

## 6. Resonant chemical processes (laser photochemistry)

By

**Prof. Boris Lukiyanchuk**

*Nonlinear and Extreme Nanophotonics Laboratory, Lomonosov Moscow State University,  
School of Physical & Mathematical Sciences, NTU*

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Host: Assoc Prof. Cesare Soci



### **Abstract**

Recent progress in IR laser chemistry is reviewed with stress on the conceptual background and experimental advances. After the discovery of isotope separation by unimolecular reactions induced by infrared lasers, the proof of collisionless infrared multiphoton excitation and dissociation of polyatomic molecules in molecular beams, and the development of a general theoretical framework in the context of unimolecular rate theory, IR-laser chemistry is nowadays a mature branch of chemical reaction dynamics and kinetics. This vibrational photochemistry of polyatomic molecules is a universal phenomenon. It occurs easily upon irradiation of a strong vibrational absorption band with sufficiently intense pulsed laser light, even though in most cases many (10 to 40) infrared photons are needed to reach the energy threshold for the reaction. We discuss various experimental schemes in laser chemistry as related to thermal reactions and ordinary photochemistry and new results in time and frequency resolved kinetic IR spectroscopy at the limit defined by the uncertainty relation. The recent detection of hyperfine effects in IR laser chemistry is reviewed as well as nonlinear intensity dependence over many orders of magnitude including observations of nonlinear intensity fall-off and IR laser ionization of molecules. An outlook is presented on different time scales for intramolecular processes and the resulting future possibilities of IR laser chemical reaction control.

### **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.