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## 32nd Summer School and International Symposium on the Physics of Ionized Gases

Belgrade, Serbia,
August 26 - 30, 2024

# CONTRIBUTED PAPERS

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ABSTRACTS of INVITED LECTURES,
TOPICAL INVITED LECTURES and PROGRESS REPORTS

**Editors:**
**Bratislav Obradović, Jovan Cvetić,**
**Miroslav Kuzmanović and Nikola Cvetanović**


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University of Belgrade –
Faculty of Physical
Chemistry

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# PREFACE

This special issue of the Publication of Astronomical Observatory in Belgrade (PubAOB) contains the contributed papers and abstracts of Plenary Lectures, Topical Invited Lectures, Progress Reports and Posters that will be presented at the 32nd International Symposium on the Physics of Ionized Gases (SPIG 2024) which will be held from 26st to 30th August 2024, in Belgrade, Serbia.

The SPIG 2024 is organized by the University of Belgrade – Faculty of Physical Chemistry and Serbian Academy of Sciences and Arts, with the support of the Ministry of Science, Technological Development and Innovation of the Republic of Serbia.

The 2nd Workshop on Swarm Physics and Gaseous Dielectrics (SPGD) and the 1st Workshop LIBS4fusion will be attached to the SPIG 2024 conference.

We expect to have regular participants (on site), who will present 11 plenary invited talks, 18 topical invited, 23 progress reports, and 58 posters within the main SPIG 2024 conference. Workshops will entail 11 invited talks within the 2nd SPGD, and 10 invited talks within the LIBS4fusion. Presentations will cover four main disciplines connected to physics of ionized gasses with strong mutual interactions and numerous applications: Atomic Collision Processes, Particle and Laser Beam Interactions with Solids, Low Temperature Plasmas and General Plasma (including Fusion and Astrophysical plasma).

The SPIG reflects the progress in plasma physics and related fields. The conference has a long tradition, starting with the first meeting in Belgrade in 1962, entitled: ”1st Yugoslav Symposium on the Physics of Ionized Gases (SPIG)”. As previous SPIG proceedings, this issue of PubAOB presents new results from theory, experiment and application in the broad area of ionized gasses phenomena.

Editors would like to thank the members of the Scientific and Advisory Committees of SPIG 2024 for their efforts in proposing the invited lectures and reviewing the contributed papers and abstracts. We would also like to thank the authors for their contribution, and to wish all participants a pleasant and productive stay in Belgrade. We are grateful to the Serbian Academy of Sciences and Arts for their long-term commitment to support this event as well as the Serbian Ministry of Science, Technological Development and Innovation for their continuing support.

*Editors:*
Bratislav Obradović, Jovan Cvetić,
Miroslav Kuzmanović and Nikola Cvetanović

Belgrade, August 2024

# Section 1.

# ATOMIC COLLISION PROCESSES

**Publ. Astron. Obs. Belgrade No. 103 (2024), 46** *Poster*
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# INVESTIGATION OF ELASTIC ELECTRON SCATTERING BY ANAESTHETIC MOLECULES IN GASEOUS PHASE

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**Abstract.** Driven by their significant impact on both global warming and ozone depletion, we conducted collaborative theoretical and experimental studies on the elastic electron scattering from anesthetic molecules (halothane, sevoflurane, isoflurane, and desflurane) at intermediate electron energies. Studies have revealed that most administered anesthetics are excreted unchanged from the patient's body into the lower atmosphere, with their release steadily rising over time. As halogenated compounds, anesthetics possess high Global Warming Potentials (GWP), and the majority among them exhibit substantial Ozone Depletion Potentials (ODP). Experimental investigations were conducted employing a crossed-beam setup, consisting of an electron gun, a single capillary gas needle, and a detection system equipped with a channeltron. To establish the absolute scale for the measured relative cross sections, the relative-flow method was employed, with argon gas serving as a reference. Theoretical calculations of the differential cross sections were conducted using the Independent Atom Model along with the Screening Corrected Additivity Rule, incorporating interference effects (IAM-SCAR+I).

This research was supported by the Science Fund of the Republic of Serbia, Grant No. 6821, Project title – ATMOLCOL.

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# ELECTRON SCATTERING CROSS SECTIONS REPRESENTED IN BELGRADE ELECTRON-ATOM/MOLECULE DATABASE (BEAM)

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**Abstract.** Electron scattering cross sections have been maintained within BEAM database with the specific emphasis on the electron interactions with metal vapour atoms. Processes that have been covered are elastic scattering, electronic state excitations and ionization.

BEAM database was promoted in 2015 (Marinković *et al*. 2015) and from the beginning it was a part of Virtual Atomic/Molecular Data Centre (Albert *et al.* 2020). Different set of electron-scattering cross sections, either differential or integral, have been maintained and curated. Currently, 17 atomic species and 18 molecular species are included in BEAM database. The usefulness of database has been demonstrated in analyzing data from Rosetta Mission (Marinković *et al*. 2017) or showing collisional datasets of importance for molecular dynamics (Vujčić *et al*. 2023).

## Acknowledgements

This research was supported by the Science Fund of the Republic of Serbia, grant #6821, project name: “Atoms and (bio)molecules-dynamics and collisional processes on short time scale” (ATMOLCOL).

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# EJECTED ELECTRON SPECTRA OF KRYPTON STUDIED BY HIGH AND LOW ENERGY ELECTRONS

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**Abstract.** The spectra of ejected electrons of krypton have been investigated by using high resolution electron spectroscopy at high and low incident electron energies and at 40°, 90° and 130° scattering angles. The features in the spectra have been identified as singly and doubly excited states, correlation satellites, and double- Auger electrons.
The experiment was performed with the high-resolution electron spectrometer OHRHRA (Jureta et al. 2021). The spectra were obtained in the Constant Analyzer Energy (CAE) mode in which the analyzer pass energy was constant, while the kinetic energy was scanned by varying the retarding ratio of the lens stack. Measurements were performed at high (2019 eV) and low (28-50 eV) electron energies, while the ejected spectra were recorded from 3.5 eV to 25 eV. This is a continuation of our studies on Auger and Coster-Kronig spectra of krypton induced by electron impact (Jureta et al. 2021).

## Acknowledgements

The work has been performed within the scope of bilateral project between Italy and Serbia of particular relevance (Grande Rilevanza) “Nanoscale insights in radiation damage”. This research was supported by the Science Fund of the Republic of Serbia, grant #6821, project name: “Atoms and (bio)molecules-dynamics and collisional processes on short time scale” (ATMOLCOL).

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# INVESTIGATION OF ELASTIC ELECTRON SCATTERING FROM DESFLURANE MOLECULE AT INTERMEDIATE ELECTRON ENERGY

JELENA VUKALOVIĆ[1,2], JELENA B. MALJKOVIĆ[1], FRANCISCO BLANCO[3], GUSTAVO GARCIA[4] and BRATISLAV P. MARINKOVIĆ[1]

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**Abstract.** Our investigation focuses on the elastic electron scattering phenomenon involving the anaesthetic molecule, desflurane, specifically at a medium energy of 250 eV. Utilizing an experimental setup employing a crossed beam technique, comprising an electron gun, a single capillary gas needle, and a detection system equipped with a channeltron, we measured the differential cross sections. To establish the absolute scale for these cross sections, we employed the relative-flow method, using argon gas as a reference. Our calculations are rooted in the Independent Atom Model (IAM), incorporating the screening corrected additivity rule (SCAR) technique, and account for interference effects.

This research was supported by the Science Fund of the Republic of Serbia, Grant No. 6821, Project title – ATMOLCOL.

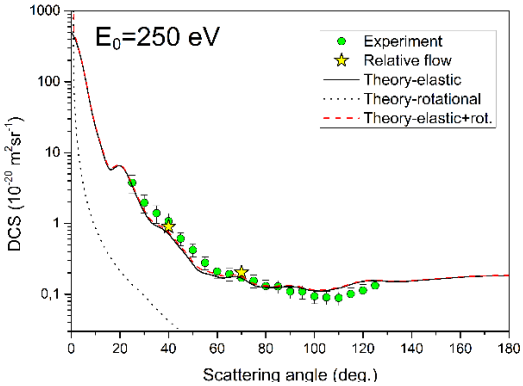


Figure 1: Differential cross section for elastic electron scattering from desflurane at 250 eV.

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