

EUROPEAN
PLASMA RESEARCH
ACCELERATOR WITH
EXCELLENCE IN
APPLICATIONS



Plasma Components and Systems

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Guidelines for discussion



For beam-driven plasma system session

the pad link is here <https://etherpad.in2p3.fr/p/eupraxia-wp10-bd-session>

For the laser-driven plasma systems session

the pad link is here : <https://etherpad.in2p3.fr/p/eupraxia-wp10-ls-session>

TRL ranking

Technological Readiness level (TRL) scale was originally defined by NASA in the 1990's as a mean for **measuring or indicating the maturity of a given technology**, from a paper sketch to its entry into the market.

	TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Definition / meaning	Basic principles observed	Technology concept formulated	Experimental proof of concept	Technology validated in a lab	Technology validated in a relevant environment	Technology demonstrated in a relevant environment	System prototype demonstration in an operational environment	System complete and qualified	Actual system proven in an operational environment
Example with a gas target for EuPRAXIA LPI	Jet	Nozzle and valve to deliver gas in vacuum environment	Supersonic gas jet characterized in density, size, etc... LWFA electron obtained	Gas Jet design integration with differential pumping for high repetition rate validated.	Gas Jet differential pumping used to generated electron at low power Gas nozzle high power laser life time tested Input and output aperture heating and energy deposition measured	Gas jet system tested with high power laser system with cooling system developed for daily operation LWFA electron obtained Coupling to beamline demonstrated. Integration tested	Gas jet system prototype tested on with nominal laser and gas parameters. Integration in the beamline. LWFA e-obtained	Gas jet system integrated in the final beamline. Daily operation	Gas jet system used in the EuPRAXIA facility to deliver e- or secondary sources to users.

TRL ranking

CONCEPTUAL PHASE				TECHNICAL DESIGN PHASE			COMMISSIONING OF EUPRAXIA FACILITY		
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State on present TRL of plasma systems

Roadmap for TRL increase to be discussed

BD plasma systems

Are e-beam parameters demonstrated with capillary discharge plasma components in the range of EuPRAXIA parameters? => Give an estimation of the TRL[2] based on this ranking scale

Issue with average power driver and discharge operation

a. heating:

- the sources of heating
- mitigation of heating

b. material resistance (inner limiting wall/cathode) => What is the demonstrated lifetime?

c. Discharge power supply driver

plasma lens: demonstrated with beam parameters ? Give an estimation of the TRL[2] based on this ranking scale

... missing point ? please add

- what is the effect of ramps at start/end of accelerating region?
- Can these be tailored precisely?
- Can other changes in longitudinal density (e.g. injection region then lower density acceleration region) be easily controlled/changed?
- can gases be recycle/reused?

LD plasma systems

1. Targets used as source delivering e- beam parameter demonstrated for LPI? => Give an estimation of the TRL[2] based on this ranking scale
2. targets used for staged acceleration delivering e- beam parameter demonstrated for LPAS ? => Give an estimation of the TRL[2] based on this ranking scale
3. target (cell /jet/capillary) as a gas delivery system:
 - gas profile reproducibility requirement?
 - Continuous flow vs pulsed (configuration driven by integration constraints)
 - specific design of vacuum systems to allow continuous flow?
4. Mitigation of laser damage issue for gas target: is there a tested solution?
5. HOFI vs capillary waveguide as long-length plasma laser-driven accelerating structure (> GeV range)?
6. plasma mirrors injection driver configuration for staging => Give an estimation of the TRL[2] based on this ranking scale. Are plasma mirrors the only injection option for laser-driven multistage accelerators? Best removal optics for laser left after acceleration stage.
7. Issue with average power driver
 - a. heating:
 - the sources of heating
 - mitigation of heating
 - b. material resistance for entrance and output of target => What is the demonstrated lifetime? What does the lifetime need to be for a practical accelerator?
8. ... missing point ? please add efficiency laser-plasma, plasma-beam. How is this measured? Optimised? Is there a ceiling?