Potential European Partnership on Metrology
Call 2021 – Green Deal and Normative

Selected Research Topic number: **SRT-v17**
Version: 1.1

Important information about these documents

This call is being held ahead of any agreement from the Commission that the relevant funding will be available. At present the relevant legislation is still under discussion in both Council and Parliament, and there is no certainty on the detailed arrangements for funding selected projects. The funding of any selected project, and the terms and conditions of participation in the projects, are dependent on completion of the legislative process and the subsequent contractual processes between the European Commission and EURAMET. Proposers submit to this call at their own risk.

Background

Last year, EURAMET submitted a draft proposal to the EC for a further research programme to be established under article 185 of the Treaty on the Functioning of the European Union (TFEU) to follow on from EMRP and EMPIR. This was published by the EC at https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe/candidates-digital-industry-and-space_en

The initiative would be called the European Partnership on Metrology and would aim to create, by 2030, a sustainable and effective system for metrology at European level that ensures Europe has a world-class metrology system that:

- Provides metrology solutions, fundamental metrological reference data and methods, offering fit-for-purpose solutions supporting and stimulating European innovation and responding to societal challenges.
- Supports and enables effective design and implementation of regulation and standards that underpin public policies that address societal challenges.

The Commission commissioned an impact assessment into this proposal and 11 others in similar priority areas, and, based on those findings, published their own proposal for the Partnership, their response to the impact assessment and a draft of the Decision on 23rd February 2021. See:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:89:FIN

https://ec.europa.eu/commission/presscorner/detail/en/ip_21_702

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021SC0035&qid=1614677899327

That draft Decision is currently under discussion in the European Council and the European Parliament.

Under the assumption that the Council and Parliament pass the basic act which would form the legal basis for this research programme, and that the participating countries named in the Draft Decision submit the required commitment letters, EURAMET is publishing these potential Selected Research Topics and draft guidance notes. These documents are not approved by the Commission nor will they lead to a binding decision by EURAMET e.V. for any further negotiation or funding. All published guides and templates are subject to amendment by the EC and EURAMET e.V. as further information becomes known.

EURAMET MSU,
Phone: +44 20 8943 6666 Email: EMPIR.msu@euramet.org
msu.euramet.org

Title: Metrology for Earth Biosphere: Cosmic rays, ultraviolet radiation and fragility of ozone shield

Abstract

Cosmic rays penetrate Earth's atmosphere and perturb its chemical stability, leading to ozone depletion, which in turn increases exposure to harmful solar ultraviolet (UV) radiation. To enhance the prediction accuracy of chemo-physical processes caused by cosmic rays in the atmosphere and assess their biological impact on human health and ecosystems, SI traceable and simultaneous measurements of cosmic rays and solar UV are needed. Proposals addressing this SRT should aim to develop the necessary tools, methods and measurement infrastructure to evaluate the mutual impact of cosmic rays and UV radiation on the Earth's biosphere, and to support EU policy makers with scientific assessments that can substantially improve policies on climate, health and anthropogenic activities.

Keywords

Cosmic rays, primary cosmic radiation, secondary cosmic radiation, ionizing radiation, UV radiation, ozone layer, ozone depletion, biosphere, climate change, LIDAR, atmosphere chemistry, anthropogenic emissions, radiosensitivity

Background to the Metrological Challenges

Cosmic rays are highly energetic particles, mostly protons, that strike our planet from all directions, ionising the atmosphere, causing changes in its chemistry and affecting the global electric circuit. These charged particles trigger secondary cosmic radiation (SCR) which, due to the products of its interaction with aerosols and air molecules, is a major driver of atmospheric chemistry together with UV radiation. Increased atmospheric ionisation caused by cosmic rays depletes the ozone layer, leading to an increase in harmful UV radiation flux towards earth with deleterious effects on human and ecological health. Cosmic rays also influence the climate and global temperature through acting on atmospheric parameters that affect atmosphere cloud cover, thus exerting another important impact on ecosystems.

Research is needed to develop a dedicated metrological framework, encompassing SI traceable measurements, technological improvements to available instrumentation, and application of new techniques to permit identification and accurate quantification of the correlations between primary cosmic radiation, secondary cosmic radiation, UV radiation, and atmospheric processes. This will enable exploration of the dependence of ozone layer thickness on the intensity of cosmic radiation and its variations as well as open up new scientific approaches to understanding the links between environmental exposures to cosmic and UV radiation, the atmosphere, and anthropogenic activities in relation to human and ecological health.

Although at present there are systems available to measure various relevant parameters (e.g. SCR flux, terrestrial UV radiation, atmospheric column ozone, atmospheric conditions, etc.,) technological upgrades to SCR detectors and LIght Detection And Ranging (LIDAR) systems in conjunction with new techniques are needed in order to perform simultaneous measurements of two or more of these parameters for a better understanding of their interplay. Furthermore, when available measurements are not sufficient to fully account for the complexities of the processes in question, they must be supplemented by theoretical models.

While the separate impacts of cosmic radiation and UV radiation on living organisms have been studied and documented extensively, there is a lack of research into the specific and common effects of combined secondary cosmic and UV radiation in mammals and plants. Experiments performed in underground laboratories with negligible SCR contribution, available at many metrology research institutions, would provide insight into the various changes in cellular cultures caused by combined ionising and UV radiation that may account for their radiosensitivity and potential dysfunctionalities in the long run. Identifying and quantifying the complex network of molecular changes will lead to new tools and biomarkers for monitoring radiation exposure and developing adequate shielding and therapeutic strategies.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The JRP shall focus on the traceable measurement of SCR, stratospheric ozone and UV radiation and the development of metrological methodologies to establish the correlations between them.

The specific objectives are

1. To upgrade the measurement capabilities of existing mobile SCR detectors and LIDAR systems, such as by development of new metrological methods to determine the dependence of SCR flux to the ground on primary cosmic radiation (PCR) and various atmospheric profiling parameters (e.g. pressure, temperature, density, aerosol concentration).
2. To quantify the correlation between PCR and solar UV radiation on the ground including their dependence on anthropogenic gas emissions with the help of simultaneous modelling and traceable measurements of (i) ground-level muon and neutron fluxes, (ii) terrestrial solar UV-irradiance, and (iii) total ozone column.
3. To determine the effects of slow electrons produced by PCR and SCR on the chemical processes in the atmosphere, in particular those impacting the ozone layer. This should include the quantification of molecular ionisation and production rate of charged molecular fragments due to the interaction between low-energy electrons and atmospheric gases of both natural and anthropogenic origin with the help of table-top experiments.
4. To assess the impact of combined SCR and UV irradiation on human health by determining the effect of mixed radiation fields on human primary and plant cells under various experimental conditions. This should include investigation of genetic, epigenetic and transcriptomic changes in cells using established radiation effect models and systems biology approaches.
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain (NMIs and DIs, atmospheric monitoring networks) standards developing organisations (BIPM Consultative Committee for Photometry and Radiometry, CIE Division 2, WMO) and end users (e.g. health and environment regulatory bodies, research institutions focused on environment, climate, medicine and biology, and radiological protection, and instrument manufacturers).

These objectives will require large-scale approaches that are beyond the capabilities of single National Metrology Institutes and Designated Institutes. To enhance the impact of the research, the involvement of the appropriate user community such as industry, standardisation and regulatory bodies is strongly recommended, both prior to and during methodology development.

Proposers should establish the current state of the art and explain how their proposed project goes beyond this. In particular, proposers should outline the achievements of the EMRP projects ENV03 solarUV and ENV59 ATMOZ and EMPIR project 19ENV04 MAPP, and how their proposal will build on those.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 2.2 M€ and has defined an upper limit of 2.7 M€ for this project.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 35 % of the total EU Contribution across all selected projects in this TP.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Feed into the development of urgent documentary standards through appropriate standards bodies,
- Transfer knowledge to the atmosphere and climate monitoring, biomedical, and radiation protection sectors.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing Joint Research Projects (JRPs)”

You should also detail how your approach to realising the objectives will further the aim of the potential European Partnership on Metrology to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Time-scale

The project should be of up to 3 years duration.