EuPRAXIA

Preparatory Phase

EuPRAXIA-PP

10/09/2024

EuPRAXIA Laser based infrastructure bid-book request

To select the site for EuPRAXIA's laser-based implementation we ask to the four candidates, including CNR (Pisa, Italy), ELI-Beamlines (Prague, Czech Republic), Rutherford Appleton Lab (Didcot, UK), and CLPU (Salamanca, Spain), to prepare a short document, called "bid-book", that meets the criteria expressed in deliverable D3.1.

The main parameters of the expected electron beam and related FEL source, are described in EuPRAXIA Conceptual Design Report.

In D3.1 the criteria and the methodology to select the labs that will host the FEL driven by plasma laser wake field acceleration are given.

A short description of the layout of the facility would be also useful to understand how the research infrastructure is intended to be developed starting from the existing facilities, including tentative figures on realization costs (both in-kind and cash) and on yearly operation costs (including staff costs). A timeline of the second site construction plans from formal approval to full operation should be also included.

A complete Technical Design Report for the realization of the infrastructure will be requested after the site choice, to follow EuPRAXIA-PP EU grant requirements. The timeline for the delivery of the TDR will be defined soon after the site choice.

The document must contain the information requested in the following tables which include the technical evaluation criteria and part of the general ones.

A brief response to the other evaluation criteria described in deliverable D3.1 and which are reported below is also necessary.

~~If already available, the expected contribution from the other EuPRAXIA laboratories, in terms of expertise or in-kind contribution can be set out.~~

The bidder should point – if necessary for each phase – for which part of the construction project they require contributions from academic and/or industry

partners from inside the EuPRAXIA collaboration, and whenever available, discussions with partners are already ongoing. It should be pointed out if the expected contributions are expertise, in-kind or financial.

Other specific information useful for evaluating the readiness and the competence of the candidates can be reported. The bidder should outline how they plan to fill the technology gaps between existing and targeted performance of components.

Commitment, statement or endorsement from political authorities, funding agency or laboratory management will be also useful for the decision.

It is possible to foresee a staged realization of the EuPRAXIA laser-plasma FEL with, e.g. an initial 1 GeV (phase 1) and a later 5 GeV (phase 2) implementation, also with a staging in repetition rate, e.g. 10-20Hz (phase 1) and later 100Hz (phase 2). In this case the tables in this bid book should be provided for both cases with incremental costs, and with envisaged dates (month-year) for the start of commissioning and the start of user operation. The overall plan ~~must to~~ should be compatible with the expected ESFRI implementation schedule of phase 1. ~~While the layout description should cover the full plan.~~ The layout description should cover both phases.

The parameters should aim at achieving the CDR parameters for EuPRAXIA, including the precisions inside the ESFRI application, while some deviations are allowed (e.g. reflecting the already available technical equipment). FEL is the paramount application and must be part of the proposal. The FEL will be judged on its science reach (e.g. FEL wavelength instead of electron beam energy). Other applications (betatron, positrons, …) can and should be mentioned if they are planned but are not essential.

Timing:

- 27 August, bid-book discussion,
- 10 September, bid-book finalization,
- 27 September, bid-book approval by CB,
- 20 December, deadline for bid-book submission with internal political/funding evaluation by bidders,
- January/February, evaluation of bid-books and discussion of prioritization process by the 2nd site choice panel:
  this phase could involve also requests of further clarification to the bidders,
- February: Information meetings with STAB and the Sponsor's Board to evaluate if there are any objections to procedure or direction taken – as light as possible,
- March, decision by dedicated CB on 2nd site proposal,
- April, submission of EU deliverable report,
  Presentation to relevant bodies (ECFA, ICFA, ESFRI, TIARA, LEAPS, …). Collection of support letters 2nd site.

The following tables assess the technical readiness level today for the EuPRAXIA 2nd site plus the required upgrades to implement the laser-driven FEL user facility and its other features.

EXPERTISE
Local Support and Expertise: The presence of local expertise in laser plasma acceleration and related fields is pivotal for project success. Evaluating the availability of skilled personnel, research institutions, universities, and industry partners who can contribute to the project and provide ongoing support is crucial for leveraging local resources and fostering collaboration.
Does the lab have expertise in:
high power laser technology
electron beam optics and handling
X-ray optics and applications
operation of FEL/Synchrotron/Accelerator facilities
laser and radiation safety
data management
user access management

FEL User Parameters
number of lines
wavelength/photon energy
type of undulator
undulator parameters
Rho parameter
number of photons per pulse
pulse length
repetition rate
photon diagnostics
number of end-station
separation scheme X rays from residual laser pulse

LASER
Laser Infrastructure: Evaluation of existing/planned laser infrastructure capabilities, including energy, repetition rate, pulse duration, and beam quality, is critical for driving laser plasma acceleration effectively and achieving desired research outcomes.
laser type
energy per pulse (existing/planned)
repetition rate (existing/planned)
pulse duration (existing/planned)
beam quality (existing/planned)
contrast ratio (existing/planned)
required service windows (daily, weekly, monthly, …)
Planned upgrades as part of the proposal:
Laser beam Quality and Stability: Assessing the stability and quality of the laser beam, including pointing stability, beam profile, energy stability, and temporal characteristics, ensures consistent and reliable laser plasma acceleration performance.
pointing stability (existing/planned)
beam profile (existing/planned)
energy stability (existing/planned)
temporal characteristics (existing/planned)
Laser Synchronization: Examining synchronization capabilities with electron beam generation and acceleration processes ensures efficient operation and coordination of laser plasma facilities, optimizing research productivity and outcomes.
laser oscillator on RF jitter (in case of external injection) - you don't need this for fully laser-driven FEL
laser on master oscillator jitter

ELECTRON BEAM

Beam Diagnostics and Control: Assessing capabilities for diagnosing and controlling accelerated electron beams, including parameters such as energy, emittance, charge, and divergence, is essential for precise experimentation and data collection in laser plasma research.
Preferred Electron Injection Scheme (Self Injection, Ionization Injection, Colliding Pulse Injection, Density Down-ramp Injection, External Injection, Shock-Induced Injection, Plasma Mirror Injection) to be used – can an external RF injector be installed in principle? Specify parameters for preferred case below, more details can be given in the technical description.
maximum energy
Rms Energy Spread
charge per bunch
Rms pulse length
Rms normalized emittance (h/v)
rep rate
electron diagnostics
removal of laser driver pulse

OPERATION
Technical Support: Evaluating the availability of skilled technical staff and support services ensures smooth operation and maintenance of laser plasma facilities, enhancing research productivity and project efficiency.
total number of people working in the lab
total number of people who will work on EuPRAXIA
number of people dedicated to laser maintenance
number of people dedicated to equipment user operation
number of people dedicated to beam lines
number of hours dedicated to EuPRAXIA users per year
number of hours dedicated to machine development per year

INFRASTRUCTURE
Experimental Infrastructure and Facilities: This includes analyzing the necessary infrastructure to support successful operation of the facility including the extent of land area suitable for construction and future expansion. Evaluating the readiness of experimental infrastructure components, such as beam lines, vacuum systems, cooling systems, target systems, and radiation shielding, and the effective support and safety of laser plasma acceleration experiments.
size of existing infrastructure (in kind)
space available for electron beam line
space available for laser and plasma chamber
space available for undulator
space available for beam line(s) & end-station(s)
infrastructure for data handling
planned extension of the infrastructure into available spaces
planned extension of infrastructure into spaces to be acquired

BUDGET
Funding and Cost Considerations: Assessing the availability of funding sources specific to laser plasma research is essential for project sustainability. This includes evaluating construction costs, operational expenses, and the overall financial viability of each candidate site to ensure adequate support for long-term project success.
value of existing infrastructure construction made available to EuPRAXIA
value of existing electron beam line made available to EuPRAXIA
value of existing laser & plasma chamber made available to EuPRAXIA
value of existing undulators made available to EuPRAXIA
value of existing beam line(s) and end station(s) made available to EuPRAXIA
value of existing manpower available for new infrastructure set-up
new budget in manpower for new infrastructure set-up
new budget for new infrastructure construction (building, shielded area….)
new budget for new equipment (electron beam line, laser, undulators, beam line(s), end-station(s)

budget for yearly operational cost (spare parts, consumable, etc…)
budget for yearly operational cost (manpower)

SCHEDULE
Schedule Considerations: The ESFRI guidelines and commitments require us to reach user operation within a certain timeline. Schedule is therefore an important criterion for our success. The overall plan should be compatible with the expected ESFRI implementation schedule of phase 1. Please use (month-year) for indicating schedule goals.
Envisaged completion dates for the site 2 TDR – for different phases, if applicable
Envisaged start of laser/beam commissioning – phase 1
Envisaged start of FEL user operation – phase 1
Envisaged start of laser/beam commissioning – phase 2, if applicable
Envisaged start of FEL user operation – phase 2, if applicable

Other General Assessment Criteria for site selection

Geographic Location: The geographic location of candidate sites plays a crucial role in accessibility and logistical considerations. Assessing factors such as proximity to transportation hubs, availability of on-site or nearby accommodations (including guest house), and ease of access for researchers, collaborators, and users is essential to ensure efficient project operations and support.
Local Support and Expertise: The presence of local expertise in laser plasma acceleration and related fields is pivotal for project success. Evaluating the availability of skilled personnel, research institutions, universities, and industry partners who can contribute to the project and provide ongoing support is crucial for leveraging local resources and fostering collaboration.
Environmental Considerations: Environmental impact assessments are conducted to evaluate the potential risks associated with laser plasma acceleration activities at each candidate site. This involves analyzing factors such as air and water quality, ecosystem sensitivity, and compliance with environmental regulations to ensure responsible and sustainable project development.

Collaborative Opportunities: Collaboration within the local scientific community is critical for the success of the project. Identifying opportunities to leverage complementary expertise and resources enhances research outcomes and fosters knowledge exchange, ultimately driving innovation and advancement in laser plasma acceleration.
Funding and Cost Considerations: Assessing the availability of funding sources specific to laser plasma research is essential for project sustainability. This includes evaluating construction costs, operational expenses, and the overall financial viability of each candidate site to ensure adequate support for long-term project success.
Legal and Regulatory Factors: Compliance with legal and regulatory requirements is paramount in site selection, in particular with those of EU-ESFRI Research Infrastructures. This involves assessing licensing procedures, permitting processes, and adherence to relevant regulations governing laser plasma facilities to ensure legal compliance and mitigate potential risks.
Defense/National Security Connection (if applicable): Evaluating any defense or national security implications associated with laser plasma research is necessary. Understanding access restrictions, security measures, and potential impacts on national security interests ensures alignment with relevant regulations and safeguards.
Political Support: Initiative of the 2nd site candidate in the development of Plasma Based Accelerator should be recognized in the corresponding national scientific strategic roadmap or in equivalent initiatives, being crucial for project continuity and success. Ensuring long-term commitment and support for laser plasma research from governmental authorities and stakeholders enhances project resilience and fosters a conducive research environment.
Safety and Security: Prioritizing safety and security measures is paramount to protect personnel, equipment, and the surrounding environment. Assessing emergency response capabilities, implementing physical security systems, and adhering to safety protocols mitigate risks and ensure a safe working environment for all involved.

Future Expansion Potential: Evaluating the potential for future expansion and scalability of laser plasma facilities is essential for accommodating research growth and technological advancements. Flexibility in infrastructure design and operations enables adaptation to evolving research needs and ensures long-term project sustainability.

Layout description of the EuPRAXIA laser-driven facility
(minimum 10 pages, maximum 20 pages excluding references but including figures)