

MAX-PLANCK-INSTITUT
FÜR PHYSIK



Protons for AWAKE: Discharge Plasma Source

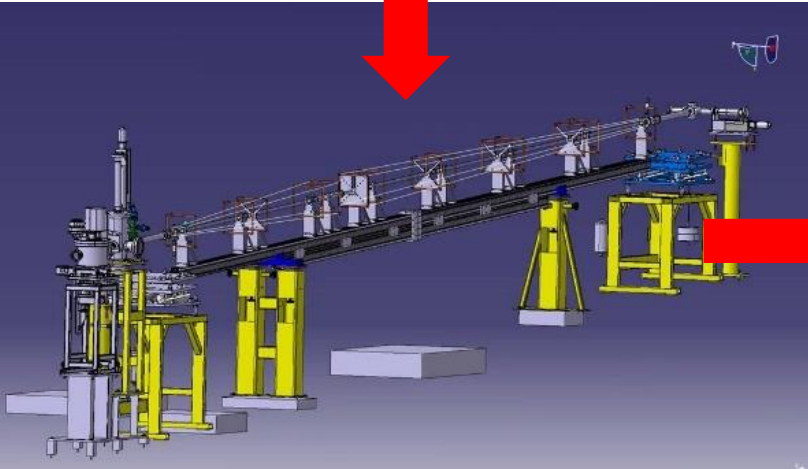
Giovanni Zevi Della Porta

PS/SPS Users Meeting - 25 May 2023

2023 plan: 2 new plasma sources

Reminder of works

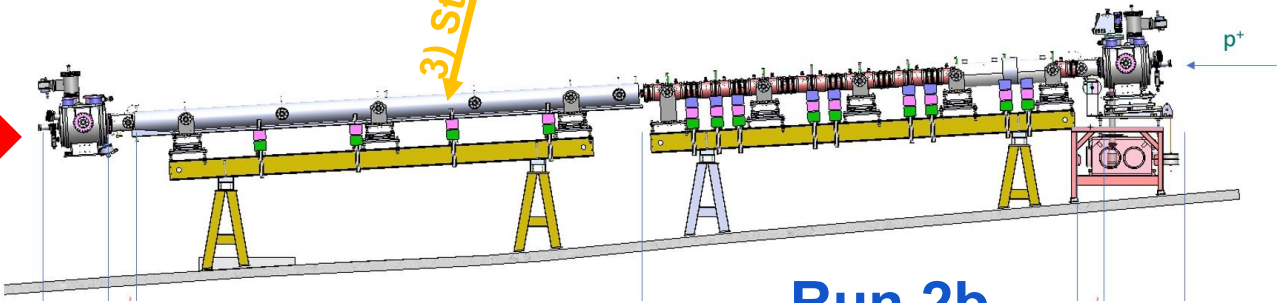
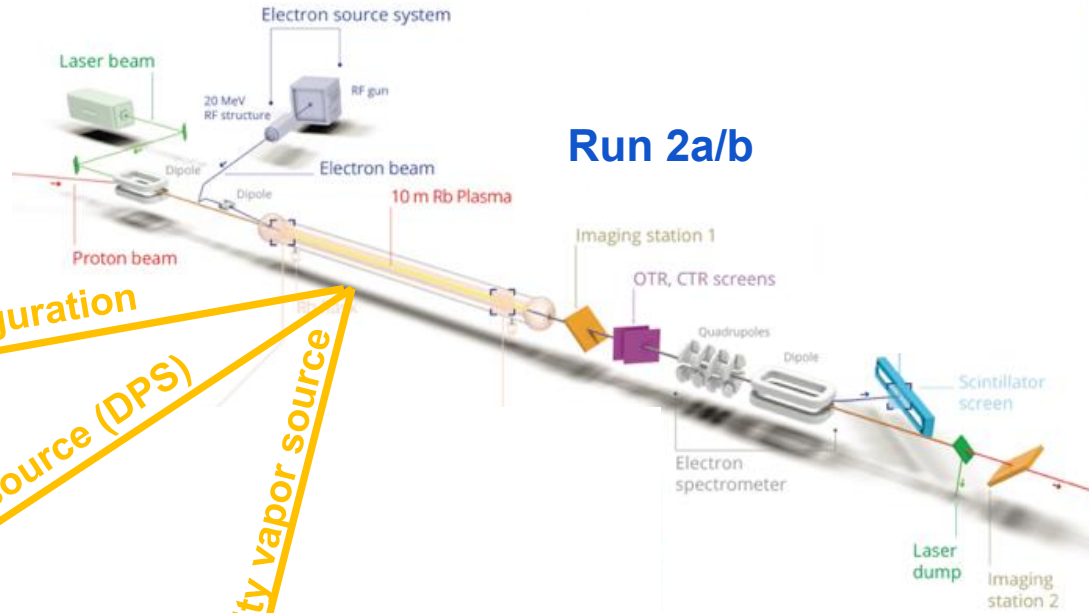
Run 2a



1) Current configuration

2) Discharge plasma source (DPS)

3) Step density vapor source



Run 2b

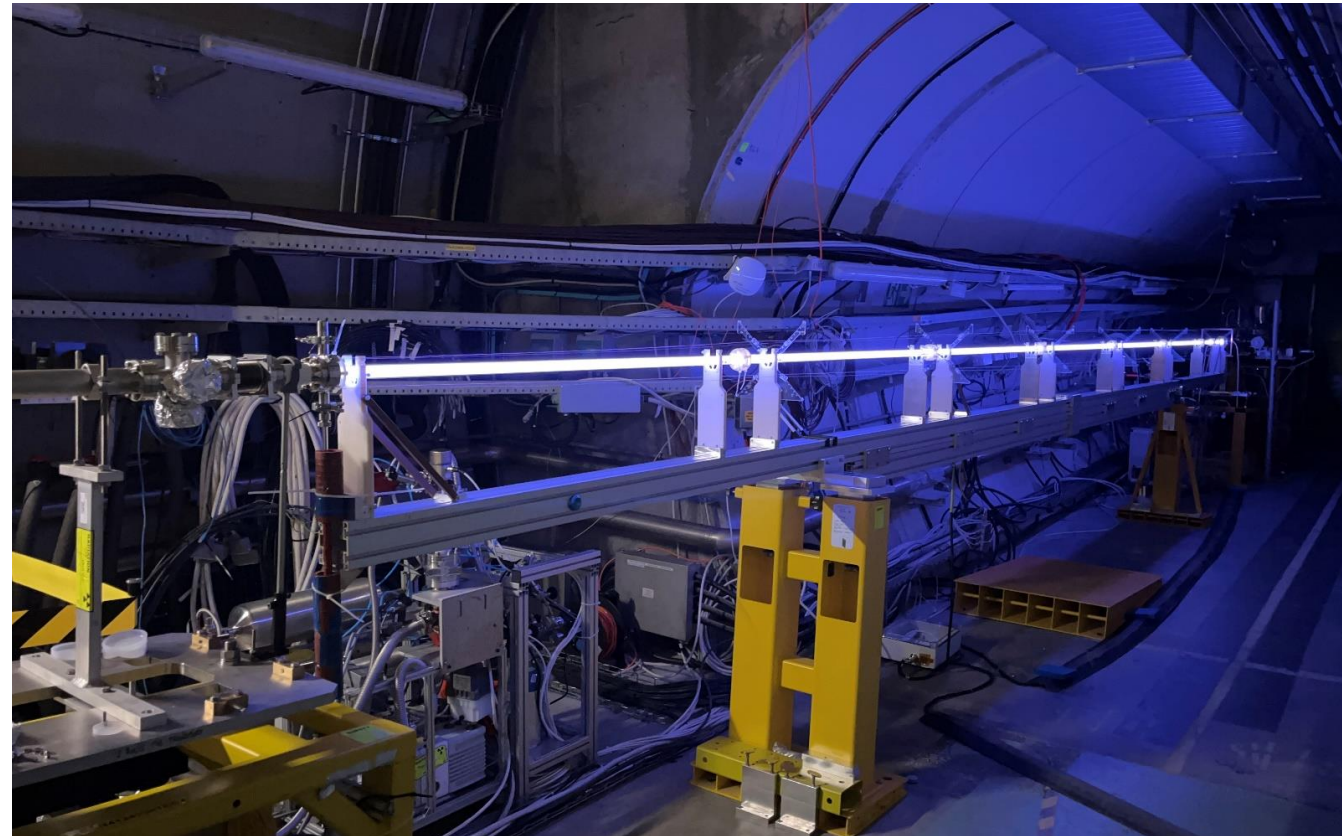
E. Guran

May 1-21 proton run: Discharge Plasma Source

- Our laser-ionized Rb vapor source cannot go beyond 10 m (i.e. few GeVs)
- The future of AWAKE requires longer plasmas to reach O(50) GeV
- **Goal of the run: demonstrate that the 10 m DPS is sufficiently stable for AWAKE**
 - DPS is modular and can be scaled to O(100)s of meters

Additionally, the DPS allows to:

- Change length (3.5, 6.5, 10 m) and continuously measure plasma light
 - —> **study development of self-modulation** ✓
- Change gas (He, Ar, Xe)
 - —> **study effect of ion mass / ion motion** ✓
- Install a BTV screen ~10 cm after exit
 - —> **study filamentation** (i.e. short-lived transverse structure of proton beam) ✓
- Plus (as with Rb): change proton intensity and plasma density to affect wakefields ✓



AWAKE issues during 3 weeks

- Week 1:
 - Monday: issue with digital camera FESA, patched on Tuesday
 - Sunday: issue with plasma source power supply, replaced with spare
- Week 2:
 - Monday: lost PC controlling fast cameras. Replaced in early-morning access
 - Friday: disconnected filter on BTV screen. Re-connected in early-morning access
- Week 3:
 - Tuesday: Access system failure caused patrol loss also in CNGS area

Three weeks statistics

- Beam almost every day, with large variations mainly due to LHC
 - Extractions per day (>0): 1000 ± 450
 - Hours per day: 10 ± 2 expecting beam, 6 ± 3 receiving beam
 - Availability: $57\% \pm 22\%$
- Coped with challenging p^+ beam conditions thanks to simplified AWAKE setup (no laser, no e^-)

