NEWSLETTER

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BIOSPHERE Training course and stakeholder workshop

It is our great pleasure to invite you to a Training Course and Stakeholder Workshop "*New methodologies and developments to investigate the influence of extraterrestrial radiation in the biosphere*" to be held at CMI in Prague and Milešovka, Czech Republic, on 1st and 2nd October 2024.

Prague skyline view (Source: Wikimedia Commons).

Meteorological observatory Milešovka (Source: Institute of Atmospheric Physics CAS).

Training course aims to bring nearer the new developments and methodologies in the BIOSPHERE whereas the stakeholder workshop aims to communicate the project results

For registration, please contact:
Iva Ambrožová (UJF CAS),
e-mail: ambrozova@ujf.cas.cz

For more information, please visit our home page https://euramet-biosphere.eu/.

Good Practice Guide for the analysis and simulation of space particle fluxes

A preliminary version of Good Practice Guide (GPG) for the analysis and simulations of space particle fluxes during minimum solar activity, maximum solar activity and the recent Solar Energetic

Particle Events has been published on the website. The GPG is intended to help interested scientists to use space data fluxes and simulation tools properly and to perform valid AtRIS simulations. The guide aims to benefit scientists working with satellite data fluxes or Geant4 simulations, students, users of simulations and interested parties working in the field targeted in the GPG.

Please visit our project website (https://euramet-biosphere.eu/index.php/publis) to see the guide's initial draft and provide feedback on it. For details, please contact: Viviane Pierrard (BIRA-IASB), e-mail: viviane.pierrard@aeronomie.be.

Registry and database for radiobiological experiments

A registry with detailed list of biological samples, major protocols and reagents used in radiobiological experiments (Effects of combined SCR and UV radiation fields on biological systems) has been uploaded in the project website.
A database which includes experiments with five different types of radiation, X-rays, γ-rays, protons, carbon ions and α-particles has been linked in our project website. More specifically, it contains 2,734 experiments performed on human cells, and it combines the physical and biophysical properties of radiation while expressing the induced biological damage.

Please visit our project website (https://euramet-biosphere.eu/index.php/publis) to see the initial drafts and provide feedback on it. For details, please contact: Alexandros Georgakilas (NTUA), e-mail: alexg@mail.ntua.gr

Videos introducing BIOSPHERE to the general public

The project consortium with the help of BIRA-IASB Public Relation team has produced six videos to bring the core of our research closer to the general public. Here, we explain in simple terms the significance and impact of extraterrestrial radiation on the Earth's biosphere. These videos may be useful to health and environmental regulatory bodies, governmental and intergovernmental panels on climate and environmental change, and experts working in the fields of environment, climate, medicine, biology, and radiation protection

The videos are published on YouTube:

WP1 *Detectors*: https://www.youtube.com/watch?v=KpCipn-36mQ,

WP2 *Measurement campaigns*: https://www.youtube.com/watch?v=-9uHemppKtk,

WP3 *Atomic and molecular processes*: https://www.youtube.com/watch?v=5NAr_YGIpQw,

WP4 *Biological effects*:

https://www.youtube.com/watch?v=baSR-NoCRdw,

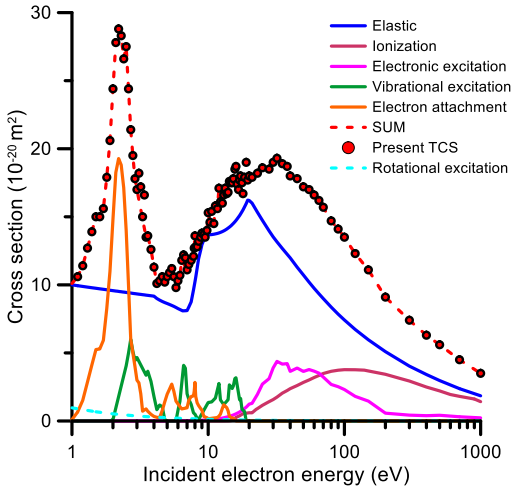
WP5 *Summary for wide public*: https://www.youtube.com/watch?v=Ixui9CviKlk, and

WP6 *Global project*: https://www.youtube.com/watch?v=WH6reSXWiik.

New results within the WP3 activities related to electron and anion scattering from atmospheric molecules

Integral electron scattering cross sections from N_2O for impact energies ranging from 1 eV to 1000 eV

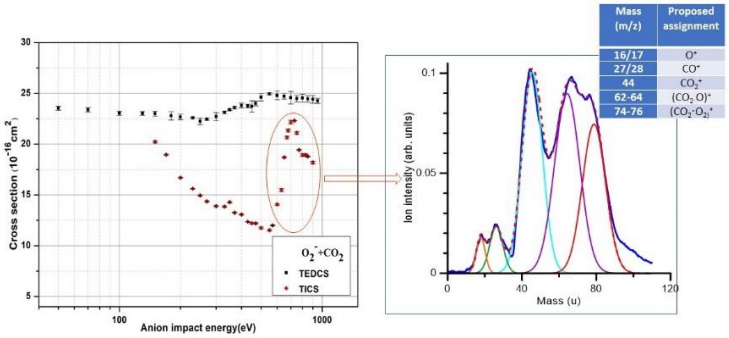
A dedicated magnetically confined electron transmission apparatus has been employed to determine the total electron scattering from N_2O for electron impact energies ranging from 1 eV to 1000 eV. In addition differential and integral elastic as well as electronic excitation and ionization cross sections have been calculated by using our well established screening corrected independent atom model with interference effects (IAM-SCAR+I). From the observed resonances on the total cross section (TCS) energy dependence, with the help of the integral elastic cross sections, absolute values of the electron attachment cross section have been derived. Using the experimental TCS as reference values, the remaining cross section data have been assigned to vibrational excitation processes. Following this procedure, a complete set of electron scattering cross section data, ready to be used for modelling electron transport in gases, have been obtained. This cross section data set is depicted in the figure below.



For more information, see the paper by A. I. Lozano, J. Rosado, F. Blanco, P. Limão-Vieira, and G. García, J. Phys. Chem. A 128¸ 699 (2024).

Superoxide anion (O_2^-) collisions with CO_2 molecules

Total electron detachment, ionization and induced cationic cross sections have been determined from the study of superoxide anion collisions with CO_2. The anion beam is generated in a pulsed hollow cathode discharge and then focused and accelerated onto a gas cell containing the CO_2 molecules at room temperature. The above cross sections have been derived from the analysis of the anion transmitted beam together with the induced cation products. The latter have been mass/charge analyzed with the help of a time-of-flight spectrometer. Results on these cross sections are shown in the figure below:



This figure shows a constant dependence of the total electron detachment cross section with incident anion energy (left). However the total ionization cross section presents a pronounced local maximum around 600 eV. Analyzing the mass of the produced cations at these impact energies (500-800 eV) we found intense signals corresponding to products with molecular masses higher than that of the CO_2 (40u). We have tentatively proposed the formation of CO_3^+ and CO_4^+. This result opens the possibility of a new high energy anion chemistry. Since this behavior has not been observed yet in any natural process it is still under theoretical investigation.

For more information, please contact Gustavo Garcia Gomez-Tejedor (CSIC), e-mail: g.garcia@csic.es.

Dicentric induction in human lymphocytes

Human peripheral blood lymphocytes were exposed to either 0.5 Gy protons (10 MeV, 4.7 keV/µm), 400 or 100 J/m^2 UVB rays. Additionally, cells combined exposures by successive irradiation with 0.5 Gy protons, directly followed by 400 or 100 J/m^2 UVB were performed.

The metaphase yield, and therefore the ability to divide upon mitogenic stimulation, decreased after combined proton and UVB exposure as well as after UVB exposure alone compared to irradiation only with protons. Furthermore, a significant dicentric (dic) induction was found in lymphocytes exposed to protons as well as to protons plus 400 J/m^2 UVB. The dic yield in cells exposed to the combined exposure was about two-fold increased compared to the dic yield after proton exposure alone. In contrast the dic yield in lymphocytes exposed to UVB alone is not significantly different from the laboratories` dic yield observed in unexposed lymphocytes (laboratories` reference data), which shows that it is not an additive effect. The findings suggest that UVB irradiation can convert proton-induced DNA damage into DNA damage that has a potential to induce more dic than after proton exposure alone. Thus, 0.5 Gy proton exposure combined with 400 J/m^2 UVB is more destructive than exposure only to 0.5 Gy protons. Samples exposed to 0.5 Gy protons and 100 J/m^2 UVB as well as samples exposed first to 100 or 400 J/m^2 UVB and thereafter to 0.5 Gy protons are still under evaluation.

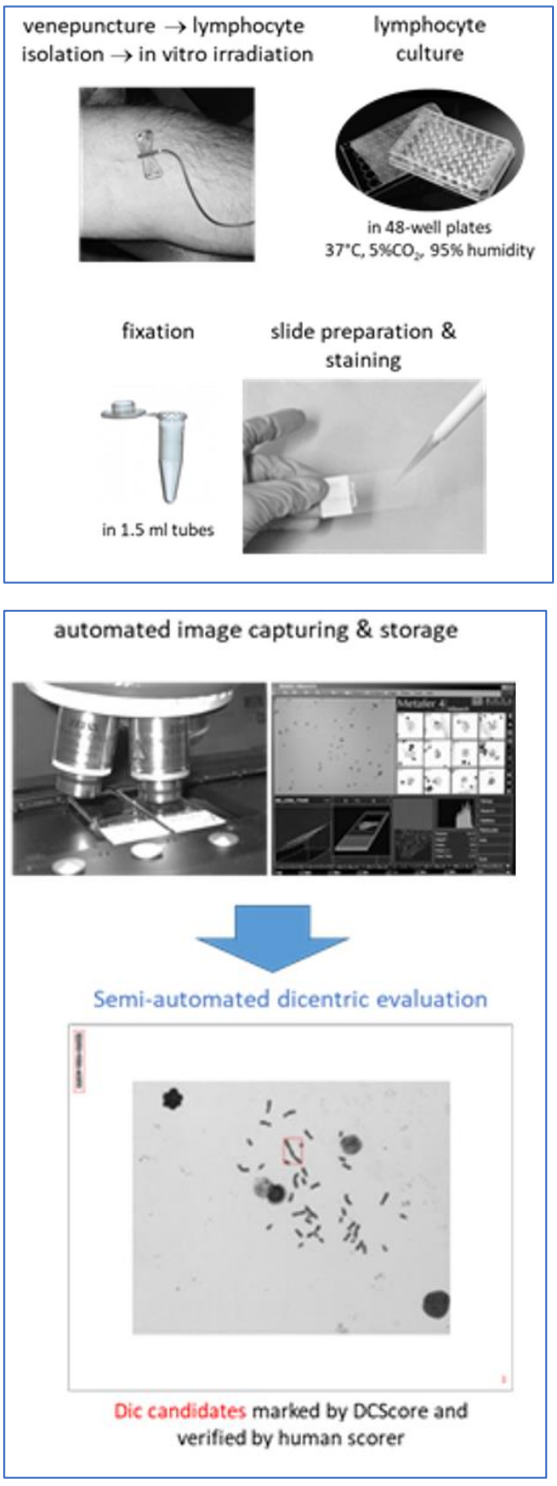


Figure 4.1: Isolated human peripheral blood lymphocytes were exposed either to 0.5 Gy protons or 400 or 100 J/m2 UVB rays, respectively, or to combined exposure by successive irradiation with protons and UVB rays followed by lymphocyte culture, cell fixation and staining. Dicentric chromosomes are quantified using metafer4 and DCScore (Metasystems, Germany) applying the semi-automatic scoring mode.

Figure: 4.1

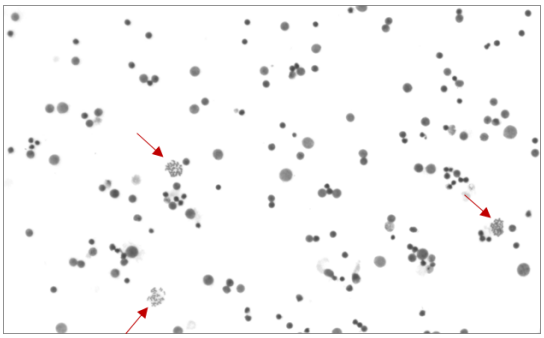


***Figure 4.2**: Human peripheral lymphocytes exposed to 0.5 Gy protons and 400 J/m^2 UVB radiation after mitotic stimulation (overview, 10x objective): Metaphase cells with condensed chromosomes (arrows) and non-dividing cell nuclei or nuclei in other stages of the cell cycle (round grey structures).*

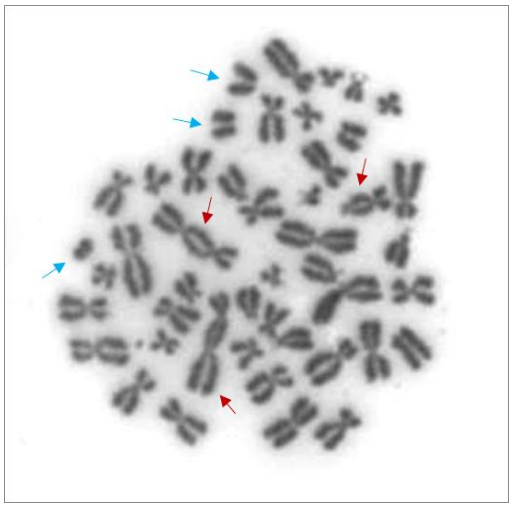


***Figure 4.3**: Human peripheral lymphocytes exposed to 0.5 Gy protons and 400 J/m^2 UVB radiation after mitotic stimulation (overview, 10x objective): Metaphase cells with condensed chromosomes (arrows) and non-dividing cell nuclei or nuclei in other stages of the cell cycle (round grey structures).*

Upcoming events

Conferences	Date / location	Reason for attending
UK Astronomy Meeting	14-19 July 2024, Hull (UK)	BIRA-IASB will make an invited presentation about new results on space radiations
EMS 2024 (European Meteorological Society)	2-6 September 2024, Barcelona (Spain)	DWD will give an oral presentation about BIOSPHERE project in general and about UV, Ozone and aerosol measurements during BIOSPHERE campaigns
1st CIPM STG-CENV Stakeholder meeting,	16-18 September 2024, BIPM Sèvres (France)	The coordinator (PTB) plans to give a talk on the progress of the project (including results from technical WPs 2, 3, and 4) WP1 leader (CEA) plans to give a talk on the development and improvement of instrumentation for cosmic radiation and LIDARs
RICAP-24 Roma International Conference on AstroParticle Physics	23-27 September 2024, Rome (Italy)	PTB plans to give an oral presentation: Influence of the Atmospheric pressure and Temperature Profiles Across Altitudes on the Muon Flux: Insights from Monte Carlo Simulations
Switch to Space	2 October 2024, Brussels, Belgian Parliament	BIRA-IASB will give an invited presentation about Space Weather for a more secure world
European Space Weather Week	4-8 November 2024, Coimbra (Portugal)	BIRA-IASB will give a presentation about the big solar and magnetospheric events (especially that of May 2024)
50th Annual Meeting on Radiation Protection	April 2025, (Hungary)	BFKH plans to give an oral presentation on Biosphere project progress, especially lessons learned in neutron measurements
EGU 2025 (European Geosciences Union)	27 April – 2 May 2025, Vienna (Austria)	DWD plans to give a presentation of BIOSPHERE and measurement campaigns
International Symposium on Correlation, Polarization and Ionization in Atomic and Molecular Collisions (COPIAMC)	August 2025, Tokio (Japan)	MPG plans to give a poster presentation on the ionization and attachment cross section measurements on CFC molecules
International Conference on Photonic, Electronic and Atomic Collisions (ICPEAC)	July 2025, Saporo (Japan)	MPG plans to give a poster presentation on the ionization and attachment cross section measurements on CFC molecules.

Past events

Please visit our homepage:

https://euramet-biosphere.eu/index.php/conferences-and-meetings

Our publications

1) DExplore: An Online Tool for Detecting Differentially Expressed Genes from mRNA Microarray Experiments, Katsiki, A.D.; Karatzas, P.E.; De Lastic, H.-X.; Georgakilas, A.G.;

Tsitsilonis, O.; Vorgias, C.E. Biology 2024, 13, 351. https://doi.org/10.3390/biology13050351

2) RadPhysBio: A Radiobiological Database for the Prediction of Cell Survival upon Exposure to Ionizing Radiation, Zanni, V.; Papakonstantinou, D.; Kalospyros, S.A.; Karaoulanis, D.; Biz, G.M.; Manti, L.; Adamopoulos, A.; Pavlopoulou, A.; Georgakilas, A.G., Int. J. Mol. Sci. 2024, 25, 4729. (https://doi.org/10.3390/ijms25094729) . Link to the database: (http://radbiodb.physics.ntua.gr/radphysbio/)
3) Effects of the Sun on the space environment of the Earth, Pierrard V., Book at Presses Universitaires de Louvain, ISBN: 978-2-39061-442-5, 208 p., 2024. (https://i6doc.com/en/book/?gcoi=28001100628290)
4) Geomagnetic Storm Effects on the LEO Proton Flux during Solar Energetic Particle Events, Kirolosse M. Girgis, Tohru Hada, Akimasa Yoshikawa, Shuichi Matsukiyo, Viviane Pierrard, Susan W. Samwel, Space weather, 21, 12, e2023SW003664., doi: 10.1029/2023SW003664, 2023. (https://doi.org/10.1029/2023SW003664)
5) The Role of Plasmasphere in the Formation of Electron Heat Fluxes, Khazanov G. V., Pierrard V., Ma Q., Botek E., Journal of Geophys. Res.: Space Physics, Vol.128, Issue 11, November 2023, e2023JA032013 (https://doi.org/10.1029/2023JA032013)
6) The atmospheric influence on cosmic ray induced ionization and absorbed dose rates, Alexandre Winant, Viviane Pierrard, Edith Botek, Konstantin Herbst, Universe, 9, 502, 1-17, 2023. https://doi.org/10.3390/universe912050
7) Exospheric Solar Wind Model Based on Regularized Kappa Distributions for the Electrons Constrained by Parker Solar Probe Observations, Pierrard V., Halekas J., Audoor C., and M. Péters de Bonhome, P. Whittlesey and R. Livi, Plasma, 6, 518-540, 2023. https://doi.org/10.3390/plasma6030036
8) Comparison of radiation belts electron fluxes simultaneously measured with PROBA-V/EPT and RBSP/MagEIS instruments. Winant, A., Pierrard, V. & Botek, E., Ann. Geophysicae, 41, 313–325, 2023. https://doi.org/10.5194/angeo-41-313-2023
9) Prediction of radiation belts electron fluxes at a Low Earth Orbit using neural networks with PROBA-V/EPT data. Botek, E., Pierrard, V., & Winant, A., Space Weather, 21, e2023SW003466, 2023. https://doi.org/10.1029/2023SW003466
10) Combined experimental and theoretical study on the elastic electron scattering cross sections of ethanol. Dinger, M., Park, Y., Hepperle, P. and Baek W.-Y., Eur. Phys. J. D 77, 52, 2023. https://doi.org/10.1140/epjd/s10053-023-00632-6
11) More than Meets the Eye: Integration of Radiomics with Transcriptomics for Reconstructing the Tumor Microenvironment and Predicting Response to Therapy. Logotheti, S., Georgakilas, A.G., Cancers, 15, 1634, 2023. https://doi.org/10.3390/cancers15061634
12) Proton flux variations during Solar Energetic Particle Events, minimum and maximum solar activity and

splitting of the proton belt in the South Atlantic Anomaly, Pierrard V., S. Benck, E. Botek, S. Borisov, A. Winant, Journal of Geophysical Research: Space Physics, 128, e2022JA031202, 2023. https://doi.org/10.1029/2022JA031202

13) Intense Storm at Low Earth Orbit and Geostationary Transfer Orbit. Viviane Pierrard, Alexandre Winant, Edith Botek, Jean-François Ripoll, Mélanie Cosmides, David M. Malaspina, Geoffrey D. Reeves and Scott A. Thaller, Simultaneous Observations of the 23 June 2015 Intense Storm at Low Earth Orbit and Geostationary Transfer Orbit, URSI Radio Science Letters, Vol. 4, 2022. doi: 10.46620/22-0016
14) Modeling of the cold electron plasma density for radiation belt physics. Ripoll J-F, Pierrard V., Cunningham G.S., Chu X., Sorathia K.A., Hartley D.P., Thaller S.A., Merkin V.G., Delzanno G.L., De Pascuale S. and Ukhorskiy A.Y., Front. Astron. Space Sci. 10:1096595, 2023. doi: 10.3389/fspas.2023.1096595
15) Radiation Type- and Dose-Specific Transcriptional Responses across Healthy and Diseased Mammalian Tissues. Sagkrioti, E.; Biz, G.M.; Takan, I.; Asfa, S.; Nikitaki, Z.; Zanni, V.; Kars, R.H.; Hellweg, C.E.; Azzam, E.I.; Logotheti, S.; Pavlopoulou, A.; Georgakilas, A.G., Antioxidants, 11, 2286, 2022. https://doi.org/10.3390/antiox11112286
16) Clustered DNA Damage Patterns after Proton Therapy Beam Irradiation Using Plasmid DNA. Souli, M.P.; Nikitaki, Z.; Puchalska, M.; Brabcová, K.P.; Spyratou, E.; Kote, P.; Efstathopoulos, E.P.; Hada, M.; Georgakilas, A.G.; Sihver, L. Int. J. Mol. Sci., 23, 15606, 2022. https://doi.org/10.3390/ijms232415606
17) Vasilopoulos, S.N.; Güner, H.; Uça Apaydın, M.; Pavlopoulou, A.; Georgakilas, A.G. Dual Targeting of DNA Damage Response Proteins Implicated in Cancer Radioresistance. Genes 2023, 14, 2227. https://doi.org/10.3390/genes14122227

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EPM 21GRD02 BIOSPHERE was launched in October 2022. It is supported by a broad global scientific community within climate research, space research, biology and medicine, atmospheric chemistry, radiation protection and metrology.

For the time being, the project BIOSPHERE has established the following collaborations by a Letter of Agreement (in the order of signature date): Collaborators by signed letters of agreement:

1. Bundeswehr Institute of Radiobiology, Germany,
2. UK Health Security Agency (Radiation Effects Department), United Kingdom,
3. University of Naples Federico II (Radiation Biophysics Laboratory), Italy,
4. Biomedical Research Foundation of the Academy of Athens, Greece.