



SPARC_LAB

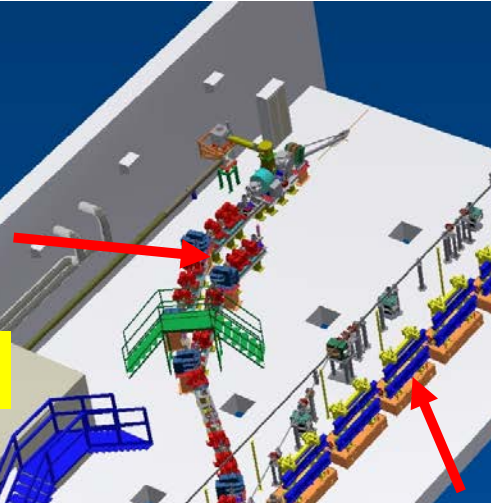
recent results and activities

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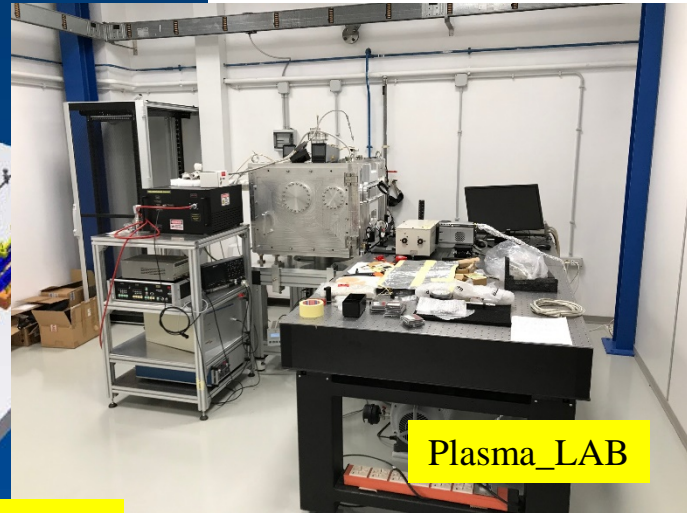
on behalf of SPARC_LAB collaboration



EuAPS



Free-electron laser



Plasma_LAB



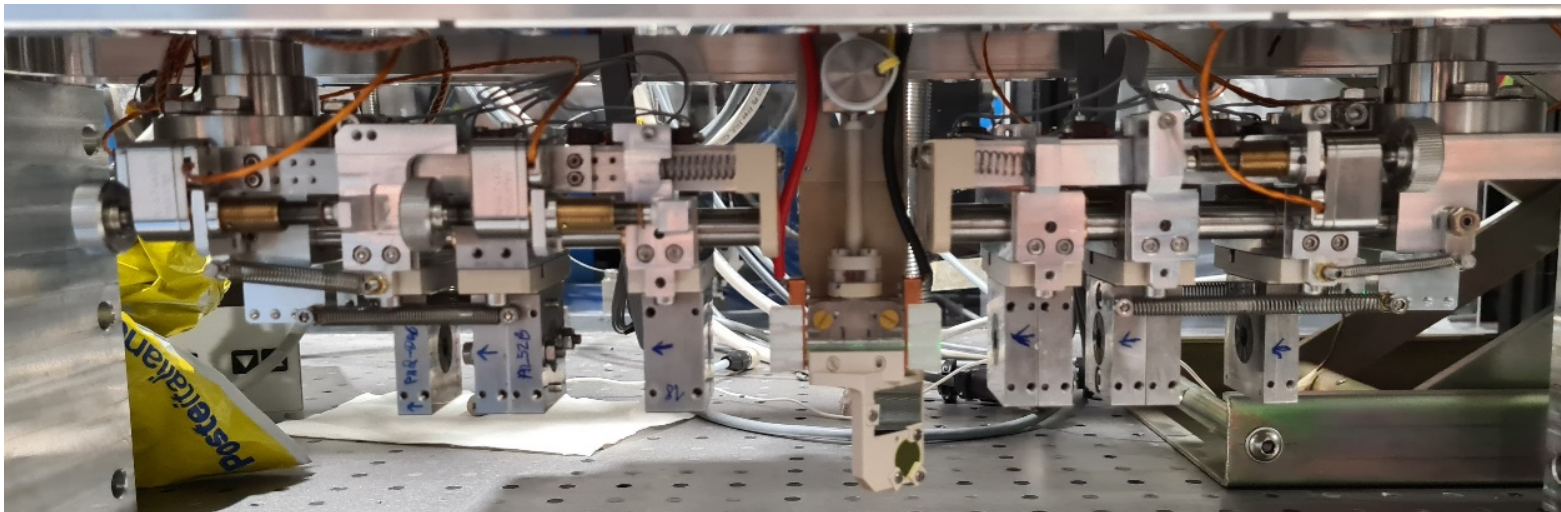
FLAME

Beam-driven experiments



- PWFA test with new focusing system
- old focusing system re-installation
- PWFA experiments: 1.0 GeV/m
- recent publications:
 - *M. Galetti et.al., Stable operation of a free-electron laser driven by a plasma accelerator, PRL 2022, accepted in publication;*

New focusing system under construction



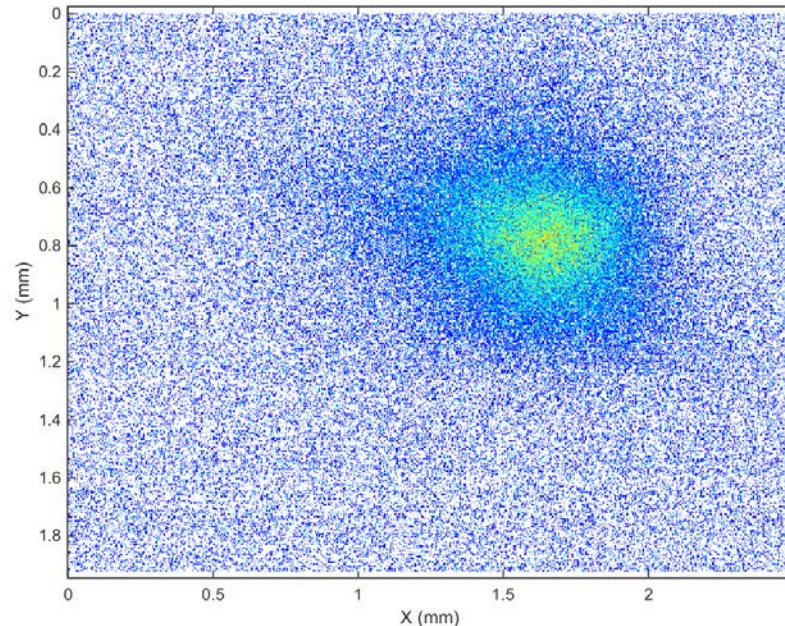
Comments

- *As follow-up of the SC report #62 recommendations the SC concurs with the SPARC_LAB strategy not to prioritize an upgrade of the K2 modulator but rather to explore what are the most promising approaches to improve RF phase stability relative to the reference signal.*
- *The SC is looking forward to plasma acceleration results with the upgraded set-up.*
- *The SC would appreciate to get, in a future meeting, more information how the EXIN effort for laser driven plasma acceleration integrates with the overall EuPRAXIA strategy.*

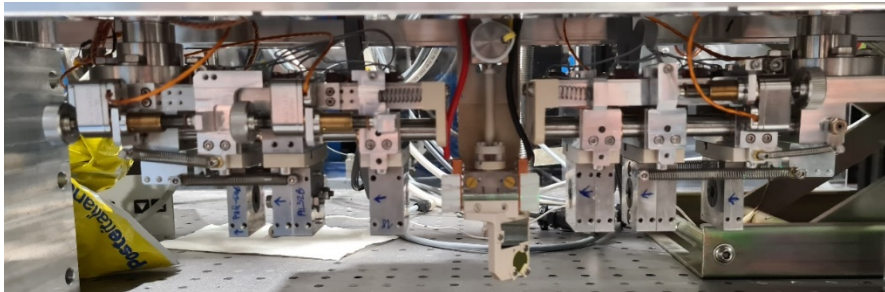
Recommendations

- *Execute your plans for the next run as presented. No specific other recommendations.*

- *The SC is looking forward to plasma acceleration results with the upgraded set-up.*

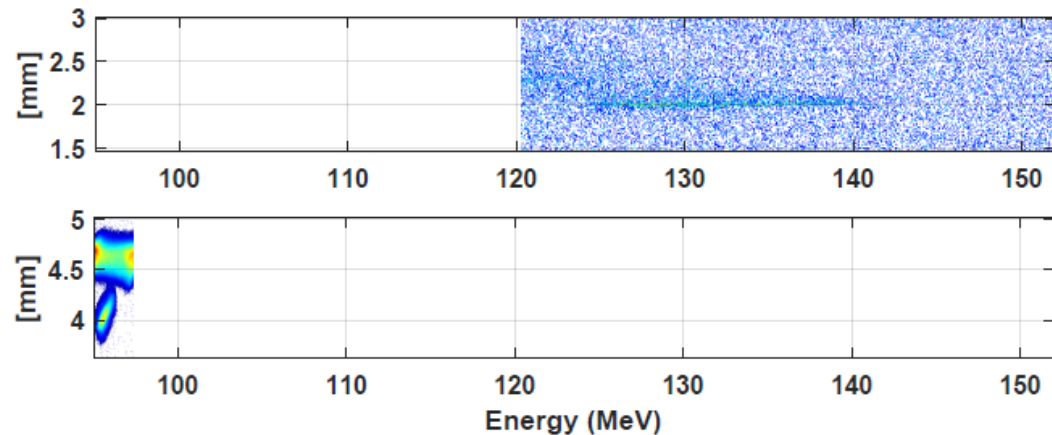
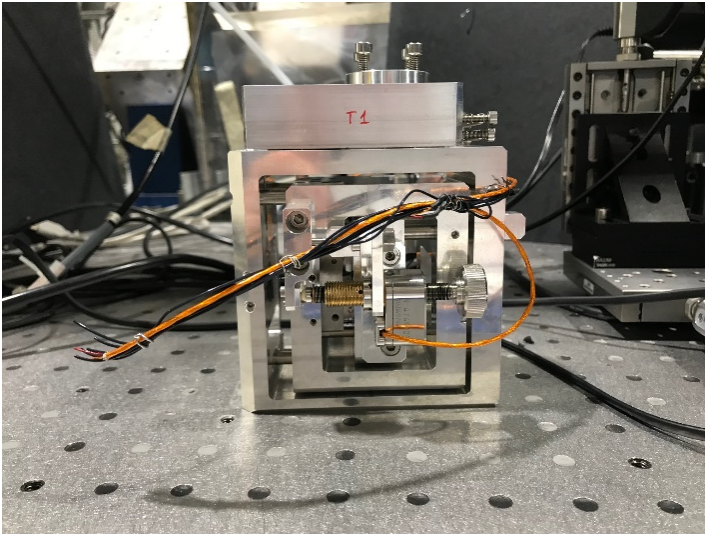


- on-crest WP, beam duration 1.2-1.4 ps RMS
- 200 pC beam charge
- best achieved spot size $\sim 35 \times 35 \mu\text{m}$
- complete insufficiency to create a plasma wake
- our best guess: significant presence of the higher order components of the magnetic field



the only possible option, within available time frame, was to go back to the old focusing system

- *The SC is looking forward to plasma acceleration results with the upgraded set-up.*



- compression WP, driver duration ~ 200 fs
- $500+50$ pC bunch train configuration
- distance between the beams ~ 1 ps
- best achieved spot size $\sim 50-80$ μm
- starting witness energy ~ 95 MeV
- final witness energy ~ 130 MeV
- **achieved gradient 1.0 GeV/m**
- massive charge loss
- lack of stability
- **matching problem**

- *The SC is looking forward to plasma acceleration results with the upgraded set-up.*

Reply

- The new focusing system has demonstrated its inability to properly focus the beam
- An alternative rout was chosen: the old system was put back in place and the driver beam charge was increased up to 0.5-1.0 nC.
- We were able to announce the field up to ~ 1.2 GeV/m
- There is still some room to grow - the beam transport and matching.

- *As follow-up of the SC report #62 recommendations the SC concurs with the SPARC_LAB strategy not to prioritize an upgrade of the K2 modulator but rather to explore what are the most promising approaches to improve RF phase stability relative to the reference signal.*

Reply

- Feed forward system was tested for further phase stabilization of the K2 with little success.
- Substitution of K2 current PNF modulator with solid state one will help with the current experiments, but will not stabilize the phase to EuPRAXIA necessary level.
- Test of the klystron loop system with the existing C-band solid state modulator is under way. The collaboration with CLARA project was initiated regarding this topic.

Courtesy: Giacomo Giannetti,
Marco Bellaveglia, Luca Piersanti

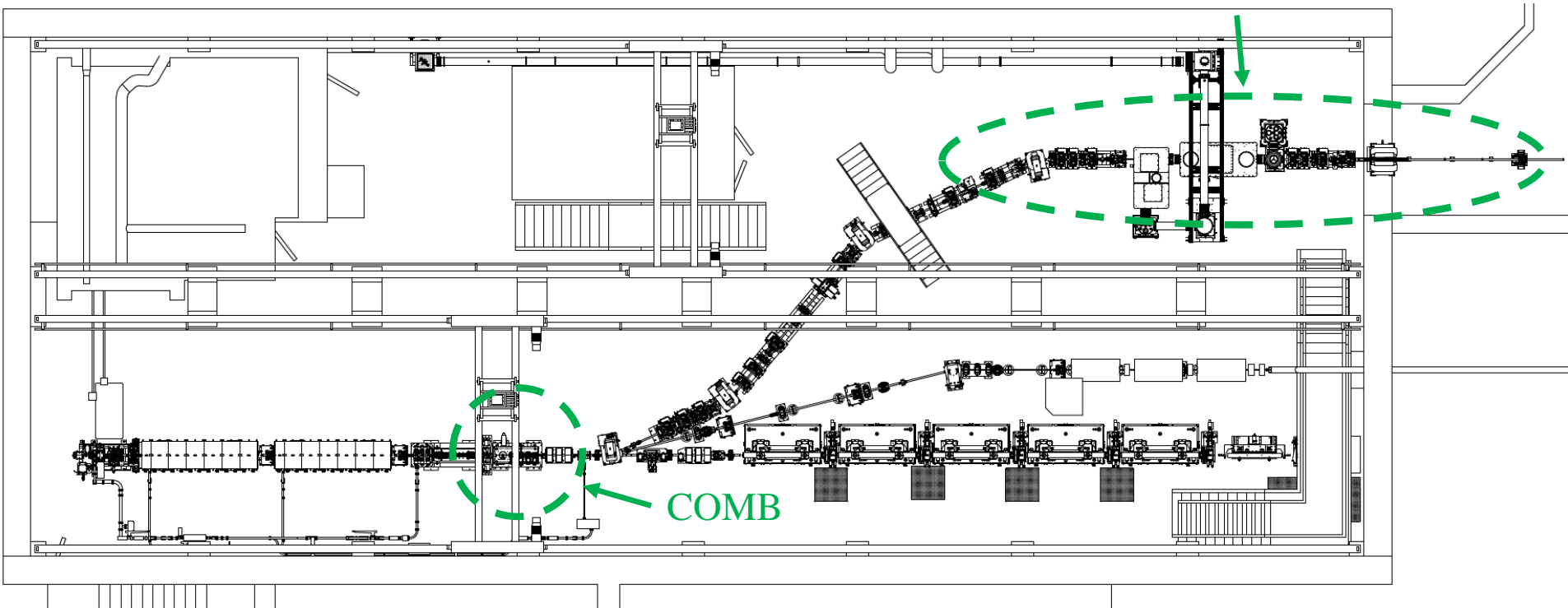
- *The SC would appreciate to get, in a future meeting, more information how the EXIN effort for laser driven plasma acceleration integrates with the overall EuPRAXIA strategy.*
- There is been some change in EXIN project, a new direction - **EuAPS**.
- A betatron radiation based, X-ray spectrum source for user application.
- Substantial change in SPARC layout - a new laser compressor will be installed into the SPARC bunker with two exits: to drive the EuAPS source and EXIN updated layout integrated into the COMB chamber.
- New user experiment area/photon diagnostics using existing EXIN line



- *The SC would appreciate to get, in a future meeting, more information how the EXIN effort for laser driven plasma acceleration integrates with the overall EuPRAXIA strategy.*

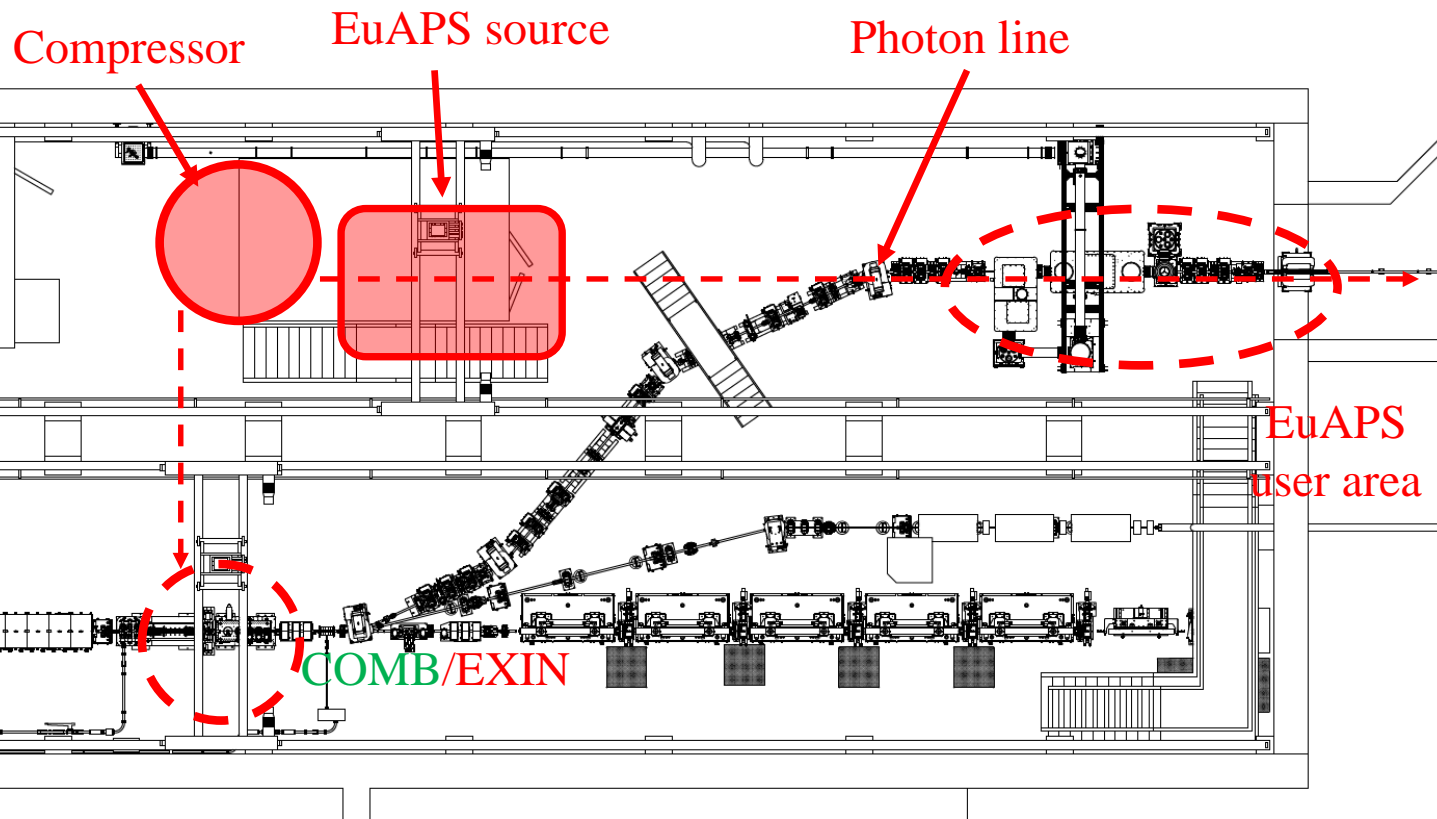
Current layout

current EXIN area





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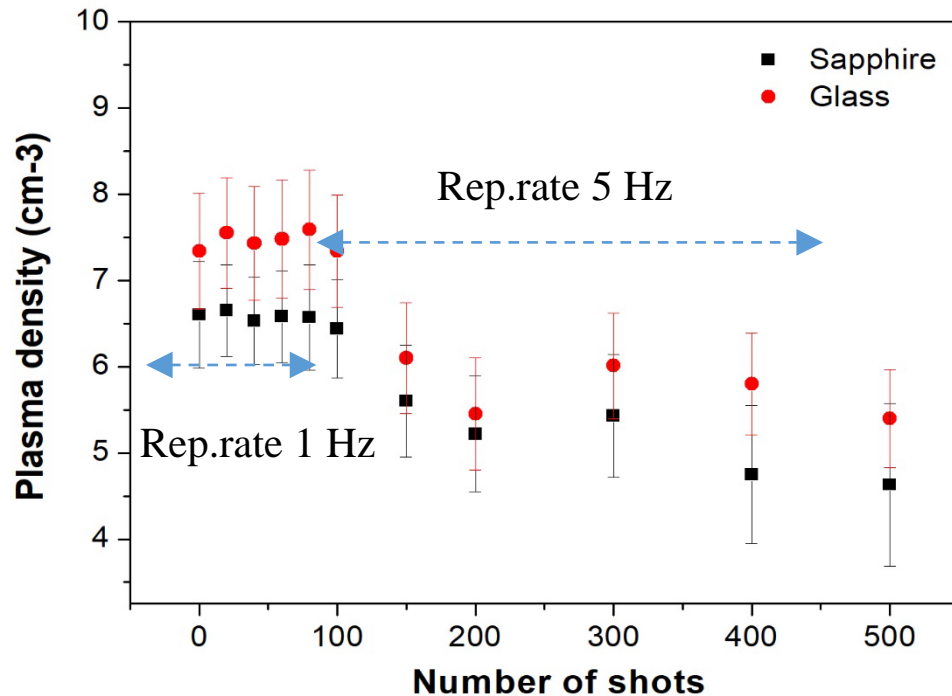




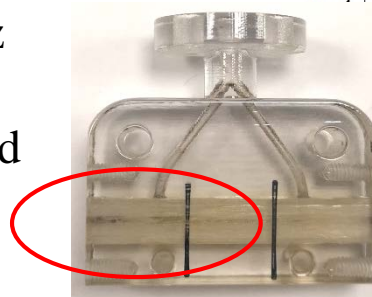
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Reply

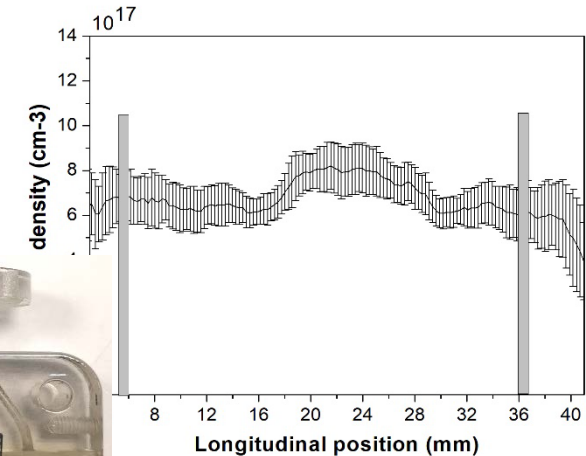
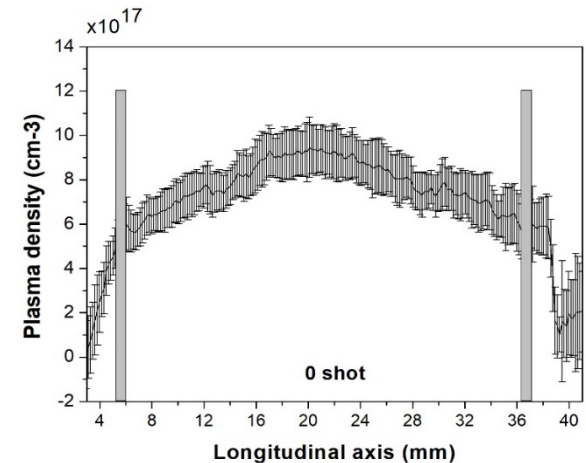
- main goal of EuAPS project, within the EuPRAXIA framework, is to be its first operational part.
- opportunity to advance our technology in laser, synchronization, beam and photon diagnostics
- first EuPRAXIA X-ray line that can be offered to the users, thus giving to us a work experience with them.



- Glass and sapphire easily can hold 1 Hz rep.rate
- at 5 Hz, however, both has demonstrated some difficulties with heat dissipation



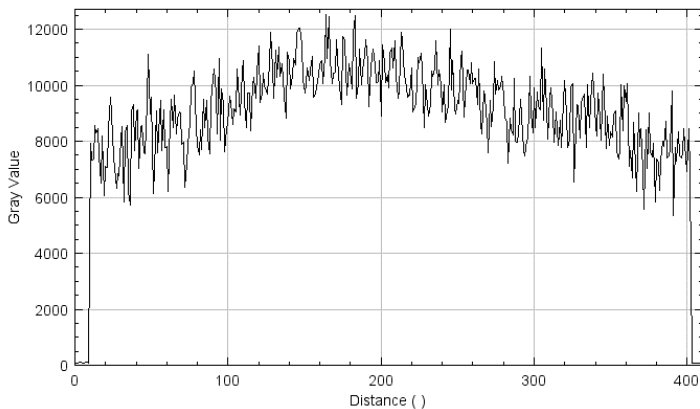
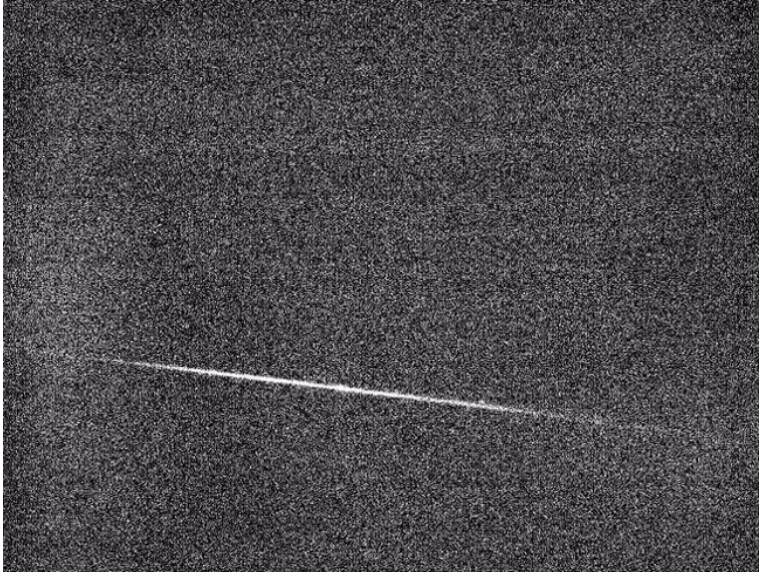
Glass capillary



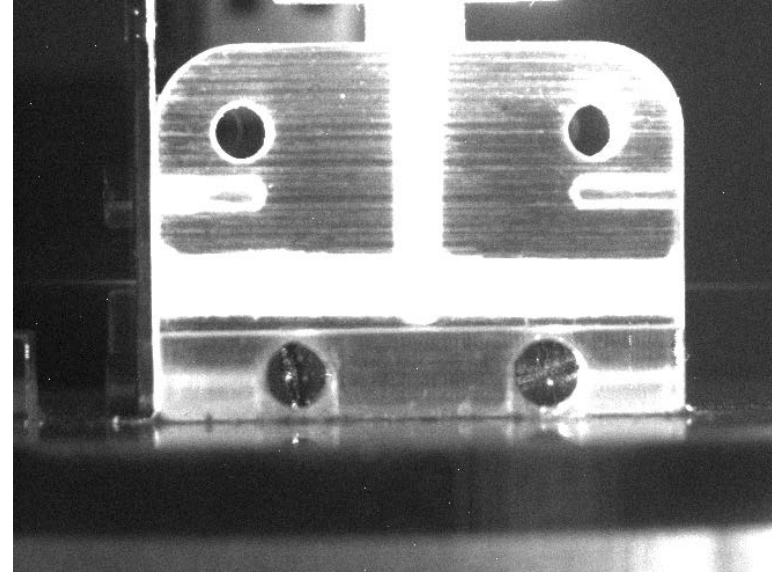
Courtesy: Angelo Biagioni

Laser filamentation

SPARC, test in the air



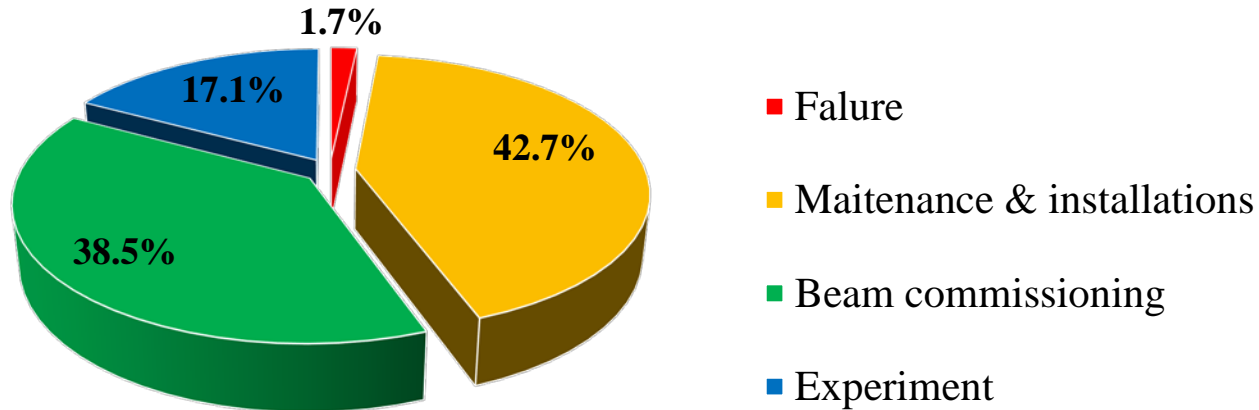
FLAME, vacuum test



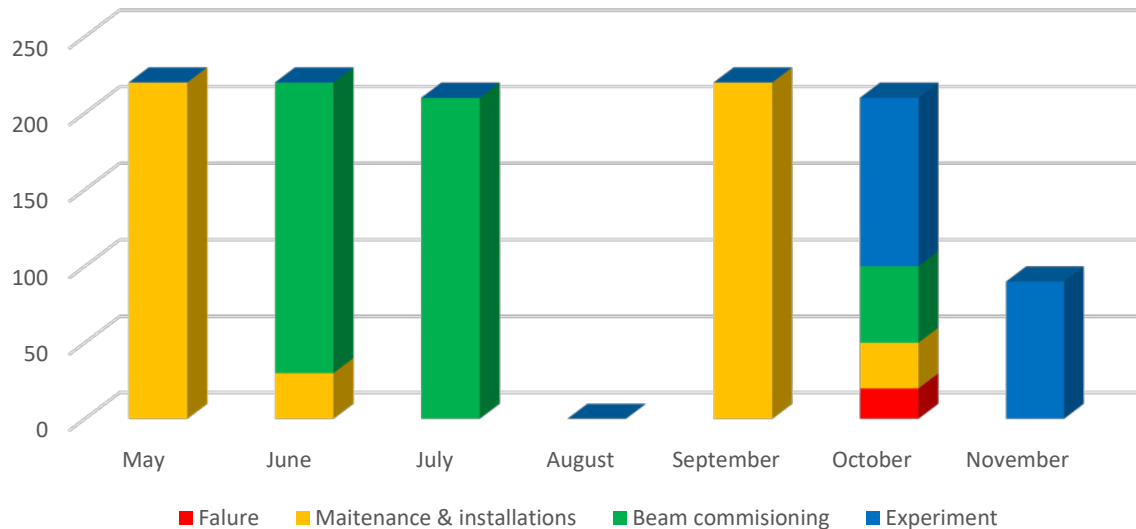
- pulse energy ~ 10 s mJ, duration ~ 100 s fs
- laser spot ~ 100 μ m
- plasma length ~ 3.5 cm
- plasma diam. ~ 0.5 mm

Courtesy: M.-P. Anania,
M. Galletti, M. DelGiorno, G. Costa

SPARC uptime

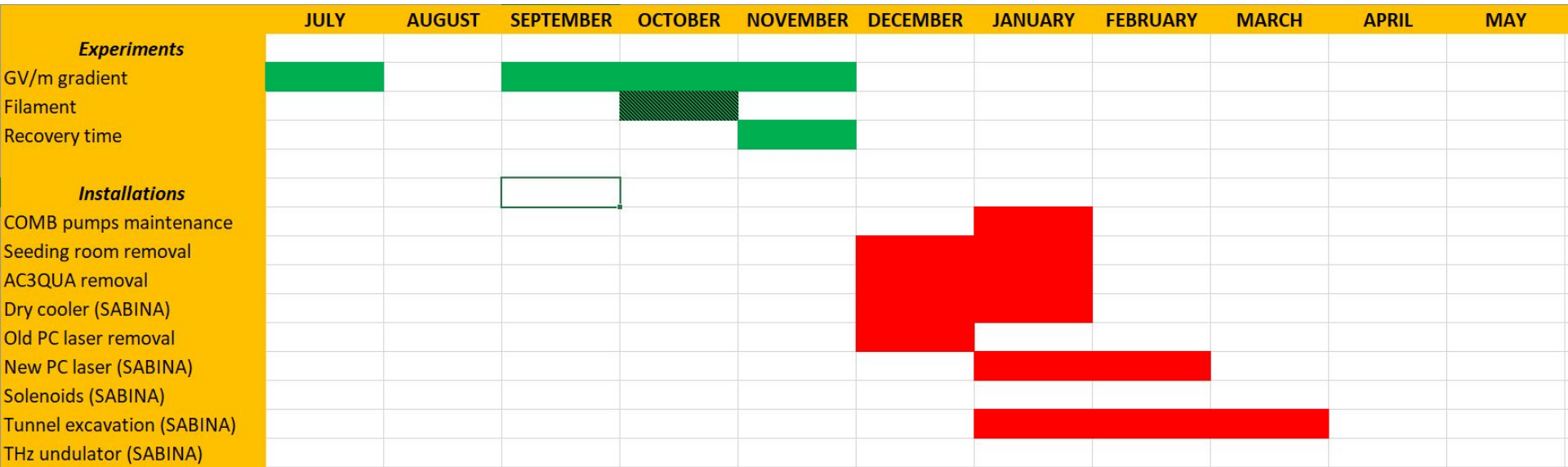


SPARC - Montly activities 2022



The whole summer run was dedicated to a new focusing system
The old focusing system was re-installed into the SPARC in September

1. **November 2022.** Continuation of the plasma experiments. We will attempt to improve our beam transport.
2. **December 2022 - April 2023.** Major SPARC overhaul, SABINA project installations. New photocathode laser, DGL line partial removal, excavation to make room for SABINA users, water and air systems at SPARC, number of smaller works/improvements/updates.
3. **April - May 2023.** Laser plasma filamentation experiments. TBA.



Thank You!

