

## 4. Resonant physical processes (nonlinear optics)

By

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Host: Assoc Prof. Cesare Soci

### **Abstract**

In this talk, we discuss inertial and noninertial nonlinearities - propagation of laser radiation in a medium with chemical inertial nonlinearity. An investigation is made of the dynamics of the propagation of laser radiation in a medium where chemical reactions are taking place. Absorption of radiation energy heats the medium and speeds up reactions. It is found that if products having optical properties other than those of the initial material are formed in a chemical reaction, a new mechanism of radiation self-interaction, *i.e.*, a slow-response chemical nonlinearity, is observed in the medium. Cases of strongly (when the medium is weakly nonlinear) and moderately (when the medium is strongly nonlinear) exothermic reactions are considered. The role of diffraction effects is investigated. It is shown that in a medium with a chemical nonlinearity, a "chemical" focusing lens overcomes the diffraction effects if the product of the radiation energy and the reaction product concentration exceeds a critical value. An experimental investigation was made of some features of the formation of temperature and concentration fields in chemically active systems interacting with laser radiation due to a feedback between "chemical" and thermal, also between concentration and thermal degrees of freedom of the system, which occurs during laser irradiation. Nonlinear optical effects (self-focusing and defocusing) during propagation of laser radiation in media having a slow-response chemical nonlinearity were observed experimentally. Strong enrichment of the gas mixture in the laser beam by one of the components was also observed.

### **Short Biography**

Boris Lukiyanchuk received his PhD (Physics and Mathematics) from P. N. Lebedev Physical Institute, Academy of Sciences of USSR in 1979 and his Doctor of Sciences from the General Physics Institute, Academy of Sciences of USSR in 1991. From 1970 to 1980, he was affiliated to the Scientific Research Institute at Moscow, Russia. He was also a Professor, Scientific Advisor and Principal Scientist at Data Storage Institute, A\*STAR, Singapore from 1999-2018. Currently he is the Professor, Head of the Nonlinear and Extreme Nanophotonics Laboratory, Lomonosov Moscow State University and Visiting Professor at SPMS, NTU. His research interests include interaction of laser radiation with matter, chemical processing with lasers, nonlinear phenomena, self-organization, laser-ablation, theory of nanocluster formation, photomodification in polymers, laser cleaning, plasmonics, metamaterials, nanoscopy, Nanophotonics and nanoparticles with high refracted index. He is a Honorary Professor at Johannes Kepler University, Austria, a recipient of the IES Prestigious Engineering Achievement Awards (2004), President's Science Award, Singapore (2013). He is a member of the Scientific Counsels of Russian Academy of Sciences, SPIE (2000) and OSA (2010). He has supervised >30 PhD students. He has authored 5 monographs and over 300 original research papers till date.