

# The 12<sup>th</sup> Dvořák Lecture

by Professor **Jorge J. Rocca**

Colorado State University, USA

## High power lasers: from intense x-ray beams to relativistic nanophotonics

Monday, June 13, 2022 at 15:00, Lecture hall, SOLID21 building  
Institute of Physics of the Czech Academy of Sciences, Na Slovance 2, 182 21 Praha 8, Czech Republic

*The lecture and the discussion will be in English only, the translation to Czech will not be provided.*

*The admission to the lecture is free, however it is necessary to reserve a seat using the registration form at: [rezervace.fzu.cz](http://rezervace.fzu.cz)*

### Annotation

Compact lasers operating at high repetition rates now achieve record powers and can operate at unprecedentedly short wavelengths. This lecture will review the development of compact plasma-based soft x-ray lasers that are enabling the realization of a variety of applications in nanoscience and nanotechnology on a table-top. Plasma-based x-ray lasers provide extremely monochromatic high energy pulses that can reach full coherence. They allow experiments such as single-shot nano-scale morphologic and composition imaging, error-free nano-patterning, and the study of the electronic structure and reactivity of nano-clusters, in compact facilities. The lecture will also discuss the use of

high intensity ultrashort optical laser pulses to volumetrically heat solid density matter into a new ultra-hot plasma regime characterized by the extreme energy densities that exist in the center of stars. We have demonstrated that the irradiation of aligned nanowires with high contrast femtosecond laser pulses of relativistic intensity can volumetrically heat near solid density matter to temperatures of several hundred million degrees. In a different set of experiments the acceleration of ions from deuterated nanowire arrays to multi-MegaVolt energies resulted in micro-scale fusion characterized by neutron yields 500 times larger than that obtained irradiating flat solid targets of the same material.



**Jorge J. Rocca**

Jorge Rocca is a University Distinguished Professor in the Department of Electrical and Computer Engineering and Department of Physics at Colorado State University. His research interests are in the physics and development of high power lasers, X-ray lasers, and the study of ultra-intense laser-matter interactions. His group is known for contributions to the development of bright table-top soft X-ray lasers, including the demonstration of the first table-top soft X-ray laser, and their appli-

cation in several fields including nanotechnology and nanoscience and the diagnostics of dense plasmas. His group has developed a multi-Hz repetition rate Petawatt-class laser, and kilowatt average power, high pulse energy picosecond solid state lasers. Recently his group showed that intense laser irradiation of ordered nanostructures creates an ultra-high energy density plasma regime leading to multi-Gigabar pressures, extreme degree of ionization, and record conversion efficiency into picosecond x-rays pulses, and micro-scale fusion. The results of this research are published in more than 280 peer review journal papers. He received the Arthur L. Schawlow Prize in Laser Science from the American Physical Society and the Willis E. Lamb Award for Laser Science and Quantum Optics. He was elected Fellow of American Physical Society, the Optical Society of America, and Institute of Electrical and Electronic Engineers. He received an IEEE LEOS Distinguished Lecturer Award. Early in his career he was a National Science Foundation Presidential Young Investigator..



**Vladimír Dvořák**

(1934–2007)

Vladimír Dvořák was a solid state physicist and the most prominent Czech scientist in the theory of ferroelectricity and structural phase transitions. He was affiliated with the Institute of Physics of the Czech Academy of Sciences in Prague for the whole productive life. He served as its director in 1993–2001 and was the main protagonist of the revolutionary reforms of the Institute after 1989. He was a member of the Learned Society of the Czech

Republic since 1995. His personality has strongly influenced the scientific program and development in the Department of Dielectrics of the Institute since the late sixties up to the present. He was a brilliant lecturer and is considered as one of the most respected directors of the Institute.

To commemorate his work and personality, the Institute Physics of the Czech Academy of Sciences decided to organize an annual festive Dvořák lecture, given by prominent internationally renowned scientists in the field related to the research pursued at the Institute..



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