

Major boost to European plasma accelerator facility

EuPRAXIA is the first European project that develops a dedicated particle accelerator research infrastructure based on novel plasma acceleration concepts and laser technology.

The European plasma accelerator community has received a major impulse for the development of a user-ready plasma accelerator facility with the funding of several multi-million euro initiatives under the umbrella of the [EuPRAXIA](#) project. These are EuPRAXIA Preparatory Phase, EuPRAXIA Doctoral Network, and EuPRAXIA Advanced Photon Sources, as well as funding for the construction of one of the sites of EuPRAXIA in Frascati, near Rome.

The EuPRAXIA project aims at the construction of an innovative electron accelerator using laser- and electron-beam-driven plasma wakefield acceleration that offers a significant reduction in size and possible savings in cost over current state-of-the-art radiofrequency-based accelerators.

The EuPRAXIA project started with a Design Study, which was funded under the EU Horizon 2020 programme, and culminated at the end of 2019 with the publication of the worldwide first Conceptual Design Report for a plasma accelerator facility. EuPRAXIA was then included in 2021 in the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap, which identifies those research facilities of pan-European importance that correspond to the long-term needs of the European research communities.

Now the EU and the UK Research and Innovation Guarantee Funds have awarded 3 M€ to the EuPRAXIA Preparatory Phase (PP), which comprises 34 participating institutes from Italy, Czech Republic, France, Germany, Greece, Hungary, Israel, Portugal, Spain, Switzerland, United Kingdom, USA and CERN as International Organization.

The new grant will give the consortium a unique chance to prepare over the next four years the full implementation and realisation of EuPRAXIA. The project will fund 548 person-months, including additional funding from UK and Switzerland, and will be supported by an additional 1,010 person-months in-kind. EuPRAXIA-PP will connect research institutions and industry from the above countries plus China, Japan, Poland, and Sweden, which had signed the EuPRAXIA ESFRI consortium agreement.

This Preparatory Phase project will define the full implementation of the 569 M€ EuPRAXIA facility as a new, distributed ESFRI Research Infrastructure for Europe.

Alongside EuPRAXIA-PP, a new Marie Skłodowska-Curie Actions Doctoral Network ([EuPRAXIA-DN](#)), coordinated by INFN – Italian National Institute for Nuclear Physics, has also been funded by the EU and the UKRI Guarantee Funds. EuPRAXIA-DN will offer twelve high-level fellowships between universities, research centres and industry that will carry out an interdisciplinary and cross-sector plasma accelerator research and training program. The network will start in January 2023 and benefit from more than 3.2 M€ of funding over its four-year duration.

EuPRAXIA-DN will focus on scientific and technical innovations and on boosting the career prospects of its Fellows. The project comprises a lot of the European expertise in this research area and involves ten universities, six national and international research centres, as well as seven partners from industry at project start.

Finally, the Italian Ministry of Universities and Research is supporting through the Next Generation EU recovery funds (PNRR) the EuPRAXIA Advanced Photon Sources project (EuAPS) with 22 M€. The

project has been promoted by INFN (leading institution), CNR – Italian National Research Council, and Tor Vergata University of Rome.

EuAPS will fulfil some of the scientific goals defined in the EuPRAXIA Conceptual Design Report by building and commissioning a distributed user facility providing users with advanced photon sources; these consist of a plasma based betatron source delivering partially coherent soft X-rays, a mid-power, high repetition rate laser, and a high power laser.

The above mentioned funding comes in addition to about 120 M€ funding for construction of the beam-driven pillar of EuPRAXIA at Frascati, close to Rome, provided by Italian government, the Latium region and INFN. Research and development activities for the beam-driven facility are currently being performed at the INFN SPARC_LAB laboratory in Frascati. The European site for the second, laser-driven leg of EuPRAXIA will be decided in June 2024 as part of the Preparatory Phase project.

Dr Massimo Ferrario, project leader at the SPARC_LAB laboratory and senior researcher at INFN, says: *“The foreseen electron energy range of one to five GeV will enable various applications in diverse domains, for instance, as a compact free-electron laser, compact sources for medical imaging and positron generation, table-top test beams for particle detectors, and deeply penetrating X-ray and gamma-ray sources for material testing. Moreover, EuPRAXIA is designed to be the required stepping stone to possible future plasma-based facilities, such as linear colliders at the high-energy physics energy frontier.”*

The coordinator of the EuPRAXIA consortium, Dr Ralph Assmann, senior research associate at INFN and Leading Scientist for Accelerator R&D at DESY, says: *“This additional success for our accelerator field has been achieved thanks to the excellence, ingenuity and hard work of several hundreds of physicists, engineers, students and support staff, who worked on EuPRAXIA since 2015, connecting 50 institutes and industries from 15 countries in Europe, Asia and the United States.”*



*Projected building for the particle-driven plasma accelerator of EuPRAXIA in Frascati, near Rome.
Credit: INFN & Mythos – consorzio stabile s.c.a.r.l.*

The EuPRAXIA Conceptual Design Report has been published in the European Physics Journal: <https://doi.org/10.1140/epjst/e2020-000127-8>. The update of the ESFRI roadmap from December 2021 is available at <https://www.esfri.eu/esfri-roadmap>.

The Members of EuPRAXIA Preparatory Phase are: *Istituto Nazionale di Fisica Nucleare (INFN); Consiglio Nazionale delle Ricerche (CNR); Elettra – Sincrotrone Trieste; Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile; Università degli Studi di Roma "La Sapienza"; Università degli Studi di Roma "Tor Vergata"; Commissariat à l'Énergie Atomique et aux Énergies Alternatives; Centre National de la Recherche Scientifique; Thales Las France SAS; Deutsches Elektronen-Synchrotron (DESY); Ferdinand-Braun-Institut; Leibniz-Institut für Höchstfrequenztechnik; Forschungszentrum Jülich; Helmholtz-Zentrum Dresden-Rossendorf; Ludwig-Maximilians-Universität München; Wigner Research Centre for Physics; University of Szeged; University of Pécs; Instituto Superior Técnico; Institute of Physics of the Czech Academy of Sciences; CERN; Institute of Accelerating Systems and Applications; Centro de Láseres Pulsados Ultracortos Ultraintensos; Hebrew University of Jerusalem; Fraunhofer Institute for Laser Technology; and Sincrotrón ALBA-CELLS.*

The Associated Partners of EuPRAXIA Preparatory Phase are: *The Queen's University of Belfast; Science and Technology Facilities Council; University of Liverpool; University of Strathclyde; University of Oxford; University of California Los Angeles; Imperial College London; Ecole Polytechnique Fédérale de Lausanne; and Swiss Federal Laboratories for Materials Science and Technology.*

The EuPRAXIA Doctoral Network comprises: *CIVIDEC, Consiglio Nazionale delle Ricerche (CNR), Istituto Nazionale di Fisica Nucleare (INFN), ELI Beamlines, Instituto Superior Técnico, Instrumentation Technologies, Lunds Universitet, and University of Pécs* as Beneficiaries, and *Carbon Digital, Ceske Vysoke Uceni Technicke V Praze, D-BEAM, ELI-NP, Fistral Training and Consultancy Ltd., FOTON, Holdsworth Associates, Consorzio di Ricerca HYPATIA, Hebrew University of Jerusalem, RACAH Institute of Physics, STFC Rutherford Lab, Vienna University of Technology, University of Liverpool, Università di Pisa, Università di Roma "La Sapienza", and Wigner Research Centre for Physics* as Associated Partners.

In addition the ESFRI consortium includes: *Synchrotron SOLEIL; Amplitude Technologies; Karlsruhe Institut für Technologie (KIT); Helmholtz-Institut Jena; Institute of Plasma Physics and Laser Microfusion (IFPILM); Łódz University of Technology; Military University of Technology; Narodowe Centrum Badan Jadrowych (NCBJ); Warsaw University of Technology; University of Warsaw; Lund University; University of Manchester; University of York; Shanghai Jiao Tong University; Institute for Molecular Science, National Institutes of Natural Sciences; Osaka University; Kansai Photon Science Institute (KPSI); RIKEN SPring-8 Center; Lawrence Berkeley National Laboratory.*