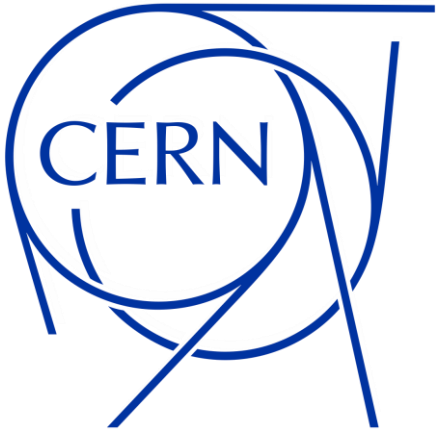


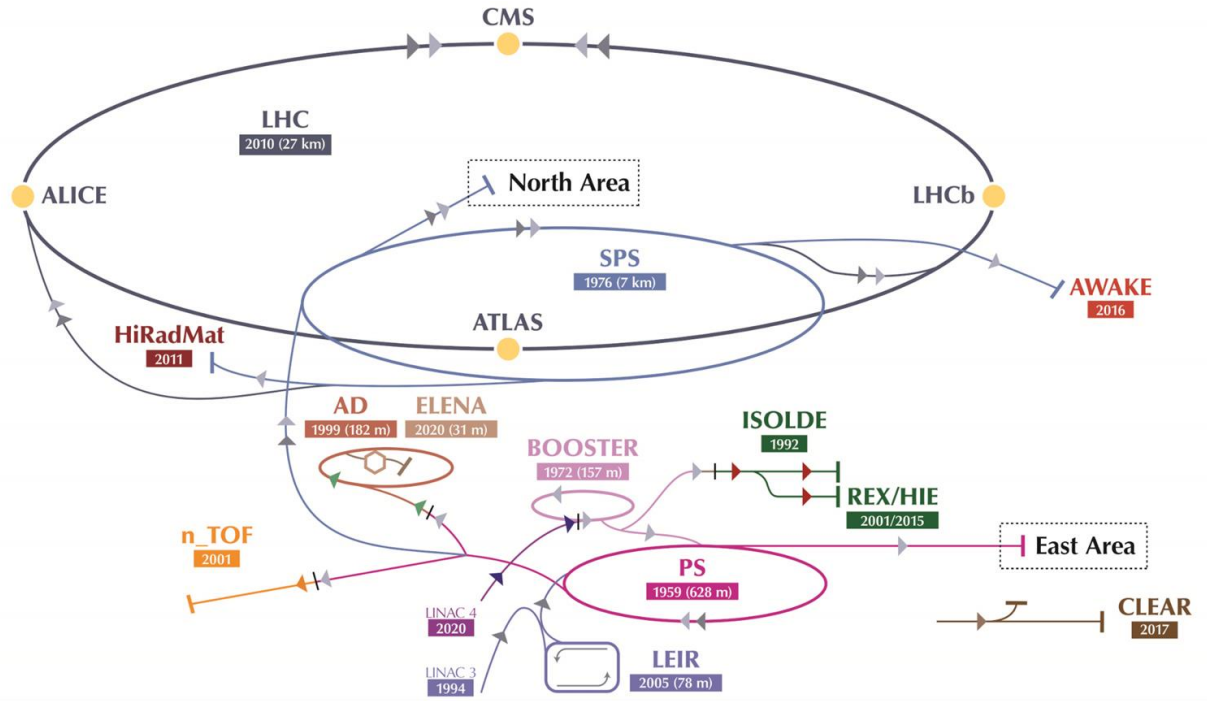
Processing and Analysis of HiRadMat Beam Line Data

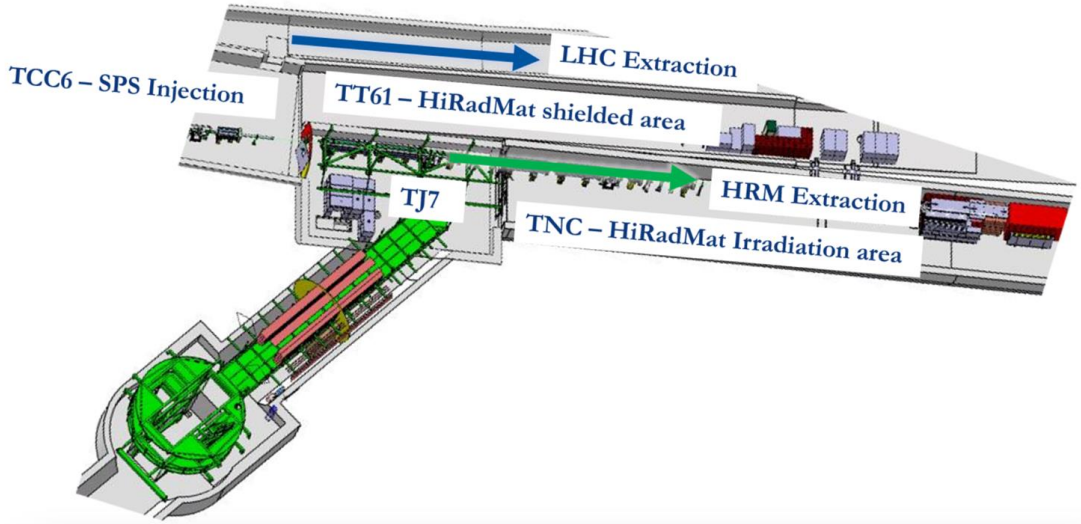
Julia White, Supervisors: Nikos Charitonidis, Alice Goillot

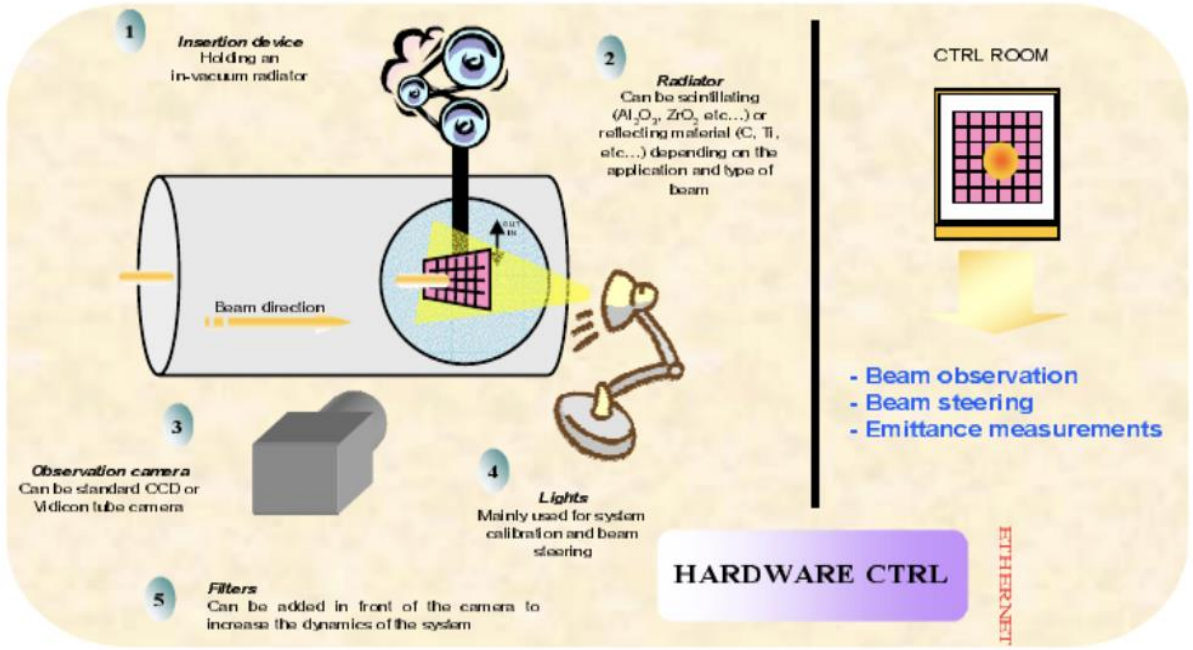
7/25/2024

HiRadMat

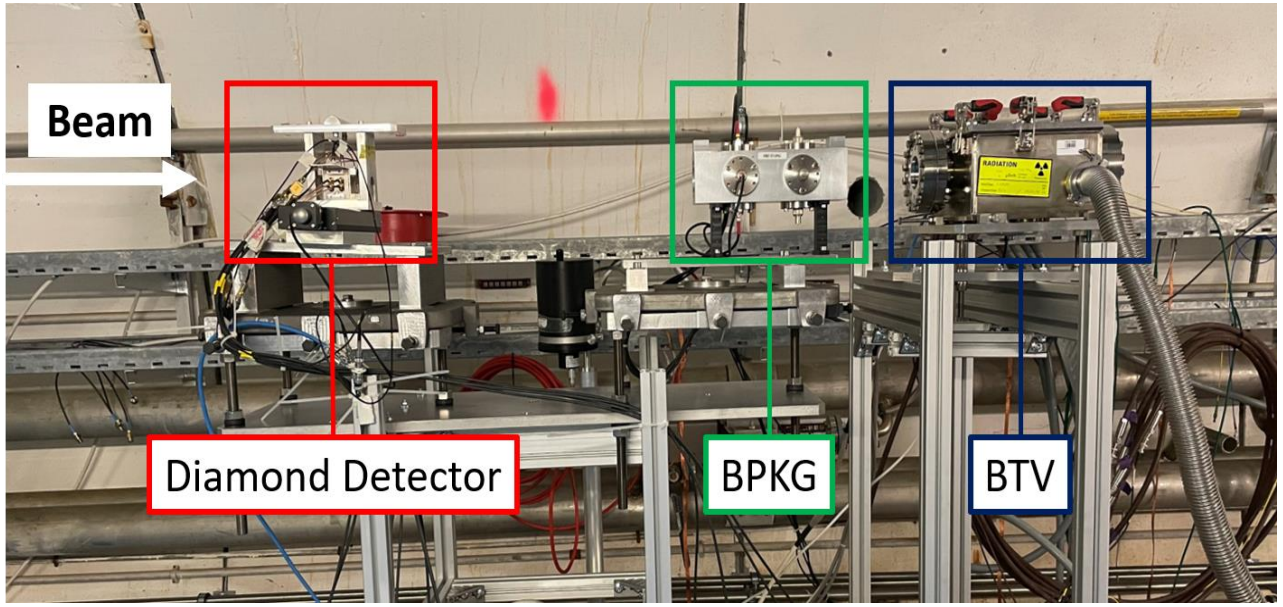
- High Intensity Radiation to Materials
- Test the effects of short beam pulses on materials and accelerator components

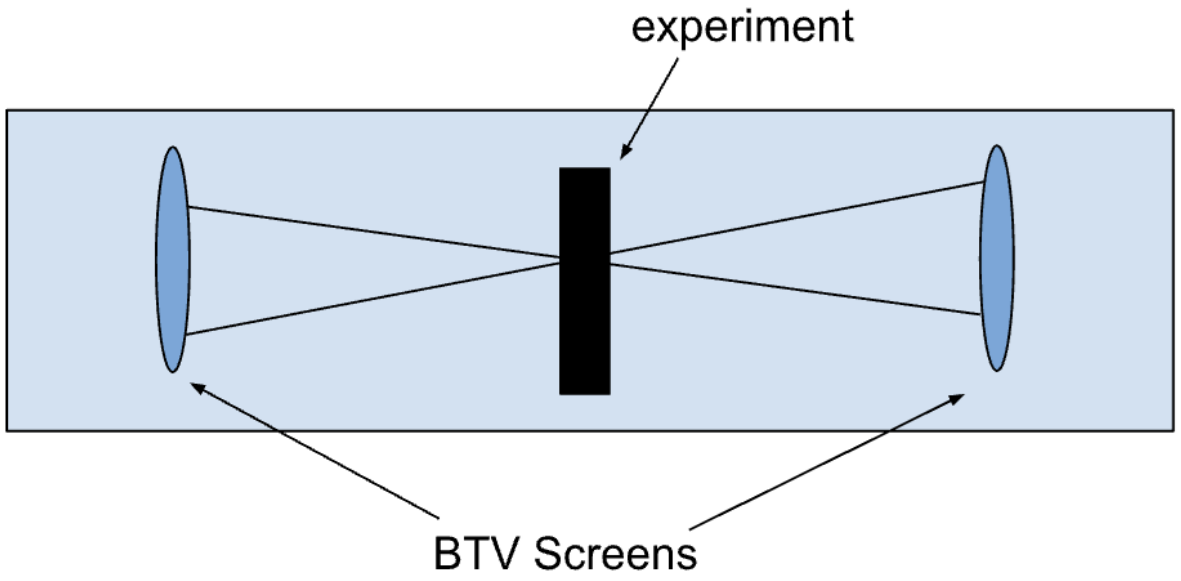




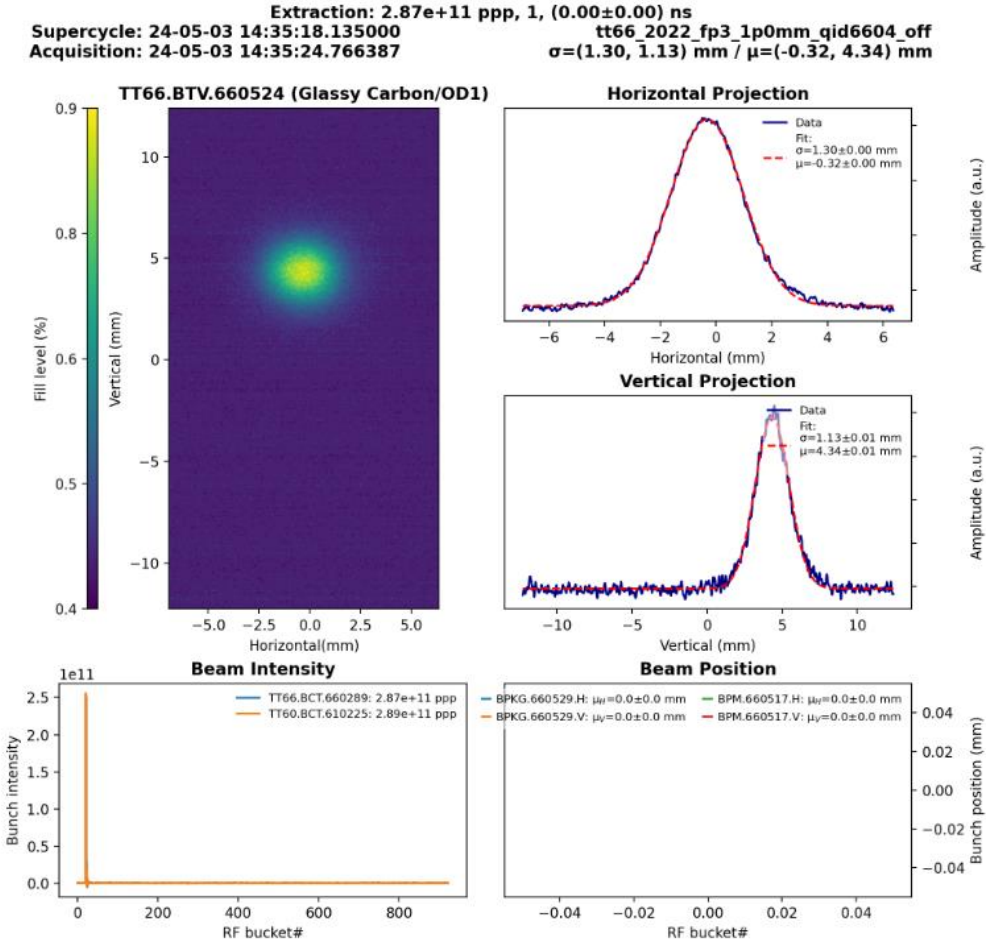

1
Insertion device
Holding an
in-vacuum radiator
2
Radiator
Can be scintillating
(Al_2O_3, ZrO_2 etc...) or
reflecting material (C, Ti,
etc...) depending on the
application and type of
beam
CTRL ROOM
Beam direction
- Beam observation
- Beam steering
- Emittance measurements
3
Observation camera
Can be standard CCD or
Vidicon tube camera
4
Lights
Mainly used for system
calibration and beam
steering
HARDWARE CTRL
ETHERNET
5
Filters
Can be added in front of the camera to
increase the dynamics of the system

S. Berger

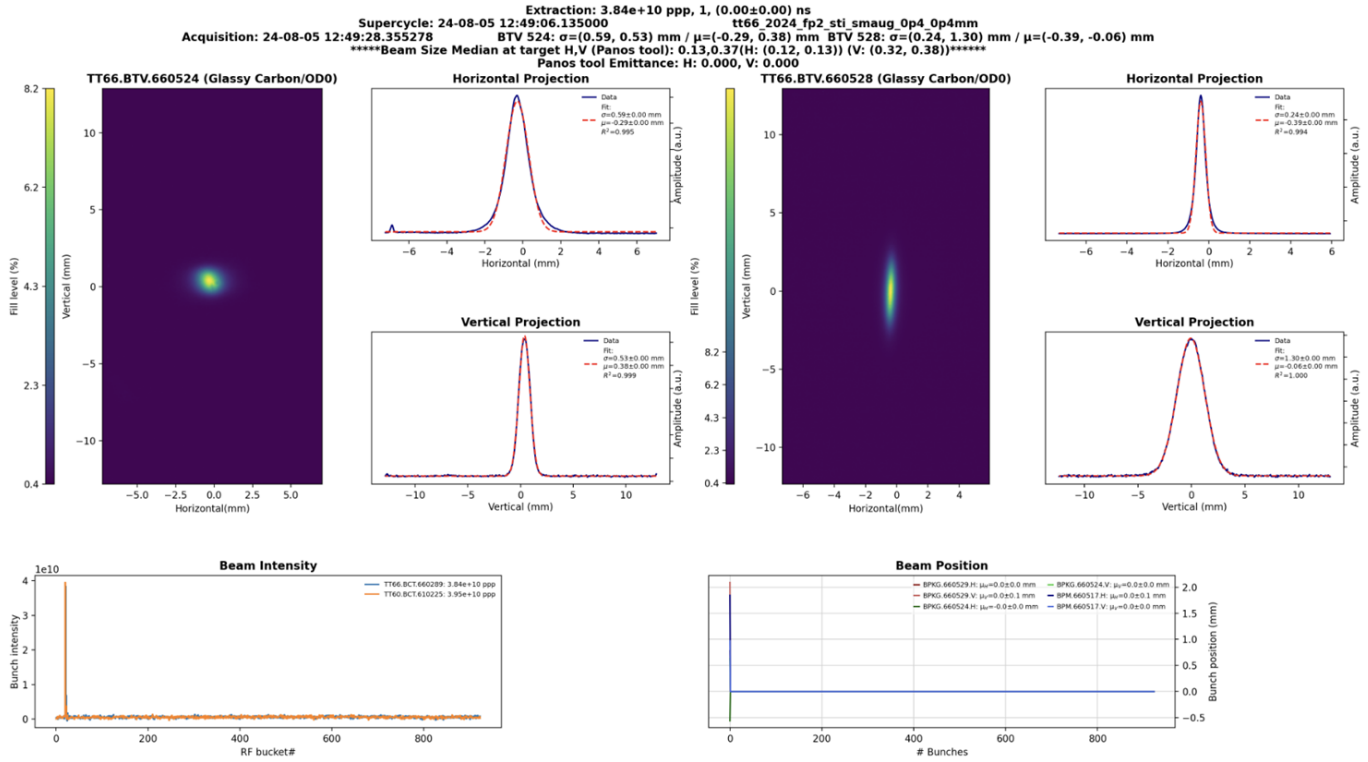

Beam
Diamond Detector
BPKG
BTV


experiment
BTV Screens

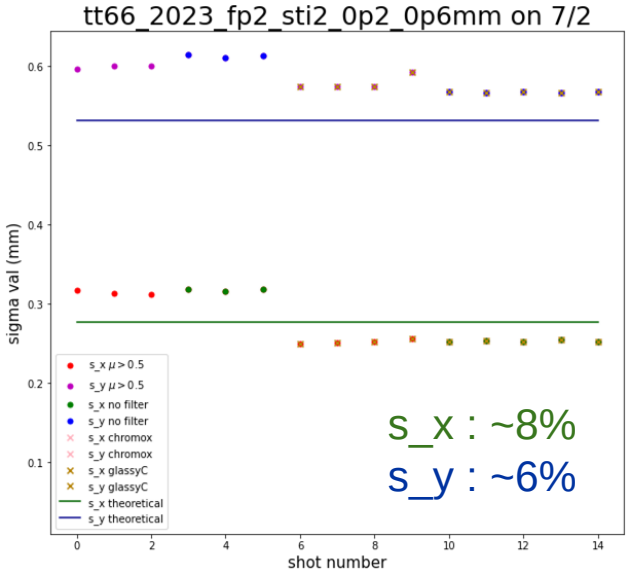
Real-Time BTV Script

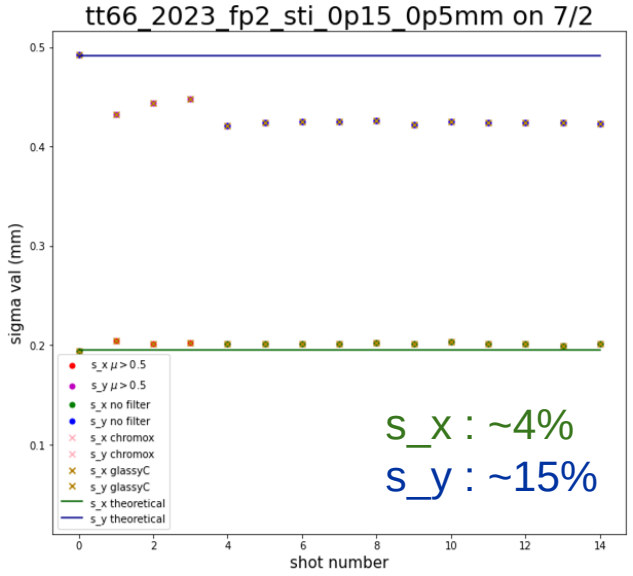


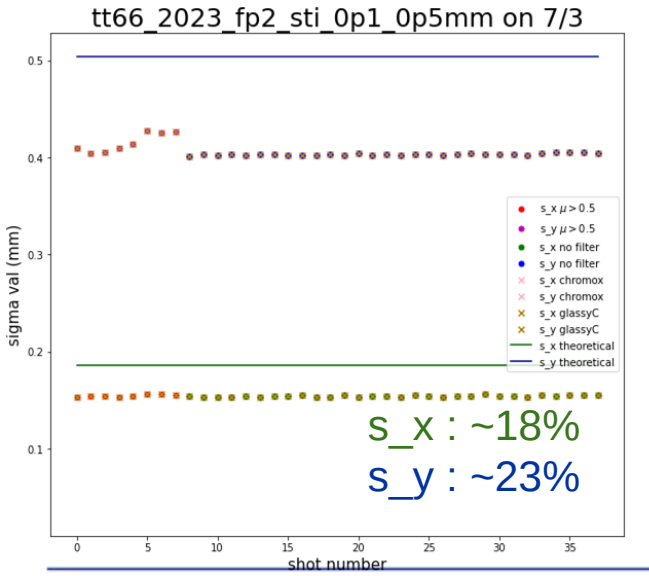
- Added the downstream BTV to the VISTAR screen
- Fixed the acquisition of the beam position monitor data and updated the plots
- Added data from a new tool that calculated the emittance and the spot size

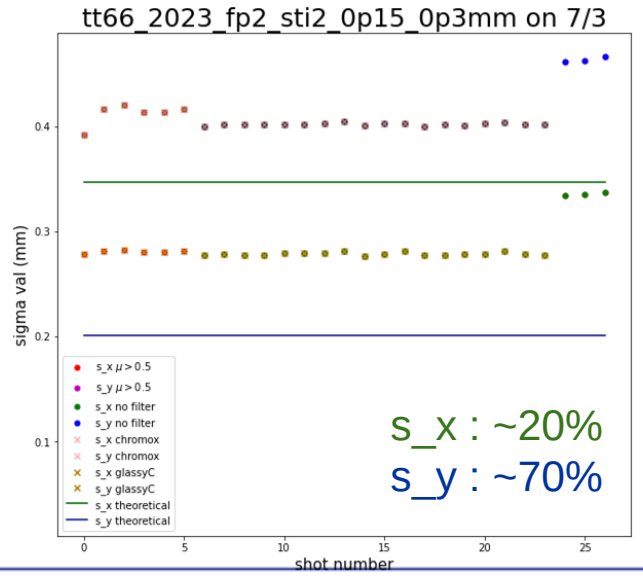


Results From July 2 and 3

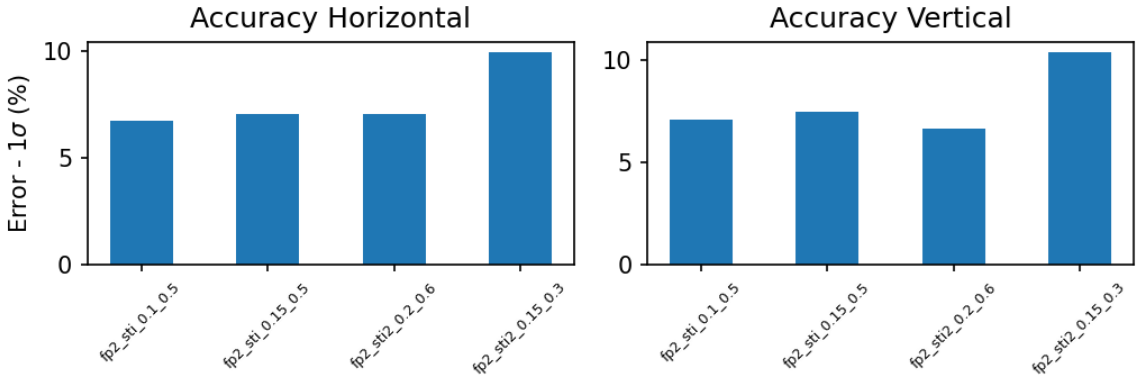




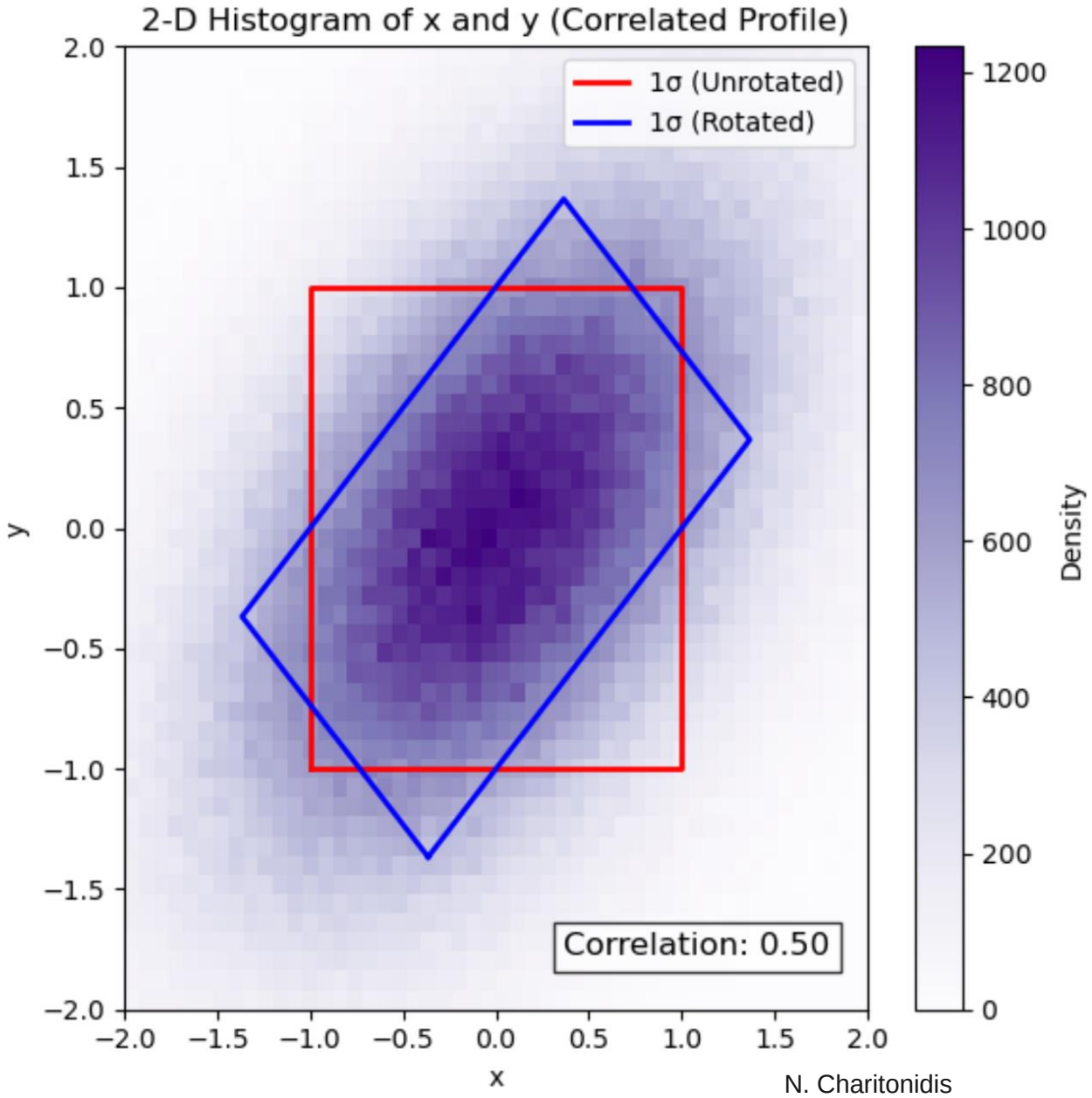




- **Analyzed the measured beam widths vs the expected ones.**
  - ➢ The expected ones are calculated in a MAD-X file.
- **Compared these values with the expected error of the BTV.**
- **Compared these values with the expected error of the optic.**



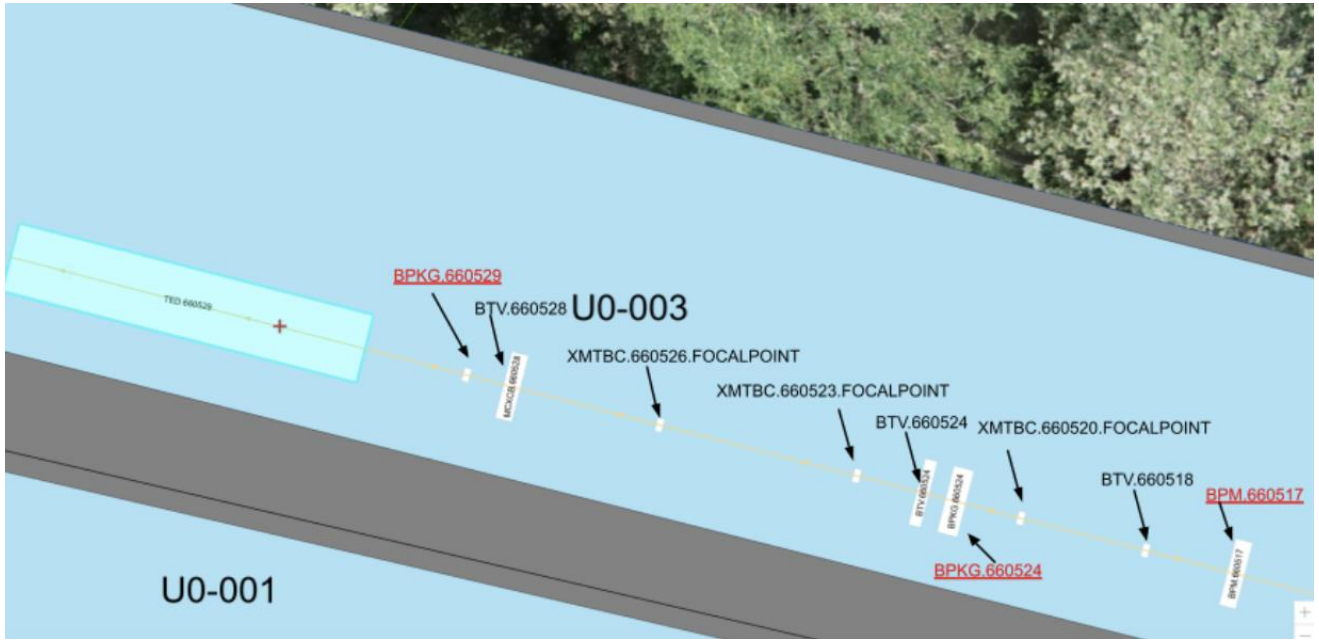
F. Velotti

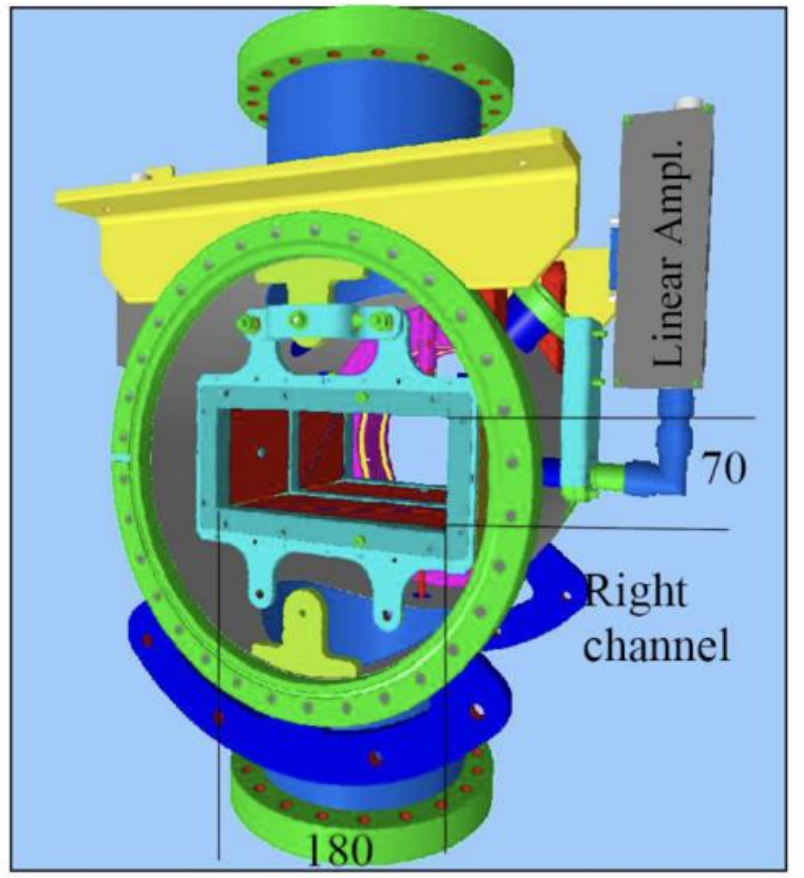


- **Rotated beams can cause problems in the theoretical beam density calculations.**
- **Calculation of the beam spot size must be done in the laboratory frame.**
  - ➢ This is not an explanation for the error in the sti2_0p15_0p3mm optic results.
- **When calculating the beam density a rotated ellipse must be used.**
  - ➢ The beam density is helpful when finding the predicted intensity.

BPM / BPKG

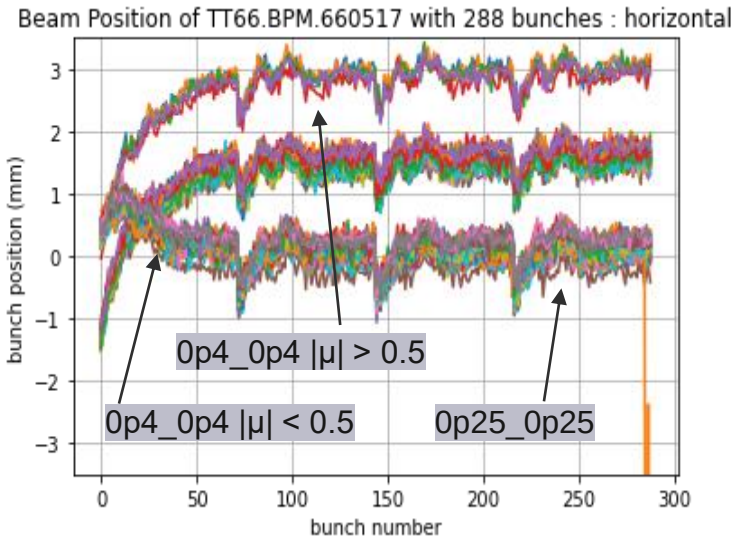
- Beam position monitors give the center of mass of the beam and the ‘longitudinal bunch shape’
- No magnets between the BPMs and BPKGs being analyzed

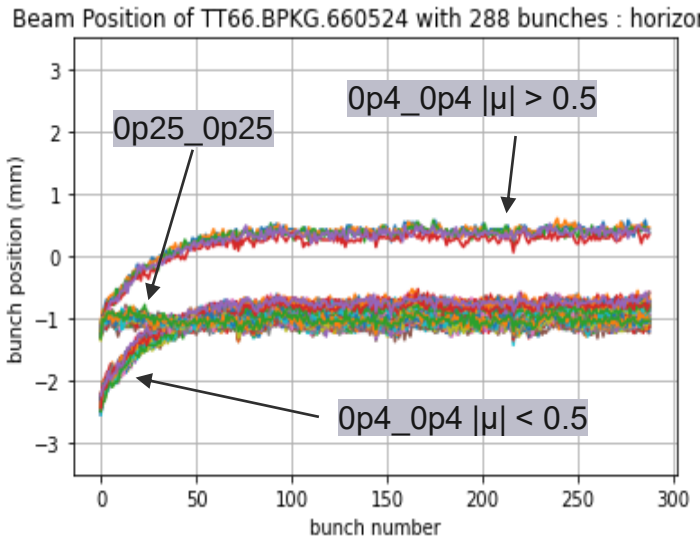


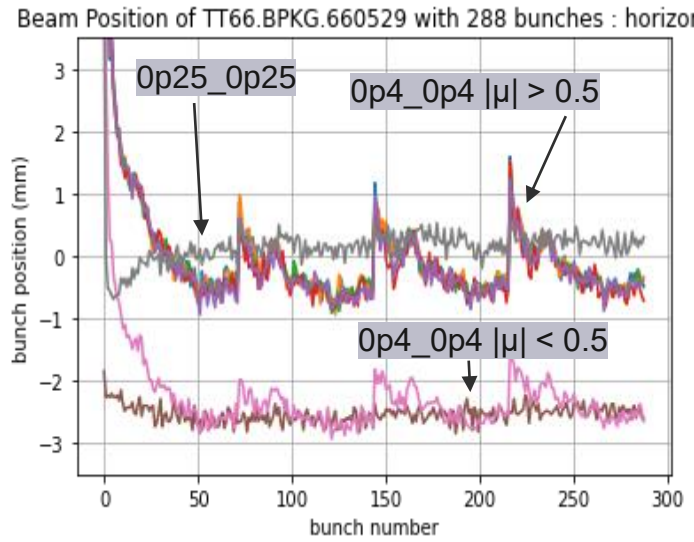


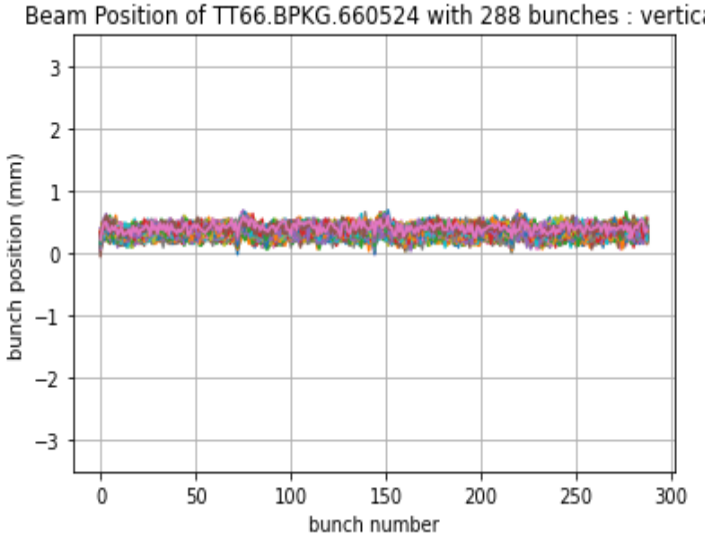
P. Forck, P. Kowina, and D. Liakin

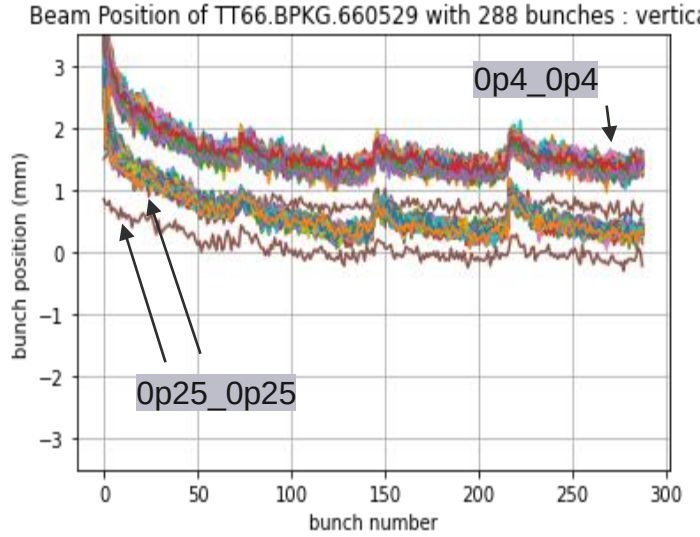
288-Bunched Shot Results





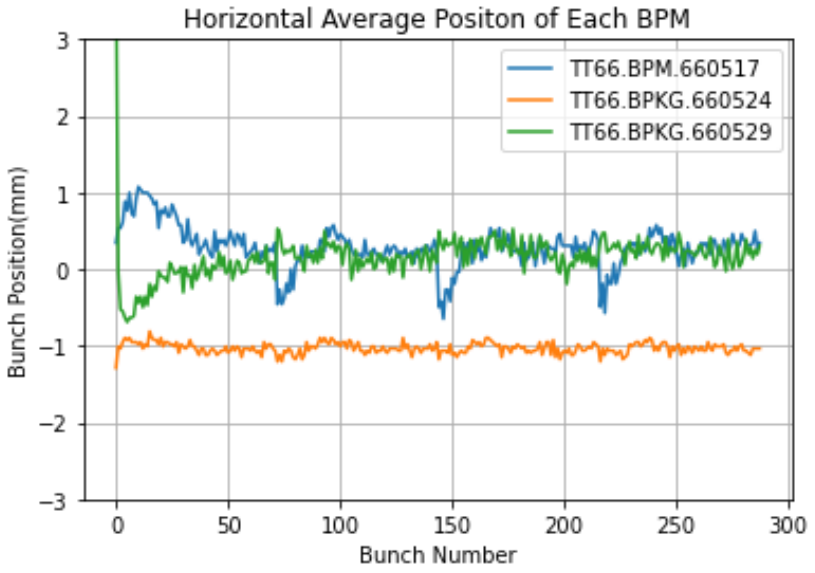


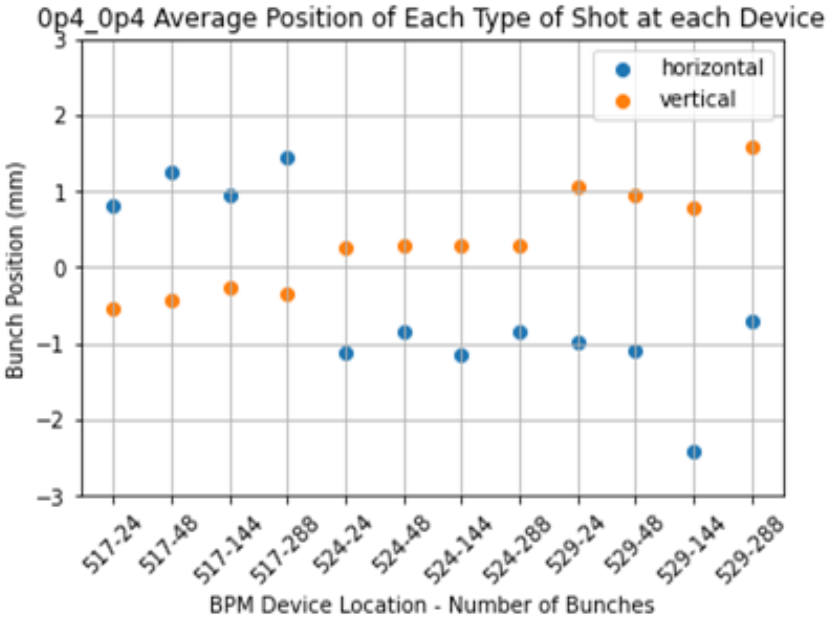


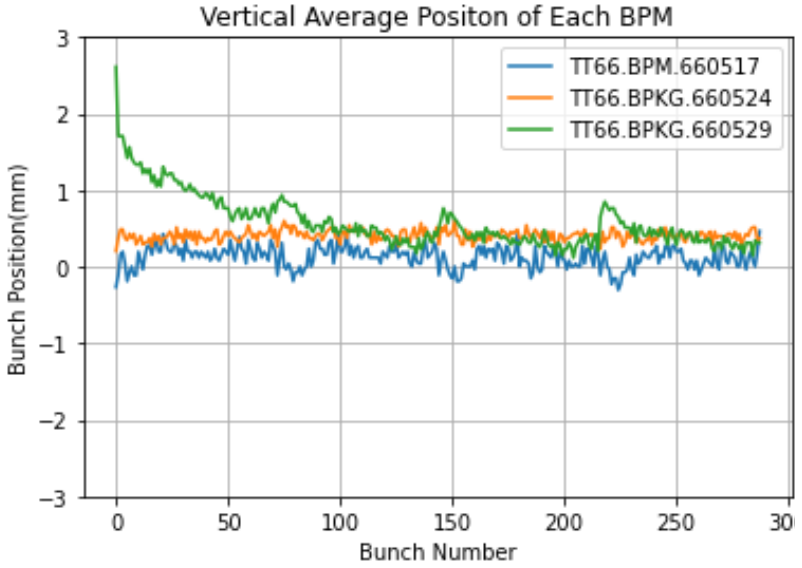


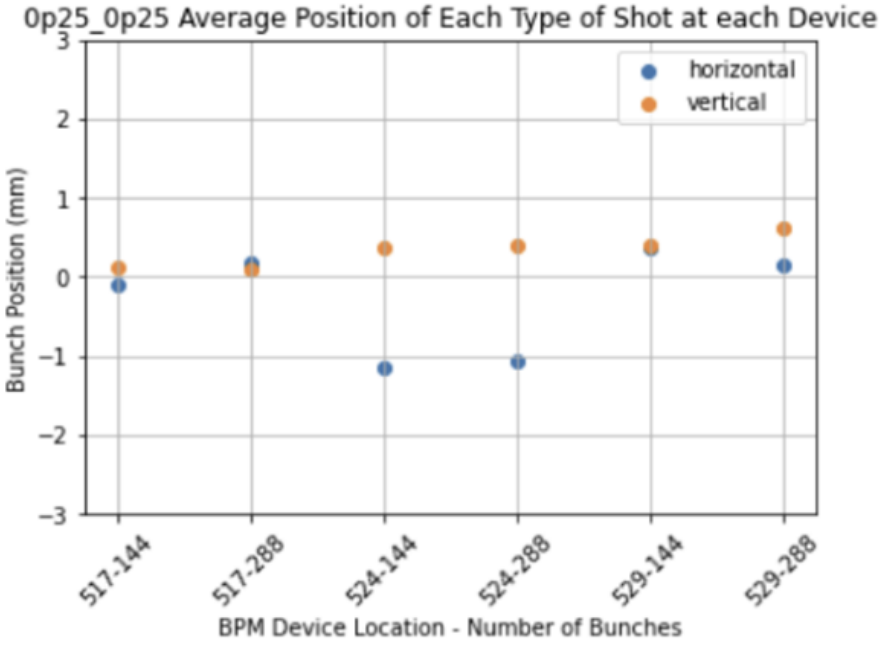
BPM Averages

- **Jumps in the bunch position occur every 72.3 ± 0.5 bunches.**
  - ➢ PS produces 72-bunched shots
- **Odd behavior is observed in the horizontal of BPKG 524.**
- **Many fewer results at BPKG 529 may affect these averages.**









Conclusions

- **Functioning VISTAR Screen deployed to be run on the SPS OP console as an *acc-py* app.**
  - Added the downstream BTV to the logbook.
  - Fixed the Beam Position monitor data acquisition and plotting in the logbook.
- **Optics Analysis:**
  - Emittance needs to be calculated more consistently to obtain better expected beam widths – added it to the logbook.
  - Rotations in the beam can affect its beam density or intensity – added the rotation adjusted area to the logbook.
- **Beam Position Monitor Analysis:**
  - Optics choice has a significant effect on the bunch position behavior.
  - Screen choice has a limited effect on the bunch position behavior.
  - Will follow up with SY/BI and SY/ABT to further understand these results

References

[1] P. Forck, P. Kowina, and D. Liakin, *Beam Position Monitors*

[2] R. Webber, *Tutorial on Beam Current Monitoring* (2000)

[3] K. Wittenburg, *Beam Loss Monitors*

[4] A. Buszydlik, *Extending the Control Software for Beam Interlock System 2* (2022)

[5] C. D. Arrowsmith et al., *Laboratory Realization of Relativistic Pair-Plasma Beams* (2023)

[6] F. Velotti, *2023/24 HED Experiment* (2024)

[7] N. Charitonidis and M. A. Jebramcik, *Coupled Transverse Beam Profiles Analysis* (2024)

[8] R. Bailey, *An Application for Research – The Large Hadron Collider*

home.cern