

**V Meeting on Astrophysical Spectroscopy -
A&M DATA - Astronomy & Earth Observations**

September 12 - 15, 2023, Palić, Serbia

**BOOK OF ABSTRACTS AND
CONTRIBUTED PAPERS**

**Edited by Vladimir A. Srećković, Milan S. Dimitrijević,
Aleksandra Kolarski, Zoran R. Mijić and Nikola B. Veselinović**

A&M DATA



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INSTITUTE OF PHYSICS | BELGRADE
NATIONAL INSTITUTE OF
THE REPUBLIC OF SERBIA

Belgrade 2023

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SCIENTIFIC RATIONALE

Efficiency of theoretical analysis, synthesis and modeling of various environments, depends on atomic data and their sources. In particular, for the modeling of stellar atmospheres and opacity calculations a large number of atomic data is needed, since we do not know a priori the chemical composition of a stellar atmosphere. The same holds for Earth observations. Consequently, the development of databases with atomic data as well as astro-geoinformatics is important. This meeting will bring together physicists, astro & geophysicists from Serbia and elsewhere to review the present stage of research in this field. The meeting is planned as an opportunity to consider the above-mentioned aspects of spectroscopic research on plenary sessions and then to work on the special mini-projects, which will result in common papers to be published in international scientific journals.

Venue

Palić, (Hotel Prezident – Palić), Serbia

CONTENTS

Invited Lectures

- Magdalena D. Christova, Milan S. Dimitrijević and Sylvie Sahal-Bréchet:
On the Stark Broadening Parameters of N VI Spectral Lines 13
- Nicolina Pop, E. Djuissi, J. Bofelli, J. Zs Mezei, F. Iacob and
I. F. Schneider:
*Dissociative Recombination and Ro-Vibrational Excitation of Molecular
Cations by Electrons: New Datasets (Cross Sections and Rate
Coefficients) - Impact in Astrophysics* 15
- Ilija B. Simonović, Danko V. Bošnjaković and Saša Dujko:
*Simulations of Positive and Negative Streamers in the AMReX
Environment* 17
- Vesna Borka Jovanović, Duško Borka and Predrag Jovanović:
Study of Radio Spectral Index of Radio Galaxy DA 240 19
- Duško Borka, Vesna Borka Jovanović, Salvatore Capozziello and
Predrag Jovanović:
*Constraining Theories of Gravity by Velocity Distribution of Elliptical
Galaxies* 21
- Milan S. Dimitrijević and Magdalena D. Christova:
*On the Stark Broadening Parameters of Al IV Spectral Lines for Stellar
Spectra Analysis and Synthesis* 23
- Jelena B. Maljković, Jelena Vukalović, F. Blanco, G. García and
Bratislav P. Marinković:
*Experimental and Theoretical Differential Cross Sections for Elastic
Electron Scattering from Isoflurane Molecule at 100eV* 25
- Jelena Marjanović, Dragana Marić and Zoran Lj. Petrović:
The Role of Breakdown Data in Atmospheric Studies 29
- Dimitrije M. Maletić, Nikola B. Veselinović, Mihailo R. Savić,
Aleksandar L. Dragić, Radomir M. Banjanac, Dejan R. Joković,
David Knezević, Miloš Travar and Vladimir I. Udovičić:
*Study on 2021 November 4 Forbush Decrease with Belgrade Muon
Station* 31
- Darije Maričić, Filip Šterc, Anatoly Belov, Dragan Roša, Damir Hržina
and Ivan Romštajn:
*Galactic Cosmic Ray Variation Caused by Different Structural Elements
of Isolated Earth-Impacting Coronal Mass Ejection* 32

Aleksandra Kolarski: <i>Lower Ionosphere Influenced by High-Class Solar Flare Events as Observed Through VLF Measurements</i>	33
<i>Progress Reports</i>	
Nikola Cvetanović, Saša S. Ivković and Bratislav M. Obradović: <i>Spectroscopic Method for Nitrogen Impurity Estimation in Helium Atmospheric Discharge</i>	47
Nenad M. Sakan, Zoran Simić, Momchil Dechev and Vladimir A. Srećković: <i>The Close Vicinity Ions as Modifiers of the Mean Form of Cut-Off Potential: Simple Approach</i>	49
Filip Arnaut and Aleksandra Kolarski: <i>Alternative Evaluation Metrics for Machine Learning Model Selection in Ionospheric VLF Amplitude Data Exclusion</i>	50
Maja Kuzmanoski, Zorica Podrašćanin, Ana Ćirišan and Zoran R. Mijić: <i>Aerosol Vertical Profiles in Belgrade, Serbia, Associated with Different Surface PM10 Concentrations</i>	52
Nikola B. Veselinović, Aleksandra Kolarski, Vladimir A. Srećković, Zoran R. Mijić, Mihailo R. Savić and Aleksandar L. Dragić: <i>Multi-Instrumental Investigation of Extreme Space Weather Events in September 2017: Data and Modeling</i>	53
Bratislav P. Marinković and Zoran R. Mijić: <i>COST Programme Role Within the Serbian Multilateral Collaboration in Science and Innovation Framework</i>	55
Zoran R. Mijić and Bratislav P. Marinković: <i>Interdisciplinary Research in the European Cooperation in Science and Technology – Advantage or Disadvantage?</i>	56
<i>Posters</i>	
Jovica Jovović and Gordana Lj. Majstorović: <i>The Broadening of Carbon Spectral Lines Emitted from a Pulsed Atmospheric Pressure Gas Discharge Source with Graphite Cathode</i>	61
Željka D. Nikitović and Zoran M. Raspopović: <i>Transport Properties of H_2^+ Ions in H_2 Gas</i>	63
Jelena Barović, Vladimir A. Srećković and Aleksandra Kolarski: <i>Examination of the Ionospheric Response to Intense Solar Activity from September 6 to 10, 2017</i>	64

Vladimir A. Srećković, Ljubinko M. Ignjatović, Sanja Tošić and Veljko Vujčić: <i>Collisional and Radiative Processes Involving Some Small Molecules: Cross Sections and Rate Coefficients</i>	66
Veljko Vujčić, Darko Jevremović and Vladimir A. Srećković: <i>ACol – Database for Collisional Processes</i>	67
Nikola V. Ivanović, Nikodin V. Nedić, Ivan R. Videnović, Djordje Spasojević and Nikola Konjević: <i>Stark Polarization Spectroscopy in the Cathode Sheath of a Grimm-Type Glow Discharge in Neon</i>	68
Vladimir A. Srećković, Ljubinko M. Ignjatović, Milan S. Dimitrijević and Nikolai Bezuglov: <i>Collisional Processes Involving Rydberg Atoms: Rate Coefficients</i>	71
Vladimir A. Srećković and Aleksandra Kolarski: <i>Impact of Strong Solar Flares on the Lower Ionosphere: Radio Waves, Satellite Observations and Modeling</i>	72
Zoran R. Mijić, Maja Kuzmanoski and Luka Ilić: <i>Data Quality Assurance and Characterization of Belgrade Raman Lidar Station</i>	73
Filip Arnaut and Aleksandra Kolarski: <i>Multilayer Perception Hyperparameter Fine-Tuning for Ionospheric VLF Amplitude Data Exclusion</i>	74
Mihailo R. Savić, Nikola B. Veselinović, Aleksandar L. Dragić, Dimitrije M. Maletić, Radomir M. Banjanac, Dejan R. Joković, David Knežević, Miloš Travar and Vladimir I. Udovičić: <i>Classification of Forbush Decrease Events Utilizing Machine Learning</i>	80
Shahrokh Pourbeyranvand: <i>Observation of Earth's Magnetic Field in Search for Earthquake Precursors</i>	81
Aleksandra Kolarski, Vladimir A. Srećković and Zoran R. Mijić: <i>VLF Propagation Parameters Modeling Related to Low Intensity Solar X-Ray Flares</i>	83
Zlatko Majlinger and Ivan Traparić: <i>New Perspectives in the Analysis of Stark Width Regularities and Systematic Trends</i>	84
SECTIONS (MINI PROJECTS)	85
PROGRAMME	87
AUTHORS' INDEX	91

Invited Lectures

Experimental and theoretical differential cross sections for elastic electron scattering from isoflurane molecule at 100eV

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Abstract

We present joint theoretical and experimental absolute differential cross section for elastic electron scattering from isoflurane molecule, for incident electron energy of 100 eV. Motivation for this research has been found in influence on global warming and ozone destruction.

Introduction

Isoflurane(2-chloro-2-(difluoromethoxy)-1,1,1-trifluoroethane, $\text{CF}_3\text{CHCl-O-CHF}_2$) It is a non-flammable halogenated ether, with a molecular weight of 184.49 g/mol, a boiling point of 48.5°C, a vapor pressure of 330 mmHg (Pub Chem), and an estimated dipole moment of 2.47D (Atomistic Models of General Anesthetics for Use in in Silico Biological Studies). Mostly because of its clinical usage, isoflurane is widely investigated, but lately, its impact on the environment has motivated further research. Namely, it is known that most of the inhaled anaesthetics are eliminated from the patient's body without being metabolized, so they are released into the lower atmosphere (Shiraishi et al. 1990). Atmospheric lifetime of isofurane is calculated to be between 2 and 5.9 years (Langbein et al. 1999), long enough to reach the stratosphere in considerable quantities. Isoflurane is known to have a high global warming potential (GWP) and it is calculated to be 545 according to (Langbein et al. 1999) and there, isoflurane can damage the ozone layer. All the above-mentioned give enough motive for research of electron interaction with this molecule.

Absolute differential cross sections of elastic electron scattering from isoflurane molecule, for incident electron energy 100 eV are reported. The experiment is performed in crossed beam setting. Relative differential cross section (DCS) is normalized on the absolute scale using the relative flow method, with Ar as a reference gas. The theory is obtained with IAM+SCAR method (Independent Atom Model + Screening Corrected Additivity Rule). A schematic drawing of halothane is shown in Fig. 1.

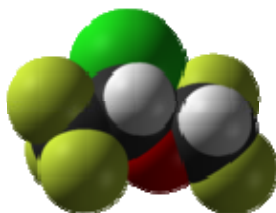


Fig. 1. Schematic drawing of isoflurane.

Experimental set up

Crossed electron-molecular beam apparatus UGRA which has been described in detail previously by Milosavljevic et al. (2006), was used for measuring absolute differential cross sections for elastic electron scattering on a halothane. The experimental set-up consists of an electron gun (hairpin electron source, up to about 1 μ A incident beam current in the energy range from 40-300 eV, a double cylindrical mirror energy analyzer (DCMA) and a channel electron multiplier as a detector. All of these components are enclosed in a double μ -metal shielded vacuum chamber. The incident electron beam is crossed perpendicularly by a molecular beam produced by stainless still needle. The electron gun can be rotated around the needle in the in a limited angular range, from -40° to 125° . The base pressure of about 4×10^{-7} mbar was obtained by a turbo-molecular pump. The working pressure was usually less than 5×10^{-6} mbar and was checked for each experimental point. The energy resolution is limited by a thermal spread of primary electrons to about 0.5 eV. Isoflurane was introduced into scattering region from a glass container via a gas line system which was heated (sample container, pipes, needle) to provide stable experimental conditions and to improve the signal. Temperature of the pipes, needle and container were kept at about 40° - 50° C. Absolute values for differential cross sections (DCSs) were obtained for 100eV incident electron energy, using relative flow technique (Nickel et al. 1989), at several scattering angles (40 and 70, 80 or 90 degrees.). In the relative flow method, the DCS for scattering of the unknown gas is determined by comparing scattering signals from a standard target (Ar), with its known differential cross

sections (Ranković et al 2018), at a given incident electron energy (E_0) and a scattering angle (θ) under identical experimental conditions. To obtain the same profiles for both gas beams, the gases must be operated at pressures behind the needle so that their mean-free paths are the same.

Gas kinetic diameter for argon ($D_{\text{ref}}=D_{\text{Ar}}$) is known to be 3.58 Å and the estimated value for isoflurane ($D_x=D_{\text{IF}}$) is 5.57 Å. For the present experiment, the ratio of driving pressures (according to their gas-kinetic diameters) is $p_{\text{Hal}}:p_{\text{Ar}}=2.4:1$. During the measurement it has been proved by varying the ratio of the halothane and Ar pressures ($\pm 20\%$) that absolute values of the cross sections do not depend significantly.

Analysis and results

Experimentally measured (green circles, for scattering angles from 20° to 110°) and theoretically calculated (black full line, 0° - 180°) DCSs, for incident electron energy 150 eV, are shown graphically in Fig. 2. DCS has characteristic behavior for molecular targets, as noticed before (Vukalović et al. 2021). It exhibits a wide minimum at about 90° . Experiment and theory are, in general, in very good agreement, considering absolute scale and shape. Concerning the normalization procedure, described in detail elsewhere (Vukalović et al. 2021), relative flow measurements are shown in Fig. 2. as yellow stars. The reference gas used was Ar, and its absolute DCS values were taken from a paper by Ranković et al.

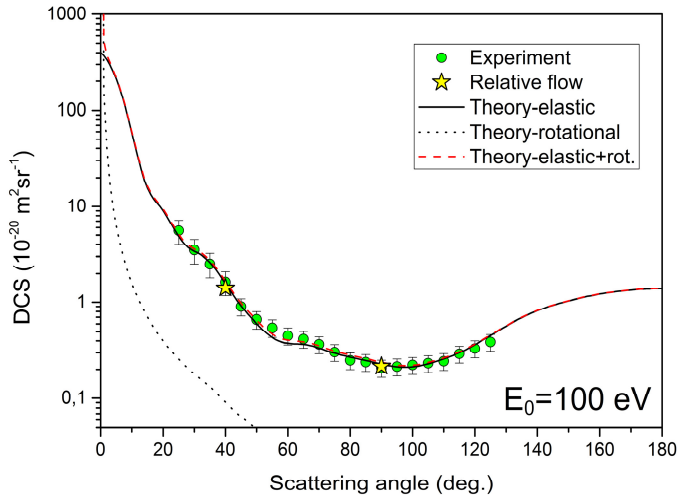


Fig. 2. Angularly dependent differential cross section for elastic electron scattering from isoflurane molecule, for incident electron energy 100 eV.

Acknowledgments

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Progress Reports

COST programme role within the Serbian multilateral collaboration in science and innovation framework

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COST – Cooperation in Science and Technology is a networking programme fully financed by the European Horizon frameworks (H2020 and HE) with the aim to foster collaboration of researchers and innovators within European countries and to contribute to the creation of European Research Area (ERA). Its main priorities are to promote and spread excellence, to foster interdisciplinary research through breakthrough science and to empower and retain young researchers and innovators. Although COST programme does not finance the research itself (it is lean on the national funding schemas of all 41 participating countries) it enables wide collaboration and networking through general or working group meetings, short term scientific missions, training schools and management meetings.

In 2022 Serbian researchers performed an individual participation in more than 750 COST Action activities. COST Actions generally last for four years, up to now, Serbian researchers chaired and co-chaired 23 Actions and participated in total of 928 Actions (<https://www.cost.eu/about/members/serbia/>). The broader statistics of Serbian participation in COST Actions can be found in Marinković et al. (2022).

Acknowledgements

Thanks are due to The Ministry of Science, Technological Development and Innovation of the Republic of Serbia and the Institute of Physics Belgrade for national COST office support.

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Marinković, Bratislav P., Ivanović, Stefan and Mijić, Zoran, “Data analysis on Serbian participation in COST Actions: Celebrating 50 years of research networks”, IV Meeting on Astrophysical Spectroscopy - A&M DATA - Atmosphere, May 30 to June 2, 2022, Fruška Gora, Serbia, Book of Abstracts and Contributed Papers, Eds: V. A. Srećković, M. S. Dimitrijević, N. Veselinović and N. Cvetanović, (Institute of Physics Belgrade, Belgrade, 2022), Progress report, pp.49-57. ISBN: 978-86-82441-57-1

Interdisciplinary research in the European Cooperation in Science and Technology – advantage or disadvantage?

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Collaboration is at the heart of modern science while interdisciplinary research plays a very important role in addressing some of the most important and complex problems. The European Cooperation in Science and Technology – COST is the oldest intergovernmental funding organization in Europe with the aim to establish the research networks among scientists and innovators. Two years ago, COST celebrated 50 years of the existence and successful networking activities. During that period COST has become one of the best mechanisms to promote science cooperation in the world. For establishing a collaboration proximity is particularly important, but once a collaboration is in place scientists manage to continue a collaboration despite a large distance. COST Actions support a variety of networking tools enabling spatial and social proximity thus increasing the level of scientific production.

In this paper review of available data on the effects of participating in a COST Action on the level of scientific production i.e., scientific co-publications between active members of an Action is given (Seeber et al., 2022a). In addition, the interdisciplinary nature of co-publications and involvement of researchers from inclusive target countries as well as young researcher is discussed. Since researcher from Serbia are involved in almost 96% of active Actions (Mijić and Marinković, 2022) it is particularly important to assess whether these effects persist after the life time of the Action.

Regarding the multidisciplinary of the new Actions approved in 2023, 54% of them cover at least two fields of science and technology, while 11% cover at least three fields. Natural sciences are represented in 49% of the Actions leading the way as the most represented field of science. Therefore, additional discussion will be given for better understanding whether Actions proposals' degree of interdisciplinarity and the relative proportion of different scientific fields, may be disadvantage or not in the project evaluation procedure in the COST research framework (Seeber et al., 2022b).

Acknowledgements

Thanks are due to The Ministry of Science, Technological Development and Innovation of the Republic of Serbia and the Institute of Physics Belgrade for national COST office support.

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A&M DATA

The fifth Meeting on Astrophysical Spectroscopy - A&M DATA - Astronomy & Earth Observations

Palić, Serbia, September 12 – 15, 2023

PROGRAMME

FIRST DAY. SEPTEMBER 12, 2023 (Tuesday)	
16:00-18:00	Arrival and Registration
18:00-18:15	Opening ceremony (Vladimir Srećković, Milan Dimitrijević)
18:15-18:30	Milan S. Dimitrijević, A brief history of the A&M DATA meetings
18:30-19:00	Magdalena D. Christova, Milan S. Dimitrijević, Sylvie Sahal-Bréchet, On the Stark broadening parameters of N VI spectral lines (Invited lecture)
19:00-20:00	Welcome Cocktail
SECOND DAY. SEPTEMBER 13, 2023 (Wednesday)	
Chairman - Vladimir Srećković	
10:00-10:30	Nicolina Pop, E. Djuissi, J. Bofelli, J. Zs Mezei, F. Iacob, I. F. Schneider, Dissociative Recombination and ro-vibrational excitation of molecular cations by electrons: new datasets (cross sections and rate coefficients) -impact in astrophysics (Invited lecture)
10:30-11:00	Ilija B. Simonović, Danko V. Bošnjaković, Saša Dujko, Simulations of positive and negative streamers in the AMReX environment (Invited lecture)
11:00-11:15	Nikola Cvetanović, Saša S Ivković, Bratislav M. Obradović, Spectroscopic method for nitrogen impurity estimation in helium atmospheric discharge
11:15-11:30	Coffee Break
Chairman - Nicolina Pop	
11:30-12:00	Vesna Borka Jovanović, Duško Borka, Predrag Jovanović, Study of radio spectral index of radio galaxy DA 240 (Invited lecture)
12:00-12:30	Duško Borka, Vesna Borka Jovanović, Salvatore Capozziello, Predrag Jovanović, Constraining theories of gravity by velocity distribution of elliptical galaxies (Invited lecture)
12:30-12:45	Milan S. Dimitrijević, Magdalena D. Christova, On the Stark broadening parameters of Al IV spectral lines for stellar spectra analysis and synthesis (Invited lecture)
12:45-13:00	Nenad M. Sakan, Z Simić, M Dechev, Vladimir A. Srećković, The close vicinity ions as modifiers of the mean form of cut-off potential, simple approach
13:00-15:00	Lunch Break

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15:00-16:00	Poster session 1 (Chairman - Nikola Cvetanović and Aleksandra Kolarski)
	Jovica Jovović, Gordana Lj. Majstorović , The broadening of carbon spectral lines emitted from a pulsed atmospheric pressure gas discharge source with graphite cathode
	Željka D. Nikitović, Zoran M. Raspopović , Transport properties of H_2^+ ions in H_2 gas
	Jelena Barović, Vladimir A. Srećković, Aleksandra Kolarski , Examination of the ionospheric response to intense solar activity from September 6 to 10, 2017
	Vladimir A. Srećković, Ljubinko M. Ignjatović, Sanja Tošić, Veljko Vujčić , Collisional and radiative processes involving some small molecules: cross sections and rate coefficients
	Veljko Vujčić, Darko Jevremović, Vladimir A. Srećković , ACol – Database for collisional processes
	Nikola V. Ivanović, Nikodin V. Nedić, Ivan R. Videnović, Djordje Spasojević, Nikola Konjević , Stark polarization spectroscopy in the cathode sheath of a Grimm-type glow discharge in neon
Vladimir A. Srećković, Ljubinko M. Ignjatović, Milan Dimitrijević, Nikolai Bezuglov , Collisional processes involving Rydberg atoms: Rate coefficients	
16:00 – 18:00	Work in Sections (Mini-Projects) 1-6
20:00	Conference Dinner
THIRD DAY. SEPTEMBER 14, 2023 (Thursday)	
Chairman – Magdalena Christova	
10:00-10:30	Jelena B. Maljković, Jelena Vukalović, F. Blanco, G. García, Bratislav P. Marinković , Experimental and theoretical differential cross sections for elastic electron scattering from isoﬂurane molecule at 100eV (Invited lecture)
10:30-11:00	Jelena Marjanović, Dragana Marić, Zoran Lj. Petrović , The role of breakdown data in atmospheric studies (Invited lecture)
11:00-11:15	Filip Arnaut, Aleksandra Kolarski , Alternative Evaluation Metrics for Machine Learning Model Selection in Ionospheric VLF Amplitude Data Exclusion
11:15-11:30	Coffee Break
Chairman – Milan Dimitrijević	
Special Session: <i>Astronomy and Earth Observations: multi-instrumental approach and theory</i>	
11:30-12:00	Maletić M. Dimitrije, Veselinović B. Nikola, Savić R. Mihailo, Dragić L. Aleksandar, Banjanac M. Radomir, Joković R. Dejan, Knezević David, Travar Miloš, Udovičić I. Vladimir , Study on 2021 November 4 Forbush decrease with Belgrade muon station (Invited lecture)
12:00-12:30	Darije Maričić, Filip Šterc, Anatoly Belov, Dragan Roša, Damir Hržina, Ivan Romštajn , Galactic Cosmic Ray Variation Caused by Different Structural Elements of Isolated Earth-Impacting Coronal Mass Ejection (Invited lecture)
12:30-13:00	Aleksandra Kolarski , Lower ionosphere influenced by high-class Solar flare events as observed through VLF measurements (Invited lecture)
13:00-13:15	Maja Kuzmanoski, Zorica Podrašćanin, Ana Ćirišan, Zoran Mijić , Aerosol vertical profiles in Belgrade, Serbia, associated with different surface PM10 concentrations
13:30-18:00	Excursion

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	Poster session 2 (Chairman - Nikola Veselinović and Zoran Mijić)
	Vladimir A. Srećković, Aleksandra Kolarski , Impact of strong solar flares on the lower ionosphere: radio waves, satellite observations and modeling
	Zoran R. Mijić, Maja Kuzmanoski, Luka Ilić , Data quality assurance and characterization of Belgrade Raman lidar station
	Filip Arnaut, Aleksandra Kolarski , Multilayer Perception Hyperparameter Fine-Tuning for Ionospheric VLF Amplitude Data Exclusion
18:00-19:00	Mihailo R. Savić, Nikola B. Veselinović, Aleksandar L. Dragić, Dimitrije M. Maletić, Radomir M. Banjanac, Dejan R. Joković, David Knežević, Miloš Travar, Vladimir I. Udovičić , Classification of Forbush decrease events utilizing machine learning
	Shahrokh Pourbeyranvand , Observation of Earth's magnetic field in search for earthquake precursors
	Aleksandra Kolarski, Vladimir Srećković, Zoran Mijić , VLF propagation parameters modeling related to low intensity solar X-ray flares
	Zlatko Majlinger, Ivan Traparić , New perspectives in the analysis of Stark width regularities and systematic trends
FOURTH DAY. SEPTEMBER 15, 2023 (Friday)	
Chairman – Felix Iacob	
10:00-10:15	Nikola Veselinović, Aleksandra Kolarski, Vladimir A. Srećković, Zoran R. Mijić, Mihailo Savić, Aleksandar Dragić , Multi-instrumental investigation of extreme space weather events in September 2017: Data and modeling
10:15-10:30	Bratislav P. Marinković, Zoran Mijić , COST programme role within the Serbian multilateral collaboration in science and innovation framework
10:30-10:45	Zoran R. Mijić, Bratislav P. Marinković , Interdisciplinary research in the European Cooperation in Science and Technology – advantage or disadvantage?
10:45-11:15	Scientific Committee Meeting
11:15	Closing Ceremony and Best poster Award

Sections (Mini-projects)

- M1 Modeling the Atmosphere: data&models,
- M2 Big data in Astronomy and Earth Observations,
- M3 A&M DATA and HPC,
- M4 A&M DATA and standards,
- M5 Radiative & Collisional Processes: databases,
- M6 Spectra: stellar and laboratory plasmas.

AUTHORS' INDEX

- Arnaut Filip 50, 74
Banjanac Radomir M. 31, 80
Barović Jelena 64
Belov Anatoly 32
Bezuglov Nikolai 71
Blanco F. 25
Bofelli J. 15
Borka Duško 19, 21
Borka Jovanović Vesna 19, 21
Bošnjaković Danko V. 17
Capozziello Salvatore 21
Christova Magdalena D. 13, 23
Ćirišan Ana 52
Cvetanović Nikola 47
Dechev Momchil 49
Dimitrijević Milan S. 13, 23, 71
Djuissi E. 15
Dragić Aleksandar L. 31, 53, 80
Dujko Saša 17
García G. 25
Hržina Damir 32
Iacob F. 15
Ignjatović Ljubinko M. 66, 71
Ilić Luka 73
Ivanović Nikola V. 68
Ivković Saša S. 47
Jevremović Darko 67
Joković Dejan R. 31, 80
Jovanović Predrag 19, 21
Jovović Jovica 61
Knezević David 31, 80
Kolarski Aleksandra 33, 50, 53, 64,
72, 74, 83
Konjević Nikola 68
Kuzmanoski Maja 52, 73
Majlinger Zlatko 84
Majstorović Gordana Lj. 61
Maletić Dimitrije M. 31, 80
Maljković Jelena B. 25
Marić Dragana 29
Maričić Darije 32
Marinković Bratislav P. 25, 55, 56
Marjanović Jelena 29
Mezei J. Zs 15
Mijić Zoran R. 52, 53, 55, 56, 73, 83
Nedić Nikodin V. 68
Nikitović Željka D. 63
Obradović Bratislav M. 47
Petrović Zoran Lj. 29
Podražčanin Zorica 52
Pop Nicolina 15
Pourbeyranv Shahrokh 81
Raspopović Zoran M. 63
Romštajn Ivan 32
Roša Dragan 32
Sahal-Bréchet Sylvie 13
Sakan Nenad M. 49
Savić Mihailo R. 31, 53, 80
Schneider I. F. 15
Simić Zoran 49
Simonović Ilija B. 17
Spasojević Djordje 68
Srećković Vladimir A. 49, 53, 64, 66,
67, 71, 72, 83
Šterc Filip 32
Tošić Sanja 66
Traparić Ivan 84
Travar Miloš 31, 80
Udovičić Vladimir I. 31, 80
Veselinović Nikola B. 31, 53, 80
Videnović Ivan R. 68
Vujčić Veljko 66, 67
Vukalović Jelena 25

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