

IX ENCUENTRO REGIONAL DE CIENCIAS FÍSICAS

UNIVERSIDAD POPULAR DEL CESAR

20 al 22 de septiembre del 2023

CONFERENCIAS PLENARIAS

Conferencia Inaugural

Dr. Jonathan Romero Fontalvo

Professional Services at Zapata Computing. Inc.

Introducción a la computación cuántica y sus aplicaciones

En este curso presentaremos los principios básicos de la computación cuántica, qué la hace diferente a la computación clásica, cuáles son algunos de los algoritmos cuánticos y sus potenciales aplicaciones industriales. Esta introducción proveerá un punto de partida a los asistentes para continuar explorando uno de los campos de la física aplicada de mayor crecimiento en los últimos años.

Conferencia plenaria I

Dr. Edwin Pedrozo Peñafiel

Research Laboratory of Electronics (RLE), MIT-Harvard Center for Ultracold Atoms (CUA)

Department of Physics MIT

Search for new physics with quantum technologies

Recent advances in the creation of controllable quantum systems have opened the door to the study of fundamental physics and the search for new physics beyond the standard model. In particular, the development of quantum simulators and quantum sensors, like tweezer arrays, optical atomic clocks, and atom interferometers, have made possible the study of quantum effects that are difficult or even impossible to study in their natural appearance. These cutting-edge quantum systems are strong candidates for detecting gravitational waves in a certain range of frequencies, searching for dark matter, detecting variations of fundamental constants, and simulating quantum gravity, among other important scientific questions. In this presentation, I will explore how Atomic, Molecular, and Optical (AMO) physics has shaped these quantum technologies for fundamental

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physics. In particular, I will focus on the development of cold quantum gases that has enabled the creation of single particles and many-body quantum systems that can be manipulated with extreme control. In general, I will give a personal perspective of the potential directions of this field.

Conferencia plenaria II

Dr. Vanderlei S. Bagnato

IFSC-University of São Paulo Brazil

BMEN- Texas A&M University -USA

Optics and photonics in life science: from cancer to microbiological control

Using photodynamic action, modern techniques are being able to promote atomic and molecular physics within cells. With that principles we can advice procedures for the treatment of cancer and microbiological control, including treatment of infections resistant to antibiotics. We shall present principles and results of the field.

Conferencia plenaria III

Dr. Juan Rafael Martínez Galarza

PhD en Astrofísica - Universidad de Leiden (Países Bajos)

Astrofísico en el Centro de Astrofísica | Harvard & Smithsonian

Centro de Datos del Telescopio Espacial Chandra (NASA)

La búsqueda de fuentes de ondas gravitacionales en el espectro electromagnético.

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Conferencia plenaria IV

Dr. Phillippe Wilhelm Courteille

Doctor en Física de la Universität Hamburg (1995).

Profesor de la Universidad de São Paulo (2011) y de la Universität Tübingen (2009)

Quantum sensing with cold atoms and matter waves

Cold atoms represent an ideal platform for the implementation of second-generation quantum technologies. Particularly interesting opportunities emerge from a coherent coupling of the atoms to single-mode light fields enabled by resonant optical cavities. In this lecture, after a general introduction into the world of cold atoms, I will present two of our research lines. In the first one, we study the interaction of ultracold atoms with a ring cavity in parameter regimes suitable for the creation of non-classical collective states of the atomic cloud with possible application in Heisenberg-limited interferometry. The regime may also allow for a global synchronization of the atomic dipoles with application in superradiant lasing. In a second research line, we are setting up a high sensitivity matter-wave interferometer for inertial sensing and gravimetry. It is based on observing in real time Bloch oscillations performed by atoms located inside a periodic optical lattice formed by two counter-propagating modes of the a cavity and exploits the fact that the periodicity of the oscillations is strictly proportional to external forces.