

## Second International Workshop on Nonequilibrium Processes in Plasma Physics and Studies of Environment

Belgrade and Novi Sad, Serbia, August 23-26, 2008

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Centre for Noneq Proc

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SPIG 2008

### Sponsors

It is our pleasure to announce that **2nd International Workshop on Nonequilibrium Processes in Plasma Physics and Studies of Environment** will be held in Belgrade and Novi Sad, Serbia, August 23-26, 2008.

The workshop originated as a part of the [FP6 COE 026328](#) which had the basic aim of promoting centers of excellence in Western Balkan countries, to facilitate dissemination of their results and to help them establish themselves in the broader arena of European and international science. So the best way to achieve all those goals was to prepare a workshop associated with the local conference [SPIG](#) (Symposium on Physics of Ionized Gases) where the participants could attend sessions in which the host Laboratory presented progress reports and papers and thereby gain a full perspective of our results. At the same time this allowed participants in the COE the opportunity to compare their results with the results of external speakers and to gain new perspectives and knowledge.

The program of the workshop was augmented by inviting some of our colleagues who visited the COE in recent years or have an active collaboration with a participating member. As the program of the COE covers a wide area of topics from application of plasmas in nano- electronics to monitoring and removal of pollutants in the atmosphere, so the program of the workshop covered an even broader range of topics with the common thread of non- equilibrium phenomena playing a major part in the basic physics and also in the technological applications. The universal symbol of non-equilibrium phenomena is Maxwell's demon and it was selected, as designed by Professor Rastko Ćirić (of Belgrade's University for Fine Arts), to be the symbol of the conference.

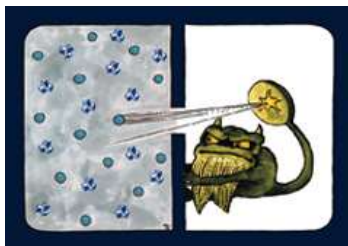
In plasma physics, the field is usually divided between equilibrium and non-equilibrium plasmas. The advantage of studying plasmas in thermal equilibrium is that they may be described by universal laws, such as Saha and Boltzmann equations. The only problem is that, apart from the very early stages in the development of the universe, such plasmas do not exist, although there are plasmas that come very close and at least satisfy the thermal laws locally. Non-equilibrium plasmas have laws unique to each situation and studies of their idiosyncrasies continue to provide a lot of food for thought for scientists, possibilities for applications and job opportunities. Or as Tolstoy wrote, 'Happy families are all alike; every unhappy family is unhappy in its own way?'. So, while making analogy of the non-equilibrium with the lack of happiness may sound discouraging, the scientists who try to observe these phenomena (like psychologists in the case of families) have plenty to study and are, therefore, likely to be happy. At the same time non-equilibrium phenomena in plasmas and in the atmosphere are extremely important. A fact we should be aware of every time we use an integrated circuit manufactured after the late 1970s or whenever weather changes, wind blows and pollution is carried in from some distant locations.

From the Introduction to the [Proceedings of the 1st Workshop](#)

### Organizers

Institute of Physics, Belgrade

Serbian Academy of Sciences and Arts



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The Workshop timetable can be downloaded from [here](#).

The Book of Abstracts is now available for [download](#).

## Topics

- **Elementary processes in plasmas**  
Electron-molecule collisions  
Positron transport and collisions  
Electron and ion swarms
- **Nonequilibrium discharges at low pressures**  
Plasma diagnostics  
Plasma modeling
- **Nonequilibrium discharges at atmospheric pressure**
- **Plasma applications**
- **Collective phenomena in plasmas**
- **Nonequilibrium processes**
- **Transport of pollutants**

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## List of speakers

### Invited lectures

Ane Aanesland (France) - [Plasma propulsion with electronegative gases](#)

Johannes Berndt (France) - to be announced

Zoltan Donko (Hungary) - [Two-dimensional dusty plasma crystals and liquids](#)

Timo Gans (UK) - The dynamics of radio-frequency atmospheric pressure plasma jets

Valery Godyak (USA) - [Formation of Non-equilibrium EEDF in Non-uniform RF Plasmas](#)

Kinga Kutasi (Hungary) - [An overview of post-discharge systems used for plasma sterilization](#)

Toshiaki Makabe (Japan) - [Low Pressure Nonequilibrium Plasma for Topdown Nanoprocesses; its structure and function](#)

Dragana Marić (Serbia) - [Hollow Cathode Discharges: Volt-Ampere Characteristics and Space-Time Resolved Structure of the Discharge](#)

Bratislav Marinković (Serbia) - [Study of Higher Excited States of Some Polyatomic Molecules Relevant for Plasma Physics and Environment](#)

Miran Mozetič (Slovenia) - [Surface functionalization of organic materials by weakly ionized highly dissociated plasma](#)

Nuno Pinhao (Portugal) - [Recent developments on PLASMAKIN – a software package to model the kinetics in gas discharges](#)

Goran Poparić (Serbia) - [Rate coefficients for vibrational and electronic excitation of the CO molecule](#)

Miles Turner (Ireland) - [How is the Bohm criterion satisfied in the presence of several positive ions?](#)

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**Progress reports**

Stephen Buckman (Australia) - [Positron Cooling, Trapping and Transport in Gases](#)

Laurence Campbell (Australia) - [Nonequilibrium calculations of the role of electron impact in the production of NO and its emissions](#)

Mirko Černak (Czech Republic) - to be announced

Uwe Czarnetzki (Germany) - [A Novel and Simple Method for Independent Control of Ion Energy and Flux](#)

Matthew Goeckner (USA) - [Direct injection of liquids into low-pressure plasmas](#)

Jasmina Jovanović (Serbia) - [Cross Sections and Transport Properties of Negative Ions in Rare Gases](#)

Achim vonKeudell (Germany) - [SiO<sub>2</sub> deposition by microplasma jets](#)

James Munro (UK) - [Progress on the construction of software tools designed to help solve the plasma chemistry data problem](#)

Deborah O'Connell (UK) - Mode transitions in radio-frequency plasmas

Antoine Rousseau (France) - [Production of molecule on a pyrex surface under plasma exposure: example of NO](#)

James Sullivan (Australia) - [High resolution, low energy positron scattering from neon](#)

Olivera Šašić (Serbia) - [Cross section Data for Modeling Non-equilibrium Plasmas in N<sub>2</sub>O](#)

Jovo Vranješ (Belgium) - [Effects of friction on modes in collisional multicomponent plasmas](#)

Serbian Academy of Sciences and Arts  
Institute of Physics Belgrade

Proceedings of the  
**2<sup>nd</sup> International Workshop on**  
**Non-equilibrium processes**  
In plasmas and environmental science

Editors: D. Marić and Z. Lj. Petrović

Belgrade, Novi Sad

August 2008

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The workshop was prepared under sponsorship of:

Ministry of Science and Technological Development, Serbia

Serbian Academy of Sciences and Arts

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Institute of Physics Belgrade, project MNTRS 141025

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# Study of Higher Excited States of Some Polyatomic Molecules Relevant for Plasma Physics and Environment

B. P. Marinković

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Since the extensive studies of polyatomic molecular spectra by Herzberg [1] and Robin [2] there have not been attempts for systematic research of higher excited states and elucidation of electronic structure that would lead to comprehensive understanding of the behaviour of bound electrons in molecules. However, a tremendous advancement in both experimental methods and theoretical analysis of particular cases became evident through a number of published papers covering all aspects of complex molecular spectra and their manifolds. On the other hand, the role of electronically excited states of polyatomic molecules had been profoundly investigated when the specific questions had been raised off like the influence of chlorofluorocarbons (CFC) on ozone layer depletion and global warming [3-5], the replacement for plasma etching molecules [6] or radiation damage of DNA deoxyribose analogue molecules [7-10].

Even for triatomic molecules such as H<sub>2</sub>O, H<sub>2</sub>S, CS<sub>2</sub> and N<sub>2</sub>O there are many discussions about the assignment of electronically excited states in terms of valence, Rydberg of mixed character. Electron excitation of the higher states of H<sub>2</sub>S molecule will be presented and the tentative assignment will be discussed. A particular interest in this molecule comes from its participation in a great number of processes. It has been recently found in interstellar molecular clouds; it is known as one of the major pollutants of the Earth's atmosphere which gives the origin of corrosive processes in metals; it is used in the synthesis of a semiconductor, tungsten sulphide (WS<sub>2</sub>); in mixtures with other gases it is used in plasma nitrocarburizing processes. The H<sub>2</sub>S molecule has a very strong dipole moment, and its presence in a gas can have significant effects on the physical properties of the gas, first of all on electrical conductivity.

## *Acknowledgments*

The work has been supported by the Ministry of Science project 141011 of Republic of Serbia.



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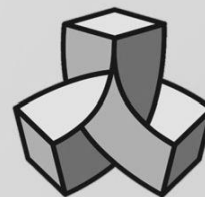
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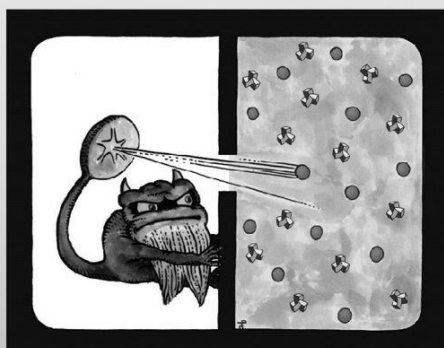
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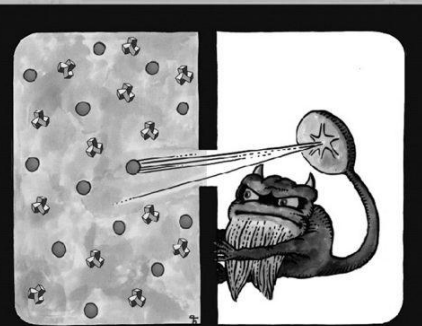
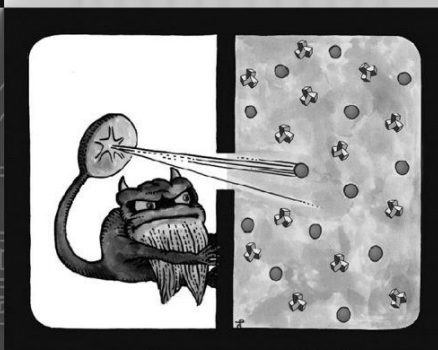


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## Workshop Topics

Electron and ion swarms  
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Nonequilibrium discharges at atmospheric pressure  
Nonequilibrium processes  
Transport of pollutants  
Plasma diagnostics  
Plasma modeling



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