CSU PHYSICS COLLOQUIUM

Relativistic Nanoscale Ultrahigh Energy Density Physics

Speaker: Jorge Rocca
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Colorado State University
4:00 PM Monday, September 11, 2017
Refreshments at 3:45 PM
Location: 120 Engineering (Hammond Auditorium)

Abstract

Ultra-high-energy-density matter, characterized by energy densities > 1 x 10^8 J cm^{-3} and pressures greater than a gigabar is encountered in the center of stars and in inertial confinement fusion capsules driven by the world's largest lasers. This talk will shown that similar conditions can be obtained with compact, ultra-high contrast, femtosecond lasers focused to relativistic intensities onto aligned nanostructure arrays [1]. Here we discuss the measurement of the key physical process. Experiment also show that aligned nanowires irradiated at relativistic intensities convert optical laser light into X-rays with record efficiency, and can drive deuterium-deuterium fusion reactions resulting in the efficient generation of ultrashort neutron pulses. Relativistic 3D particle-in-cell-simulations, validated by these measurements, predict that irradiation of nanostructures at intensities of > 1 x 10^{22} W cm^{-2} will lead to a virtually unexplored ultra-high energy density plasma regime characterized by energy densities in excess of 8 x 10^{10} J cm^{-3}, equivalent to a pressure of 0.35 Tbar.

1. B. Bargsten et al. Science Advances **3**, e1601558 (2017)

Biographical Sketch

Jorge Rocca is a University Distinguished Professor in the Departments of Electrical and Computer Engineering and of Physics at Colorado State University. His research interests are in the physics and development of compact X-ray lasers, the study of relativistic laser interactions with matter, and the development of compact ultra-intense lasers to drive them. His group is known for contributions in the development of bright table-top soft X-ray lasers and their application in several fields, including the demonstration of the first table-top soft X-ray laser. Prof. Rocca received the Arthur. L. Schawlow Prize in Laser Science from the American Physical Society in 2011, and the Willis Lamb Prize for Laser Science and Quantum Optics in 2102. He was elected Fellow of the American Physical Society, the Optical Society of America, and the IEEE.