Re[incontri] di Fisica Partenopea

Report of Contributions

https://indico.unina.it/e/reincontri2024

Contribution ID : **72** Type : **Oral**

Epidemic Dynamics in Interconnected Populations: Scaling and Policy Implications

mercoledì 18 dicembre 2024 10:30 (20)

Understanding the dynamics of infectious disease spread in interconnected populations is crucial for effective public health planning. In our increasingly mobile world, traditional modeling approaches often fall short in capturing the complexities of disease transmission across vast distances. This paper presents an innovative framework that combines the conceptual simplicity of ordinary differential equations (ODEs) with the predictive capabilities of computational models to analyze epidemic dynamics on interconnected networks. We derive scaling laws for epidemic propagation delays using perturbation expansion techniques, highlighting the influence of network topology and migration flux. Our findings reveal the diminishing returns of mobility reduction policies in mitigating epidemic spread, particularly after the outbreak has settled. This work contributes to a deeper understanding of the mechanisms driving infectious disease dynamics, providing quantitative insights for public health authorities to assess risks and optimize response strategies.

Primary author(s) : SCALA, Antonio (CNR)

Presenter(s) : SCALA, Antonio (CNR)

Session Classification : Statistical Physics

Track Classification : Statistical Physics

Contribution ID : **73** Type : **Poster**

Modeling chromatin 3D organization from sparse contact data using a polymer-physics based approach

The rapid advancement of comprehensive genome mapping techniques, such as Hi-C, for investigating the three-dimensional configuration of the genome within the nucleus has uncovered complex chromatin architectures at multiple scales, including A/B compartments, topologically associating domains (TADs), and chromatin loops. These structural elements of the 3D genome are linked to crucial genomic functions, such as gene transcription, although the variability of 3D genome structures and their functional implications at the single-cell level remain largely elusive. Emerging single-cell Hi-C (scHi-C) technologies now facilitate the genomic mapping of 3D chromatin configurations in individual cells, offering the potential to elucidate fundamental connections between genome structure and function at single-cell resolution across diverse biological contexts. Nevertheless, there is a significant deficiency in computational methodologies capable of physically characterizing the sparse scHi-C data. Here, we employ a polymer-physics based approach, which relies on phase-separation mechanisms, combined with machine learning, to impute contact maps from the sparse scHi-C data and to analyze the cell-to-cell variability of three-dimensional (3D) chromatin organization through their polymer models.

Primary author(s) : VERCELLONE, Francesca (Università degli Studi di Napoli Federico II); Dr. BIANCO , Simona

Presenter(s) : VERCELLONE, Francesca (Università degli Studi di Napoli Federico II)

Contribution ID : **74** Type : **Oral**

JWST and the high redshift Universe

mercoledì 18 dicembre 2024 12:30 (20)

I will talk about the recent discoveries on high redshift galaxies made by JWST in the last year, and what we can expect from the next rounds of observations.

Primary author(s) : ANNUNZIATELLA, Marianna

Presenter(s) : ANNUNZIATELLA, Marianna

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **75** Type : **Poster**

The Relativity in a room

Gravitomagnetic effects are some of the most peculiar predictions of General Relativity. It is known that spinning astrophysical sources drag space-time around them, a phenomenon known as frame-dragging. The Lense- Thirring effect is one of its consequences. It consists in the precession (with respect to the fixed-stars) of the rotation axis of a test-gyroscope in the gravitational field of a spinning mass. The INFN experiment GINGER (Gyroscopes IN GEneral Relativity) foresees the construction of a ground-based system of large-frame ring laser gyros with the aim of measuring the Lense-Thirring effect generated by the Earth's rotation. In this poster we describe the physical principles behind a ring laser gyro and the recent results achieved by the GINGER collaboration. In addition, various applications will be illustrated, with a focus on research in fundamental Gravitation Physics.

Partial list of references:

[1] Francesco Giovinetti et al., Front. Quantum Sci. Technol. 3, 1363409 (2024) http://dx.doi.org/10.3389/frqst.2024.1363409.

[2] Angela D. V. Di Virgilio et al. Phys. Rev. Lett. 133, 013601 (2024).

[3] F. Bosi, G. Cella, and A. Di Virgilio et al., Phys. Rev. D 84, 122002 (2011) http://link.aps.org/doi/10.1103/PhysRevD.84.1220

[4] A. D. V. Di Virgilio et al., Phys. Rev. Res. 2, 032069(R) (2020) http://link.aps.org/doi/10.1103/PhysRevResearch.2.032069.

[5] S. Capozziello et al., Eur. Phys. J. Plus 2021, 136, 394.

[6] https://home.infn.it/it/comunicati-stampa-full/209-comunicati-stampa-2024/6700-metti-la-relativita-in-una-stanza

Primary author(s) : GIOVINETTI, Francesco (Università degli Studi di Napoli Federico II & INFN Napoli)

Co-author(s) : Prof. CAPOZZIELLO, Salvatore; Prof. PORZIO, Alberto; DI VIRGILIO, Angela D. V.

Presenter(s) : GIOVINETTI, Francesco (Università degli Studi di Napoli Federico II & INFN Napoli)

Contribution ID : **76** Type : **Oral**

Superconducting Nanowires as Targets for Sub-GeV Dark Matter

mercoledì 18 dicembre 2024 15:10 (20)

Superconducting nanowires represent a rapidly developing technology with a broad spectrum of applications in fields such as space communications, lidar, and quantum information science. This talk explores the potential of using superconducting nanowires both as targets and sensors for the direct detection of sub-GeV dark matter. These devices offer exceptional sensitivity to small energy deposits in electrons and demonstrate remarkably low dark count rates, making them ideal for probing electron recoils resulting from dark matter scattering and absorption interactions. We present sensitivity plots for a 4.2 ng NbN device with a dark count rate of $5 \times 10^{-4} s^{-1}$ dark count rate and discuss the projected sensitivities for larger detectors.

Primary author(s) : CALABRESE, Roberta

Presenter(s) : CALABRESE, Roberta

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **77** Type : **Oral**

Fisica freelance

giovedì 19 dicembre 2024 11:40 (20)

Dopo il dottorato in Fisica teorica ed un breve periodo come Post-doc, ho sperimentato gli ambienti di lavoro di una start-up, di una grande azienda e di una scuola superiore. Finché ho deciso di provare a costruire una carriera come fisico freelance. Oggi (novembre 2024) insegno matematica e fisica in un liceo per la metà del tempo, e faccio il fisico freelance per l'altra metà. Questo talk è duplice. Nella prima parte, parlerò della fisica computazionale come strumento didattico per la scuola superiore. Nella seconda, farò una panoramica delle mia attività come Fisico libero professionista, con l'auspicio che possano ispirare chiunque cerchi attività alternative all'accademia, alla grande azienda e al sistema scolastico.

Primary author(s) : Dr. GARGIULO, Fernando (Istituto di Scuola Superiore Don Lorenzo Milani, Gragnano)

Presenter(s) : Dr. GARGIULO, Fernando (Istituto di Scuola Superiore Don Lorenzo Milani, Gragnano)

Session Classification : Outside Academia

Track Classification : Outside Academia

Contribution ID : **78** Type : **Oral**

Self-consistent surface superconductivity in time-reversal symmetric Weyl semimetals

Weyl semimetals host topologically protected surface states, the so-called Fermi arcs, that have a penetration depth into the bulk that depends on surface-momentum, and diverges at the Weyl points. It has recently been observed in PtBi2 that such Fermi arc states can become superconducting, with a critical temperature larger than that of the bulk. Here we introduce a general variational method that captures the interplay between surface and bulk superconductivity, for any bulk Hamiltonian that harbors (topological) surface states with varying penetration depth. From the self-consistent solutions we establish that the surface state localization length of Weyl semimetals leads to characteristic features in the surface superconductivity, with a gap depending on surface momentum and a penetration length for the order parameter that is temperature-dependent due to competition with the bulk superconductivity.

Primary author(s) : Dr. TRAMA, Mattia (IFW - Dresden)

Co-author(s) : Dr. KÖNYE, Viktor (University of Amsterdam); Dr. FULGA, Ion Cosma (IFW - Dresden); Prof. VAN DEN BRINK, Jeroen (IFW - Dresden)

Presenter(s) : Dr. TRAMA, Mattia (IFW - Dresden)

Session Classification : Condensed Matter

Track Classification : Condensed Matter

Contribution ID : **79** Type : **Oral**

Modeling the human genome through polymer physics

mercoledì 18 dicembre 2024 10:10 (20)

In the nucleus of cells, chromosomes have been discovered to self-organize into a complex spatial architecture that serves vital functional purposes as, for instance, genes have to establish specific physical contacts with their distal DNA regulators to control transcriptional activities. However, how the system self-assembles to shape the folding of our genome and its functions is only poorly understood. In this talk, I discuss principled models of interacting polymers from statistical mechanics to investigate the mechanisms whereby distal DNA sequences recognise and interact with each other. Those theories are validated against independent experiments, opening to new tools for real-world applications, such as the prediction of the effects of disease-associated mutations, linked to congenital disorders or cancer, on genome 3D structure.

Primary author(s) : Dr. CONTE, Mattia (Università di Napoli Federico II & INFN)

Presenter(s) : Dr. CONTE, Mattia (Università di Napoli Federico II & INFN)

Session Classification : Statistical Physics

Track Classification : Statistical Physics

Contribution ID : **80** Type : **Poster**

Superconducting nanostrip photon-number-resolving detector for photon number distribution reconstruction

A detector capable of resolving the number of photons is crucial for numerous applications, including quantum communication and quantum optics. Using a photon-number-resolving detector allows us to both determine the number of incident photons and reconstruct their distribution [1]. This capability is particularly important at telecom wavelengths, where silicon detectors are ineffective. One promising solution is superconducting nanostrip photon detectors, which exhibit a low dark count rate, picosecond time resolution, and near-unit efficiency at the wavelength 1550 nm [2]. In this work, we present the study of a photon-number-resolving detector based on an array of high-efficiency NbN nanostrips, which are suitable for operation at temperatures around 2 K. We model the response of this detector using a matrix and reconstruct the photon number distribution of the incoming light.

[1] F. Marsili et al, Physics and application of photon number resolving detectors based on superconducting parallel nanowires, New J. Phys. 11, 045022 (2009).

[2] I. E. Zadeh et al, Superconducting nanowire single-photon detectors: A perspective on evolution, state-of-the-art, future developments, and applications, Appl. Phys. Lett. 118, 190502 (2021).

Primary author(s) : Mr. ERCOLANO, Pasquale (Dip. di Fisica "E. Pancini", Università degli Studi di Napoli Federico II, I-80125 Napoli, Italy); Prof. PORZIO, Alberto (DICEM Università di Cassino e del Lazio Meridionale); Dr. EJRNAES, Mikkel (CNR-SPIN Institute of Superconductors, Innovative Materials and Devices, I-80078 Pozzuoli, Italy); Mr. BRUSCINO, Ciro (Dip. di Fisica "E. Pancini", Università degli Studi di Napoli Federico II, I-80125 Napoli, Italy); Dr. SALVONI, Daniela (Photon Technology Italy srl, via Giacinto Gigante 174, 80128 Napoli Italy); Mr. BUKHARI, Syed Muhammad Junaid (Dip. di Fisica "E. Pancini", Università degli Studi di Napoli Federico II, I-80125 Napoli, Italy); Dr. HUANG, Jia (Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences (CAS), 200050 Shanghai, PRC); Mrs. PELUSO, Martina (Dip. di Fisica "E. Pancini", Università degli Studi di Napoli Federico II, I-80125 Napoli, Italy); Dr. ZHANG, Chengjun (Photon Technology Italy srl, via Giacinto Gigante 174, 80128 Napoli Italy); Prof. LI, Hao (Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences (CAS), 200050 Shanghai, PRC); Prof. YOU, Lixing (Shanghai Institute of Microsystem and Information Technology (SIMIT), Chinese Academy of Sciences (CAS), 200050 Shanghai, PRC); Prof. PARLATO, Loredana (Dip. di Fisica "E. Pancini", Università degli Studi di Napoli Federico II, I-80125 Napoli, Italy); Prof. PEPE, Giovanni Piero (Dip. di Fisica "E. Pancini", Università degli Studi di Napoli Federico II, I-80125 Napoli, Italy)

Presenter(s) : Mr. ERCOLANO, Pasquale (Dip. di Fisica "E. Pancini", Università degli Studi di Napoli Federico II, I-80125 Napoli, Italy)

Contribution ID : **81** Type : **Oral**

What quantization means for a mathematician

In this talk I will present the famous Kontsevich Formality theorem, which solves the problem of quantization for any Poisson manifolds. Poisson manifolds encodes the information of classical mechanical systems, while quantum systems are encoded by star products. Kontsevich proved that for any Poisson manifold there exists a star product by proving that we can construct a(n L-infinity) morphism connecting those structures.

Primary author(s) : ESPOSITO, Chiara (Università di Salerno)

Presenter(s) : ESPOSITO, Chiara (Università di Salerno)

Session Classification : Quantum Gravity

Track Classification : Quantum gravity and noncommutative geometry

Contribution ID : **82** Type : **Poster**

High Energy Neutrinos from CCSNe

Core-collapse supernovae (CCSNe) are driven by low-energy (MeV) neutrinos, which release most of the system's gravitational binding energy. However, certain CCSNe with dense circumstellar material (CSM) can produce high-energy (HE) neutrinos (GeV and above) through hadronuclear (pp) or photohadronic (pγ) interactions, as the supernova ejecta interact with the CSM to form shocks and accelerate protons. These HE neutrinos offer a unique opportunity to probe cosmic ray acceleration mechanisms, complementing the insights provided by MeV neutrinos from nuclear processes.

Two main production mechanisms for HE neutrinos in CCSNe are considered: the interaction between supernova ejecta and CSM and relativistic choked jets (CJs), which are similar to gamma-ray bursts (GRBs) but do not pierce the stellar envelope, leading to neutrino emission without gamma-ray counterparts.

KM3NeT/ARCA experiment is well-suited for detecting high-energy neutrinos from cosmic sources, including core-collapse supernovae (CCSNe). Such observations can extend the detection horizon beyond the Magellanic Clouds, offering valuable insights into the astrophysical processes driving cosmic ray acceleration and the lifecycle of massive stars.

Primary author(s) : OLIVIERO, Veronica

Presenter(s) : OLIVIERO, Veronica

Contribution ID : **83** Type : **Poster**

Measuring nuclear fragmentation with the FOOT experiment

The FOOT (FragmentatiOn Of Target) experiment measures nuclear fragmentation cross sections in the 50-700 MeV/A energy range with about 5% uncertainty. Target nuclei (16O,12C) fragmentation induced by proton beams is studied via an inverse kinematic approach employing 16O, 12C beams impinging on graphite and polyethylene targets. Two complementary setups are used: the nuclear emulsions spectrometer measures the production of light charged nuclear fragments ($Z \leq 3$), while the electronic setup focuses on the heavier ($Z \geq 3$) fragments.

This contribution will discuss the first cross section fragmentation results with the nuclear emulsion spectrometer and the current status of the experiment.

Primary author(s) : Mr. BOCCIA, Vincenzo (Department of Physics "E. Pancini"); Prof. LAURIA, Adele (Department of Physics, "E. Pancini"); Dr. GALATI, Giuliana (University of Bari, Physics Department); Prof. MONTESI, Maria Cristina (Department of Chemistry, Federico II); Prof. DE LELLIS, Giovanni (Department of Physics "E. Pancini"); Dr. ALEXANDROV, Andrey (INFN Naples Section); Dr. TIOUKOV, Valeri (INFN LNGS)

Presenter(s) : Mr. BOCCIA, Vincenzo (Department of Physics "E. Pancini")

Contribution ID : **84** Type : **Poster**

Defect induced heavy meson dynamics in the QCD conformal window

Upon introducing an heavy quark in the perturbative regime of the QCD conformal window we precisely determine the associated heavy meson spectrum and wave functions in terms of the number of light flavours and mass. We then compute the conformal Isgur-Wise function which is a central quantity in heavy quark physics. We further determine the impact of the residual low energy confining dynamics on the heavy meson spectrum. As a working framework, we adapt the heavy quark effective theory to the perturbative conformal window dynamics. Our work lays the foundations to systematically go beyond the infinite mass defect approximation in conformal field theories.

Primary author(s) : DI RISI, Vigilante (University of Naples Federico II, INFN Sez. Napoli)

Presenter(s) : DI RISI, Vigilante (University of Naples Federico II, INFN Sez. Napoli)

Contribution ID : **86** Type : **Oral**

The Future of the ex Physics Pavilions of the Mostra d'Oltremare - New Perspectives for Research, Technology, and Education

giovedì 19 dicembre 2024 12:40 (20)

The Former Physics Pavilions of the Mostra d'Oltremare house a unique scientific and cultural heritage, bearing witness to a period of great innovation and intellectual activity. Today, these historic spaces offer an extraordinary opportunity to become a catalyst for social and cultural development through the establishment of a Center of Excellence dedicated to innovative scientific and technological research, continuous education and training, as well as dissemination of scientific knowledge. The restoration and revitalization of these pavilions is the central mission of the "All'Ombra del Cervo di Rodi" Association, which recently organized a workshop to identify potential research opportunities, technological advancements, and educational initiatives that could shape the envisioned Center of Excellence. Starting with a brief historical overview, the workshop's key activities will be presented, alongside preliminary concepts for a feasibility plan aimed at creating a Center of Excellence, which could be focused on quantum research and implementations, as well as on continuous education.

Primary author(s) : LA RANA, Giovanni (On behalf of the "All'Ombra del Cervo di Rodi" Association)

Presenter(s) : LA RANA, Giovanni (On behalf of the "All'Ombra del Cervo di Rodi" Association)

Session Classification : Outside Academia

Track Classification : Outside Academia

Contribution ID : **87** Type : **Poster**

Realizing non-Hermitian dynamics via non-unitary photonic with structured light

In recent years, non-Hermitian photonics collected significant attention as a rising field in optics due to the emergence of numerous physical concepts and novel effects. Unlike systems described by a Hermitian Hamiltonian, where the Hermitian conjugate ensures system closure to the environment and energy conservation, a non-Hermitian system characterized by complex eigenvalues enables the description of open systems and facilitates understanding of how a system can interact with the environment. Here, we propose an innovative approach for simulating non-Hermitian dynamics by realizing a non-unitary photonic quantum walk based on a light beam propagating in free space and manipulated via step operators acting jointly on its polarization and transverse momentum. Within this framework, we use the latter degrees of freedom to encode the coin and walker systems, respectively, typically characterizing coined quantum walks. To induce spin-rotation, we utilize a uniform liquid-crystal (LC) plate and an LC dichroic polarization grating to obtain a spin-dependent non-unitary translation operation on the walker. Through the combination of liquid crystals and absorbing dyes, we can manipulate both polarization and light amplitude, effectively recreating a dispersive system. This development yields a compact and versatile platform that significantly expands the scope of photonic simulations in studying quantum dynamics. It, also, introduces a new dimension for manipulating topological states, enabling the observation of phenomena such as those related to non-Hermitian topological phases.

Primary author(s) : Mrs. SAVARESE, PAOLA

Presenter(s) : Mrs. SAVARESE, PAOLA

Contribution ID : **88** Type : **Oral**

Learning Universe with Artificial Intelligence

mercoledì 18 dicembre 2024 14:30 (20)

I will present a project collecting machine learning tools to extract physical parameters from the major sky surveys and predict the cosmological parameters using million to billion galaxy samples.

Primary author(s) : Dr. NAPOLITANO, Nicola R. (UniNA); Prof. NAPOLITANO, Nicola R. (UniNA Department of Physics "E. Pancini")

Presenter(s) : Dr. NAPOLITANO, Nicola R. (UniNA)

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **89** Type : **Oral**

First data from the prototype of DarkSide-20k in Napoli

mercoledì 18 dicembre 2024 15:50 (20)

DarkSide-Proto0 (Proto0) is an experiment developed within the DarkSide-20k project, a dark matter direct detection experiment that aims to hunt for WIMPs using a two-phase argon time projection chamber (TPC). In preparation for the future DS-20k experiment, Proto0 focuses on investigating and optimizing the production of the ionization signal (S2) in two-phase argon TPCs and validating many of the novel technologies featured in the DS-20k detector on a smaller scale. To achieve this, Proto0 is equipped with a compact TPC designed to accommodate two PDUs, the 20x20 cm² SiPM-based photon counters developed for DS-20k. The main feature of the Proto0 detector is its flexible TPC design, with independently moving components during operation. This enables an optimization study of S2 formation in relation to geometrical factors and electrical properties. The results obtained from Proto0's scientific program will help fine-tune the DS-20k TPC design and contribute to a broader understanding of the engineering behind future two-phase experiments. The experiment is currently located at the cryogenic laboratory of Unina/INFN Napoli, where it is collecting data using a specially designed cryogenic setup, complete with argon condensation, recirculation, and purification loops.

Primary author(s) : RUDIK, Dmitrii (UNINA)

Presenter(s) : RUDIK, Dmitrii (UNINA)

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **90** Type : **Poster**

Searching for isospectrality in General Relativity: black hole vs wormhole

The quasi-normal modes (QNMs) of a Morris-Thorne type wormhole (WH) are compared to the Schwarzschild black hole (BH) within General Relativity. We investigating the similarities between the two QNM spectra (numerical isospectrality) for perturbations of different spin. How well does a WH mimic the QNM spectrum of a BH ?

Primary author(s) : DE SIMONE, Ciro (Univerisity of Naples "Federico II")

Presenter(s) : DE SIMONE, Ciro (Univerisity of Naples "Federico II")

Contribution ID : **92** Type : **Poster**

LSBGnet: Detection for LSBGs and UDGs using deep learning.

Detecting and characterizing low-surface brightness galaxies (LSBGs) and ultra-diffuse galaxies (UDGs) is known to be challenging due to their faint surface brightness, posing a significant hurdle for traditional detection methods. Recently, artificial neural networks proven to have a powerful learning ability, which can learn the features of the object from the image and complete classification or parameter regression tasks. Thus, artificial neural networks have been increasingly applied in astronomy field to handle the rising volume and complexity of photometric image. Object detection algorithms, one of the branches of computer vision, have greater capabilities than traditional classification and regression algorithms. Thus, it can accomplish large-scale galaxy detection tasks. In this work, we propose LSBGnet framework, a deep neural network specifically designed for automatic detection of LSBGs and UDGs. First, we use the images from Sloan Digital Sky Survey (SDSS) to train and test the model. The performance of the LSBGnet-SDSS model is outstanding in this work, and the recall and precision of LSBGnet model is more than 97% on the test set. Then, we select Dark Energy Survey (DES) sample to test the performance of the LSBGnet and the model achieved more than 97.5% recall and precision. Those result show that our LSBGnet model can accurately detect LSBGs from photometric images. Given the excellent performance of LSBGnet, we decided to use it for large-scale detection for UDG, a subset of LSBG, on KIDS DR5 (Kilo Degree Survey Data Release 5). We built the LSBGnet-KiDS model using the LSBGnet framework with iterative detection method. We utilize the LSBGnet-KiDS model to detect for UDGs from all photometric images of KiDS DR5 and obtained 966 UDG candidates. In this process, we successfully completed a large-scale detection for UDGs without using known UDG samples. When faced with a large-scale specific object detection task and the number of samples is not enough to build a model, we can utilize this method handle it. It also provides an effective approach to detection for specific objects for the upcoming surveys.

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Presenter(s) : SU, Hao (Department of Physics "E. Pancini", University of Naples Federico II)

Contribution ID : **93** Type : **Poster**

Study of Shortcuts to Adiabaticity on QAOA

The Quantum Approximate Optimization Algorithm (QAOA) is a promising hybrid quantum-classical algorithm that can solve combinatorial optimization problems. The quantum part of the algorithm involves using parametric unitary operations on a quantum computer to prepare a trial solution state. The parametric QAOA angles are variationally optimized minimizing a cost function using classical methods. We study a generalized QAOA ansatz that includes corrections to the Trotter expansion at the first and second order based on the Baker-Campbell-Hausdorff (BCH) expansion, that we call QAOA-2CD. In our work, we have better performances of QAOA-2CD with respect to QAOA. In a regime in which QAOA is close to Quantum Annealing (QA), these new unitaries correspond to the countediabatic potential of Shortcuts to Adiabaticity. The latter assists the adiabatic evolution limiting excited state hoppings of the ground state and making the evolution time-independent. In our work, we reveal an expected connection between a property valid for QAOA-2CD and QA. A system with a huge minimal gap Δ_eg can be treated easily not only in QA but also in QAOA and QAOA-2CD.

Primary author(s) : VIZZUSO, MARA (Università degli Studi di Napoli Federico II)

Presenter(s) : VIZZUSO, MARA (Università degli Studi di Napoli Federico II)

Session Classification : Quantum Technology

Contribution ID : **94** Type : **Oral**

Does gravity act on the quantum vacuum? The ARCHIMEDES experiment.

mercoledì 18 dicembre 2024 14:50 (20)

Nel paradigma della Relatività Generale, l'attrazione gravitazionale è un fenomeno geometrico dello spaziotempo avvertito tanto dai corpi massivi che dai campi puramente energetici, come il campo elettromagnetico. In quest'ottica, anche il concetto di peso cambia, perchè non dipende solo dalla quantità di materia ma anche dall'energia interna. Trattandosi di una teoria classica, si ritiene plausibile l'effetto di attrazione sui campi classici, ma non è ovvio immaginare questo fenomeno sui campi quantistici, a causa delle divergenze nel calcolo dell'energia di vuoto. L'esperimento ARCHIMEDES (INFN - CSN2) si propone di misurare la variazione di peso di un cristallo superconduttivo di BSCCO mentre viene indotta una variazione di energia di vuoto interna dalla transizione di fase. La variazione di peso attesa è così piccola (0.5 fN) che è stato necessario costruire *ad hoc* una bilancia opto-meccanica di alta precisione operante presso il futuro SUN Laboratory (Lula, NU), essendo la Sardegna uno dei luoghi con rumore sismico più basso d'Europa.

In the paradigm of General Relativity (GR), gravitational attraction is a geometric phenomenon of spacetime felt by both massive bodies and massless fields, such as the electromagnetic field. In this context, the concept of weight also changes, because it depends not only on the amount of matter but also on internal energy. Since GR is a classical theory, the effect of attraction on classical fields is considered plausible, but it is not obvious to imagine this phenomenon on quantum fields, due to divergences in the calculation of vacuum energy. The ARCHIMEDES experiment (INFN - CSN2) aims to measure the weight change of a superconducting BSCCO crystal while an internal vacuum energy variation is induced by the phase transition. The expected weight variation is so small (0.5 fN) that a high-precision opto-mechanical balance had to be built *ad hoc* at the future SUN Laboratory (Lula, NU), Sardinia being one of the places with the lowest seismic noise in Europe.

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Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **95** Type : **Poster**

Development of general-purpose dc SQUIDs with sub-micrometric circuit elements

The direct current Superconductive Quantum Interference Device (dc SQUID) is one of the most established applications of superconductor technology. Their often-unrivalled sensitivity to magnetic flux translates into numerous applications for SQUID sensors, such as low-temperature thermometry or current sensing for electrical metrology. In this contribution, we present the integration of superconductive, sub-micrometric Nb "fine-pitch" coils into existing Nb/AlOx/Nb SQUID designs for improved signal input. The "fine-pitch" coil layouts allow to significantly extend the range of input inductances and increased signal-to-SQUID inductive coupling while maintaining the SQUID loop inductance and the overall compactness of the sensors. In a SQUID current sensor, to maximize the inductive coupling constant k between the signal input coil and the SQUID loop, means to achieve a low coupled energy sensitivity $\varepsilon_c = (1/k^2) \times \varepsilon$ - where ε is the SQUID-intrinsic energy sensitivity. The contribution will provide details of the fabrication process and design aspects of the integrated sensors, as well as characterization results.

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Presenter(s) : Mr. ESATTORE, Mauro (Physikalisch-Technische Bundesanstalt (PTB))

Contribution ID : **96** Type : **Oral**

The PDU test facility for the Darkside20k experiment.

mercoledì 18 dicembre 2024 15:30 (20)

The DarkSide-20k is a 20-tonne fiducial mass dual phase Liquid Argon Time Projection Chamber (LArTPC) detector for the direct dark matter search, filled with low radioactivity Argon and equipped with customised cryogenic SiPM photosensors. The experiment will be constructed in INFN Gran Sasso underground Laboratory (LNGS), and is expected to be free of any instrumental background for an exposure of >100 tonne year. The DarkSide SiPMs were developed specifically for LAr use in collaboration with Fondazione Bruno Kessler (FBK). This activity leaded to the production and assembly of large surface arrays of SiPMs (20×20 cm2) the Photo Detection Units (PDU) in a INFN dedicated production site NOA at LNGS. The total of 528 PDUs will be produced in the following year to be allocated on the two Optical Planes (OP) of the TPC (with ˜21 m2 total SiPM surface). All PDUs before installation on the OP must be tested and qualified in LN, this will done in a dedicated test facility (PDU Test Facility) designed, assembled and commissioned in Naples Cryogenic Laboratory for the Dark Matter Direct Searches of UNINA Physics Department. Two one-month long testing campaigns with very first 6 and later 10 PDUs were conducted in Naples in May and October of 2024. The PDUs were tested for varying over-voltage values and different readout and power configurations. The key parameters like SPE position, Base line RMS, signal-to-noise ratio, Gain and Sensitivity as a function of time were acquired for the stability study. The description of tests and results will be presented in this talk.

Primary author(s) : Dr. DMITRII, Rudik (UNINA / INFN); Dr. SUVOROV, Yury (UNINA / INFN Sez. Napoli)

Presenter(s) : Dr. SUVOROV, Yury (UNINA / INFN Sez. Napoli)

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **97** Type : **Poster**

Innovative Pointing Strategies for the Cherenkov Telescope Array Observatory: Divergent Mode Observations

The Cherenkov Telescope Array Observatory (CTAO) represents the next generation of Imaging Atmospheric Cherenkov Telescopes, the most effective ground-based instruments for gamma-ray detection. Compared to the current generation, CTAO introduces a significant leap in capabilities with a large number of telescopes distributed across two sites: 15 in the Northern hemisphere and 60 in the Southern hemisphere. This configuration enhances energy sensitivity, broadens the observable energy range, and improves source localization. The high number of telescopes also provide the unique opportunity of testing new pointing strategies, which are not feasible with the current generation, limited to a maximum of five telescopes. In particular, the benefits of a divergent pointing strategy -consisting of telescopes pointing in a slightly outward direction from one another- has been studied since 2013. This approach expands the field of view (FoV) at the cost of reduction in sensitivity and resolution. Conversely, narrowing the FoV with a convergent mode can improve these aspects, providing flexibility for diverse scientific goals.

Primary author(s) : AMBROSINO, Daniele (Università degli Studi di Napoli Federico II)

Presenter(s) : AMBROSINO, Daniele (Università degli Studi di Napoli Federico II)

Contribution ID : **98** Type : **Oral**

Searching for TeV-emitting candidates among the X-ray bright blazar population

mercoledì 18 dicembre 2024 12:10 (20)

The purpose of this work is to understand if, among the blazars not detected by Fermi-LAT, a population of TeV emitting sources could be detected by current or future Cherenkov telescopes. We cross-matched the 5BZCAT catalog of blazars with the most recent catalogs of point-like source, to determine if the X-ray emission can be used as an effective proxy to find and characterize candidate TeV-emitting blazars.

Primary author(s) : IULIANO, ANTONIO (INFN Sezione di Napoli); Dr. MARCHESI, Stefano (Università di Bologna)

Co-author(s) : Dr. DA VELA, Paolo (INAF OAS Bologna); Dr. DORO, Michele (INFN Sezione di Padova); Dr. PRANDINI, Elisa (INFN Sezione di Padova); Dr. MICELI, Davide (INFN Sezione di Padova); Dr. ZANIN, Roberta (CTAO gGmbH)

Presenter(s) : IULIANO, ANTONIO (INFN Sezione di Napoli)

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **99** Type : **Poster**

Large-scale free-space photonic circuits in two dimensions

Optical degrees of freedom, such as those associated with spatial, spectro-temporal, or polarization features of the optical field, serve as a convenient resource for encoding information. The abundance of tools for their accurate manipulation established photonics as a versatile platform for both classical and quantum information processing tasks. Optical processors based on linear circuits, performing a variety of tasks, are often referred to as photonic circuits, in analogy with canonical circuits processing electrical signals. When used as optical simulators, the overall optical transformation maps to a unitary temporal evolution operator. By monitoring the system output one can observe directly optical analogues of classical or quantum dynamics. Here we realized a compact photonic circuit in free-space, implementing all-optical mode-coupler operations in a transverse two dimensional large-scale regime, as an alternative to the traditional integrated waveguides approach to optical information processing. We tested it by implementing unitary transformations associated with 2D quantum walks on transverse modes of structured light.

Primary author(s) : AMMENDOLA, Maria Gorizia (Scuola Superiore Meridionale - Università degli Studi di Napoli Federico II); Dr. DI COLANDREA, Francesco (Università degli Studi di Napoli Federico II); Prof. CARDANO, Filippo (Università degli Studi di Napoli Federico II); Prof. MARRUCCI, Lorenzo (Università degli Studi di Napoli Federico II)

Presenter(s) : AMMENDOLA, Maria Gorizia (Scuola Superiore Meridionale - Università degli Studi di Napoli Federico II)

Contribution ID : **100** Type : **Oral**

LINE: a Loop Integrals Numerical Evaluator for LHC physics

With the increasing precision of experimental measurements in collider physics, testing the Standard Model requires ever more accurate theoretical predictions. LINE is a software designed to contribute to this goal by addressing the numerical computation of multi-loop Feynman integrals solving differential equations via series expansion. The code is written in C to efficiently leverage arbitrary precision libraries, implementing low-level representations of mathematical objects and algebraic manipulations. This approach ensures both speed and accessibility, going beyond proof of concept and making large-scale cluster computations more feasible.

Primary author(s) : PRISCO, Renato Maria (Università degli Studi di Napoli Federico II & INFN Napoli); TRAMONTANO, FRANCESCO (Università Federico II di Napoli); Dr. RONCA, Jonathan (Università degli Studi di Padova & INFN Padova)

Presenter(s) : PRISCO, Renato Maria (Università degli Studi di Napoli Federico II & INFN Napoli)

Session Classification : Astro Physics & Particle

Track Classification : Particle Physics

Contribution ID : **101** Type : **Poster**

An innovative compact lidar for atmospheric aerosol, water vapour and transmissivity measurements

An innovative lidar system was recently made operational as part of the mobile unit for the atmospheric remote sensing of the Naples National Facility (NF) of the ACTRIS Aerosol Cloud and Trace Gases Research Infrastructure. The lidar is a two wavelength elastic/Raman compact and transportable system, with scanning unit, specially designed to investigate the atmosphere in a very large range of altitudes (from about 150m-to 30km), combining compactness, accuracy, autonomy in remote use and ease of operation. The system was calibrated and tested according to the standard quality assurance procedures for ACTRIS NF operation, demonstrating high performances in term of signal-to-noise ratio of all detected signals in both analogical and photon-counting regimes. Measurements made by this lidar will be reported, showing off how this instrument can conduct in-depth analysis of atmospheric particulate matter, obtaining optical properties of the particles and transmissivity of the atmosphere.

Primary author(s) : MANZO, Matteo (Università degli studi di Napoli "Federico II")

Presenter(s) : MANZO, Matteo (Università degli studi di Napoli "Federico II")

Contribution ID : **102** Type : **Oral**

(No) exotic monsters in the early Universe

mercoledì 18 dicembre 2024 12:50 (20)

The recent data by the JWST satellite identify what seems an excess of luminous objects in the early Universe. It has been proposed that this may be evidence that exotic monsters lurk in the cosmic Dark Ages. I will show how -while such excesses seems to be consistent and real- they can not be explained by some of the most extreme versions of “dark matter supported stellar objects” that myself and others postulated in the past, contrary to the claims in this sense.

Primary author(s) : IOCCO, FABIO (Università di Napoli ”Federico II”)

Presenter(s) : IOCCO, FABIO (Università di Napoli ”Federico II”)

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **103** Type : **Oral**

Stories of Statistical Physics and Computational Biology

mercoledì 18 dicembre 2024 11:10 (20)

Within the cell nucleus of eukaryotic organisms, chromosomes are organized in a complex, non-random three-dimensional (3D) spatial structure, which is intimately linked to vital functional purposes. Indeed, a correct folding allows an efficient communication between genes and their distal regulatory elements while, if altered, can cause severe diseases. Here I will discuss how Polymer Physics, combined with Molecular Dynamics simulations and Machine Learning based inference, represent a powerful tool to quantitatively investigate the complexity of 3D organization of real genomes, as highlighted by recent microscopy and biochemical experiments. I will show that simple physical processes, widely studied in Statistical Mechanics, such as phase-separation of molecular aggregates and symmetry breaking mechanisms, allow us to make sense of recent experimental observations including the in olfactory receptor choice in olfactory sensory neurons (OSN). Finally, polymer models can be used to study the impact of disease-linked genetic mutations or the effect of viral infections as SARS-CoV-2, opening the way to new potential tools in Biomedicine.

Primary author(s) : Dr. CHIARIELLO, Andrea Maria (Dipartimento di Fisica Ettore Pancini, Università di Napoli Federico II)

Presenter(s) : Dr. CHIARIELLO, Andrea Maria (Dipartimento di Fisica Ettore Pancini, Università di Napoli Federico II)

Session Classification : Statistical Physics

Track Classification : Statistical Physics

Contribution ID : **104** Type : **Poster**

LOCAL ERGOTROPY IN MANY-BODY LOCALIZED QUANTUM BATTERIES

The local ergotropy, the maximum amount of work extractable via local unitary transformations, is theoretically investigated in an out-of-equilibrium localized many-body quantum battery. In this analysis, we focus on the one-dimensional disordered XXZ Heisenberg model. Extensive simulations are conducted to model the dynamics using matrix product states and to optimise unitary transformations discharging the subsystem made of two spins. A comparison between local and switch-off ergotropy behaviour is presented for ergodic, Anderson and many-body localized phases. Analysing several chain lengths, spin couplings and disorder strengths, it is observed that the extractable work is much larger for localized than for ergodic phases from short up to long times. Moreover, signatures for localization phenomena are identified through quantum thermodynamic quantities, such as the local ergotropy. Although this quantity is derived from the unitary transformations of the subsystem, it remains a global quantity of the system. Indeed, good markers for many-body localized phases can be found in the time behaviour not only of the entanglement entropy of the subsystem, but also of the local ergotropy and its quantum fluctuations. Our work sheds lights on the complex interplay between local ergotropy and many-body localized phases relevant for more realistic quantum batteries and for more general identifications of many-body quantum effects.

Primary author(s) : Mr. FORMICOLA, Francesco (University of Naples Federico II)

Co-author(s) : Prof. DE FILIPPIS, Giulio (University of Naples Federico II); Ms. DI BELLO, Grazia (University of Naples Federico II); Dr. FARINA , Donato (University of Naples Federico II); Prof. PERRONI, Carmine Antonio (University of Naples Federico II)

Presenter(s) : Mr. FORMICOLA, Francesco (University of Naples Federico II)

Contribution ID : **105** Type : **Poster**

Post-Quantum Cryptography and the Foundation of Quantum2Pi

The advent of quantum computers threatens to render traditional cryptographic systems, based on problems like prime factorization and discrete logarithms, obsolete. This challenge is not only technological but also fundamentally physical, as quantum computing leverages the unique properties of quantum mechanics. The scientific community is developing advanced post-quantum cryptography (PQC) techniques alongside complementary physical approaches like Quantum Key Distribution (QKD) to address this.

Lattice-based cryptography, one of the pillars of PQC, relies on mathematical problems that remain intractable even for quantum computers. Specifically, the complexity of lattice problems—such as the Learning With Errors (LWE) and the Shortest Vector Problem (SVP)—is deeply connected to profound geometric and numerical properties. These algorithms offer resistance to future quantum attacks and promise for applications like homomorphic encryption, paving the way for secure computations on encrypted data.

On the other hand, **Quantum Key Distribution** (QKD) represents an innovative paradigm that leverages fundamental principles of quantum mechanics, such as the no-cloning theorem and entanglement, to ensure intrinsically secure key generation. Unlike purely mathematical algorithms, QKD is grounded in physical laws, offering unconditional security at the physical level.

At the crossroads of advanced mathematics, computer science, and physics, these challenges demand innovative solutions that combine cutting-edge research with practical applications. This is why I founded the startup **Quantum2Pi**, an ambitious initiative dedicated to redefining security standards in the quantum era. The foundation of Quantum2Pi stems from realizing the need to unify mathematical and physical approaches to build resilient security in the quantum era. The goal is to develop solutions that integrate lattice-based cryptography with technologies like QKD, creating a security ecosystem that not only withstands quantum computing but also reflects a deep understanding of our universe's physical laws. At Quantum2Pi, we aim to bridge advanced theoretical research with practical applications, addressing not only the technological domain but also engaging the scientific community to collectively shape the future of quantum security.

Primary author(s) : Dr. CHIRICO, Ugo (Federico II and Quantum2pi)

Presenter(s) : Dr. CHIRICO, Ugo (Federico II and Quantum2pi)

Contribution ID : **106** Type : **Oral**

Predictive polymer models of genome 3D structure

mercoledì 18 dicembre 2024 10:50 (20)

Chromosomes have a complex spatial structure that serves vital functional purposes, yet their self-organization principles are largely unknown. I discuss our recent work combining polymer physics and machine learning to understand how chromosomes are folded and regulated in the cell nucleus. After a brief overview of recent experimental advances to measure chromosome 3D structure, I discuss our physics models showing that phase transition mechanisms can control chromosome architecture and its link with gene regulation and cell function. Several experiments have confirmed those models, notably their predictions on how genetic mutations result in diseases such as congenital disorders, opening the way to novel applications in biomedicine.

Primary author(s) : Dr. BIANCO , Simona

Presenter(s) : Dr. BIANCO , Simona

Session Classification : Statistical Physics

Track Classification : Statistical Physics

Contribution ID : **107** Type : **Oral**

The Enchantment of Oxygen

giovedì 19 dicembre 2024 10:35 (20)

Oxygen, the lifeblood of all living beings, is both a blessing and a challenge for us material physicists working on the materials growth for electronics. Superconductivity, ferroelectricity, ferromagnetism, and multiferroicity—these remarkable properties of materials in oxides electronics are intrinsically linked to the presence of oxygen. In this presentation, we will explore how oxygen plays a pivotal role in these phenomena.

Primary author(s) : Prof. DE LUCA, Gabriella Maria

Presenter(s) : Prof. DE LUCA, GABRIELLA MARIA (Diapartimento di Fisica "E. Pancini")

Session Classification : Condensed Matter

Track Classification : Condensed Matter

Contribution ID : **108** Type : **Poster**

The DarkSide Proto-0 Exeriment in Napoli

DarkSide-20k is an experiment aimed at the direct search for WIMP dark matter, currently under construction at LNGS. It employs a 50-ton (20-ton fiducial) two-phase argon time projection chamber (TPC). Among the many innovations of the DS-20k TPC is the use of newly developed, radiopure SiPM-based photon counters, produced in a dedicated facility at LNGS, NOA, and tested in the Cryogenic Laboratory at INFN Napoli. DarkSide-Proto0 (Proto0) is its official prototype, focusing on the geometrical optimization of the ionization signal (S2) production in two-phase argon TPCs and validating many of the novel technologies featured in the DS-20k detector on a smaller scale. The main feature of the Proto0 detector is its flexible TPC design, with independently movable components during operation. The results obtained from Proto0's scientific program will help fine-tune the DS-20k TPC design and contribute to a broader understanding of the engineering challenges behind future two-phase experiments. The experiment is currently collecting data using a specially designed cryogenic setup, complete with argon condensation, recirculation, and purification loops.

Primary author(s) : MATTEUCCI, Giuseppe (INFN Sez. Napoli, Università degli Studi di Napoli Federico II)

Presenter(s) : MATTEUCCI, Giuseppe (INFN Sez. Napoli, Università degli Studi di Napoli Federico II)

Contribution ID : **109** Type : **Oral**

”lo zen e l’arte di accettare gli inviti il più tardi possibile”

giovedì 19 dicembre 2024 12:00 (20)

Su come ho fatto di tutto per non accettare l’invito del professor Iocco, non riuscendoci.

Primary author(s) : Prof. SANTANGELO , Pietro

Presenter(s) : Prof. SANTANGELO , Pietro

Session Classification : Outside Academia

Track Classification : Outside Academia

Contribution ID : **110** Type : **Poster**

The light burden of memory: constraining primordial black holes with high-energy neutrinos

Primordial Black Holes with a mass lighter than 10^{15}g are expected to have evaporated by now according to Hawking's semi-classical approximation for black holes evaporation. Recent works have pointed out that quantum effects, known as "memory burden", may slow the evaporation of black holes, potentially allowing a population of light primordial black holes (PBHs) to survive until today and contribute to the dark matter energy density. We investigate PBHs with masses $M_{\rm PBH} \leq 10^9$ g that are currently evaporating and emitting high-energy particles, including neutrinos, in the local Universe. Using recent IceCube data, we place new constraints on the parameter space of PBHs and the memory burden effect. Additionally, we explore the sensitivity of future neutrino observatories such as IceCube-Gen2 and GRAND. Our results highlight the critical role of neutrino observations in probing scenarios with suppressed evaporation and light PBH masses.

Primary author(s) : CHIANESE, Marco (University of Naples Federico II); BOCCIA, Andrea (Scuola Superiore Meridionale); IOCCO, FABIO (Università di Napoli "Federico II"); SAVIANO, Ninetta (INFN Napoli); MIELE, GENNARO

Presenter(s) : BOCCIA, Andrea (Scuola Superiore Meridionale)

Contribution ID : **111** Type : **Oral**

Cosa ho imparato parlando e scrivendo di scienza

giovedì 19 dicembre 2024 12:20 (20)

Alcune considerazioni sulla comunicazione della scienza, maturate nella mia esperienza personale tra scuole, festival, libri, tv e teatro.

Primary author(s) : Prof. COVONE, Giovanni (University Federico II)

Presenter(s) : Prof. COVONE, Giovanni (University Federico II)

Session Classification : Outside Academia

Track Classification : Outside Academia

Contribution ID : **112** Type : **not specified**

Welcome and introduction

mercoledì 18 dicembre 2024 10:00 (10)

Contribution ID : **113** Type : **not specified**

What quantization means for a mathematician

giovedì 19 dicembre 2024 10:15 (20)

In this talk I will present the famous Kontsevich Formality theorem, which solves the problem of quantization for any Poisson manifolds. Poisson manifolds encodes the information of classical mechanical systems, while quantum systems are encoded by star products. Kontsevich proved that for any Poisson manifold there exists a star product by proving that we can construct a(n L-infinity) morphism connecting those structures.

Presenter(s) : ESPOSITO, Chiara (Università di Salerno)

Session Classification : Cosmology & Quantum Gravity

Contribution ID : **114** Type : **Oral**

AGN variability studies in Naples: toward next generation surveys

mercoledì 18 dicembre 2024 11:50 (20)

I will describe the activity aimed at characterising AGN through their variability in preparation for next generation LSST surveys.

Primary author(s) : Prof. PAOLILLO, Maurizio (Università di Napoli Federico II)

Presenter(s) : Prof. PAOLILLO, Maurizio (Università di Napoli Federico II)

Session Classification : Astro Physics & Particle

Track Classification : Astrophysics & Astroparticle Physics

Contribution ID : **115** Type : **Oral**

Superconducting Nanowire Single Photon Detectors: From Research to Industry

giovedì 19 dicembre 2024 10:55 (20)

Superconducting nanowire single photon detectors (SNSPDs) are advanced devices renowned for their high sensitivity, low noise, and fast speed, making them ideal for single photon detection applications such as quantum communication, photonic quantum computing, imaging, and LIDAR. Today, I will share the advanced SNSPD technologies developed by our group and discuss our efforts to transition these innovations from research to industry.

Primary author(s) : Dr. DANIELA, Salvoni (Photon technology Italy SRL); Prof. PIERO PEPE, GIOVANNI (UNINA); Prof. PARLATO, LOREDANA (UNINA); Dr. PELUSO, MARTINA (UNINA); Dr. BRUSCINO, ciro; Dr. ZHANG, chengjun (UNINA)

Presenter(s) : Dr. ZHANG, chengjun (UNINA)

Session Classification : Condensed Matter

Track Classification : Condensed Matter