Status of SPARC_LAB

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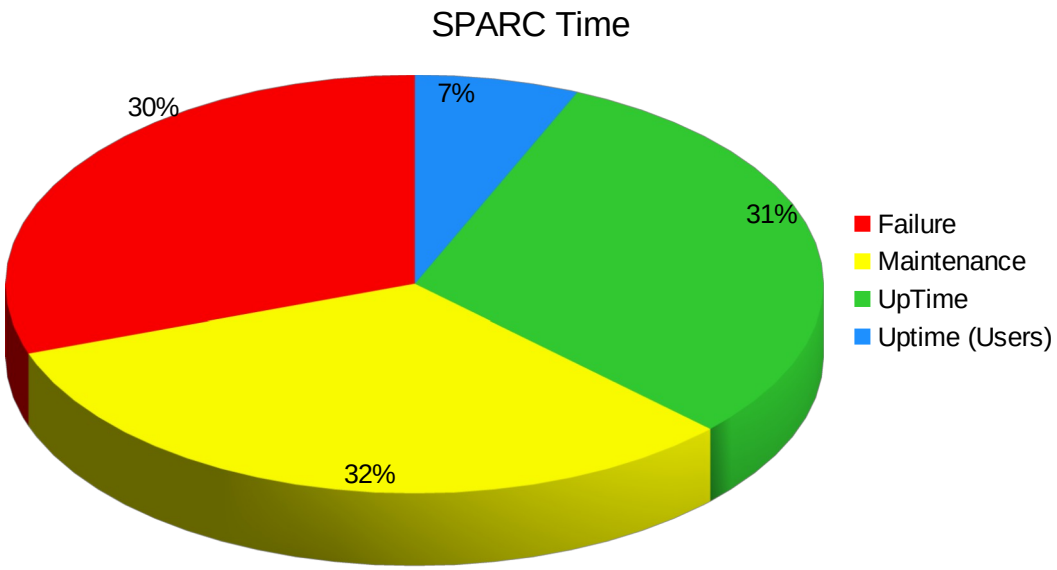
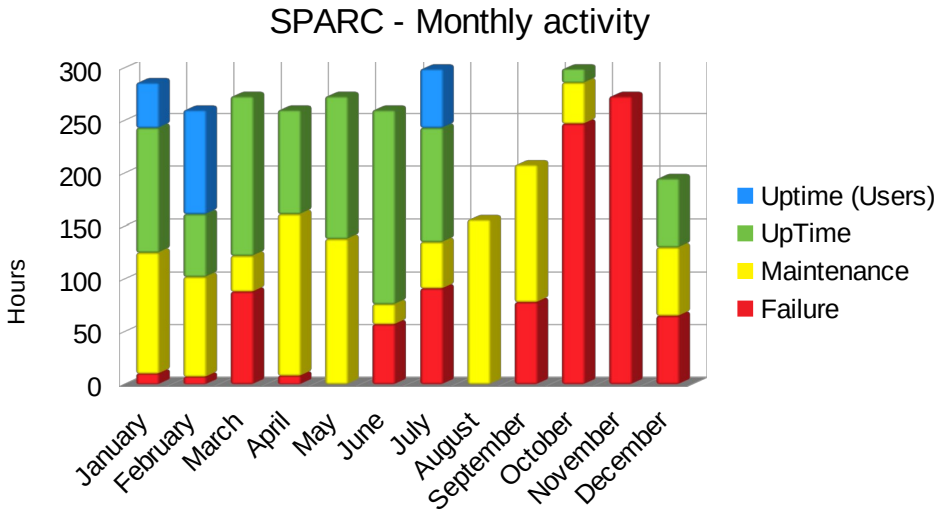
On behalf of the SPARC_LAB collaboration

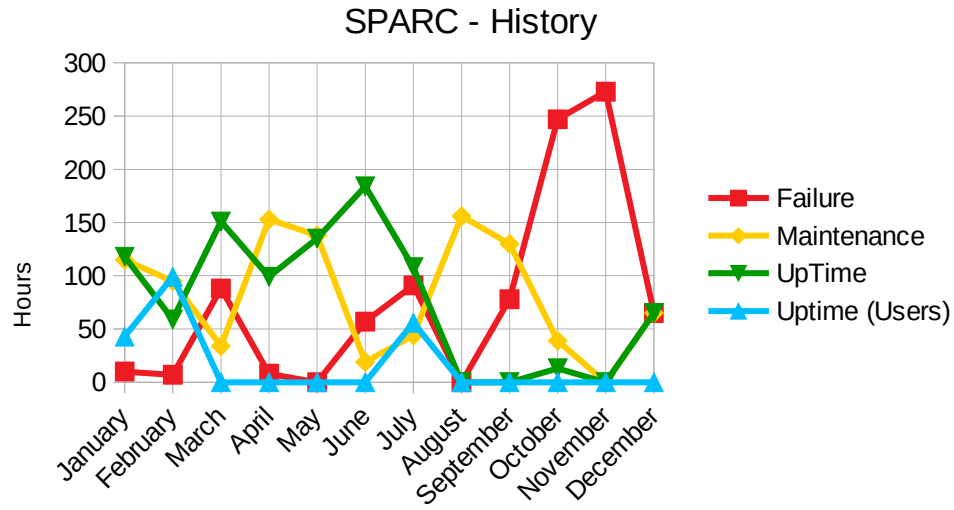
SPARC - Short summary

- Status
  - After the shutdown due to VERDI laser fault (Sept-Dec 2019), the replacement has been installed in the week of 9-13 December. One week (16-20 Dec) of run time dedicated to
    - Evaluation of jitters: <20 fs MIRA OSC. <35-60 fs RF system. **20-30 fs jitter between 2 bunches during VB**
    - Beam measurements to evaluate misalignment of AC3QUADS
- Program
  - Jan-July dedicated to plasma acceleration experiment. Several fixes done last summer
  - Installations for EXIN will proceed in parallel (during Monday openings)
  - User experiments planned for September 2020
  - Start of SABINA installations from October 2020 (GUN, Laser, Solenoids, THz undulator, ...)
- Request to Accelerator Division
  - (Urgent) replacement parts of the LASER system

Details of 2019 SPARC time







*In **2018** it was*

- *33% Up Time (SPARC+users)*
- *37% Maintenance*
- *30% Failure*

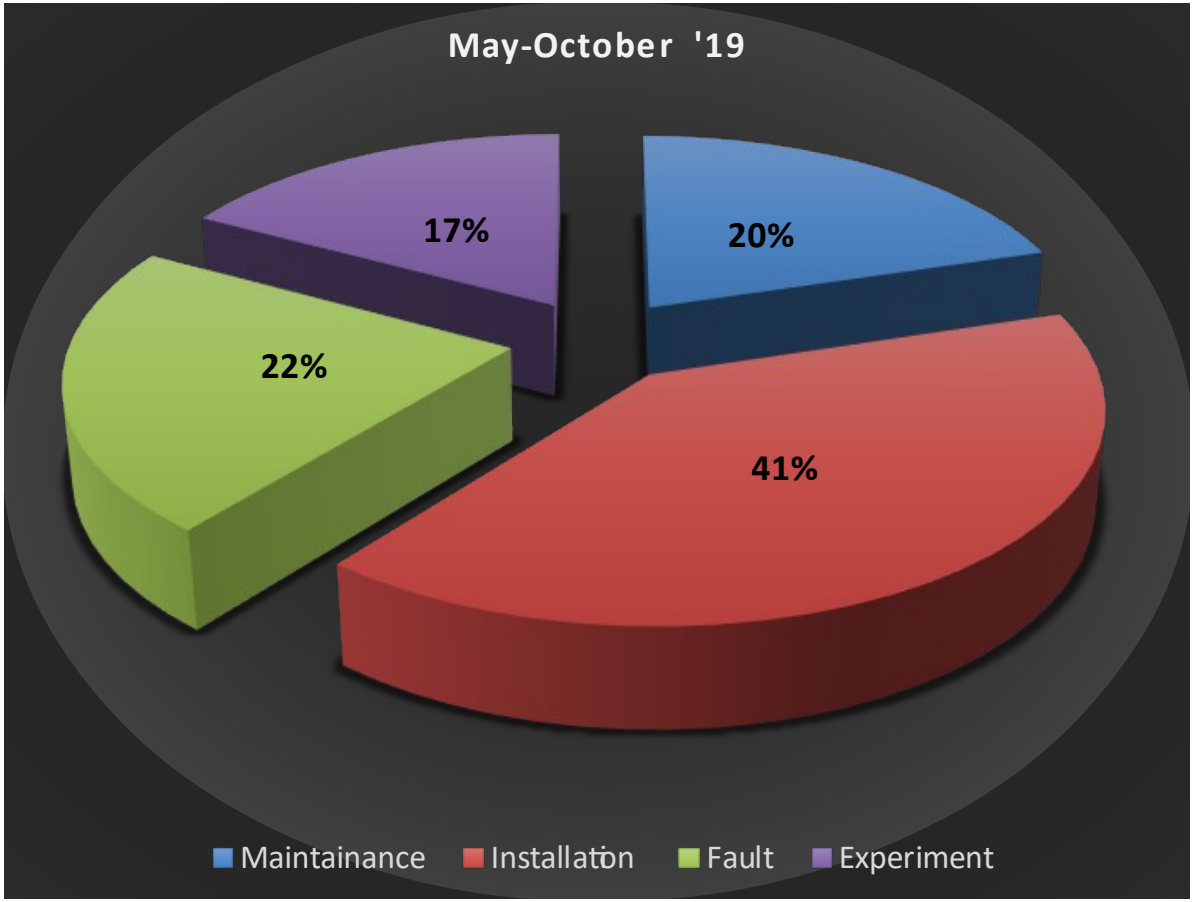
FLAME - Short summary

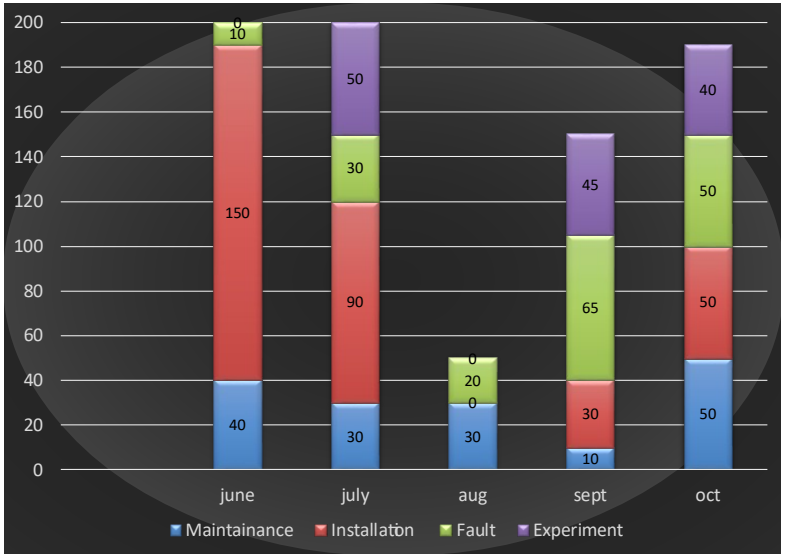
Optimize the current set-up and start X-Ray measurements.

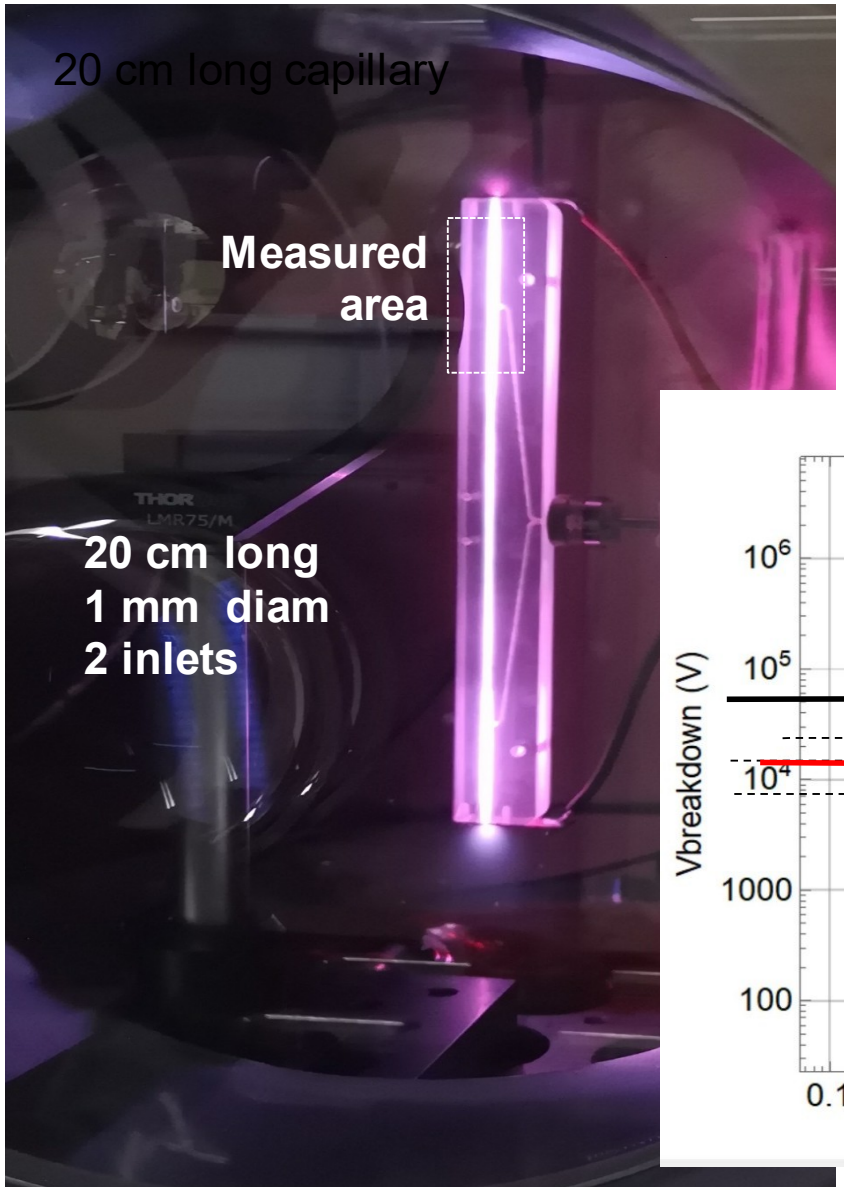
Extend the accelerator length to increase beam energy by using longer gas-jet and/or other gas target (capillary, gas-cell etc.).

Try different injection scheme to improve beam quality and tune energy, charge and emitted radiation.

Details of 2019 FLAME time

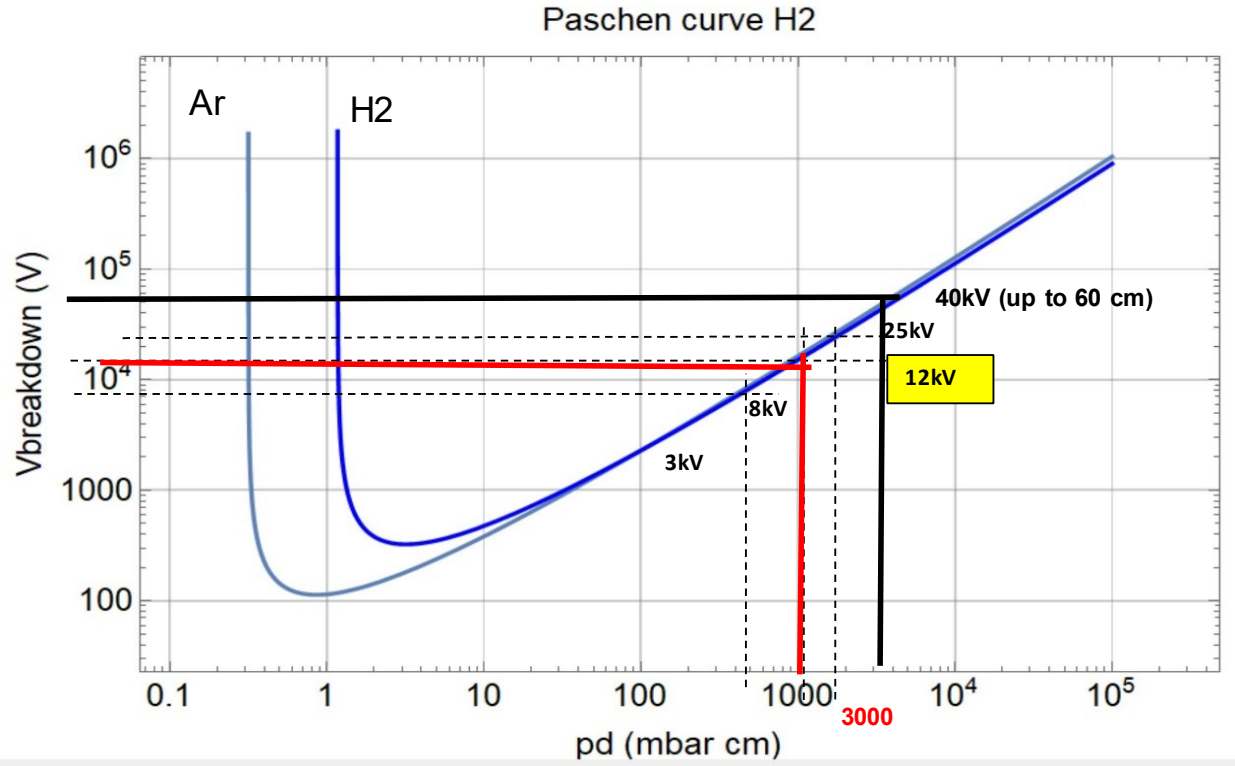






We are going to reach the EuPraxia goal by using the plasma module at Sparc_lab: here 20 cm-long capillary with two inlets can be ionized:

- Minimum voltage (Vb) 12 kV
- Plasma current 250 A
- Plasma density 3×10^{17} cm^{-3}



Compression Working Point

RF power

- Line 1 → 30 MW, Line 2 → 42 MW, Line 3 → 29 MW

RF Gun phase

- GUN → **40**°+2° from phase zero

RF phases (with respect to the on-crest ones)

- S1 → -90°
- S2 → -30°
- C3 → -36°

Magnets → **now only the last two triplets on S1 are used. AC2SOL turned off**

- GUNSOL → 213 A
- AC1SOL → 0 A, 0 A, 0 A, **110 A, 120 A**
- AC2SOL → **OFF**

Final beam parameters

Driver

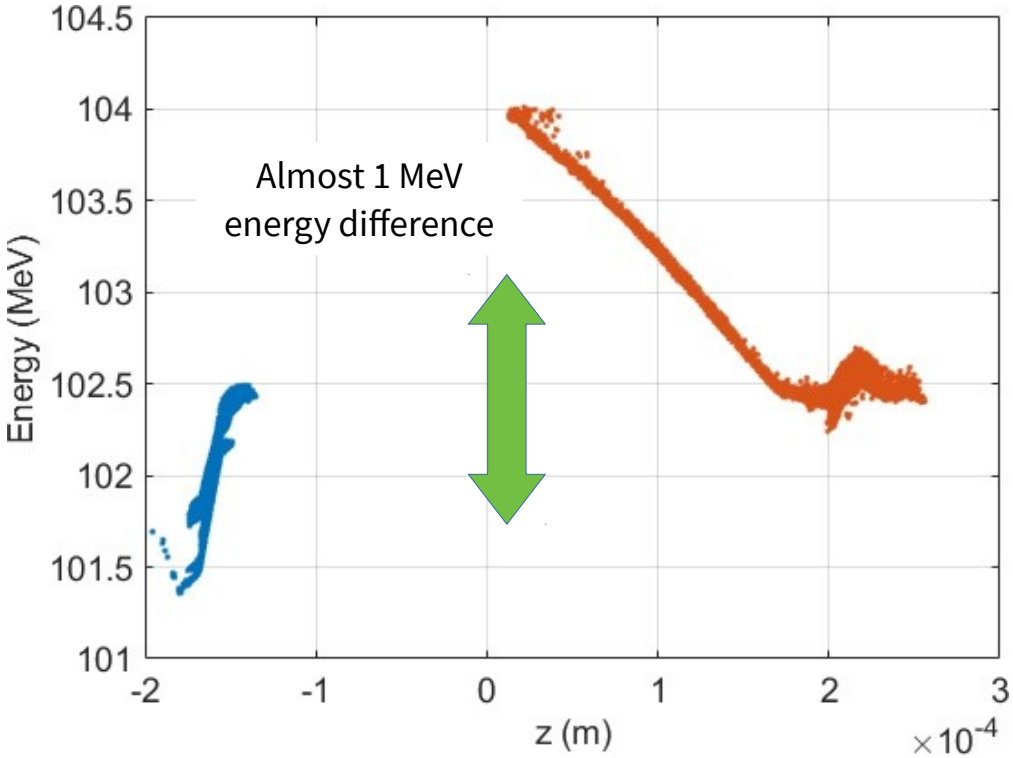
- Duration: 174 fs (rms)
- Energy spread: 0.4 MeV
- Emittance: 2.8 um

Witness (without Driver it is more over-compressed)

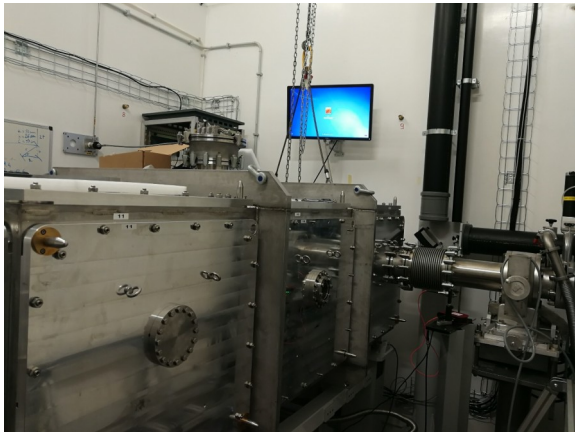
- Duration: 20 fs (rms) → 30 fs without Driver
- Spread: 0.2 MeV → 0.5 MeV without Driver
- Emittance: 0.7 um → 0.4 um without Driver

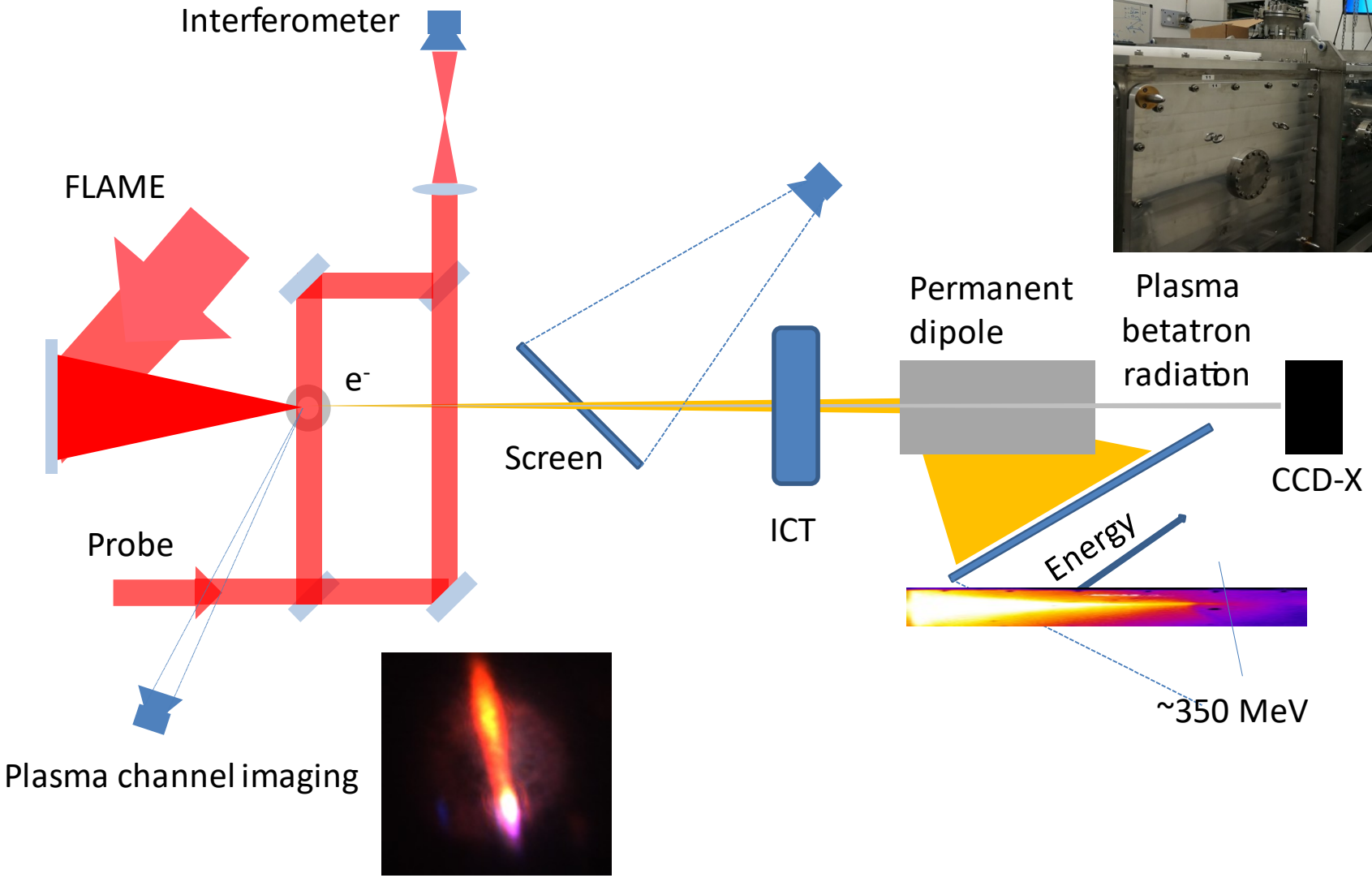
D+W (entire beam)

- Distance → 1.1 ps (330 um), Duration → 360 fs
- Energy spread: 0.44 MeV
- Emittance → 2.8 um



FLAME plasma acceleration experiment





EXIN beamline status

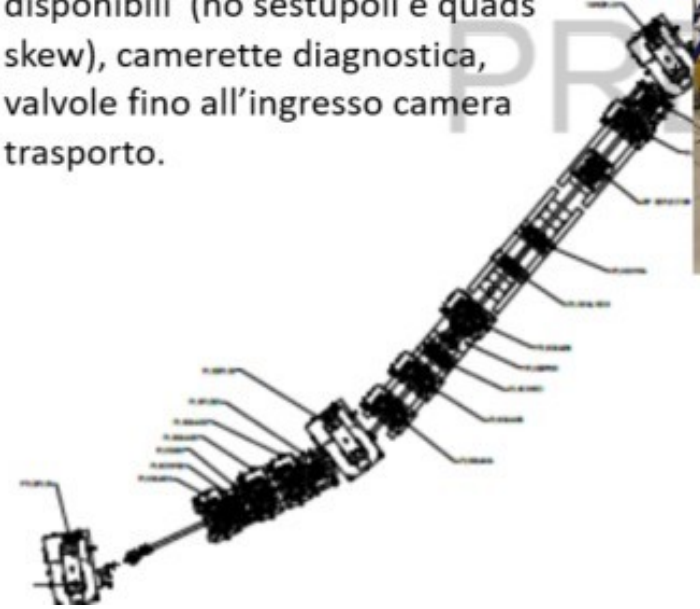
Trasporto Laser Flame:

smontato camere specchi finali e relativi supporti.

- In lavorazione i nuovi supporti
- le camere smontate da modificare mire per allineamento
- smontare tratto di linea aria compressa

Trasporto e-:

Montati girder, elementi magnetici disponibili (no sestupoli e quads skew), camerette diagnostica, valvole fino all'ingresso camera trasporto.



Camere trasporto e interazione

Posizionate in grey room per prove di vuoto statico e con H2
I montaggi proseguiranno nei lunedì di apertura fino ad Agosto

Requests

Continue with operator shifts. SPARC will run all the week

- From Monday afternoon (installations/maintenance in the morning) to Friday evening

Need to buy replacements parts for the LASER system. Currently we have:

- **1 VERDI laser → no replacement**
- **1 EVOLUTION laser → no replacement**
- **2x CFR lasers → no replacement**

Request to Accelerator Division

- **Vacuum**: planned to change all the ionic pump power supplies with newer ones, maintenance
- **SIM**: continue with EXIN installations and 3D printing of capillaries. Alignment of AC3QUADs
- **Magnets**: maintenance, new steering magnets for accelerating sections and EXIN
- **RF (low-level + LINAC)**: maintenance
- **Controls**: development of FLAME control system

Request to Technical Division

- **Electrical service**: some works planned on the laser clean room to better protect the power supply from current spikes, independent laser power line, maintenance
- **Water plants**: valves for the KLYSTRON are still missing, new PLC supervisor, maintenance