entropy production, M. Zamparo and M. Semeraro, Journal of Mathematical Physics (64) 2023

[8] Work fluctuations for a confined Brownian particle: the role of initial conditions, G. B. Carollo, M. Semeraro, G. Gonnella and M. Zamparo, Journal of Physics A: Mathematical and Theoretical (43) 2023

Primary authors: Dr SEMERARO, Massimiliano (Università di Bari and INFN Bari); Dr SUMA, Antonio (Università di Bari and INFN Bari); Dr ZAMPARO, Marco (Università del Piemonte Orientale); Prof. GONNELLA, Giuseppe (Università di Bari and INFN Bari)

Presenter: Dr SEMERARO, Massimiliano (Università di Bari and INFN Bari)

Session Classification: Applied theory

Contribution ID: **135** Type: **not specified**

On relation perturbative QFT and the stochastic approach in cosmology

Wednesday, 21 May 2025 10:40 (15 minutes)

I would like to discuss recent results in well-known (and not so much) techniques to calculate correlation functions in de Sitter space and beyond. The main focus of my talk is the connection of the stochastic formalism to perturbative QFT's results in curved spacetime.

Based on arXiv: [2410.16226] and work in progress.

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Presenter: PETRIAKOVA, Polina (Istituto Nazionale di Fisica Nucleare)

Session Classification: Formal aspects

Contribution ID: **136** Type: **not specified**

Topological phase transitions of Active Brownian Particles under shear

Wednesday, 21 May 2025 17:40 (15 minutes)

Active Brownian Particles (ABPs) are known to exhibit rich non-equilibrium behaviors.
The phase diagram shows two phase transitions: from a liquid state to a hexatic state, characterized by quasi-long-range orientational order and short-range translational order, and, at decreasing density, from a hexatic state to a solid state, where both orientational and translational order are quasi-long-range. These transitions are Kosterlitz-Thouless-like.
In this study, we want to study how this behaviour changes and whether the exponents of such transitions are still universal for a system of ABPs subjected to shear flow. By employing numerical simulations and theoretical analysis, we explore how anisotropic shear stress competes with active crystallisation, modifying the system's structural, dynamical and topological properties.
These results provide new insights into the properties of active crystalline phases, with potential implications in the design of new materials.

Primary authors: MORETTI, Daniela (Istituto Nazionale di Fisica Nucleare); GONNELLA, Giuseppe (Istituto Nazionale di Fisica Nucleare); CARENZA, Lucio Mauro (Università degli studi di Bari Aldo Moro); DIGREGORIO, Pasquale (Istituto Nazionale di Fisica Nucleare)

Presenter: MORETTI, Daniela (Istituto Nazionale di Fisica Nucleare)

Session Classification: Applied theory

Contribution ID: **137** Type: **not specified**

CALICO: parametric annihilators for loop integrals & special functions

Thursday, 22 May 2025 09:40 (15 minutes)

We elaborate on the method of parametric annihilators for deriving relations among integrals. Annihilators are differential operators that annihilate multi-valued integration kernels appearing in suitable integral representations of special functions and Feynman integrals. We describe a method for computing parametric annihilators based on efficient linear solvers and show how to use them to derive relations between a wide class of special functions. These include hypergeometric functions, Feynman integrals relevant to high-energy physics and duals of Feynman integrals. We finally present the public Mathematica package CALICO for computing parametric annihilators and its usage in several examples.

Primary author: FONTANA, Gaia (University of Zürich)

Presenter: FONTANA, Gaia (University of Zürich)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **138** Type: **not specified**

Two-loop QCD amplitudes for top-pair production in association with a jet

Thursday, 22 May 2025 09:55 (15 minutes)

The production of a top-quark pair in association with a jet is a high priority process for the Large Hadron Collider. The sensitivity to fundamental parameters of the Standard Model and the increasing precision of experimental data demand that this process is computed to at least the next-to-next-to-leading order (NNLO) in QCD, for which theoretical challenges must be overcome. In this talk, I will discuss the computation of the two-loop QCD scattering amplitudes, the main bottleneck to achieve NNLO predictions. I will present results for the gluonic channel in the leading colour approximation, with a focus on the mathematical techniques that allow us to tackle the extreme degree of algebraic complexity due to the large number of variables, and the appearance of complicated special functions.

Primary author: ZOIA, Simone (University of Zurich)

Presenter: ZOIA, Simone (University of Zurich)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **139** Type: **not specified**

Theoretical aspects of computing two-loop Feynman integrals for top-pair production in association with a jet

Thursday, 22 May 2025 10:10 (15 minutes)

The calculation of Feynman integrals is a fundamental component in the computation of scattering amplitudes and often represents a major bottleneck in achieving phenomenological predictions for observables at particle colliders. In five-point scattering processes involving massive particles, the algebraic and analytic complexity significantly increases due to the large number of kinematic variables and the emergence of intricate mathematical structures in Feynman integral representations. In this talk, I will discuss these challenges in the context of NNLO QCD corrections to top-pair production in association with a jet in the leading-colour approximation. Specifically, I will present the construction of a specialised basis of Feynman integrals designed to expose key mathematical properties that are crucial for both achieving simplifications at the amplitude level and developing efficient numerical evaluation methods.

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Presenter: BECCHETTI, Matteo (Università di Bologna)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **140** Type: **not specified**

The moments of the spectral form factor in SYK

Wednesday, 21 May 2025 11:40 (15 minutes)

In chaotic quantum systems the spectral form factor exhibits a universal linear ramp and plateau structure with superimposed erratic oscillations. The mean signal and the statistics of the noise can be probed by the moments of the spectral form factor, also known as higher-point spectral form factors. We identify saddle points in the SYK model that describe the moments during the ramp region. Perturbative corrections around the saddle point indicate that SYK mimics random matrix statistics for the low order moments, while large deviations for the high order moments arise from fluctuations near the edge of the spectrum. The leading correction scales inversely with the number of random parameters in the SYK Hamiltonian and is amplified in a sparsified version of the SYK model, which we study numerically, even in regimes where a linear ramp persists. These findings reveal how deviations from random matrix universality arise in disordered systems and motivate their interpretation from a bulk gravitational perspective.

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Presenter: LEGRAMANDI, Andrea (Istituto Nazionale di Fisica Nucleare)

Session Classification: Formal aspects

Contribution ID: **141** Type: **not specified**

Isospin Strikes Back

Thursday, 22 May 2025 15:10 (15 minutes)

The decay of a charmonium vector meson $c\bar{c}$ into the $\Lambda\bar{\Sigma}^0$ + c.c. state can be considered purely electromagnetic under the assumption of isospin conservation. The first-order interaction is therefore mediated by a virtual photon, similar to the non-resonant process $e^+e^- \to \Lambda\bar{\Sigma}^0$ + c.c. in the Born approximation. Given the nature of these two processes, any discrepancy between their measurements can be attributed to an isospin-violating contribution in the charmonium state decay.

Thanks to its high luminosity and the large amount of collected data, the BESIII collaboration has recently reported the measurement of the decay ratio BR($\psi(2S) \to \Lambda\bar{\Sigma}^0$ + c.c.), which represents the first-ever measurement of this process and is currently published in the Particle Data Group.

Using this data, along with the decay ratio for the J/ψ state and the cross-section values for neutral baryon-antibaryon pair production, it is possible to extract the electromagnetic coupling value from both measurements independently. In this presentation, we will discuss the BESIII result and demonstrate the procedure for quantifying the extent of potential isospin violation. We will conclude that the experimental measurement obtained by the collaboration excludes the presence of significant isospin violation phenomena in the decay $\psi(2S) \to \Lambda\bar{\Sigma}^0$ + c.c.

Primary author: ROSINI, Francesco (Istituto Nazionale di Fisica Nucleare)

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Presenter: ROSINI, Francesco (Istituto Nazionale di Fisica Nucleare)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **142** Type: **not specified**

Progress on two-loop integrals for top-pair production plus a W boson

Thursday, 22 May 2025 10:25 (15 minutes)

The associated production of a top-antitop quark pair with a W boson is one of the heaviest signatures probed at the LHC. The corresponding rates have been found to be consistently higher than the Standard Model predictions, calling for improved theoretical predictions.
In this talk I will discuss one of the main bottlenecks for the exact computation of the two-loop QCD amplitude, namely the Feynman integrals. I will discuss a method for evaluating the integrals by computing and solving the systems of differential equations they satisfy. I will present strategies to address the complexity of the computation, which involves complicated analytic structures, such as nested square roots and elliptic functions, and expressions with an high degree of algebraic complexity.

Primary author: POZZOLI, Mattia (Università di Bologna & INFN Bologna)

Presenter: POZZOLI, Mattia (Università di Bologna & INFN Bologna)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **143** Type: **not specified**

Strong CMB bounds on ALPS form strings

Tuesday, 20 May 2025 17:20 (15 minutes)

Axion-like particles (ALPS), radiated from a network of cosmic strings, may be a large part of Dark Matter (DM). In the era of precision Cosmology, it is possible to characterize the effect of such particles - which almost scale invariant distribution function spans many orders of magnitudes in momentum - on the observables. In this work, we employ the CLASS code and Planck 2018 data to place bounds on the abundance and on other distinctive parameters of ALPS from strings. We focus on the mass range 10^-20 - 10^-15 eV, and we find the strongest constraint on the ALP decay constant f_a if the ALP's mass is between (10^-20,10^-18) eV, where we are able to improve the bound on f_a from overabundance of DM by more than a factor of 3. As a result, the ALPS from strings we considered cannot make up for more than one tenth of DM at three sigma, if the ALP mass is between 10^-20-10^-18 eV.

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Presenter: IMPAVIDO, Riccardo (Istituto Nazionale di Fisica Nucleare)

Session Classification: Astro/Cosmo

Contribution ID: **144** Type: **not specified**

Study of the scalar and pseudoscalar meson mass spectrum of QCD above the chiral transition, using an effective Lagrangian approach

Thursday, 22 May 2025 16:55 (15 minutes)

The fundamental theory of strong interactions, known as Quantum ChromoDynamics (QCD), exhibits rich symmetry properties that underlie the behavior of hadronic matter. In the limit of N_f light quark masses, QCD possesses an approximate chiral symmetry $U(1)_V \otimes U(1)_A \otimes SU(N_f)_V \otimes SU(N_f)_A$. The special unitary part of this symmetry group is spontaneously broken to its vectorial subgroup $SU(N_f)_V$ at low temperatures, leading to the emergence of pseudo-Goldstone bosons. At temperatures above a critical value $T_c^{(N_f)}$, however, lattice simulations show that the chiral condensate $\langle\overline{\psi}\psi\rangle$, which is the order parameter of the breaking process, vanishes and the chiral symmetry $SU(N_f)_V \otimes SU(N_f)_A$ is approximately restored. Conversely, $U(1)_A$ symmetry remains broken at every temperature because of a quantum anomaly. Whether the $U(1)_A$ symmetry is effectively restored at temperatures higher than $T_c^{(N_f)}$, as the magnitude of the anomalous term decreases, remains a subject of active research.
In this work, expanding on previous analyses [1,2], we employ the extended linear sigma (EL_σ) model to investigate the mass spectrum of scalar and pseudoscalar mesons in a realistic $N_f = 2+1$ flavor scenario (with degenerate up and down quarks and a heavier strange quark: $0 < m_u = m_d \ll m_s$) above the critical temperature $T_c^{(N_f)}$. The model's predictions are then critically compared with available lattice QCD results [3], where meson screening masses are extracted from chiral susceptibilities, which correspond to two-point correlation functions of suitable interpolating operators. The expected restoration of chiral symmetry should manifest as degeneracies in correlators and screening masses for meson channels related by symmetry transformations.

1. Enrico Meggiolaro and Alessandro Mordà. Remarks on the $U(1)$ axial symmetry and the chiral transition in QCD at finite temperature. $Phys.Rev.D$, 88(9):096010, 2013.
2. Enrico Meggiolaro. Study (using a chiral effective Lagrangian model) of the scalar and pseudoscalar meson mass spectrum of QCD at finite temperature, above T_c. arXiv:2310.10339 [hep-ph].
3. Alexei Bazavov et al. Meson screening masses in (2+1)-flavor QCD. $Phys.Rev.D$, 100(9):094510, 2019.

Primary authors: Dr CIANTI, Giulio (Sapienza Università di Roma); MEGGIOLARO, Enrico (PI)

Presenter: Dr CIANTI, Giulio (Sapienza Università di Roma)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **145** Type: **not specified**

Embedding interacting dark energy models in trace-free Einstein gravity

Tuesday, 20 May 2025 17:05 (15 minutes)

In trace-free Einstein gravity, the energy-momentum tensor of matter is not necessarily conserved and so the theory offers a natural framework for interacting dark energy models with a constant equation of state w=−1. From the point of view of quantum gravity phenomenology, it has been argued that such violations of energy-momentum conservation might originate from discreteness at the Planck scale. We show that within this framework it is possible to build models that are free from perturbative instabilities, which are otherwise known to affect a large class of interacting dark energy models.
We analyze in detail a simple such model where the energy-momentum transfer potential is proportional to the energy density of cold dark matter, which is also equivalent to a generalized dark matter model with a constant equation of state. Interestingly, requiring that there are no gradient instabilities implies that energy is transferred from dark matter to dark energy. We study the evolution of cosmological perturbations in this model and discuss observational constraints.

Primary author: Dr DE CESARE, Marco (Istituto Nazionale di Fisica Nucleare)

Presenter: Dr DE CESARE, Marco (Istituto Nazionale di Fisica Nucleare)

Session Classification: Astro/Cosmo

Contribution ID: **146** Type: **not specified**

Numerical Methods for Holography

Wednesday, 21 May 2025 11:25 (15 minutes)

In the last decades, the **holographic principle** has been a powerful ally in high-energy physics, both as a tool and as an insight.
I will present how holography can be used in the context of nonperturbative analysis of **QCD-like theories**, providing examples of confinement and phase structure. I will focus on instances that do not require strong analytical control and can thus be tackled numerically, showing how even for high-energy physics, **numerical methods** can yield fruitful results and illuminating visual insights, either via simulations or numerical solutions.

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Presenter: GILIBERTI, Mauro (Istituto Nazionale di Fisica Nucleare, Università degli Studi di Firenze)

Session Classification: Formal aspects

Contribution ID: **147** Type: **not specified**

Direct current memory effects in effective-one-body waveform models

Tuesday, 20 May 2025 15:20 (15 minutes)

The direct current (DC) memory is a non-oscillatory, hereditary component of the gravitational wave (GW) signal that represents one of the most peculiar manifestations of the nonlinear nature of GW emission and propagation. In this work, by transforming the results provided in Ebersold et al.[Phys.Rev.D 100 (2019) 8, 084043] in harmonic coordinates and quasi-Keplerian parametrization, we provide the DC memory in terms of the effective-one-body (EOB) phase-space variables, with a relative accuracy of 2.5PN and in an expansion for small eccentricity up to order six. Our results are then implemented in TEOBResumS-Dalí, thus providing the first EOB model with DC memory contributions. This model is then used to assess the impact on the waveform and the main features of the DC memory, also addressing its dependence on the eccentricity of the binary system at its formation.

Primary authors: PLACIDI, Andrea (University of Perugia); GRILLI, Elisa (Istituto Nazionale di Fisica Nucleare); GRIGNANI, Gianluca (Istituto Nazionale di Fisica Nucleare); ORSELLI, Marta (Istituto Nazionale di Fisica Nucleare); ALBANESI, Simone (Friedrich-Schiller-Universität Jena)

Presenter: GRILLI, Elisa (Istituto Nazionale di Fisica Nucleare)

Session Classification: Astro/Cosmo

Contribution ID: **148** Type: **not specified**

Integrable quantum circuits

Wednesday, 21 May 2025 15:30 (15 minutes)

Quantum circuits provide an efficient way to describe the time evolution of a physical system by decomposing it into elementary, discrete steps that can be efficiently implemented on a quantum computing architecture. Despite recent advancements, problems such as error propagation and information loss are still present.
Integrable unitary circuits have the property that the operator describing the circuit's dynamical evolution commutes with an infinite number of conserved charges, which constrain the dynamics and make it possible to use analytical methods to compute physical observables.
In this talk, I will introduce the interesting topic of integrable quantum circuits and I will address two fundamental questions: "Given a quantum circuit, how can I determine if it is integrable?"and "Can I systematically construct such circuits?"
I will explore these questions by generalizing the integrable trotterization procedure and constructing the fundamental algebraic objects necessary to understand integrability properties.
This talk is based on the recent results of arXiv:2406.12695 and arXiv:2503.04673.

Primary authors: PALETTA, Chiara (University of Ljubljana); Dr DUH, Urban (University of Ljubljana); Prof. POZSGAY, Balázs (Eötvös Loránd University Budapest); Prof. PROSEN, Tomaž (University of Ljubljana); Prof. ZADNIK, Lenart (University of Ljubljana)

Presenter: PALETTA, Chiara (University of Ljubljana)

Session Classification: Applied theory

Contribution ID: **149** Type: **not specified**

A new modular mechanism for neutrino masses from low-scale seesaw

Tuesday, 20 May 2025 16:20 (15 minutes)

In the presence of a finite modular flavour symmetry, fermion mass hierarchies may be generated by a slight deviation of the modulus from a symmetric point. This small parameter governing charged-lepton mass hierarchies may also be responsible for the breaking of lepton number in a symmetry-protected low-scale seesaw. In this talk, I will illustrate the implementation and the phenomenological implications of this connection.

Primary author: PARRICIATU, Matteo (Istituto Nazionale di Fisica Nucleare)

Presenter: PARRICIATU, Matteo (Istituto Nazionale di Fisica Nucleare)

Session Classification: Astro/Cosmo

Contribution ID: **150** Type: **not specified**

Probing axion interactions with light generations of quarks through astroparticle and flavour physics

Tuesday, 20 May 2025 17:35 (15 minutes)

Axions are among the best motivated realizations of physics Beyond the Standard Model (BSM). First of all, such particles, even with masses in the MeV-GeV range, may help address fundamental problems, ranging from the strong CP problem to dark matter. Secondly, the axion couplings to ordinary matter are not constrained by any known symmetry and, thus, are free parameters of the BSM theory. In this talk, I will show how quite different sources of experimental information, ranging from data at flavour facilities to astrophysical observables, are absolutely crucial to put relevant constraints on the magnitude of such parameters. I will mainly focus on both flavour-universal and flavour-violating couplings of the axion with the light generations of quarks, namely up, down and strange. From the point of view of astroparticle physics, novel bounds can be obtained both from axion emission from core-collapse supernovae and from axion absorption at neutrino detection facilities, e.g. at the Hyper-Kamiokande water Cherenkov detector. Concerning, instead, flavour physics, complementary constraints can be obtained from three-body kaon decays (with an axion in the final state) at NA62 and LHCb. Some prospects for future theoretical studies will be also briefly discussed.

Primary author: VITTORIO, Ludovico (Sapienza Università di Roma and INFN, Sezione di Roma)

Presenter: VITTORIO, Ludovico (Sapienza Università di Roma and INFN, Sezione di Roma)

Session Classification: Astro/Cosmo

Contribution ID: **151** Type: **not specified**

Leptophilic ALPs at laboratory experiments

Thursday, 22 May 2025 17:40 (15 minutes)

In this talk I will review the collider phenomenology of leptophilic axion-like particles (ALPs), i.e. pseudoscalar particles that couple only to charged leptons. Loops of charged leptons induce effective interactions of the ALPs with photons, which depend on the momenta of the interacting particles and differ between pseudoscalar and derivative lepton couplings. I will systematically discuss the form of the interaction with photons for general external momenta and identify the regimes when it can be safely approximated by an effective coupling constant. I will use these results to derive novel constraints from LEP and calculate state-of-the-art limits from E137 and NA64 for four different scenarios, in which the ALPs couple either to a single lepton generation or universally to all, for both pseudoscalar and derivative lepton couplings. I will collect complementary bounds from astrophysics, flavour, and other laboratory experiments to chart the allowed parameter space of leptophilic ALPs in the MeV-GeV mass range.

Primary author: FEDELE, Marco

Presenter: FEDELE, Marco

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **152** Type: **not specified**

Constraining UV freeze-in of light relics with current and next-generation CMB observations

Tuesday, 20 May 2025 18:05 (15 minutes)

The Cosmic Microwave Background (CMB) provides a powerful tool for testing the existence of light particle species beyond the Standard Model (BSM). In particular, light relics produced via freeze-in are a common feature of models where new light degrees of freedom interact too weakly with the Standard Model (SM) plasma to achieve full thermalization in the early Universe. This talk focuses on ultraviolet (UV) freeze-in scenarios, where the new light species is produced through non-renormalizable interactions typical of BSM models. Several benchmark BSM models are explored, including axion-like particles from Primakoff production, massless dark photons, and light right-handed neutrinos. We discuss the impact on the effective number of neutrino species and demonstrate that next-generation CMB observations will be able to complement—and in some cases surpass—current astrophysical, laboratory, and collider constraints on the couplings of the SM to the light relic.

Primary author: CALONI, Luca (University of Coimbra)

Presenter: CALONI, Luca (University of Coimbra)

Session Classification: Astro/Cosmo

Contribution ID: **153** Type: **not specified**

The $X(3872)$ Puzzle: Insights from Effective Field Theories

Thursday, 22 May 2025 17:25 (15 minutes)

The (in)famous $X(3872)$ was the first exotic particle discovered in 2003, compatible with a tetraquark interpretation. More than twenty years have passed since then, yet its internal dynamic remain an open question. Currently, the most established models describe the $X(3872)$ either as a compact tetraquark, where quarks interact via color forces, or as a $\bar{D}^0 D^0$ mesonic molecule, given that its mass is incredibly close to the di-meson threshold. The study of the internal dynamics of exotic particles provides a fundamental probe for understanding QCD in its confinement regime. In this talk, we will explore how the language of non-relativistic effective field theories can be applied to study the nature of the $X(3872)$, drawing inspiration from well-established approaches used to describe low-energy proton-neutron interactions. Finally, we will discuss our findings in light of the results produced by LHCb and in anticipation of upcoming analyses.

Primary author: GERMANI, Davide (Sapienza Università di Roma e Istituto Nazionale di Fisica Nucleare)

Presenter: GERMANI, Davide (Sapienza Università di Roma e Istituto Nazionale di Fisica Nucleare)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **154** Type: **not specified**

Precise QCD for associated top production

Thursday, 22 May 2025 10:40 (15 minutes)

The production of a top quark pair in association with a heavy boson is a class of processes of high importance at LHC, both for precision Standard Model studies and new physics searches: top-pair production in association with a Higgs boson allows for a direct measurement of the top-quark Yukawa coupling, while the cross section of top-pair production in association with a W boson has been observed consistently higher than the Standard Model value by different experimental collaborations.
In this talk we present our recent computation of the NNLO QCD corrections to both these processes, with an emphasis on their phenomenological applications.

Primary author: DEVOTO, Simone (University of Ghent)

Presenter: DEVOTO, Simone (University of Ghent)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **156** Type: **not specified**

UV asymptotics of the generating functional of correlators of superfield twist-2 operators in $\mathcal{N} = 1$ SYM theory

Wednesday, 21 May 2025 10:10 (15 minutes)

We provide a new construction of superfield collinear twist-2 operators as infinite-dimensional, irreducible representations of the collinear superconformal algebra in the zero-coupling limit of $\mathcal{N} = 1$ supersymmetric Yang-Mills (SYM) theory in a manifestly gauge-invariant and supersymmetric-covariant fashion.This construction makes manifest their mixing and renormalization properties at one loop. We compute their asymptotic renormalization-group improved generating functional in Euclidean superspace and its planar and leading nonplanar large-N expansion. We verify that the leading nonplanar asymptotic RG-improved generating functional matches the structure of logarithm of a functional superdeterminant of the corresponding nonperturbative object arising from the glueball/gluinoball effective action, which it should be asymptotic to at short distances because of the asymptotic freedom. Hence, our large-N computation sets strong ultraviolet asymptotic constraints on the nonperturbative solution of large-N $\mathcal{N} = 1$ SYM theory that may be a pivotal guide for the search of such a solution.

Primary authors: SCARDINO, Francesco (Istituto Nazionale di Fisica Nucleare); SANTONI, Giacomo (Istituto Nazionale di Fisica Nucleare)

Presenter: SANTONI, Giacomo (Istituto Nazionale di Fisica Nucleare)

Session Classification: Formal aspects

Contribution ID: **157** Type: **not specified**

Merging NLO QED corrections at hadron colliders: Z and Z+photon production using the MiNLO′ method

Thursday, 22 May 2025 11:25 (15 minutes)

In order to match the increasing precision of modern particle colliders, it is essential to have accurate theoretical predictions for the cross sections of physical processes and their associated distributions. These predictions are often obtained via Monte Carlo event generators which combine the fixed-order calculation, computed as a perturbative expansion in the coupling constants, with a parton shower and further hadronization. Using the Multi-Scale Improved NLO (MiNLO′) prescription, it is possible to resum to all orders the logarithms arising from kinematic configurations that involve different scales in such a way that the resulting distribution is NLO accurate both for fully inclusive and 1-jet predictions. The MiNLO′ method was introduced specifically for QCD radiation and it has already provided remarkable results. In this talk, I will present the abelianization of the MiNLO′ method in the context of QED radiation for the neutral current Drell-Yan. More specifically, I will discuss the behaviour of the Sudakov form factor when we switch from QCD to QED and the challenges that such Sudakov form factor poses in its actual computation.

Primary author: BELLONI, Filippo (Istituto Nazionale di Fisica Nucleare)

Presenter: BELLONI, Filippo (Istituto Nazionale di Fisica Nucleare)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **158** Type: **not specified**

Accidental Composite Dark Matter and Grand Unification

Thursday, 22 May 2025 12:10 (15 minutes)

We consider models in which the Standard Model is extended with dark quarks that belong to fragments of vector-like representations of the grand-unifying group SU(5), and are charged under a new confining non-Abelian interaction. We consider both strongly-coupled and weakly-coupled régimes, corresponding to the dark quarks being lighter or heavier than the confinement scale, respectively. We discuss the difference in the ordering of the spectrum of the dark baryons, the lightest of which are dark matter candidates, being accidentally stable. We focus particularly on the classification of the models and their phenomenology in the presence of a scalar dark quark that is a total singlet under the Standard Model gauge group.

Primary author: PALMISANO, Stefano (Istituto Nazionale di Fisica Nucleare)

Presenter: PALMISANO, Stefano (Istituto Nazionale di Fisica Nucleare)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **159** Type: **not specified**

Hunting axion dark matter with anti-ferromagnets: a case study with nickel oxide

Tuesday, 20 May 2025 17:50 (15 minutes)

We show that nickel oxide, which is already a very promising target to look for sub-MeV dark matter scattering, can be employed to hunt axion dark matter, with masses in the meV range and couplings to electrons allowing them to potentially be QCD axions. We describe the interactions between axions and the collective excitations of nickel oxide in terms of a universal effective field theory, built solely out of symmetry arguments. The processes of conversion into one or two excitations provide, respectively, a narrowband and a broadband channel for the axion search, and the possibility of varying an external magnetic field up to a phase transition point allows to cover a large portion of a yet unexplored parameter space, reaching axion masses down to few fractions of an meV. Our results underline nickel oxide as an ideal candidate for a multi-purpose target for light dark matter searches.

Primary authors: CATINARI, Pier Giuseppe (Istituto Nazionale di Fisica Nucleare); ESPOSITO, Angelo (Istituto Nazionale di Fisica Nucleare); PAVASKAR, Shashin (University of Illinois at Urbana-Champaign)

Presenter: CATINARI, Pier Giuseppe (Istituto Nazionale di Fisica Nucleare)

Session Classification: Astro/Cosmo

Contribution ID: **160** Type: **not specified**

On the fate of evaporating black holes: how the burden of their memory stabilizes them

Tuesday, 20 May 2025 15:35 (15 minutes)

The "memory burden"effect describes how an object's stored information resists its own decay. This effect is especially pronounced in "saturons"—systems with maximal entropy consistent with unitarity—of which black holes are prime examples. I will show how this memory burden can halt Hawking evaporation, stabilizing black holes against complete decay. Importantly, this mechanism is not limited to gravitational systems: it also appears in renormalizable field theories. To illustrate its broader relevance, I will present a soliton model that shares key features with black holes and is similarly stabilized by its memory content. Finally, I will discuss unique phenomenological implications and potential observational signatures, particularly relevant for dark matter scenarios

Primary author: ZANTEDESCHI, Michael (Istituto Nazionale di Fisica Nucleare)

Presenter: ZANTEDESCHI, Michael (Istituto Nazionale di Fisica Nucleare)

Session Classification: Astro/Cosmo

Contribution ID: **161** Type: **not specified**

Bayesian reweighting analyses of parton distribution functions

Thursday, 22 May 2025 17:10 (15 minutes)

The Bayesian reweighting is a well established technique in the context of parton distribution functions (PDFs) analyses. Since the seminal work of Giele and Keller, this approach has been employed to quickly evaluate the compatibility of existing extractions with new experimental data, or with data not included in the dataset for the fit. In this talk, I will present the first applications of such a method to extractions of transverse momentum dependent PDFs (TMDs), and its extension and generalization to the case of a simultaneous reweighting of multiple, independent extractions.

Primary author: Dr FLORE, Carlo (Università di Cagliari e INFN, Sezione di Cagliari)

Presenter: Dr FLORE, Carlo (Università di Cagliari e INFN, Sezione di Cagliari)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **162** Type: **not specified**

RG running and mixing for $\Delta F = 2$ Four-Fermion Operators in χSF schemes

Thursday, 22 May 2025 15:25 (15 minutes)

We study the renormalization and mixing of the $\Delta F = 2$ Four-Fermion Operators (FFO), starting from the problem of the computation of the perturbative running for $N_{\rm f} = 3$ and showing how this problem is solved through the use of the Poincaré-Dulac theorem. We then illustrate the procedure to evaluate the non-perturbative running from the hadronic scale ($O(\Lambda_{QCD})$) to the electroweak scale ($O(M_W)$), where we hope to safely make contact with perturbation theory. This procedure goes through the computation of the Step-Scaling Functions (SSF) in the Schrödinger Functional (SF) setup. We finally present preliminary numerical results for the non-perturbative running.

Primary authors: VLADIKAS, Anastassios (Istituto Nazionale di Fisica Nucleare); DE DIVITIIS, Giulia Maria (Istituto Nazionale di Fisica Nucleare); DALLABRIDA, Mattia (Istituto Nazionale di Fisica Nucleare); PAPINUTTO, Mauro Lucio (ROMA1); MARINELLI, Riccardo (Istituto Nazionale di Fisica Nucleare)

Presenter: MARINELLI, Riccardo (Istituto Nazionale di Fisica Nucleare)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **163** Type: **not specified**

Monopole-fermion scattering in a chiral gauge theory

Wednesday, 21 May 2025 11:55 (15 minutes)

The scattering of charged massless fermions on magnetic monopoles at low-energy in the s-wave presents a long-standing final state puzzle: it seems to be generally impossible to construct an outgoing state conserving all charges. Indeed, bosonizing the low-energy EFT, one is seemingly led to particles of fractional charge.

In this talk I describe this problem starting from a UV complete chiral gauge theory, and descending to the EFT. This step allows us to discuss and exclude some existing proposed solutions to the puzzle. I will argue that the correct solution is introducing a topological operator.

I will conclude by commenting on non-abelian charges and some open problems.

Primary authors: KUNTZ, Adrien (SISSA); BUCCIOTTI, Bruno (Scuola Normale Superiore di Pisa); TRINCHERINI, Enrico (SNS); JULIANO, Leonardo (Istituto Nazionale di Fisica Nucleare)

Presenter: BUCCIOTTI, Bruno (Scuola Normale Superiore di Pisa)

Session Classification: Formal aspects

Contribution ID: **164** Type: **not specified**

The Cabibbo Angle from Inclusive τ Decays

Thursday, 22 May 2025 15:40 (15 minutes)

The inclusive hadronic decays of the τ lepton offer an alternative method for extracting the CKM matrix elements $V_{\rm ud}$ and $V_{\rm us}$. In this talk, I will discuss recent results from the ETM Collaboration on the inclusive hadronic decay rate of the τ, obtained in $N_f = 2+1+1$ QCD using the novel HLT method. This approach circumvents the well-known inverse Laplace transform problem that hinders this calculation, allowing us to obtain first-principles results without relying on the operator-product expansion or perturbative QCD. Apart from isospin-breaking (IB) effects, all systematic uncertainties are under control. In the $\bar{u}s$ channel we obtain $|V_{us}|_{\tau-{\rm latt}-{\rm incl}} = 0.2189(7)_{\rm th}(18)_{\rm exp}$, which reveals a 3σ tension with purely hadronic determinations of $|V_{us}|$. Since this tension can no longer be attributed to the OPE approximation, it prompts a closer examination of experimental uncertainties and highlights the importance of determining IB corrections from first principles. I will briefly present an update on the ongoing status of our calculation of these corrections.

Primary author: GAGLIARDI, Giuseppe (Istituto Nazionale di Fisica Nucleare)

Presenter: GAGLIARDI, Giuseppe (Istituto Nazionale di Fisica Nucleare)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **165** Type: **not specified**

Weak rates in strongly coupled cold quark matter

Wednesday, 21 May 2025 12:10 (15 minutes)

The rates of flavor-changing weak processes are crucial in determining the conditions of beta equilibrium in neutron stars and mergers, influencing the damping of oscillations, the stability of rotating pulsars, and the emission of gravitational waves. We derive a formula for these rates at nonzero temperature, to leading order in the Fermi coupling and exact in the QCD coupling. Utilizing a simple phenomenological holographic model dual to QCD, we study massless unpaired quark matter at high densities. We numerically compute the rate for small deviations from beta equilibrium and derive an analytic approximation for small temperatures. Our findings reveal that, compared to the perturbative result, the rate is suppressed by logarithmic factors of the temperature.

Primary authors: OLZI, Andrea (Istituto Nazionale di Fisica Nucleare); Prof. HOYOS, Carlos (University of Oviedo); Dr RODRIGUEZ-FERNANDEZ, David (University of Madrid)

Presenter: OLZI, Andrea (Istituto Nazionale di Fisica Nucleare)

Session Classification: Formal aspects

Contribution ID: **166** Type: **not specified**

Determination of the Λ–parameter of $\mathrm{SU}(N)$ Yang–Mills theories in the Twisted Gradient Flow scheme on the lattice

Thursday, 22 May 2025 15:55 (15 minutes)

We present our preliminary determinations of the Λ–parameter of $\mathrm{SU}(N = 3, 5, 8)$ Yang–Mills theories and of its large–N limit in the Twisted Gradient Flow renormalization scheme on the lattice. First, we determine Λ in units of a low-energy renormalization scale μ_{had} using the step-scaling method. Then, to express Λ in units of the conventional reference scale $\sqrt{8t_0}$, we determine the non-dimensional conversion factor $\mu_{\mathrm{had}}\sqrt{8t_0}$. Lattice simulations are performed with the Parallel Tempering on Boundary Conditions algorithm to deal with the well-known problem of topological freezing.

Primary authors: GIORGIERI, Andrea (Istituto Nazionale di Fisica Nucleare); BONANNO, Claudio; DASILVA GOLÁN, Jorge Luis (Physics Deparment, Brookhaven National Laboratory); GARCÍA PÉREZ, Margarita (Instituto de Física Téorica UAM-CSIC); D'ELIA, Massimo (Istituto Nazionale di Fisica Nucleare)

Presenter: GIORGIERI, Andrea (Istituto Nazionale di Fisica Nucleare)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **167** Type: **not specified**

Subspace-enhanced Variational Quantum Eigensolvers via k-frame optimization

Wednesday, 21 May 2025 15:15 (15 minutes)

In this talk, we extend the Variational Quantum Eigensolver (VQE) approach to improve the estimate of the ground state of a quantum system by minimizing the expectation value of a target Hamiltonian on a k-frame—a set of k linearly independent orthonormal states—that define a k-dimensional subspace within the full Hilbert space. This search is then supplemented by an exact diagonalization in the optimal subspace. We find that this method significantly improves ground state estimation accuracy and optimization efficiency. We provide theoretical justification for these improvements by investigating the correlation between ground state infidelity and the loss function, as well as analyzing the expressivity of the k-frame formulation in comparison to the standard version of VQE.

Primary authors: CLEMENTE, Giuseppe (Istituto Nazionale di Fisica Nucleare); INTINI, Marco (Università di Pisa, INFN Pisa)

Presenter: INTINI, Marco (Università di Pisa, INFN Pisa)

Session Classification: Applied theory

Contribution ID: **168** Type: **not specified**

Lattice determination of the QCD low-energy constant ℓ_7 from staggered fermions

Thursday, 22 May 2025 16:10 (15 minutes)

Chiral perturbation theory (\chiPT) provides a powerful low-energy effective description of Quantum Chromodynamics (QCD), parameterized by a set of low-energy constants (LECs) that encode the effects of QCD dynamics at hadronic scales. Among all the next-to-leading order LECs, ℓ_7 is the least known and suffers from the largest uncertainties.
Moreover, It plays a crucial role as the only NLO term that parametrizes isospin-breaking effects in χPT and has implications related to the axion phenomenology.

In this work, we compute the scheme- and scale-independent LEC ℓ_7 by means of numerical lattice QCD simulations with $N_{\rm f} = 2 + 1$ quark flavors. Our calculation is performed with staggered fermions by suitably generalizing the methods introduced by the ETM Collaboration for the Wilson discretization. Adopting 12 gauge ensembles with 3 different values of the pion mass, and 4 different values of the lattice spacing, we are able to achieve controlled continuum and chiral limit extrapolations. Our final result $\ell_7 \times 10^3 = 2.81(91)$, agrees with and substantially improves on previous determinations.

Primary authors: BONANNO, Claudio; SANFILIPPO, Francesco (Istituto Nazionale di Fisica Nucleare); MARTINELLI, Guido (Istituto Nazionale di Fisica Nucleare); D'ELIA, Massimo (Istituto Nazionale di Fisica Nucleare); DIONISIO, Roberto (Istituto Nazionale di Fisica Nucleare)

Presenter: DIONISIO, Roberto (Istituto Nazionale di Fisica Nucleare)

Session Classification: Hadron/Flavor/Lattice

Contribution ID: **169** Type: **not specified**

Rescuing bileptons from Landau pole

Thursday, 22 May 2025 11:55 (15 minutes)

It is well known that the Standard Model (SM) is not a complete theory, but rather an effective one, describing particle phenomenology in some energy range. Different ways of extending the SM have been formulated, among these there is the class of the so-called 331 extensions. These depend ona free parameter β.It is well known that 331 models with $\beta = \sqrt{3}$ predict the existence of exotic doubly-charged gauge bosons, the bileptons, currently searched for at LHC. These models exhibit a Landau pole at the TeV scale which makes the model non-perturbative at this energy scale and non-predictive above.
In this study, we analyze and discuss ways to overcome these limitations by shifting the Landau pole at higher energies modifying the matter content of the theory introducing extra families and extra Higgs fields.

Primary authors: PERDONÀ, Giovanna Paola (Sapienza Università di Roma); RICCIARDI, Giulia (Istituto Nazionale di Fisica Nucleare); MORISI, Stefano (Università federico II Napoli)

Presenter: PERDONÀ, Giovanna Paola (Sapienza Università di Roma)

Session Classification: QCD/EW/BSM pheno

Contribution ID: **186** Type: **not specified**

Imperfect Axions

Tuesday, 20 May 2025 14:40 (25 minutes)

Presenter: DI LUZIO, Luca (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **187** Type: **not specified**

TBD

Wednesday, 21 May 2025 09:00 (40 minutes)

Presenter: TOMASIELLO, Alessandro (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **188** Type: **not specified**

TBD

Wednesday, 21 May 2025 12:25 (25 minutes)

Presenter: MEINERI, Marco (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **189** Type: **not specified**

Information decomposition and the informational architecture of complex systems

Wednesday, 21 May 2025 14:35 (40 minutes)

Presenter: STRAMAGLIA, Sebastiano (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **190** Type: **not specified**

Dynamics across quantum phase transitions in Rydberg atom arrays

Wednesday, 21 May 2025 16:00 (25 minutes)

Presenter: NOTARNICOLA, Simone (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **191** Type: **not specified**

Non-Conventional Computing for HEP

Wednesday, 21 May 2025 17:55 (25 minutes)

Presenter: CARRAZZA, Stefano (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **192** Type: **not specified**

TBD

Thursday, 22 May 2025 09:00 (40 minutes)

Presenter: MALTONI, Fabio (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **193** Type: **not specified**

TBD

Thursday, 22 May 2025 12:25 (25 minutes)

Presenter: BUTTAZZO, Dario (INFN Pisa)

Contribution ID: **194** Type: **not specified**

A new route to QCD phenomenology: hadronic spectral densities from the lattice

Thursday, 22 May 2025 14:30 (40 minutes)

Presenter: TANTALO, Nazario (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **195** Type: **not specified**

TBD

Thursday, 22 May 2025 17:55 (25 minutes)

Presenter: CORNELLA, Claudia (CERN)

Contribution ID: **196** Type: **not specified**

Neutrinos and dark sectors: the quest for the origin of neutrino masses

Friday, 23 May 2025 10:50 (40 minutes)

Presenter: PASCOLI, Silvia (University of Bologna)

Contribution ID: **197** Type: **not specified**

TBD

Friday, 23 May 2025 09:00 (40 minutes)

Presenter: BARTOLO, Nicola (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **198** Type: **not specified**

TBD

Friday, 23 May 2025 09:40 (40 minutes)

Presenter: MASTROLIA, Pierpaolo (Istituto Nazionale di Fisica Nucleare)

Contribution ID: **199** Type: **not specified**

TBD

Friday, 23 May 2025 11:30 (40 minutes)

Presenter: BARBIERI, Riccardo

Contribution ID: **200** Type: **not specified**

The Science of the Einstein Telescope

Tuesday, 20 May 2025 14:00 (40 minutes)

Presenter: MAGGIORE, Michele (Geneva University)

Contribution ID: **201** Type: **not specified**

Indirect detection probes of Minimal Dark Matter 5-plet

Tuesday, 20 May 2025 16:35 (15 minutes)

We critically reassess the Minimal Dark Matter model and propose new indirect detection signatures. Specifically, for the originally proposed accidentally stable SU(2) 5-plet, we compute the photon flux arising from Dark Matter Bound State Formation and Sommerfeld Enhancement, highlighting the appearance of several spectral lines. After analyzing the key features of this flux, we explore the constraints on the 5-plet imposed by FERMI-LAT observations of the galactic diffuse emission, as well as the projected sensitivity of the upcoming Cherenkov Telescope Array (CTA) in searches targeting Dwarf Spheroidal Galaxies.

Primary author: MARINO, Giulio (Università di Pisa)

Presenter: MARINO, Giulio (Università di Pisa)

Session Classification: Astro/Cosmo