

MAX-PLANCK-INSTITUT
FÜR PHYSIK



Run Coordination: preparation for Run 2b

Giovanni Zevi Della Porta

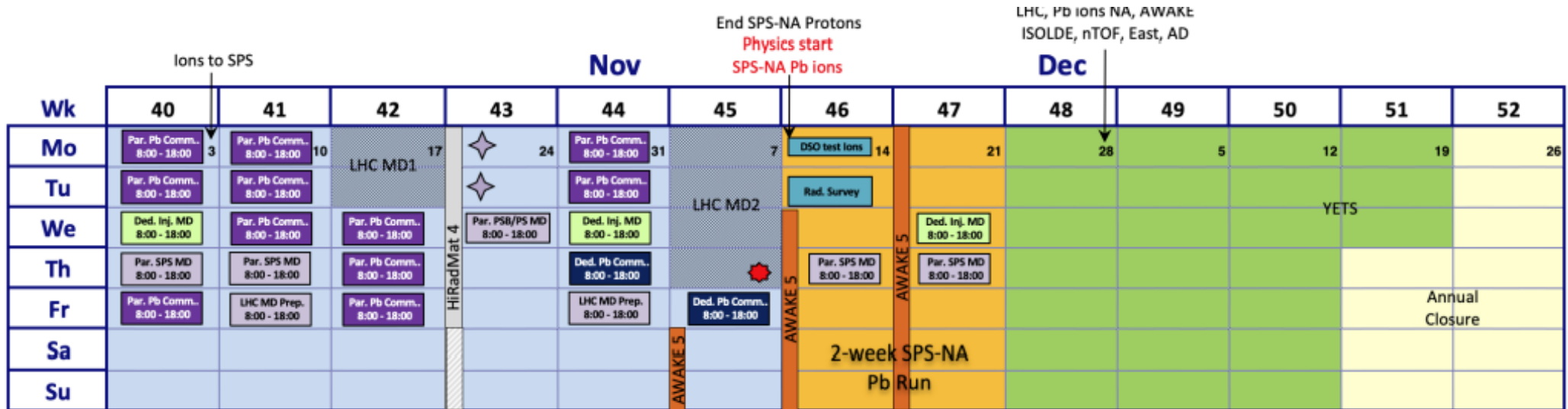
AWAKE Collaboration Meeting - 25 April 2023

<https://indico.cern.ch/event/1256286>

Looking back: November 2022

- First run with Heavy Ions. No major issues for AWAKE, better beam availability than expected.
- 1 day dedicated to e⁻ acceleration:
 - Prepare for Run 2b experiments
 - Emittance measurement with new cameras → See Fern's talk
- ~10 days dedicated to:
 - Plasma density ramp at the entrance: electron/proton timing scans
 - Hosing (electron-bunch seeded): misalignment by moving proton bunch position
 - SMI of wide proton bunch → See paper by Livio and Patric on SM development
 - eSSM and SSM at higher plasma densities
 - Plasma light: laser/proton timing scans

Version 1.3.

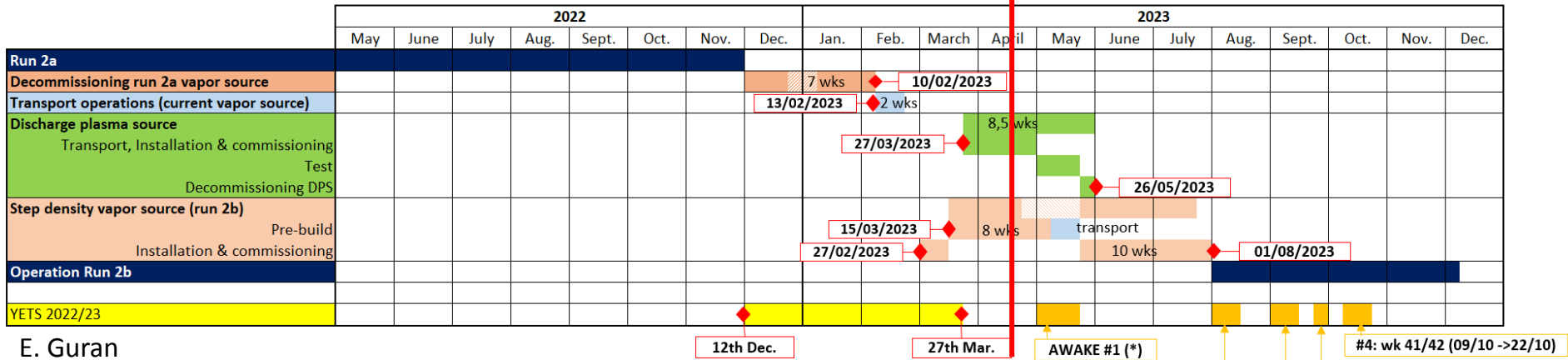


2023 schedule

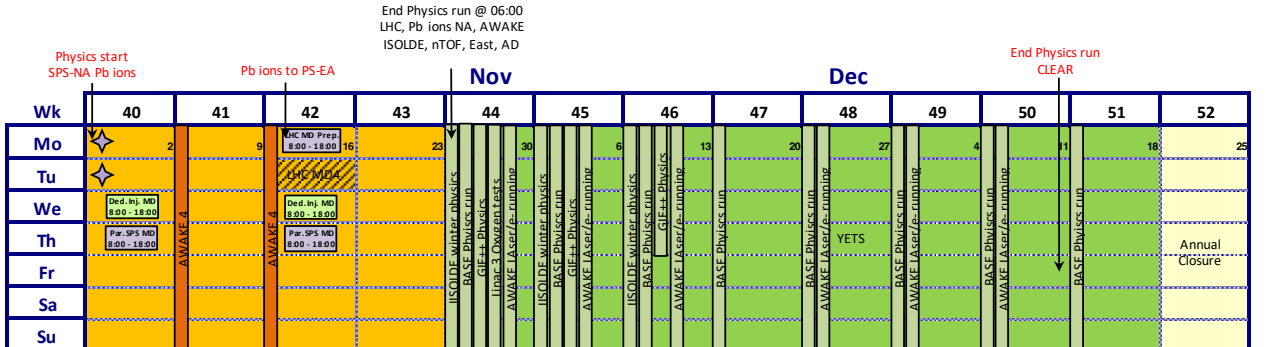
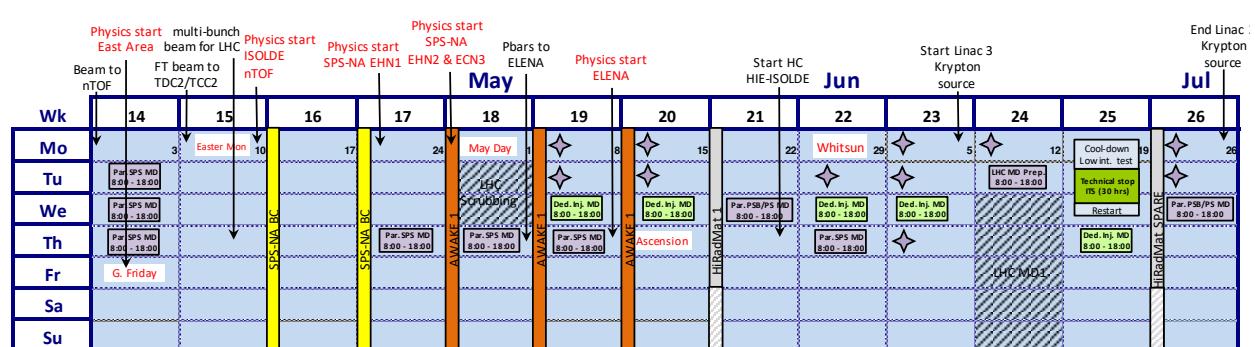
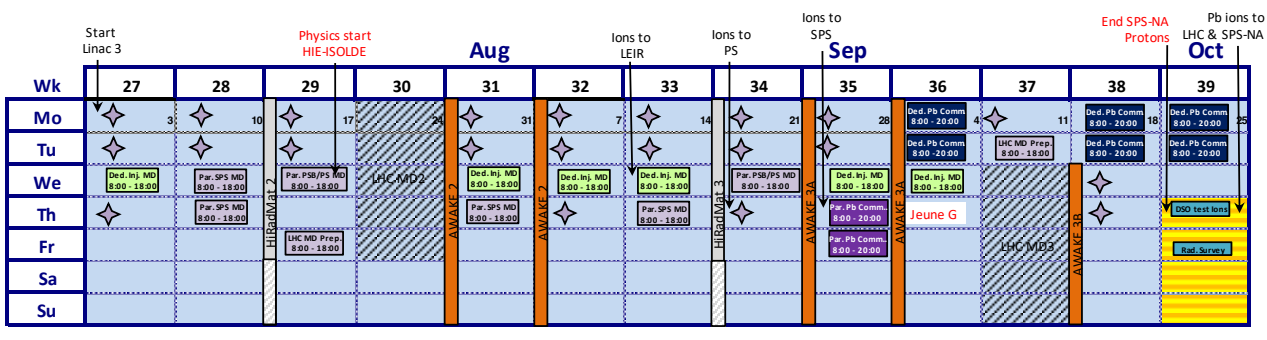
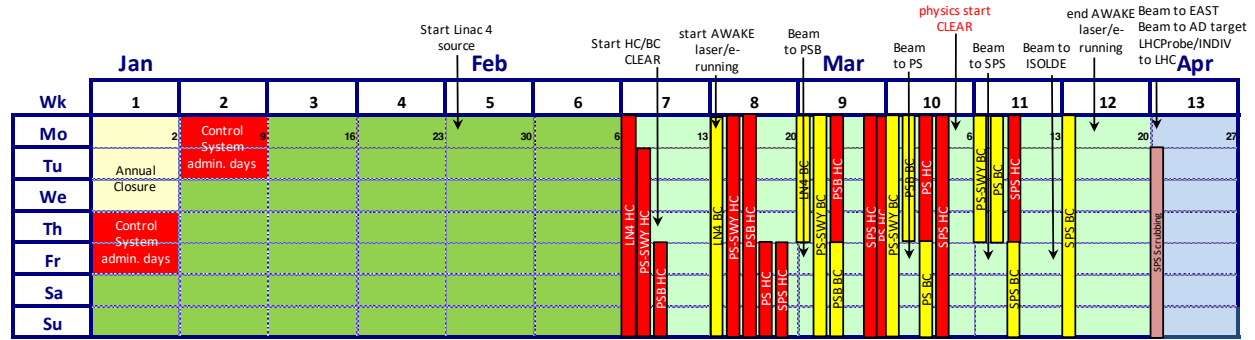


- Challenging year: tunnel activities worthy of a long-shutdown, on top of ~10 weeks of protons

- Proton runs:
 - May 1-21
 - July 31 - August 13
 - Aug. 28 - Sept. 10
 - September 20-24
 - October 2-22

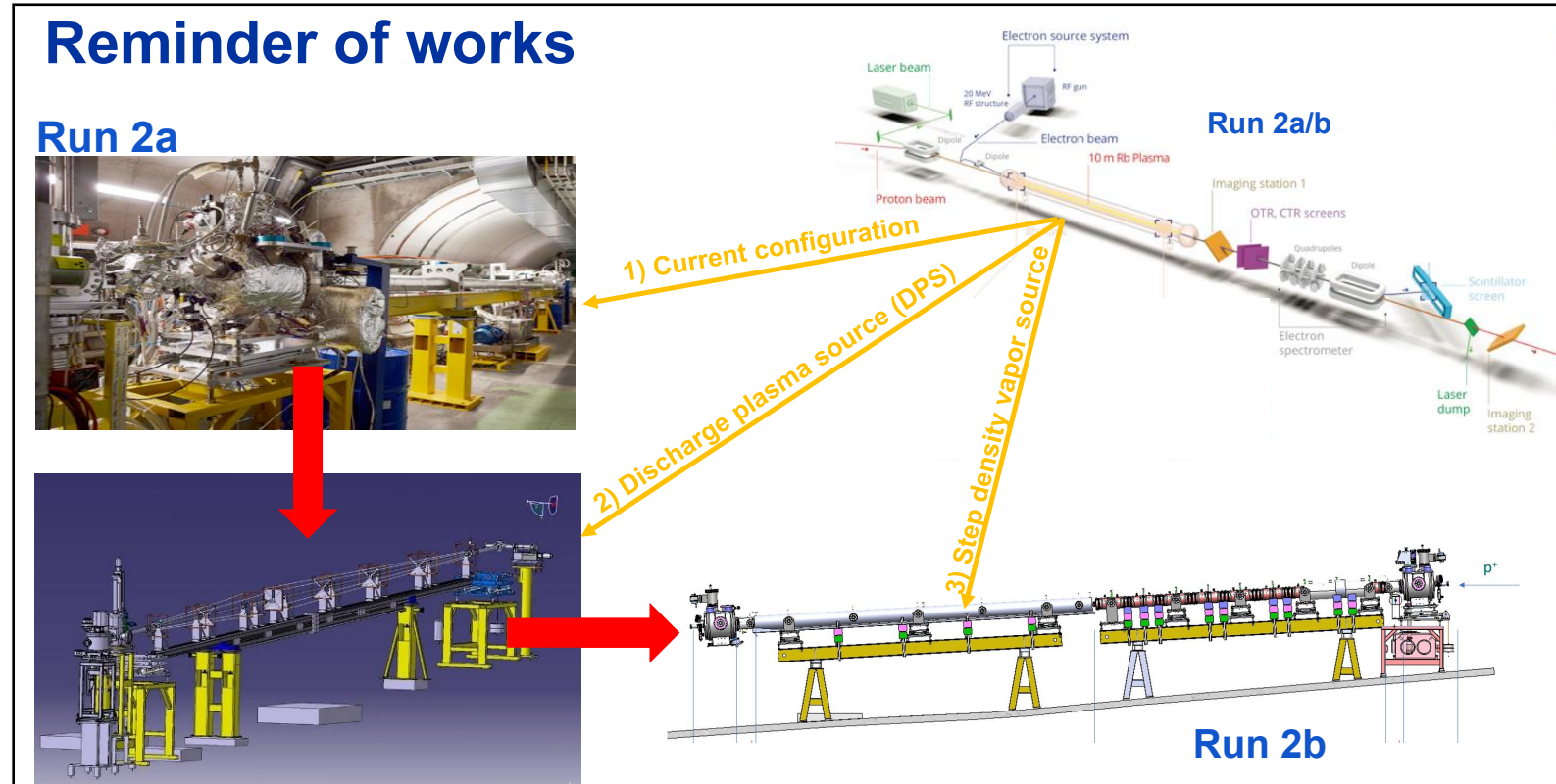


E. Guran



Organization and Meetings

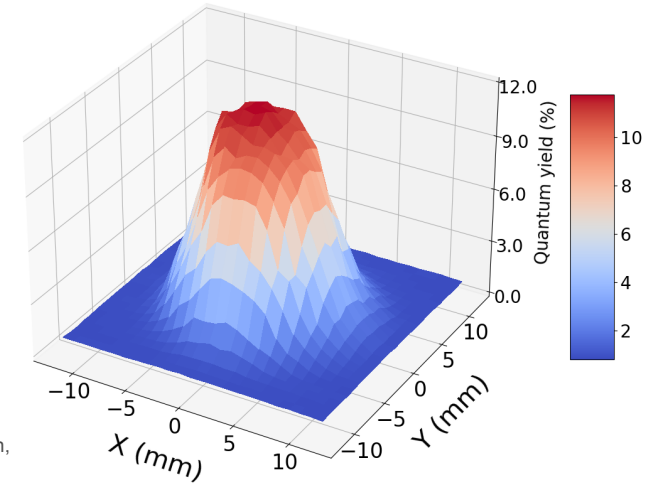
- Coordination installation run 2a to 2b (E. Guran):
 - <https://indico.cern.ch/category/14915/>
- Weekly Experimental Activities (L. Verra):
 - <https://indico.cern.ch/category/8675/>
- Monthly Run Coordination (G. Zevi Della Porta):
 - <https://indico.cern.ch/category/8675/>



E. Guran

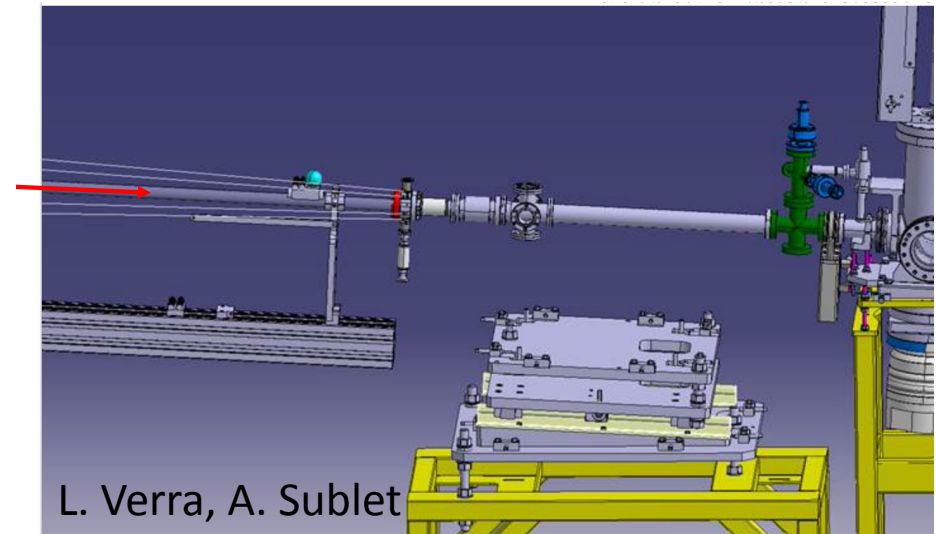
2023 timeline and highlights, so far

- Jan-Feb:
 - Decommission Run 1 vapor source
 - Electron photo-injector vacuum leak: install spare cathode
 - Install new corrector magnet on electron beamline
 - Cherenkov Diffraction Radiation (ChDR) BPM upgrades
- March:
 - Recovered and commissioned electron beam with new cathode. QE measured
 - e⁻ beam trajectory and optics studies → See Vittorio's talk
 - e⁻ beam for ChDR BPM → See Beth's talk
 - Transport/Install Discharge Plasma Source → See Alban's talk
- April:
 - Commission DPS → See Alban's talk
 - Install new screen near plasma exit
 - Install 4 new cameras for plasma light
 - First test of DPS with proton beam



Eduardo Granados, Miguel Martinez-Calderon, Steffen Doebert, Ralf Rossel, Eric Chevallay

Parameter	2023	2022	2021
QE	15%	25%	5.5% (used)
Saturated QE	4%	5%	1.8%
Saturation fluence	<5 uJ/cm ²	2.5 uJ/cm ²	4 uJ/cm ²

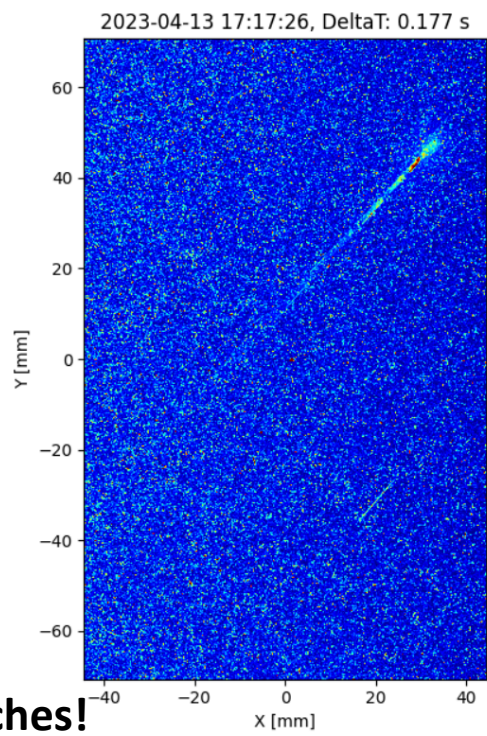


L. Verra, A. Sublet

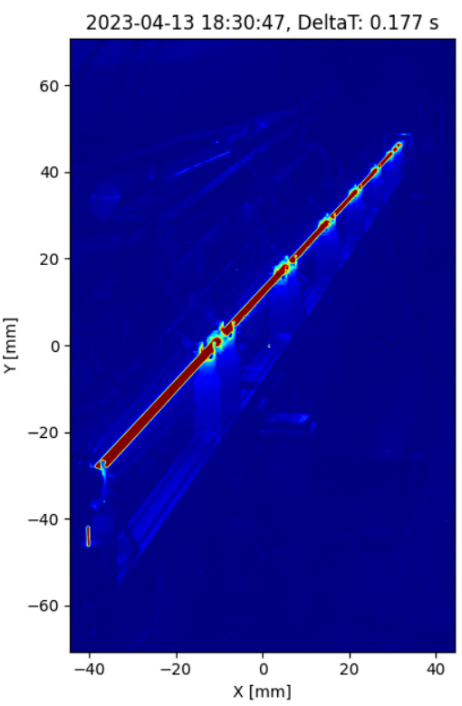
Successful test of diagnostics and DPS with protons

- Protons on new BTV screen
- DPS signal synchronous with proton arrival
- Diagnostics synchronous with protons and DPS
- Observed micro-bunching at expected frequency

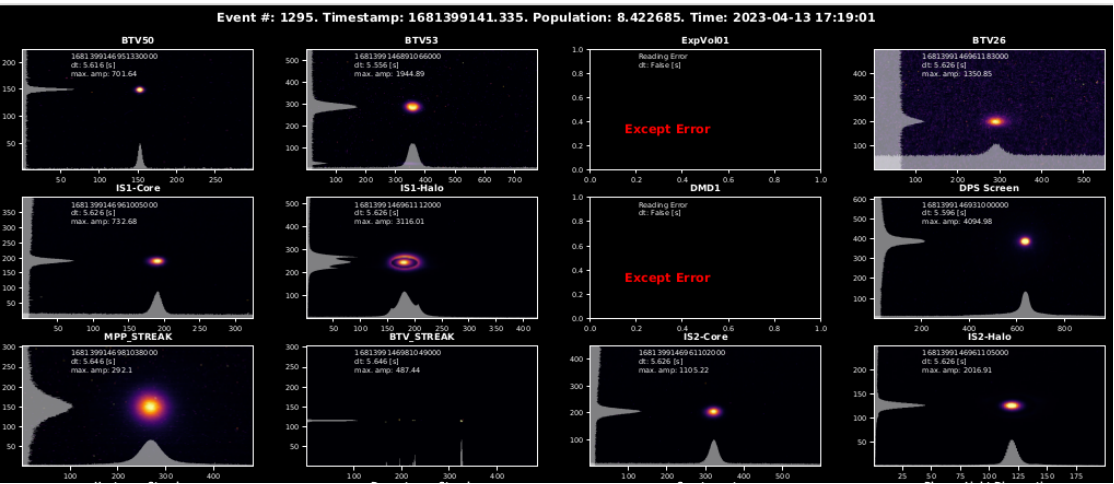
Fluorescence light of p+



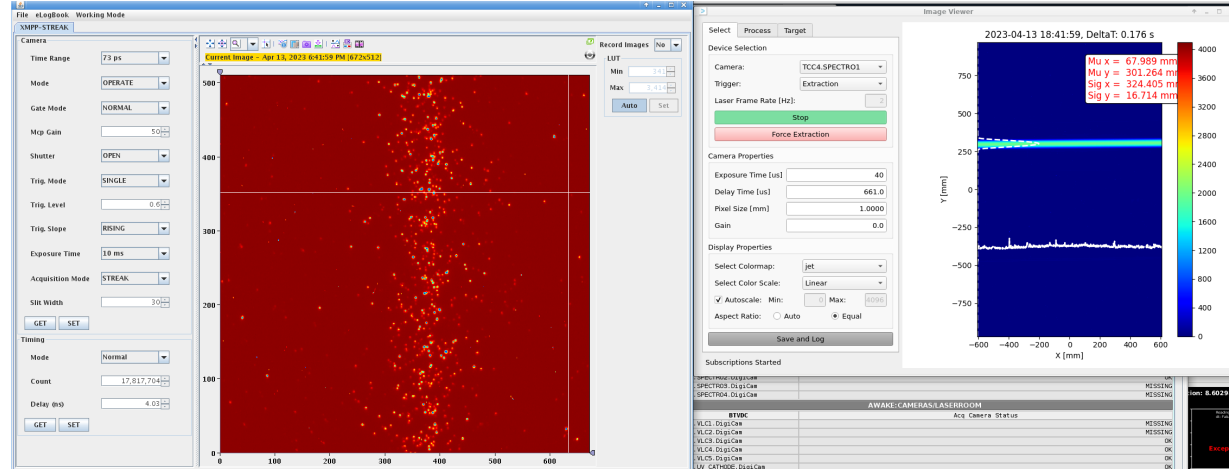
Plasma discharge



Protons on all BTVs



Microbunches!



2023 Activities/Issues

Run periods

- (laser) Align marker [and IR] on streak camera ✓
- (e) Estimate uncertainty from IN/OUT screen motion ✓
- (e) Commission orthogonal steering with new corrector ⚠ ✓
- (p) Estimate position uncertainty on YAG vs OTR screen
- (e) Test 4D tomography of beam ⚠ ✓
- (e) Commission optimizer to match beamline to injector ⚠
- (e) Test cycling (vs de-gaussing) for hysteresis ✓

BTVs and Streak Camera

- Complete commissioning of BI DAQ ⚠
- Replace broken cameras: DMD1, 426.CORE ✓
- Move hardware IN position for CTR screen (avoid damage) ✓
- Align BTV lines ✓
- Align Downstream-to-Upstream line, marker laser line ✓
- Install OTR screen on BTV354 ✓
- Install new OTR screen at plasma exit ✓
- Improve imaging in optical line to upstream streak camera ⚠
- Estimate noise on Basler cameras before/after run
- Install new server for additional cameras

Rubidium

- Add automated warnings when Rb open

Other Instrumentation

- Fix BPM 412319 sending no data ✓
- Install additional channels to Oasis scope ⚠
- Fix eBPM calibration signal
- Add proton/OTR light to DPS scope ✓
- Calibrate new BCT with pilot proton beam

Laser

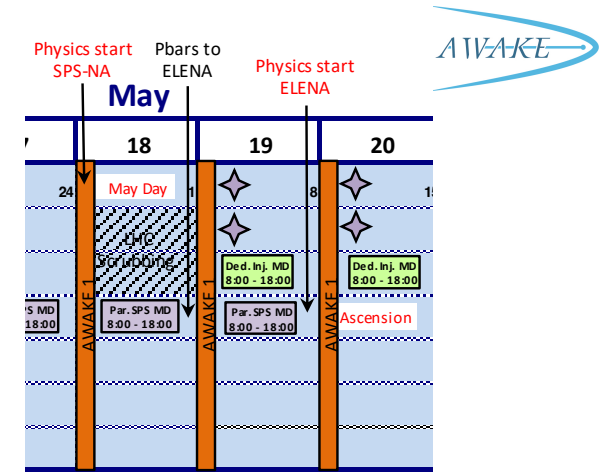
- Replace Energy Meter 4
- Set up remote locking to RF ✓
- Upgrade laser alignment, add diode laser to virtual line
- Reflective optics project ⚠
- Enable LBDP2 automatic movement
- Add protection for BTV 412442 in interlock ✓
- Shift delay stage in TCV4
- Repair UV line optics causing dark area in beam profile
- Produce new spare cathode

Data Acquisition / Data Quality

- Run 2 simultaneous StreakScan GUIs
- Plasma light not recorded in 1Hz EventBuilder ✓
- Add ICT to Event Builder (check synch at 1 Hz)
- Automated frequency plot from streak camera ✓
- Check DPS+DAQ with calibration trigger ⚠ ✓
- Add PMT settings to Event Builder

Datataking during the DPS run

- Working on planning for physics topics, plasma and beam conditions
 - Accesses during 2nd and 3rd Wednesdays (no beam from SPS)



P. Muggli (<https://indico.cern.ch/event/1276807/>)

Possible 3 week plan with physics topics



POSSIBLE EXPERIMENTAL PROGRAM



default:
 3e11p+ vary for SMI, if interesting for CFI and Ion Motion
 narrow bunch (except CFI)

Mo.-Tues.: **start- scan delay DFT, f_mod, Ar, 1-5e14/cc**

Wed.:

Thurs.: **SMI, plasma light, Ar, 1-5e14/cc, 1-3e11p+**

Fri.-Sat.: **CFI: wide bunch, Xe, 1e14-2e15/cc, scan delay DFT, f_mod, Xe**

Sun.-Mon.: **ion motion-SMI Ar-He, 1-5e14/cc, scan delay DFT, f_mod, He**

Tues.: **H**

Wed.-Thurs. am: 10m -> 6.5m+3.5m

Thurs.-Sun.: **SMI, Ar, 1-5e14/cc, 1-3e11p+, 6.5m, 3.5m**

Mon. Tues.: **CFI wide bunch, Xe, 1e14-2e15/cc, ion motion-SMI Ar-He, 1-5e14/cc,**

Tues. pm (alignment)-Wed.: 6.5m+3.5m -> 3.5m+6.5m

Thurs.-Sun.: , (3.5+6.5)m density step, need to know step height, repeat what is interesting

Topics:
Plasma: Ar, Xe, He
SMI: Ar
CFI: Xe
Ion motion Ar-He
H: low density, flat beams?
 Plasma light: `sprinkle`

L. Verra (<https://indico.cern.ch/event/1263911/>)

Possible CFI scans

	1x10 ¹⁴ /cc	5x10 ¹⁴ /cc	1x10 ¹⁵ /cc	5x10 ¹⁵ /cc
L=3.5m	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹
L=6.5m	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹
L=10m	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹	Nb=1x10 ¹¹ Nb=3x10 ¹¹

Personpower

- Assigned roles and shifts for daily operations
- Account for training of new students, allow for thesis of senior students
 - 0) DPS (2 people)
 - 1) DAQ (Event Builder, Basler reboots), Data Quality, CCC
 - 2) Streak camera timing/settings/alignment
 - 3) Plasma light (PMT)
 - 4) BTV, Gated Cameras, Grating Camera
 - 5) Responsible for the measurement
- Many experts needed “on-call”, if there are issues
 - Unique conditions, extremely tight schedule: run is FINISHED after 3 weeks, no 2nd chance!
 - Timing, Instrumentation, Vacuum, Controls, Marker Laser
 - CERN RP and AWAKE RPE prepared for access every day, including weekends

Thinking ahead

- Current focus is on the DPS run
 - Excellent performance with test beam is encouraging
- The rest of the year will be even more challenging
 - New plasma source: intense installation in June/July
 - 7 weeks of protons in a 12-week period (August-October)
 - Several key people leaving or writing PhD theses
- Perfect chance for new and returning collaborators to jump in!

