Rencontres de Physique des Particules 2026

Rapport sur les contributions

https://indico.in2p3.fr/e/rpp2026

ID de Contribution: **1** Type: **Non spécifié**

Review talk: Gravitational Waves from Black Hole Reheating

mercredi 11 mars 2026 14:10 (40 minutes)

Orateur: Dr GOUTTENOIRE, Yann (Tel Aviv University)

Classification de Session: Particle cosmology

ID de Contribution: **2** Type: **Non spécifié**

Interacting dark sector with intrinsic entropy couplings

mercredi 11 mars 2026 14:50 (20 minutes)

The persistent discrepancies between predictions of the standard cosmological model and high-precision measurements across multiple probes remain a significant challenge in modern cosmology. Over the past decade, mounting evidence for tensions in key cosmological parameters - derived through both model-dependent and independent methods - has motivated the exploration of extensions to the standard paradigm. Among the most compelling directions is the dark sector, whose fundamental nature remains largely unknown. In particular, the microphysical properties of dark matter are still poorly understood beyond its gravitational role. In this talk, I will introduce a new class of interactions between dark matter and dark energy, formulated within a relativistic fluid framework. In this scenario, dark matter carries non-trivial intrinsic entropy with scale-dependent fluctuations, encoding additional internal degrees of freedom. Coupling this entropy to a scalar-field dark energy component gives rise to distinctive signatures in the growth of cosmic structure, opening a novel window into dark sector physics and on new physics in the standard model as a way of reconciling the observed cosmological tensions.

Orateur: Dr TEIXEIRA, Elsa (LUPM Montpellier)

Classification de Session: Particle cosmology

ID de Contribution: **3** Type: **Non spécifié**

Gravitational waves from flavoured SU(2) early-universe phase transitions

mercredi 11 mars 2026 15:10 (20 minutes)

We show that first-order phase transitions generically arise during the breaking of TeV-scale SU(2) flavour gauge symmetries and can generate gravitational-wave signals observable by next-generation detectors. These transitions occur only for order-one flavour gauge couplings: beyond $g_f \sim 1.0 - 1.5$, one-loop corrections to the quartic interaction dominate the thermal potential and weaken the transition. To obtain reliable predictions, we match each phase transition to its steady-state hydrodynamical solution, capturing out-of-equilibrium plasma effects through an effective friction parameter primarily sourced by soft flavour gauge boson interactions with the Standard Model plasma. This treatment reveals both runaway solutions for strong transitions and regions of the parameter space where gravitational-wave production is enhanced even as the transition strength decreases. Finally, we demonstrate that the Einstein Telescope provides the most relevant probe of these flavour scenarios, with the proposed Big Bang Observer offering marginal additional sensitivity.

Orateur: CHRYSOSTOMOU, Anna (LPTHE)

Classification de Session: Particle cosmology

ID de Contribution: **4** Type: **Non spécifié**

No room for monopole dark matter

jeudi 12 mars 2026 12:10 (20 minutes)

The magnetic monopole of a dark sector has been advocated as an appealing dark matter candidate, since its stability naturally follows from topological arguments. I will revisit the computation of the monopole abundance generated by a thermal phase transition, exploring the three regimes where the phase transition is second order, weakly first order, or supercooled. This will allow us to identify the parameter space regions where the monopole relic density can match the observed dark matter abundance. However, a dark sector featuring monopoles necessarily contains stable electrically-charged particles, namely massive vector bosons. I will show that the abundance of gauge bosons, under minimal assumptions, is always far larger than the monopole one. This result leads to the conclusion that dark monopoles cannot constitute a sizeable fraction of dark matter in the minimal model, contrarily to what has been previously claimed.

Orateur: FERRANTE, Giacomo

Classification de Session: Dark matter

ID de Contribution: **10** Type: **Non spécifié**

Review talk: Status and perspectives of Direct Dark Matter searches

jeudi 12 mars 2026 09:00 (40 minutes)

Orateur: SCOTTO LAVINA, Luca (LPNHE Paris)

Classification de Session: Dark matter

ID de Contribution: **11** Type: **Non spécifié**

The Galactic Centre Excess via leptophilic dark matter in $U(1)_{L_i-L_j}$ models

jeudi 12 mars 2026 09:40 (20 minutes)

The particle nature of dark matter remains one of the most important open questions in physics. An intriguing clue is the γ-ray excess observed by Fermi-LAT toward the Galactic Center, whose spectrum resembles the expected signal from annihilating weakly interacting massive particles. However, many conventional dark matter models are now strongly constrained by direct detection and collider experiments. In this talk, I will explore a class of anomaly-free extensions of the Standard Model based on gauged lepton-number differences, $U(1)_{L_i-L_j}$, as well as $U(1)_{B-L}$. I will show how these models can simultaneously account for the Galactic Center excess, satisfy the relic abundance requirement, and remain consistent with laboratory constraints. Particular attention will be given to the $L_\mu - L_e$ model, which not only provides a good fit to the data but also connects naturally with the long-standing $(g-2)_{\mu,e}$ anomalies.

Orateur: KOECHLER, Jordan (INFN Turin)

Classification de Session: Dark matter

ID de Contribution: **12** Type: **Non spécifié**

Indirect searches for realistic sub-GeV Dark Matter models in present and upcoming observations

jeudi 12 mars 2026 10:00 (20 minutes)

Indirect searches for Dark Matter (DM) particles with mass in the MeV - GeV scale have received significant attention lately. Pair-annihilations of such DM particles in the Galaxy can give rise to MeV - GeV gamma-rays via prompt emission, sub-GeV e+e-'s in cosmic-rays, as well as a broad photon spectrum ranging from X-rays to soft gamma-rays, produced by the secondary emissions from DM induced e-(e+)'s via inverse Compton scattering, bremsstrahlung and in-flight annihilation processes. In this talk I shall focus on two realistic sub-GeV DM models, namely, the vector-portal and the scalar-portal model, and present the corresponding indirect detection constraints from existing X-rays, gamma-rays and cosmic-ray observations, based on all of the above-mentioned signals. I shall also present the prospects of the upcoming MeV photon telescope COSI to probe such signals from these DM models. I shall show that for both types of DM models new unconstrained DM parameter space can be probed at the upcoming instruments like COSI.

Orateur: KAR, Arpan (LPTHE, Sorbonne University)

Classification de Session: Dark matter

ID de Contribution: **13** Type: **Non spécifié**

Freeze-in with low reheating temperature

jeudi 12 mars 2026 10:20 (20 minutes)

The freeze-in mechanism is an alternative mechanism for dark matter production to standard thermal freeze-out. Freeze-in computations are typically performed assuming a very high initial (”reheating”) temperature. However, this temperature is poorly constrained and can take relatively small values. I will discuss dark matter freeze-in in such a scenario and highlight how dark matter production is impacted compared with the “infinite” reheating temperature case.

Orateur: REGGIO, Thomas (LPCA)

Classification de Session: Dark matter

ID de Contribution: **14** Type: **Non spécifié**

Review talk: Gravitational probes of ultralight dark matter

jeudi 12 mars 2026 11:10 (40 minutes)

Orateur: KIM, Hyungjin

Classification de Session: Dark matter

ID de Contribution: **16** Type: **Non spécifié**

Piezoaxionic Detection of Axion Dark Matter with Precessing Nuclear Spins

jeudi 12 mars 2026 11:50 (20 minutes)

The piezoaxionic effect enables the conversion of axion-induced nuclear Schiff moments into measurable voltages in piezoelectric crystals. We propose a heterodyne implementation in which controlled nuclear spin dynamics are used to mix the axion oscillation frequency with the nuclear Larmor frequency. This produces sideband signals that allow frequency scanning through the applied magnetic field.

Orateur: YAHYA, Baraa (IPhT (CEA-SACLAY))

Classification de Session: Dark matter

ID de Contribution: **17** Type: **Non spécifié**

Constraining long-lived dark sector particles with Lyman-alpha and CMB

mercredi 11 mars 2026 15:30 (20 minutes)

In this talk [based on 2602.10078], I will show how measurements of the intergalactic medium (IGM) temperature from the Lyman-α forest can be used to constrain long-lived dark sector particles with lifetimes larger than 10^{16} s. Such particles deposit energy into the IGM through decays to Standard Model states, thereby modifying its late-time thermal history. I will also revisit constraints on these models from Planck measurements of the optical depth to reionization, and demonstrate that Lyman-α bounds provide a complementary window to those from the CMB. The resulting model-independent constraints can be reinterpreted across a wide range of decaying hidden-sector scenarios, including evaporating primordial black holes and dark photons.

Orateur: VERMA, Sonali (Universite Libre de Bruxelles)

Classification de Session: Particle cosmology

ID de Contribution: **18** Type: **Non spécifié**

Review talk: Scattering amplitudes

jeudi 12 mars 2026 16:00 (40 minutes)

Orateur: DE ANGELIS, Stefano

Classification de Session: QFT

ID de Contribution: **19** Type: **Non spécifié**

How Parisi-Sourlas supersymmetry constrains the scalar sector

jeudi 12 mars 2026 16:40 (20 minutes)

The scalar sector of the Standard Model is the least constrained of the three parts. While supersymmetry has been used in order to impose constraints on it, it seems that these aren't stringent enough to lead to discovery of new effects on their own. In this contribution I'd like to recall the idea of Parisi and Sourlas from 1982 and show how it can lead to new constraints on the scalar sector.

Orateur: NICOLIS, Stam (LMPT Tours)

Classification de Session: QFT

ID de Contribution: **20** Type: **Non spécifié**

Chiral Dynamics: Do Symmetries Have to Break?

jeudi 12 mars 2026 17:00 (20 minutes)

Gauge-fermion theories and their IR fate remain puzzling mysteries in QFT, even after decades of study. Beyond their theoretical interest, they may play a natural role in extensions of the Standard Model, such as grand unified theories, dynamical symmetry breaking, and models of quark and lepton substructure. Yet our limited understanding of their nonperturbative dynamics severely hampers their application to realistic theories of nature. It is therefore of utmost importance to gain insight into their IR behavior. Using functional methods based on the Effective Average Action, we investigate from first principles the dynamics of a class of chiral gauge theories. Our results reveal a rich structure, ranging from IR conformality to novel patterns of chiral symmetry breaking. In addition, we find evidence for confinement without symmetry breaking, a phenomenon that may provide a natural realization of Symmetric Mass Generation and offer new perspectives on lattice regularization of chiral fermions.

Orateur: VATANI, Shahram (CP3 UCLouvain)

Classification de Session: QFT

ID de Contribution: **21** Type: **Non spécifié**

The 3-loop hadronic vacuum polarization in chiral perturbation theory

jeudi 12 mars 2026 17:20 (20 minutes)

We compute hadronic vacuum polarization, an observable whose precision limits several important tests of the Standard Model, using two-flavor chiral perturbation theory to three loops (next-to-next-to-next-to-leading order). Particular attention is given to the loop integrals, several of which are not found in literature, and which display a novel set of relations beyond what is found through integration by parts. Our result is intended to serve as a starting point for phenomenological calculations, as well as the computation of finite-volume corrections in lattice QCD.

Orateur: SJO, Mattias sebastian (CPT Marseille)

Classification de Session: QFT

ID de Contribution: **22** Type: **Non spécifié**

Contributed talk

jeudi 12 mars 2026 17:40 (20 minutes)

Classification de Session: QFT

ID de Contribution: **23** Type: **Non spécifié**

Review talk: Machine learning

vendredi 13 mars 2026 11:20 (40 minutes)

Orateur: BUTTER, Anja (LPNHE)

Classification de Session: Colliders

ID de Contribution: **24** Type: **Non spécifié**

QCD Theory Meets Information Theory

vendredi 13 mars 2026 12:00 (20 minutes)

We begin by reviewing how NLL accuracy is achieved in modern parton showers—highlighting the recent Sherpa implementation—and then introduce our new information-theoretic matching framework to achieve beyond NLL accuracy. By minimizing a Kullback–Leibler functional under constraints set by precision QCD input observables (including theory uncertainties), we embed high-order predictions into fully differential, particle-level simulations with strictly positive event weights and the ability to impose multiple observable constraints simultaneously. As a proof of concept, we apply the method to the distributions in e^+e^- collisions, revealing the overlooked role of logarithmic moments of thrust and related event shapes.

Orateur: ASSI, Ben (University of Cincinnati)

Classification de Session: Colliders

ID de Contribution: **25** Type: **Non spécifié**

The dead cone effect in heavy quark jets

vendredi 13 mars 2026 12:20 (20 minutes)

Orateur: Dr PEREZ RAMOS, Redamy

Classification de Session: Colliders

ID de Contribution: **27** Type: **Non spécifié**

Review talk: Quark-gluon plasma dynamics in heavy-ion collisions

vendredi 13 mars 2026 14:10 (40 minutes)

Orateur: BOGUSLAVSKI, Kirill (SUBATECH)

Classification de Session: QCD

ID de Contribution: **28** Type: **Non spécifié**

Revisiting extremely high energy QED bremsstrahlung in matter

vendredi 13 mars 2026 15:10 (20 minutes)

Very high energy electrons passing through ordinary matter initiate electromagnetic showers that are produced by bremsstrahlung and pair production. At extremely high energies, the quantum-mechanical duration of these processes becomes longer than the mean free time for elastic scattering in the medium, which leads to a significant suppression of bremsstrahlung (and pair production). This phenomenon is known as the Landau–Pomeranchuk–Migdal (LPM) effect. We revisit the LPM suppression of bremsstrahlung, accounting for quantum disruption of that effect from pair production. We find that there are very large corrections to the LPM bremsstrahlung rate due to the quantum overlap of bremsstrahlung and subsequent pair production. Although it was argued qualitatively in the 1960s that pair production would further reduce the bremsstrahlung rate beyond the already suppressed LPM bremsstrahlung rate, we reach the opposite conclusion: quantum overlap between bremsstrahlung and pair production substantially enhances the bremsstrahlung rate relative to the standard LPM result. We support our qualitative arguments with an analytic calculation of the effect.

Orateur: ELGEDAWY, Omar (Ecole Polytechnique, CPHT)

Classification de Session: QCD

ID de Contribution: **29** Type: **Non spécifié**

Quantum thermodynamics and spin polarization in boost-invariant fluid of Dirac fermions

vendredi 13 mars 2026 15:30 (20 minutes)

The spin polarisation of Dirac fermions is an important observable in the Quark Gluon Plasma (QGP), as it allows connecting an entirely quantum property to the thermodynamic gradients at the freeze-out stage. For a correct description of experimental data, non-equilibrium effects play a crucial role, but they are harder to study and involve some theoretical ambiguities. I will present exact quantum non-equilibrium calculations for a fluid of Dirac fermions undergoing Bjorken expansion, both with and without finite spin density. These results allow a better understanding of the so-called shear-induced polarisation, as well as the thermodynamic role of a spin potential, in a physically-motivated non-equilibrium scenario.

Orateur: PALERMO, Andrea

Classification de Session: QCD

ID de Contribution: **30** Type: **Non spécifié**

Quantum (and classical) detection of gravitational waves: scope and limitations

mercredi 11 mars 2026 15:50 (20 minutes)

LIGO, VIRGO and Kagra (just to name a few) represent outstanding feats of engineering that have launched us in a new era of gravitational-wave (GW) detection. Even so, we may wonder whether their sensitivity is enough to detect very high-frequency signals of beyond-Standard-Model origin, such as those sourced by primordial stochastic GW backgrounds, primordial black holes, or black hole superradiance. In this talk, I will argue that the sensitivity of present-day and near-future GW detectors will most likely prove insufficient in this regard. I will present the theoretical framework in which this question can be rigorously addressed and where to formally prove some heuristic expectations from the literature.

Orateur: BILISCO, Paolo (IPhT - Université Paris-Saclay)

Classification de Session: Particle cosmology

ID de Contribution: **31** Type: **Non spécifié**

Review talk: Neutrinos

mercredi 11 mars 2026 16:40 (40 minutes)

Orateur: ROSAURO-ALCARAZ, Salvador (LPCA-CNRS)

Classification de Session: Neutrinos

ID de Contribution: **32** Type: **Non spécifié**

Primordial lepton asymmetries: new constraints and consequences for sterile neutrino dark matter

mercredi 11 mars 2026 17:20 (20 minutes)

Resonant production via active–sterile neutrino oscillations in the presence of large lepton asymmetries (the Shi–Fuller mechanism) remains a compelling scenario for keV-scale sterile neutrino dark matter. For a long time, the constraints on such asymmetries were obtained thanks to big bang nucleosynthesis and cosmic microwave background measurements, but did not properly account for the evolution of the lepton number between the "high temperature" region (relevant for sterile neutrino production) and the "low temperature" epoch (relevant for cosmological observables). I will present recent progress on the description of the evolution of asymmetries due to neutrino oscillations, which allowed us to obtain updated and accurate three-flavor constraints. As a result, large regions of sterile neutrino parameter space are reopened, substantially strengthening the viability of the Shi–Fuller mechanism.

Orateur: M. FROUSTEY, Julien (Institut d'Astrophysique de Paris (IAP))

Classification de Session: Neutrinos

ID de Contribution: **33** Type: **Non spécifié**

Neutrino interaction rates at MeV temperatures and their role in decoupling

mercredi 11 mars 2026 17:40 (20 minutes)

The dynamics of neutrinos and antineutrinos at MeV temperatures sets the Standard Model prediction for the effective number of relativistic species, N_{eff}, a key target for upcoming CMB and BBN measurements. Reaching a suitable theoretical accuracy demands control over sub-percent effects in the relevant interaction rates. In this talk I will review recent progress on precision calculations of neutrino production, annihilation, and scattering rates in a QED plasma, including next-to-leading order corrections, thermal effects, and electron mass corrections, and comment on how such rate coefficients serve as input for non-equilibrium neutrino kinetic equations. I will then present a fast, flexible, and accurate momentum-averaged framework, and outline its extension to BSM scenarios.

Orateur: JACKSON, Greg (SUBATECH (CNRS/IN2P3))

Classification de Session: Neutrinos

ID de Contribution: **34** Type: **Non spécifié**

Review talk: Flavour

vendredi 13 mars 2026 09:10 (40 minutes)

Orateur: MAHMOUDI, Farvah (Lyon University)

Classification de Session: QCD

ID de Contribution: **35** Type: **Non spécifié**

The two-photon decay amplitude of $K_L \to \mu^+\mu^-$ from Lattice QCD

vendredi 13 mars 2026 09:50 (20 minutes)

The decay of a long-lived kaon to a pair of muons (KL2mu) could serve as a precision test of the Standard Model (SM) and a probe to physics beyond due to its sensitivity to physics at high energies. A precise determination of the size of the long-distance, two-photon contribution to KL2mu – as well as its interference with the analytically-computable short-distance (SD) contribution – are crucial for making a meaningful comparison between the SM prediction and experiment. In this talk, I will present the ongoing effort from the RBC/UKQCD collaboration to extract the two-photon decay amplitude of KL2mu using Lattice Quantum Chromodynamics. In particular, I will discuss the methodology and results from our first, exploratory study on a gauge ensemble at physical pion mass [arXiv:2509.04346].

Orateur: Dr CHAO, En-Hung

Classification de Session: QCD

ID de Contribution: **36** Type: **Non spécifié**

What can Regge theory tell us about hadron dynamics and spectroscopy?

vendredi 13 mars 2026 10:10 (20 minutes)

The spectrum of light hadrons encodes essential information about the non-perturbative dynamics of QCD. Most observed hadrons are resonances, rigorously defined as poles of scattering amplitudes in the complex energy plane. Their properties, such as masses, widths, and couplings, are therefore determined by the analytic structure of the amplitudes describing low-energy hadronic interactions. Regge theory provides a theoretical framework to study scattering amplitudes through their analytical continuation to complex values of the orbital angular momentum, revealing singularities known as Regge poles that represent t-channel exchanges. At sufficiently high energies, this formulation extends the notion of fixed-spin particle exchange to entire families of states with the same quantum numbers and increasing spin called Regge trajectories. Recent high-statistics data from dedicated hadron-spectroscopy programs at experiments such as GlueX, CLAS12, and COMPASS have renewed interest in Regge-based approaches to the analysis of peripheral production processes. In this talk, I will review recent theoretical developments in the description of light meson photoproduction within the framework of Regge theory and discuss what they reveal about hadron dynamics and spectroscopy.

Orateur: MONTANA, Gloria (Universitat de Barcelona & ICCUB)

Classification de Session: QCD

ID de Contribution: **37** Type: **Non spécifié**

Investigating Quarkonium Physics

vendredi 13 mars 2026 10:30 (20 minutes)

Quarkonia are bound states formed by a heavy-quark pair. They are commonly described within the framework of non-relativistic QCD. Yet, this description is not sufficient to fully exploit data involving quarkonium production, which still hide precious information and call for theoretical improvements. In this talk, I will try to give a (biased) perspective on what quarkonium physics can teach us, how it probes QCD at energy scales different from other particles (e.g., light mesons, Higgs, ⋯), thereby providing complementary information, and what the challenges ahead are.

Orateur: MAXIA, Luca (LPTHE - Sorbonne & CNRS)

Classification de Session: QCD

ID de Contribution: **38** Type: **Non spécifié**

Cold quark matter: Renormalization group improvement

vendredi 13 mars 2026 14:50 (20 minutes)

We will discuss the recent developments in renormalization group improvements of the cold and dense QCD pressure (Phys. Rev. D 111, 034020 and Phys. Rev. Lett. 129, 212001) at next-to-next-to leading order (NNLO) through the renormalization group optimized perturbation theory (RGOPT) and at all-order resummation of the soft modes. RGOPT applied for the very first time at NNLO displayed a significant reduction in sensitivity to variations of the arbitrary renormalization scale as compared to the state-of-the-art NNLO results. This confirms previous NLO investigations that the RGOPT resummation scheme provides improved convergence properties and reduced renormalization scale uncertainties, thus being a promising prescription to improve perturbative QCD at high and mid range baryonic densities.

Orateur: M. FERNANDEZ, Loïc (Laboratoire Charles Coulomb)

Classification de Session: QCD

ID de Contribution: **39** Type: **Non spécifié**

Long-Lived Particles from Meson and Muon Decays at Rest at Spallation Sources

mercredi 11 mars 2026 18:00 (20 minutes)

We provide a systematic survey of spallation sources around the world and their potential to search for new light particles. We study the sensitivity of existing neutrino detectors to the decay in flight of light particles produced in the decay at rest of pions, muons, and kaons. At J-PARC, we show that the magnetized gaseous argon detectors of ND280 could place leading limits on light particles decaying to e^+e^- and that the liquid-scintillator detectors of the J-PARC Sterile Neutrino Search at the JSNS (JSNS^2) experiment can exploit double- and triple-coincidence signals from $\mu^+\mu^-$ and $\pi^+\pi^-$ to place new limits on particles produced in kaon decay. We find that the Coherent Captain Mills detector at Los Alamos and the suite of COHERENT detectors at Oak Ridge, despite their smaller size, would also have a promising sensitivity to particles produced in pion and muon decays, depending on background levels. Spallation sources have the potential to explore more than an order of magnitude beyond current constraints in some new physics models, encouraging further study on data acquisition and background rejection by experimental collaborations.

Orateur: URREA GONZALEZ, Salvador

Classification de Session: Neutrinos

ID de Contribution: **40** Type: **Non spécifié**

Round table discussion

jeudi 12 mars 2026 14:00 (1h 30m)

Orateurs: TEIXEIRA, Ana M. (LPCA - Clermont); GEORGEOT, Bertrand; BENAKLI, Karim (CNRS); VACAVANT, Laurent (IN2P3); KRAML, Sabine (CNRS - LPSC Grenoble); Prof. MAMBRINI, Yann (CNRS, IJCLab, Université Paris-Saclay)

Classification de Session: Round table discussion