# Current and near future planned SPARC_LAB Activities

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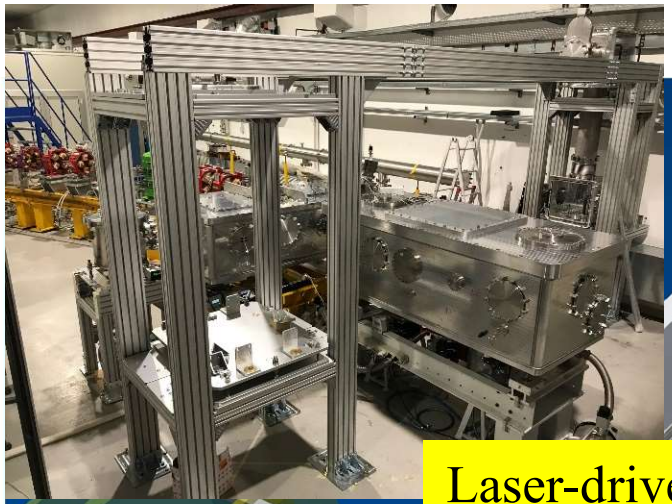
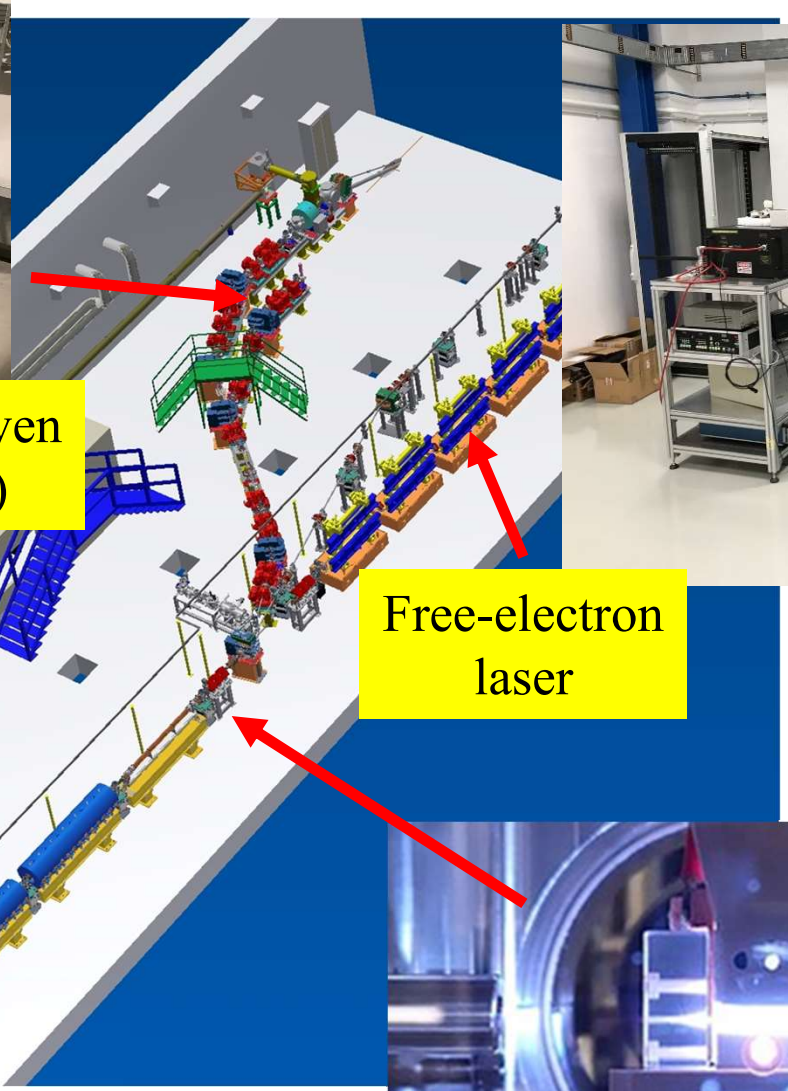
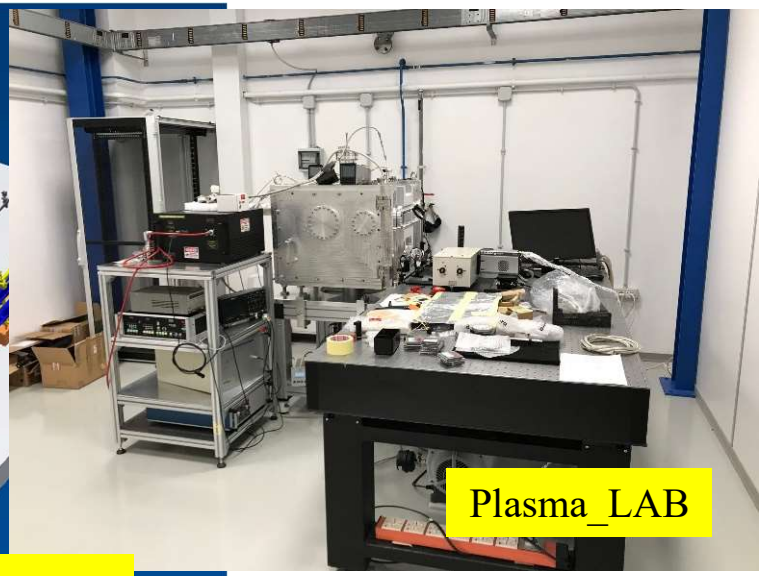
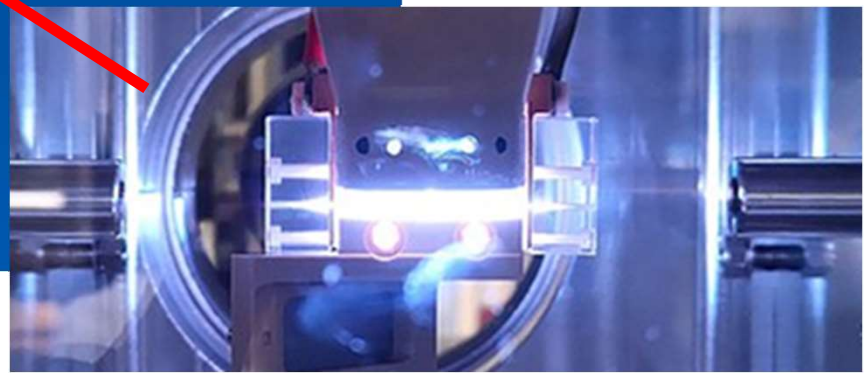
***on behalf of SPARC_LAB collaboration***

# *SPARC_LAB facility*









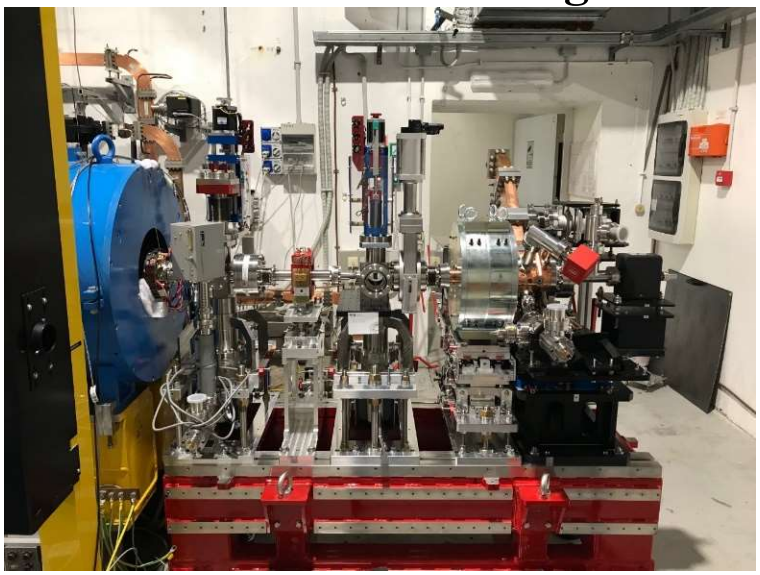
Laser-driven (EXIN)

Free-electron laser

Plasma_LAB

Beam-driven experiments

## Gun commissioning

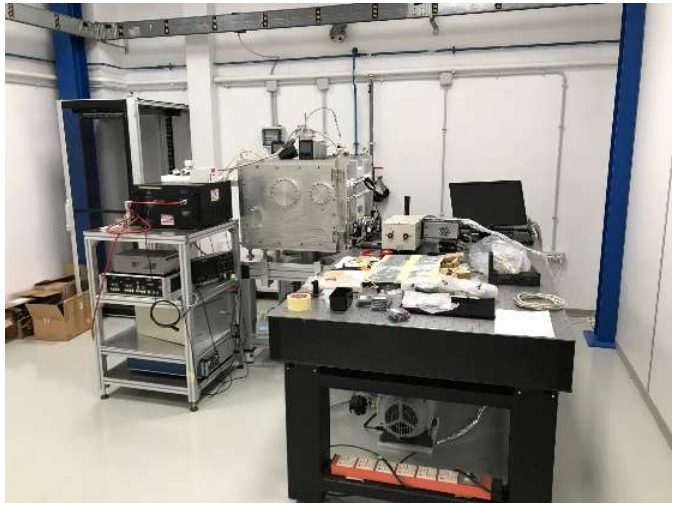


- gun commissioning
- UV vs “blue” experiments
- external users
- C-band modulator installations (SABINA)
- EXIN beam line installations
- plasma laboratory relocation
- new focusing system
- recent publications:
  - ***M.Galetti et.al.,*** *Advanced Stabilization Methods of Plasma Devices for Plasma-Based Acceleration, Symmetry 14*(3) **(2022)**, 450;
  - ***R. Pompili et al.,*** *"Free-electron lasing with compact beam-driven plasma wakefield accelerator.” Nature 609* ***(2022)****, pp 659-662.*

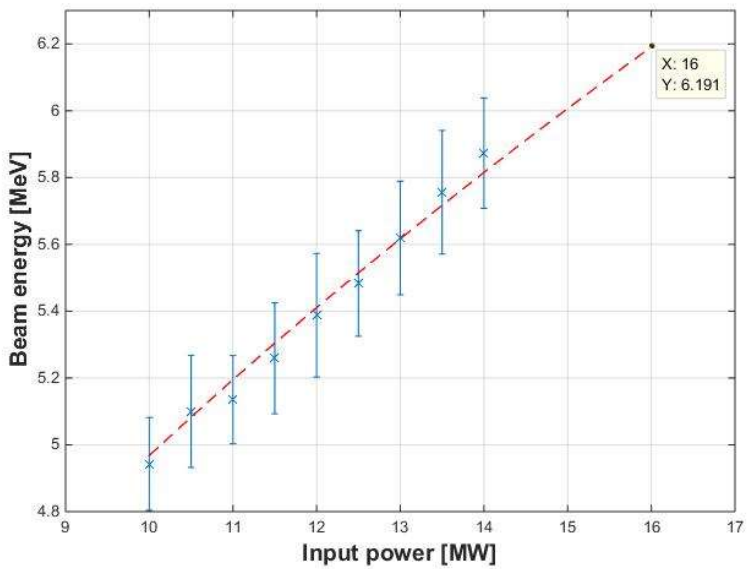
## EXIN line

## C-band modulator (SABINA)

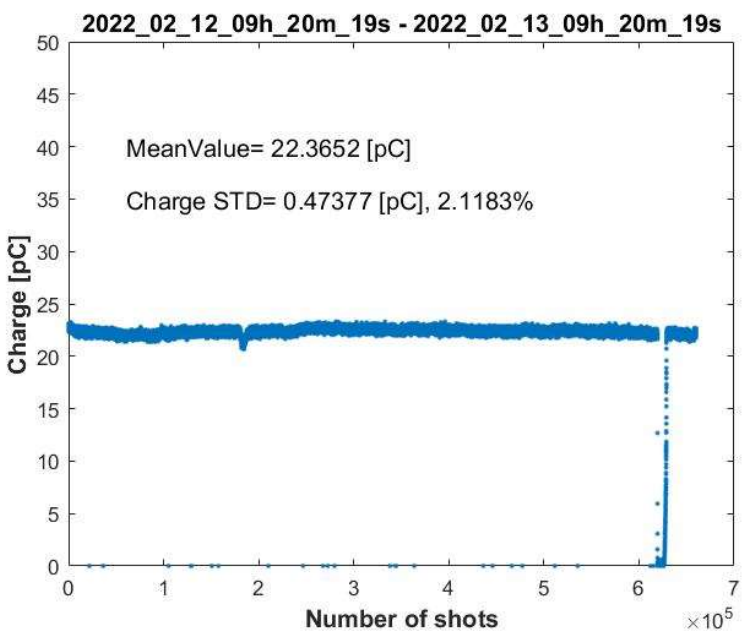

## new plasma laboratory

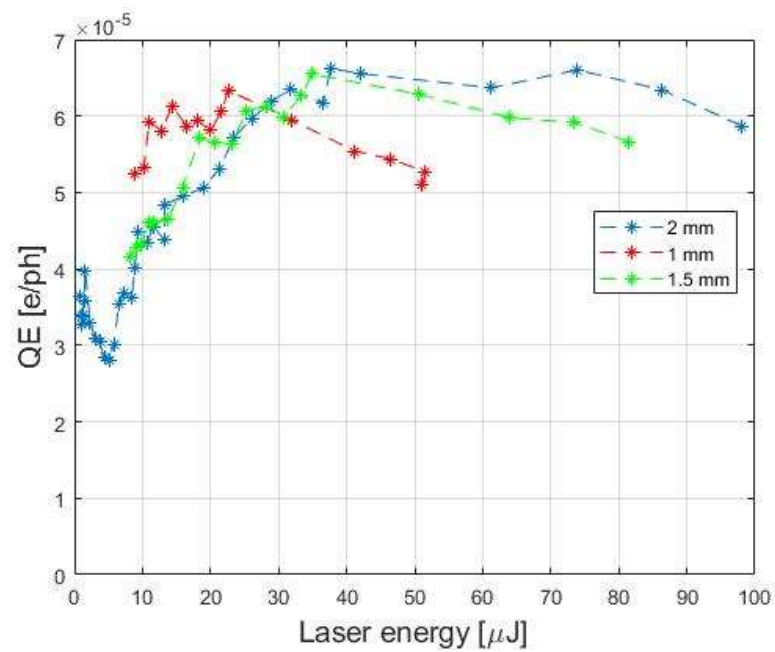


# *Gun commissioning*

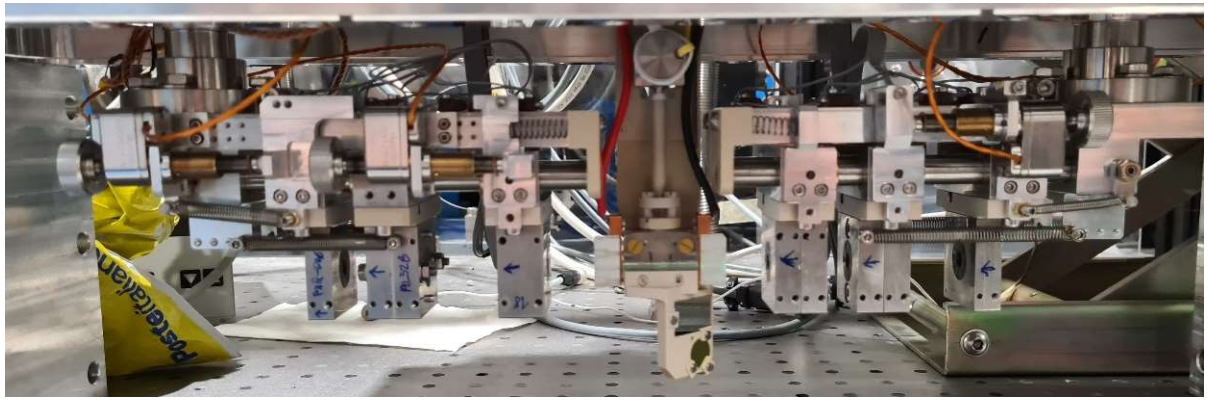



| | Old gun | New gun |
|---|---|---|
| Peak field, [MV/m] | ~102 | ~112 |
| Beam energy [MeV] | 5.2 | 5.8 |
| QE, [e/ph] | $\sim 10^{-6}$ | $\sim 6.0\times 10^{-5}$ |
| Dark Current, [pC] | $\sim 1.5\text{-}2.0\times 10^{3}$ | ~22.3 |
| Discharge rate | 1/5min (??) | 1/day |



New focusing system
under construction



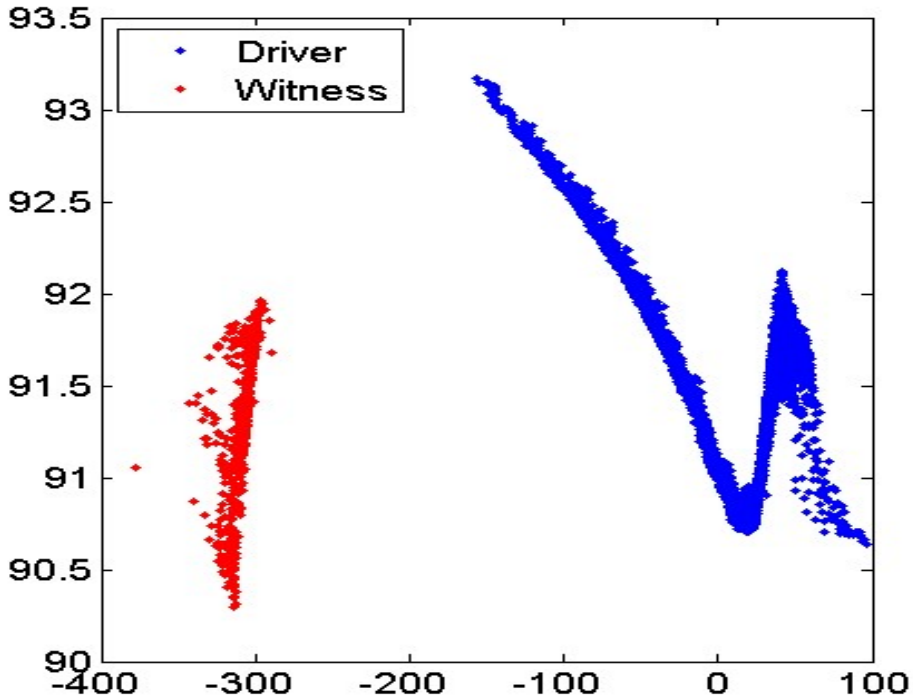

**Completed:**

- C-band modulator installation
- new focusing system for plasma injection
- overhaul of the cathode laser control system
- EXIN line installation
- number of minor changes/updates inside the SPARC bunker

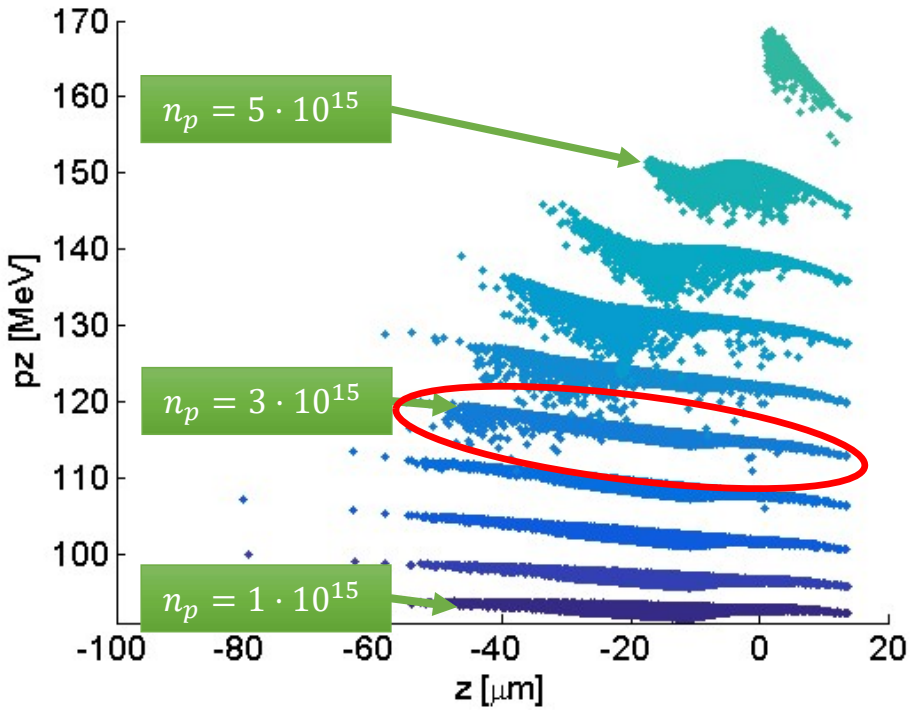
**SPARC operation restart June 27th**

**The summer-autumn run has only one objective - 1GeV/m gradient**

**500 pC working point**




**witness LPS**



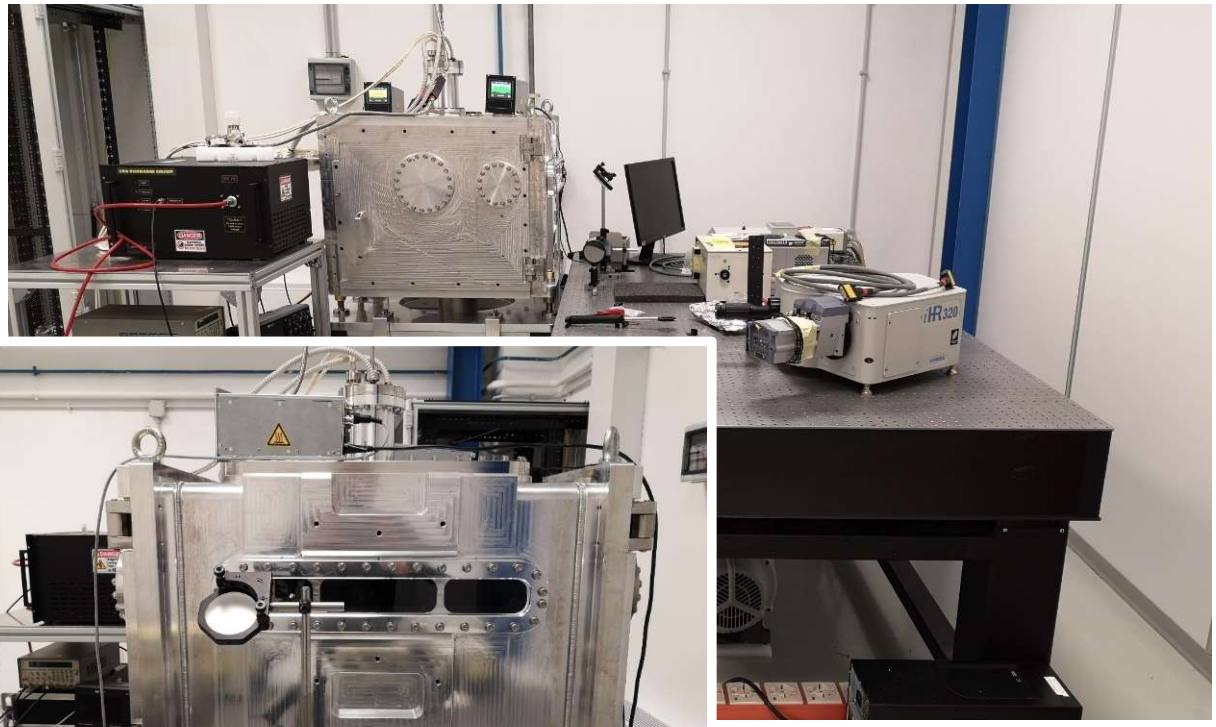

- higher charge driver beam, 200 → 500 pC
- new focusing system for plasma injection

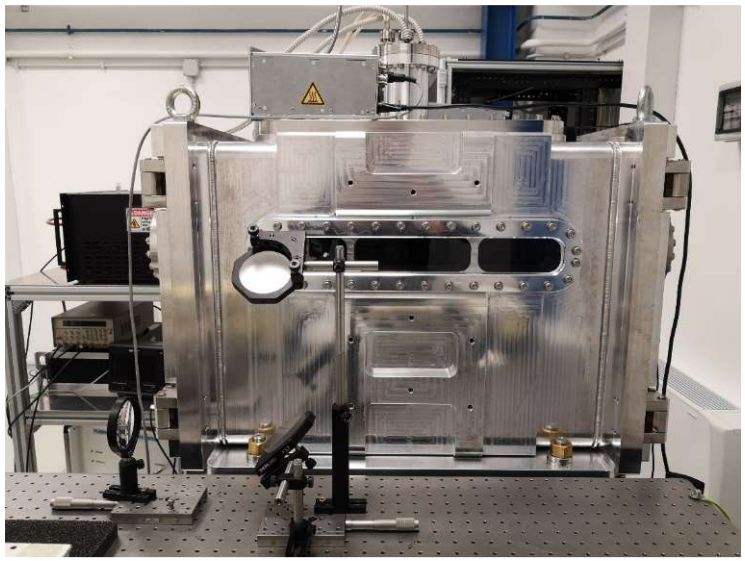
Alternative option -1 nC driver

New options should give us access to a higher plasma density

Courtesy: Stefano Romeo

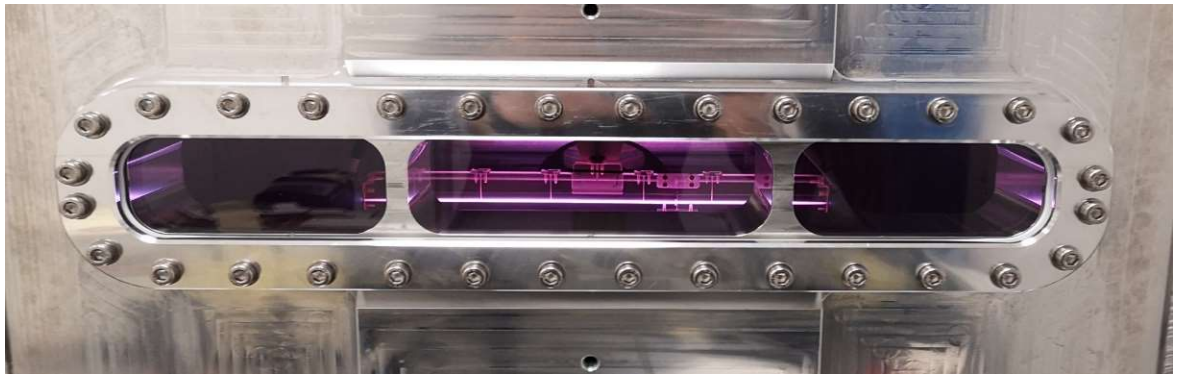
# *Plasma laboratory*





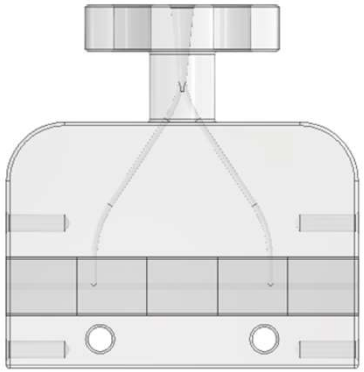
- laboratory was moved to a new location:
  - larger plasma chamber
  - updated pumping system
  - new high voltage source
- experiments with the long EuPRAXIA style capillary

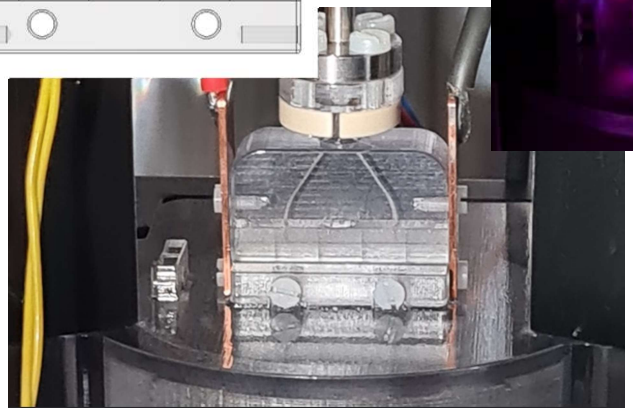
Last result in the Plasma_Lab: First EuPRAXIA plasma source to reach 1.1 GeV (1.5 GV/m) - **40 cm long**

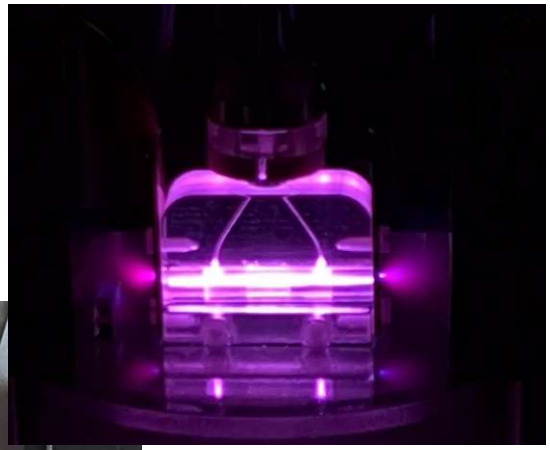


Courtesy: Angelo Biagioni

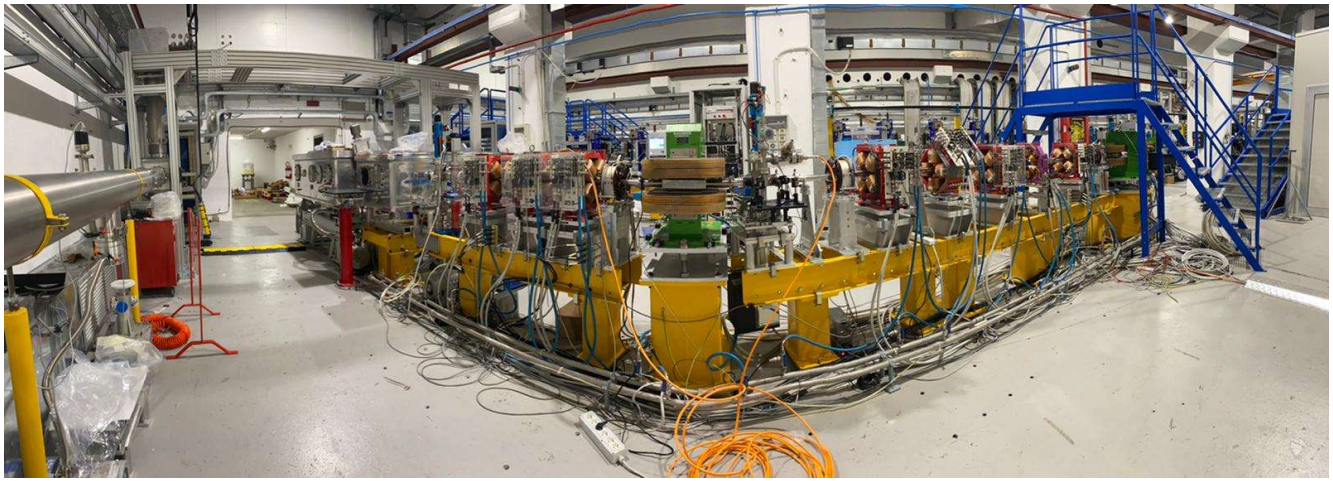
# *EXIN@FLAME*







- First test at FLAME with a more robust material (sapphire). All previous test done with 3D printed capillary (aging issue).
- To get the 3cm total length for a inner diameter of 500um, we had to split the sapphire in 5 pieces.
- Good discharge with 10 kV, 500 A.



- Mounted and cabled all the mirrors of the EXIN beam-line and EOS diagnostic is also in place.
- Vacuum tests of the optical beamline done.

Courtesy: Maria-Pia Anania

1. March – May 2022. All sorts of installations. New C-band modulator, new focusing system for plasma experiments, EXIN line, additional diagnostics.
2. June – July 2022. PWFA experiments. New focusing system and higher charge for the driver should provide us with desirable 1 GeV/m.
3. September – December 2022. PWFA experiments. Optionally the autumn run can include EXIN synchronization test and/or EuroLab external users.
4. January – May 2023. Major SPARC overhaul, SABINA project installations. New section solenoids, THz undulators (DGL line), excavation to make room for SABINA users, water and air systems at SPARC, number of smaller works/improvements/updates.

# *SPARC_LAB chart 2022-2023*

Thank You!