ACP/ASP Guest Professor

Prof. Igor Lednev

Prof. Igor K. Lednev, Professor at the Department of Chemistry, State University of New York at Albany, USA, is visiting the Abbe Center and Abbe School of Photonics as a Guest professor in February and March 2017. During his stay he will give six lectures in the area of vibrational spectroscopy.

Igor Lednev received his PhD from Moscow Institute of Physics and Technology in 1983, studying Analytical and Physical Chemistry. He then held a position as a group leader at the Institute of Chemical Physics, Russian Academy of Sciences till 1994. As an academic visitor, Lednev worked in several leading laboratories around the world in countries including the United Kingdom, Japan, Canada and Germany. In 1997, Dr. Lednev came to the US and joined Prof. Sanford Asher's laboratory at the University of Pittsburgh, until moving to the University at Albany in 2002.

Dr. Lednev’s research is focused on the development and application of novel laser spectroscopy for biochemical research, disease diagnostics and forensic purposes. To name a few accomplishments, Lednev’s group discovered a new type of protein folding-aggregation phenomenon, spontaneous refolding of amyloid fibrils. In collaboration with Prof. Larry Nafie and Dr. Rina Dukor, they discovered that amyloid fibrils possess and vary their supramolecular chirality depending on aggregation conditions. Lednev’s laboratory developed a new method for biological stain and gunshot residue forensic analysis and a new method for Alzheimer’s disease diagnostics based on vibrational spectroscopy. Together with Prof. Sanford Asher, Lednev built the first nanosecond time resolved temperature-jump apparatus with ultraviolet Raman spectroscopic detection. He was first to utilize two-color diffuse reflectance flesh photolysis. Dr. Lednev served as an advisory member for the White House Subcommittee on Forensic Science. He serves on the editorial boards of five scientific journals including Journal of Raman Spectroscopy, Wiley, Forensic Chemistry, Elsevier and Biochimica et Biophysica Acta - Proteins and Proteomics, Elsevier. Igor Lednev is a Fellow and a Governing Board member of the Society for Applied Spectroscopy and of several other editorial and conference boards. He received a number of awards and has co-authored over 180 publications in peer-reviewed journals, including a 2009 article in Forensic Science International, a top journal in the field, which is one of the most downloaded and most cited papers from this journal.
Lecture 1: Overview of main research projects in Lednev laboratory: vibrational spectroscopy for fundamental studies of amyloid fibrils and new method developments for forensic purposes and medical diagnostics
Monday, February 20, 2017, 4:30 pm
ACP Auditorium, Albert-Einstein-Str. 6

The Lednev laboratory at the University at Albany, State University of New York is focused on building new instruments and developing new approaches for fundamental biophysics/biochemistry and applied forensics and medical diagnostics. The application of deep UV resonance Raman (DUVRR) spectroscopy, Raman hyperspectroscopy, polarized Raman spectroscopy, vibrational circular dichroism (VCD), surface enhanced Raman spectroscopy (SERS) and tip enhanced Raman spectroscopy (TERS) will be discussed in addition to advanced statistical analysis of spectroscopic data.

Lecture 2: Vibrational spectroscopy for forensic applications: Part 1 – detection and characterization of gunshot residue
Wednesday, February 22, 2017, 4:00 pm
IPHT seminar room, Albert-Einstein-Str. 9

This lecture will review the application of Raman and attenuated total reflection (ATR) FTIR microspectroscopy for the detection and characterization of gunshot residue (GSR). Specifically, the detection of organic and inorganic GSR particles on adhesive tape will be discussed. The differentiation of firearm – ammunition combination based of Raman and ATR FTIR spectroscopy of a single GSR particle will be reviewed.

Lecture 3: Vibrational spectroscopy for forensic applications: Part 2 – Identification and characterization of biological stains
Thursday, February 23, 2017, 2:00 pm
IPHT seminar room, Albert-Einstein-Str. 9

In this lecture, a new forensic approach based on Raman microspectroscopy will be discussed with specific application for biological stains recovered at the scene of crime. In particular, statistical models for the identification of body fluid traces, differentiation of peripheral and menstrual blood as well as animal and human blood, and determining the time since deposition of bloodstains will be shown. Examples of application of attenuated total reflection (ATR) FTIR for forensic purposes will be also discussed.
Lecture 4: Deep UV Raman spectroscopy for structural characterization of proteins and protein aggregates  
Thursday, March 2, 2017, 2:00 pm  
IPHT seminar room, Albert-Einstein-Str. 9

In this lecture, unique capabilities of deep UV resonance Raman (DUVRR) spectroscopy for characterizing protein structure and dynamics will be discussed. This will include the application of (i) temperature-jump, nanosecond, time-resolved DUVRR spectroscopy for real-time protein folding studies, (ii) two-dimensional correlation DUVRR spectroscopy for studying the early stages of amyloid fibrillation and (iii) hydrogen-deuterium exchange combined with DUVRR spectroscopy for studying amyloid fibril polymorphism.

Lecture 5: Complementary vibrational spectroscopic methods for understanding amyloid fibril structure and polymorphism: from polarized Raman to VCD, SERS and TERS  
Monday, March 20, 2017, 2:00 pm  
IPHT seminar room, Albert-Einstein-Str. 9

Despite a significant medical importance, the structure and formation mechanism of amyloid fibrils is not well understood. This is in part because of limitations of solution NMR and X-ray crystallography, when these major tools of structural biology are applied to insoluble and nanocrystalline fibrils. In this lecture, unique capabilities of polarized Raman spectroscopy, vibrational circular dichroism (VCD), surface enhanced Raman spectroscopy (SERS) and tip enhanced Raman spectroscopy (TERS) for structural characterization of amyloid fibrils, fibril polymorphs in particular, will be discussed.

Lecture 6: Raman hyperspectroscopy for medical diagnostics and forensic purposes  
Thursday, March 23, 2017, 2:00 pm  
IPHT seminar room, Albert-Einstein-Str. 9

This lecture will overview the application of Raman hyperspectroscopy and advanced statistics for the development of a new method for Alzheimer’s disease diagnostics based on blood serum. Specifically, the differentiation between Alzheimer’s disease patients at mild and moderate stages of the disease and healthy controls, as well as Alzheimer’s disease and other dementia patients will be demonstrated. The proof-of-concept study of phenotype profiling, the differentiation of race and sex in particular, based on dry traces of body fluids will be discussed.