PAUL SCHERRER INSTITUT

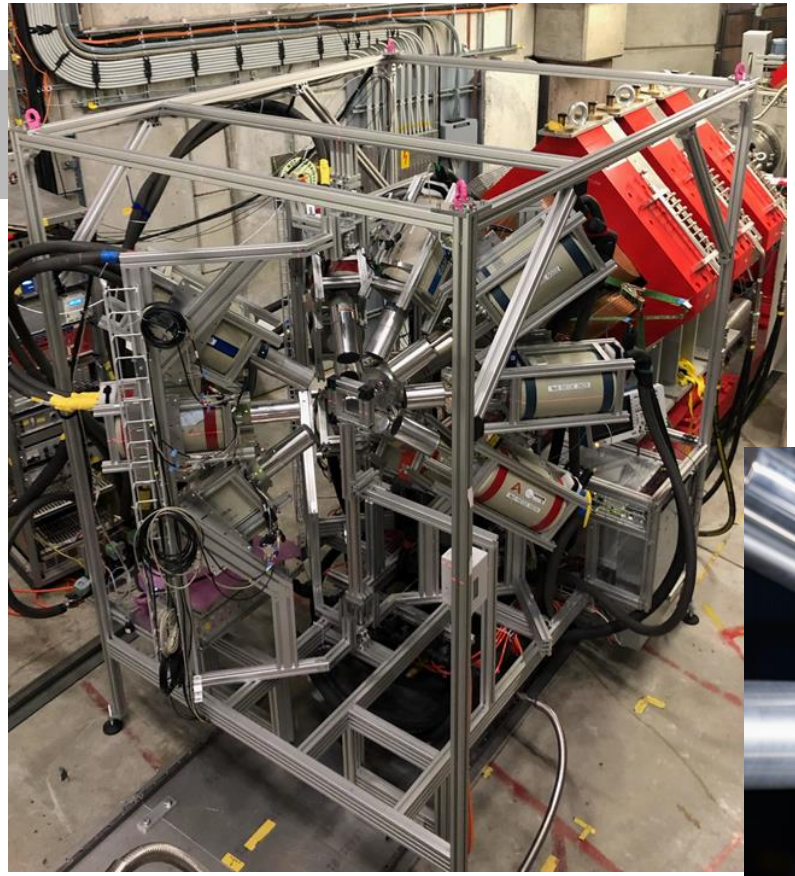
PSI

Gianluca Janka :: MIXE :: Paul Scherrer Institute

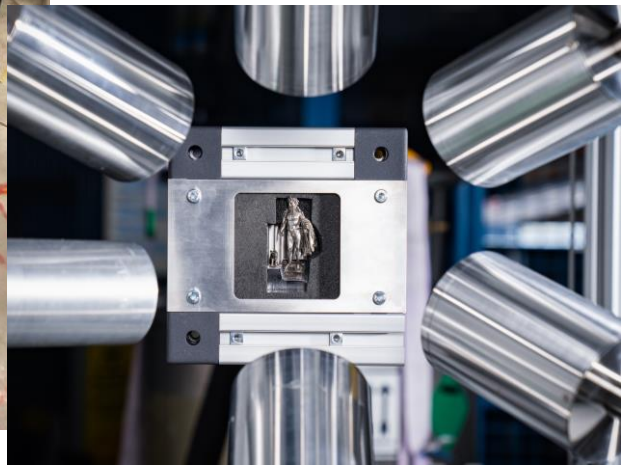
Future Improvements of MIXE and GIANT

MIXE mid-term meeting, 05.12.2022

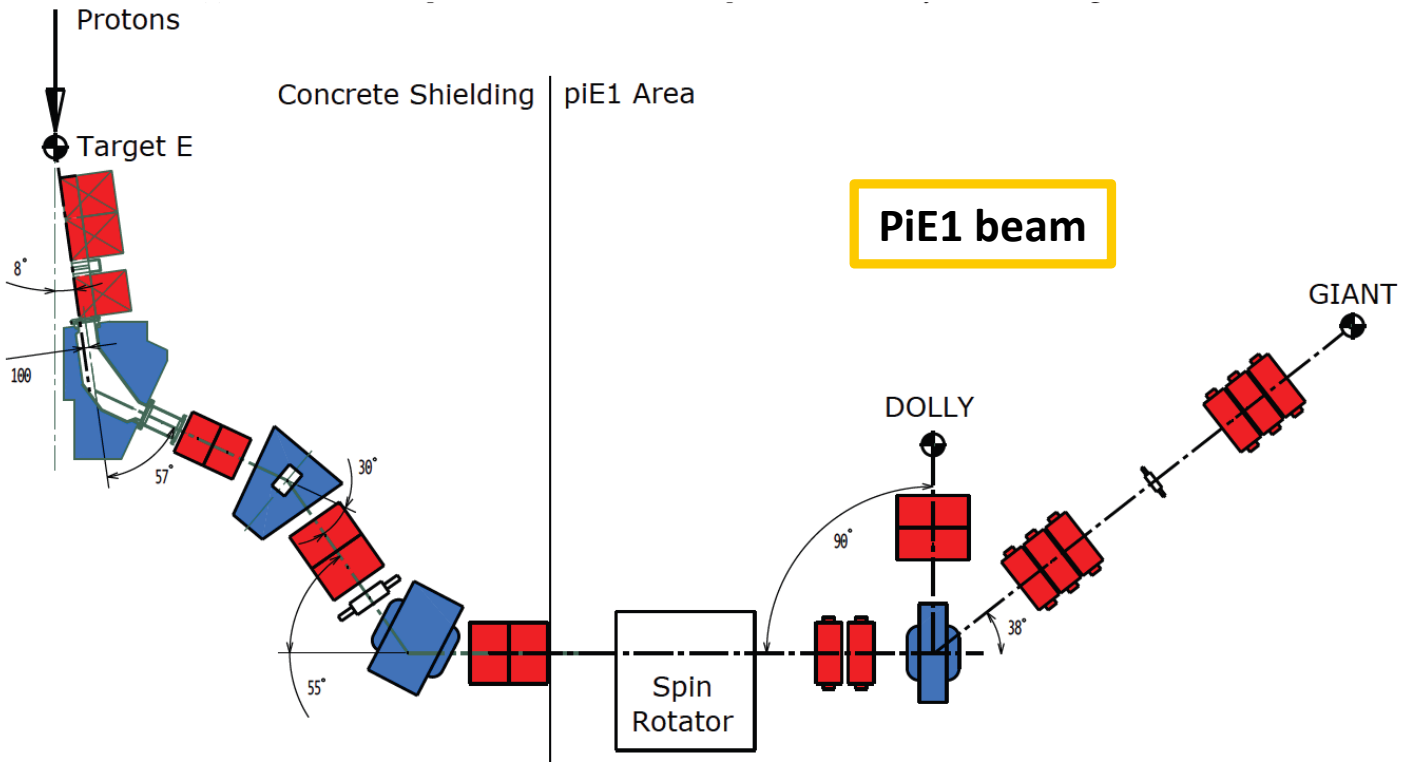
Reality



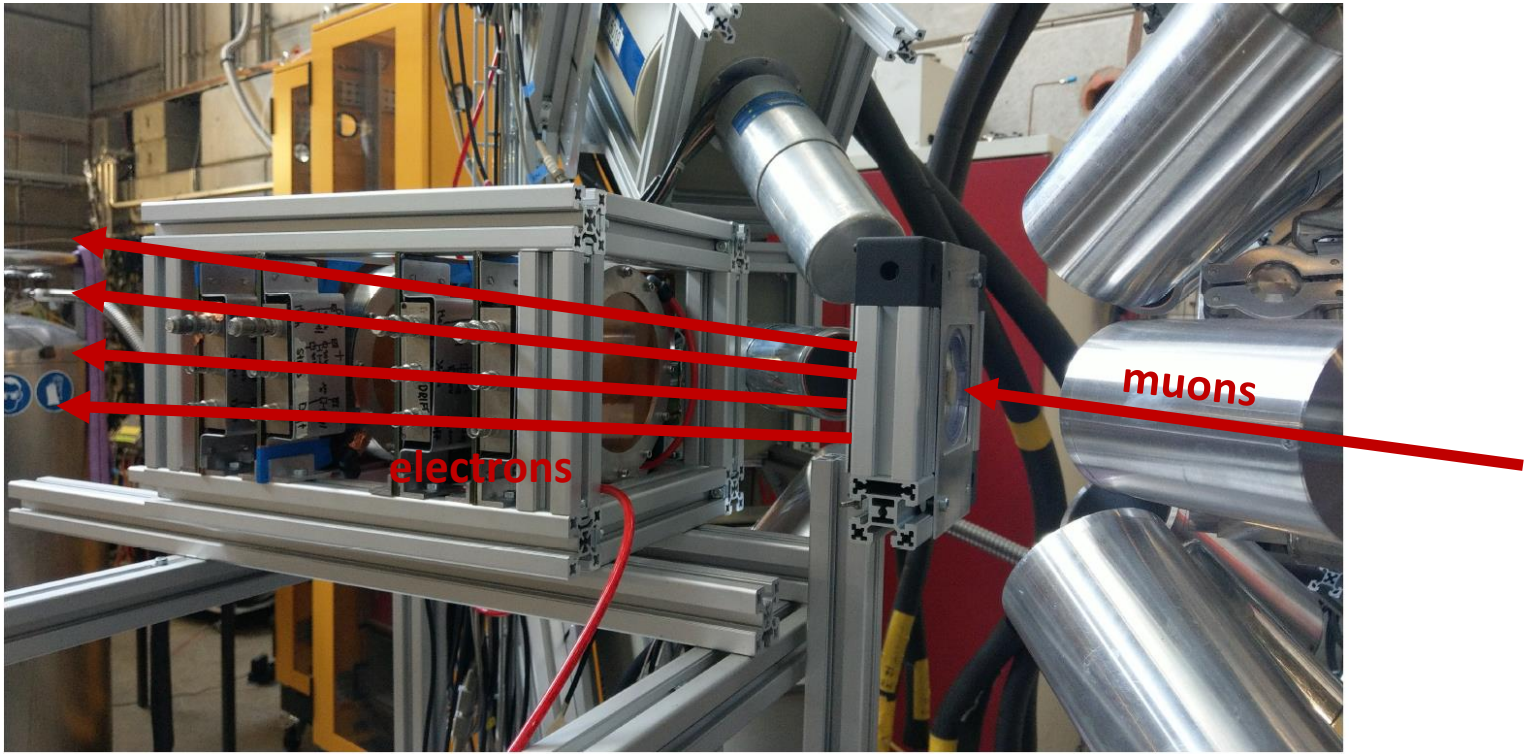
- (Nearly) complete setup
  - Setup time roughly 6 hours
- Reproducible
- (Semi-)automatic LN2 refill
- Sample station twin in control room
  - Roughly 5 min sample change
  - Linear mover in discussion
- Max 8 freely rotating arms (currently 5)
- Max 4 BigMac HPGe per arm



Characterization of beam spot



Characterization of beam spot



Characterization of beam spot

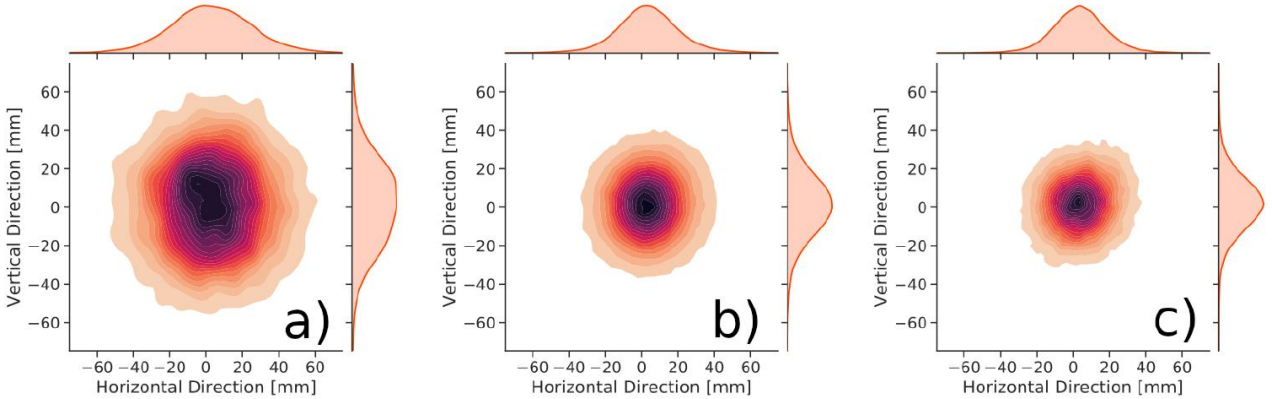
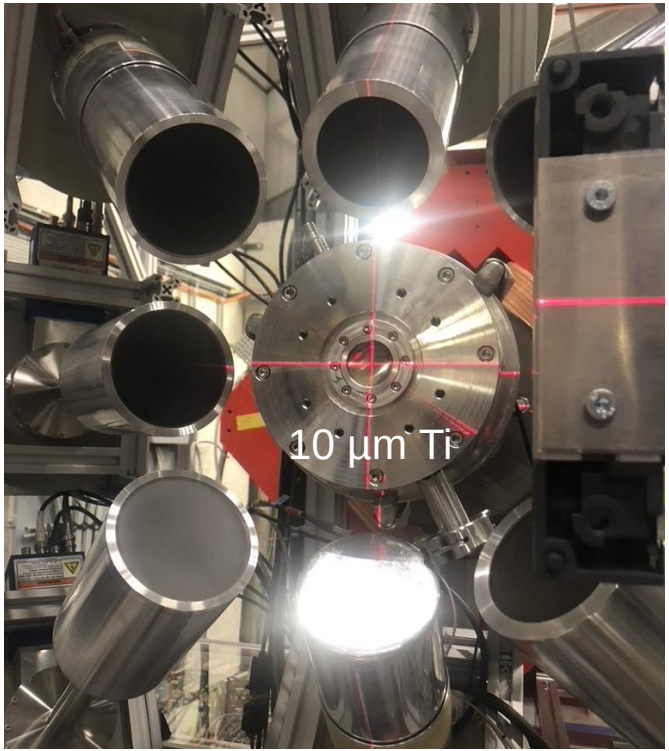
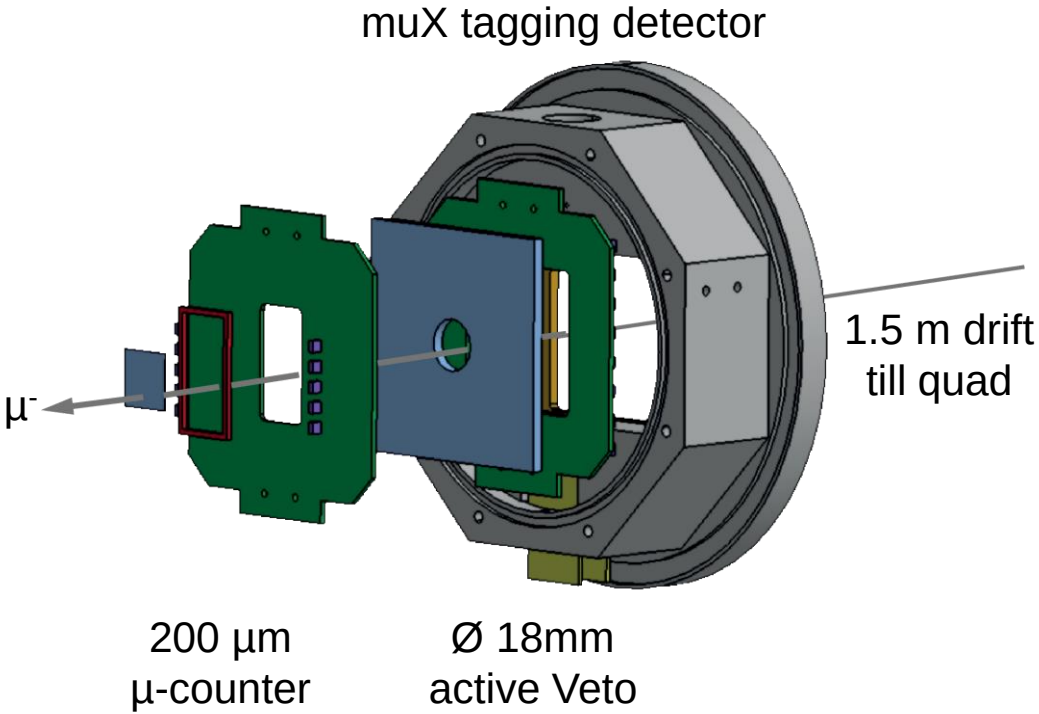


Figure 5: Beam spots on target during the MIXE campaign in 2022 May in πE1 for different momenta: (a) 25 MeV/c, (b) 35 MeV/c and (c) 45 MeV/c .

Momentum (MeV/c)	σ_x (mm)	σ_y (mm)
25	22.06(18)	23.54(18)
33	17.52(3)	18.07(3)
35	16.55(3)	17.24(3)
45	14.45(6)	14.34(6)

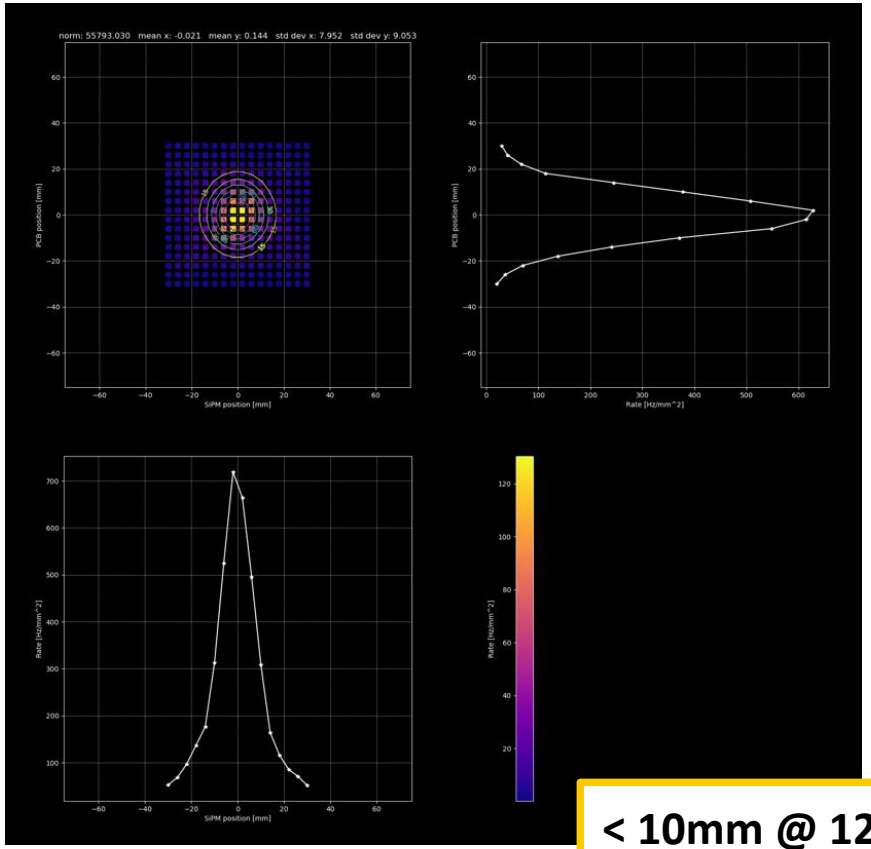
Improvement of beam spot





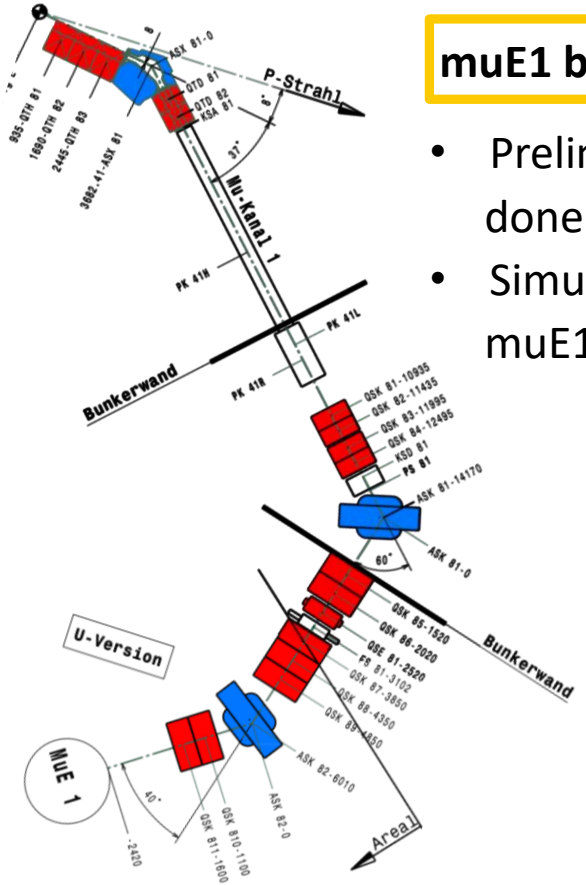
Improvement of beam spot

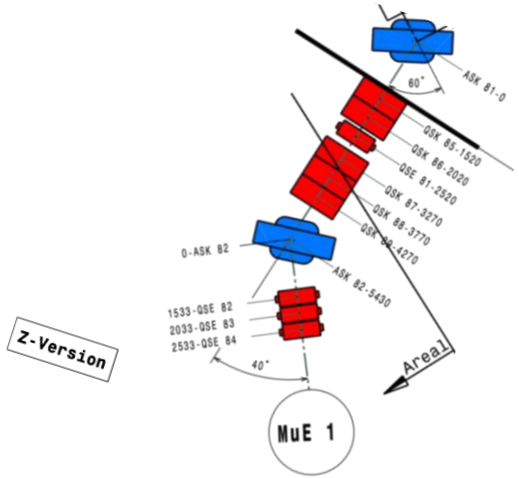
Group of Anna Soter,
SiMon (SiPM based beam Monitor)



< 10mm @ 12.5 MeV/c

Finding alternative (or permanent?) beamline



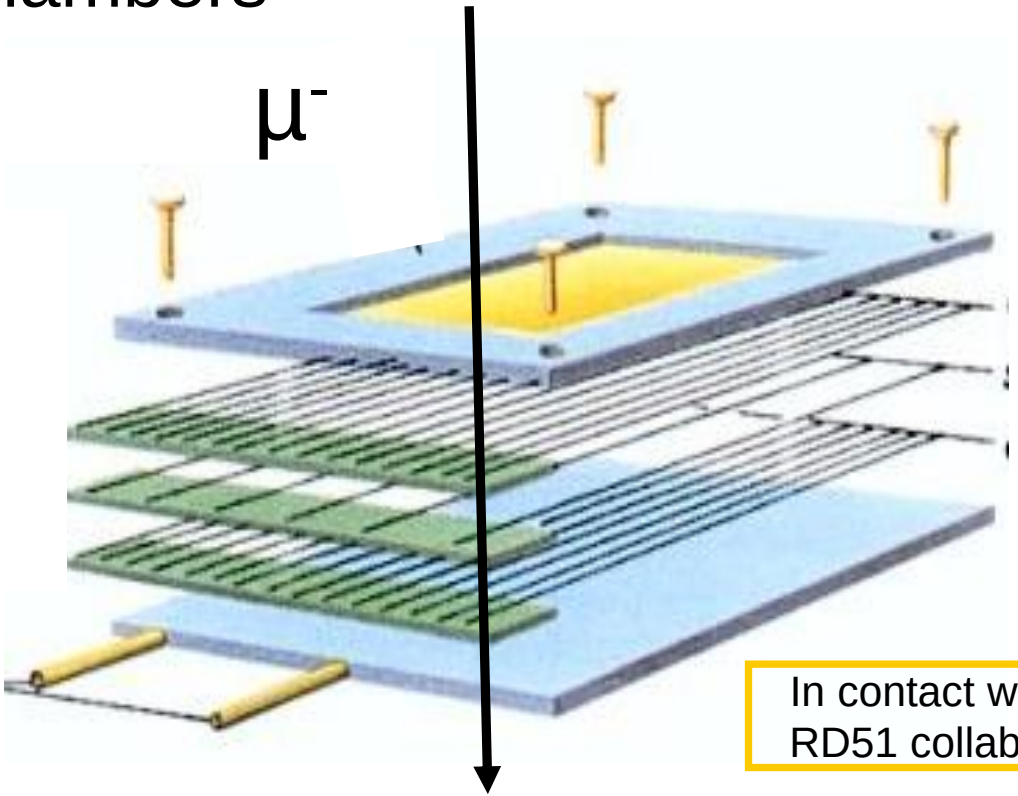


muE1 beam

- Preliminary measurements of negative muon rates at muE1 done by Lars & Sayani
- Simulations to start understanding and optimizing muE1 and PiE1 will be done by Chen Cong

Design of muon tracking chamber

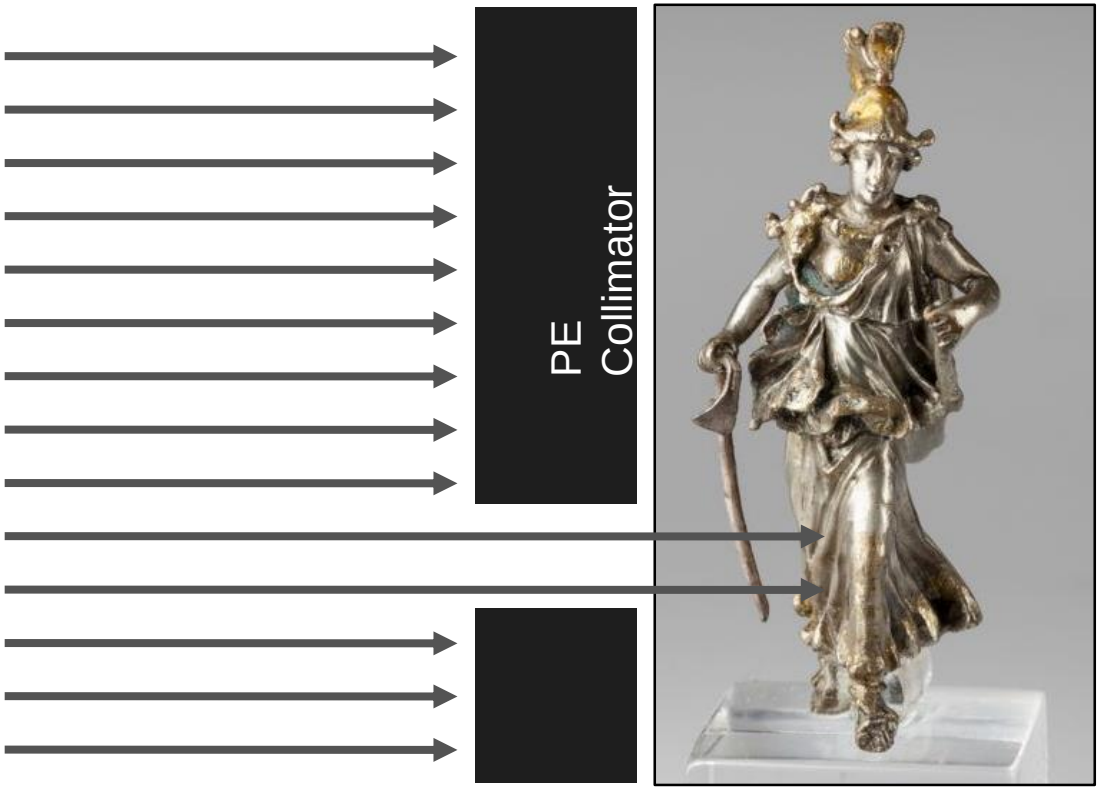
Wire Chambers



In contact with experts from RD51 collaboration (CERN)

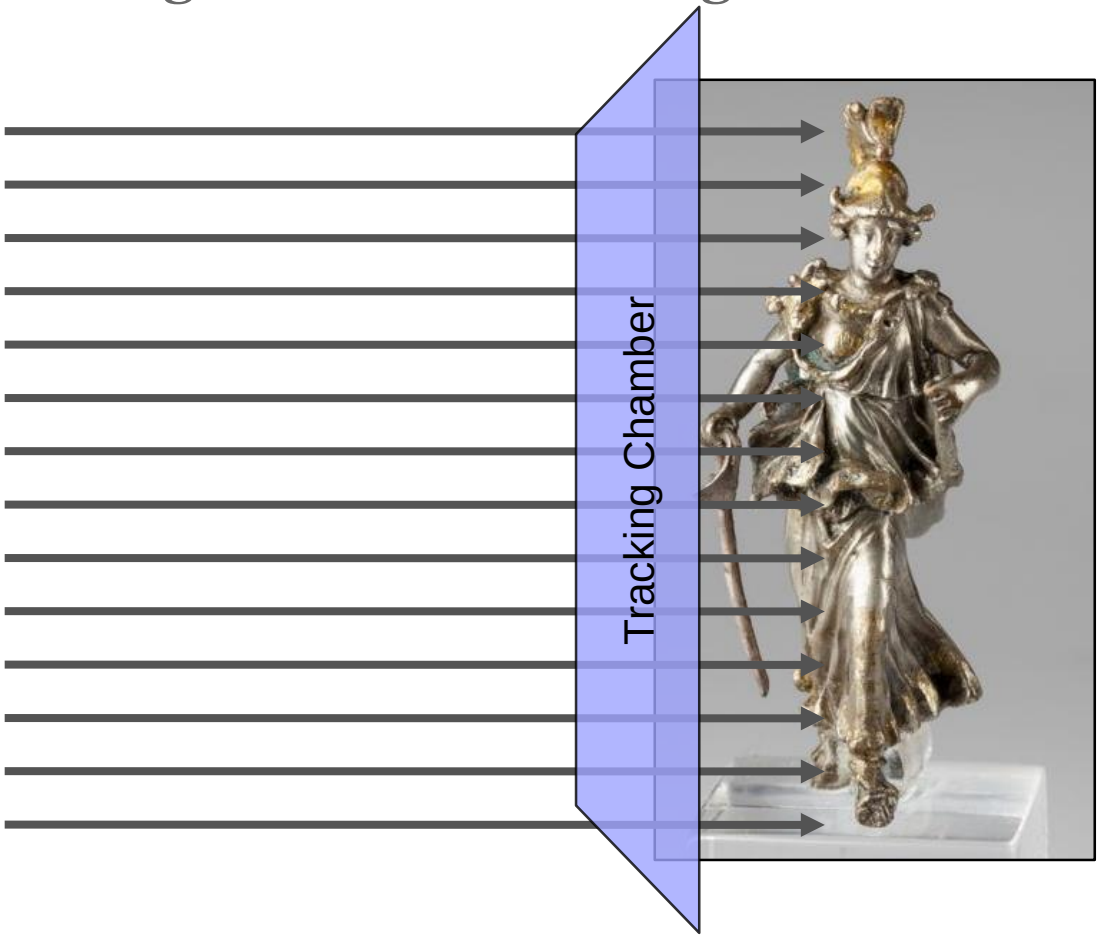
Design of muon tracking chamber

μ^-



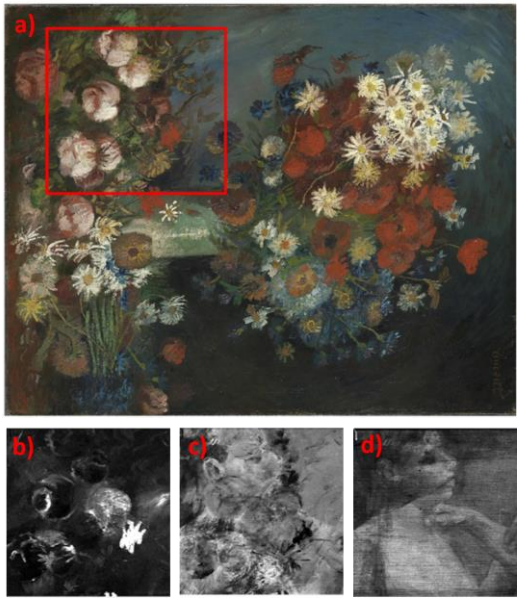
Design of muon tracking chamber

μ^-



Design of muon tracking chamber

- Collimation can be done offline → no muons get lost, no collimation background
- Background coming from other material than sample (frame, detectors) can be rejected
- Opens possibility to perform 3D MIXE tomography:



a) Vincent van Gogh's Flower Still Life with Meadow Flowers and Roses, summer 1886 (Kröller–Müller Museum, Otterlo, the Netherlands), rotated for illustration purposes.

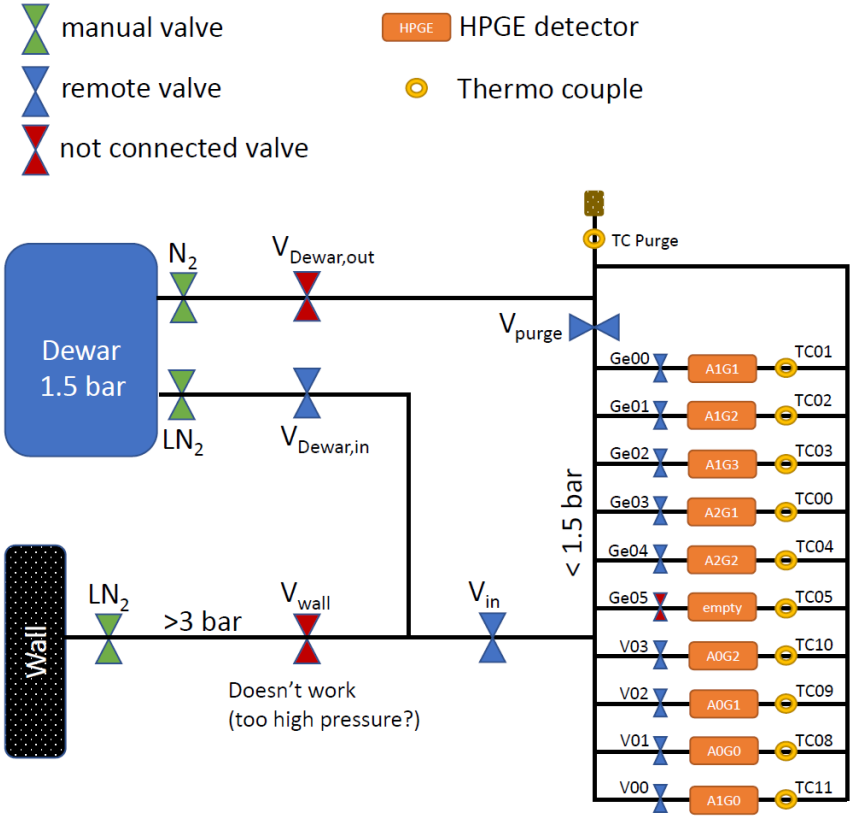
b) Hg fluorescence signal of the area in the red box, flowers are visible.

c) Zn fluorescence signal of the same area, hints of a human face visible.

d) Zn fluorescence measured from the back of the painting with less absorption, revealing the human face as part of an overpainted wrestling scene..

M. Alfeld and J. A. C. Broekaert, Spectrochimica Acta Part B 88, 211- 230 (2013)

Automatized LN2 filling



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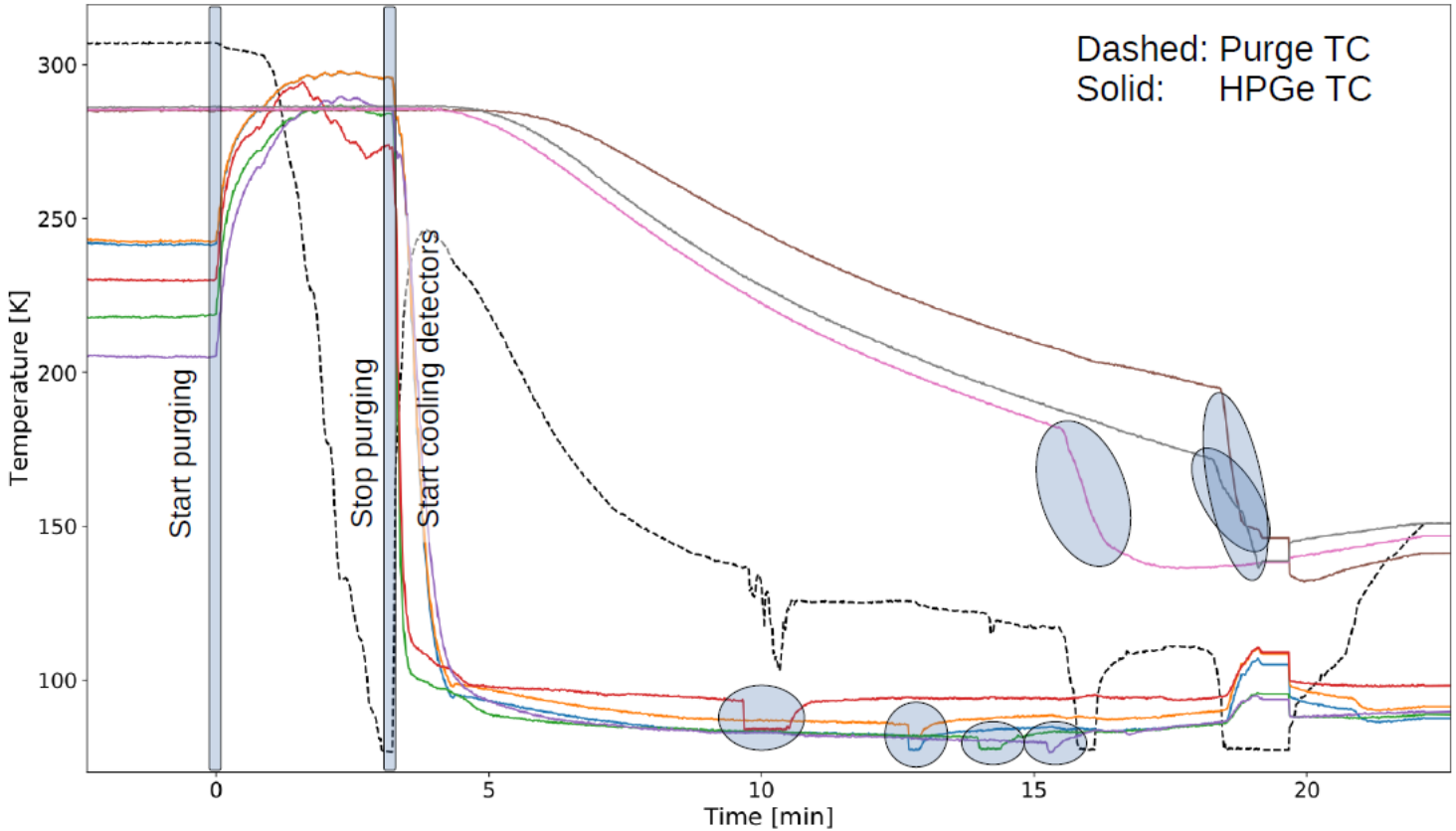
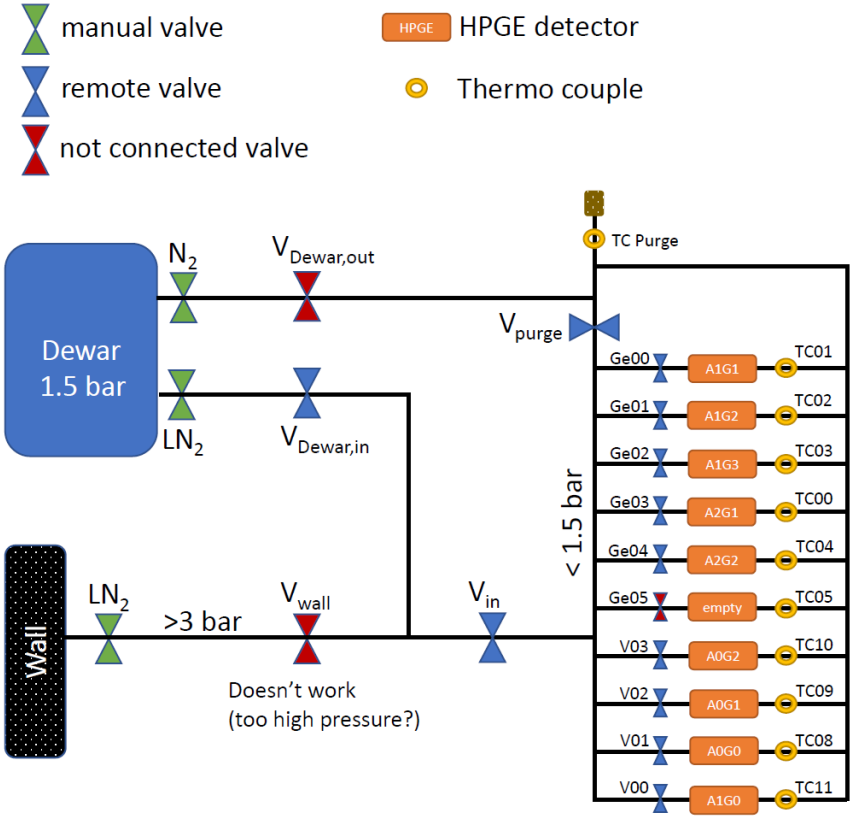
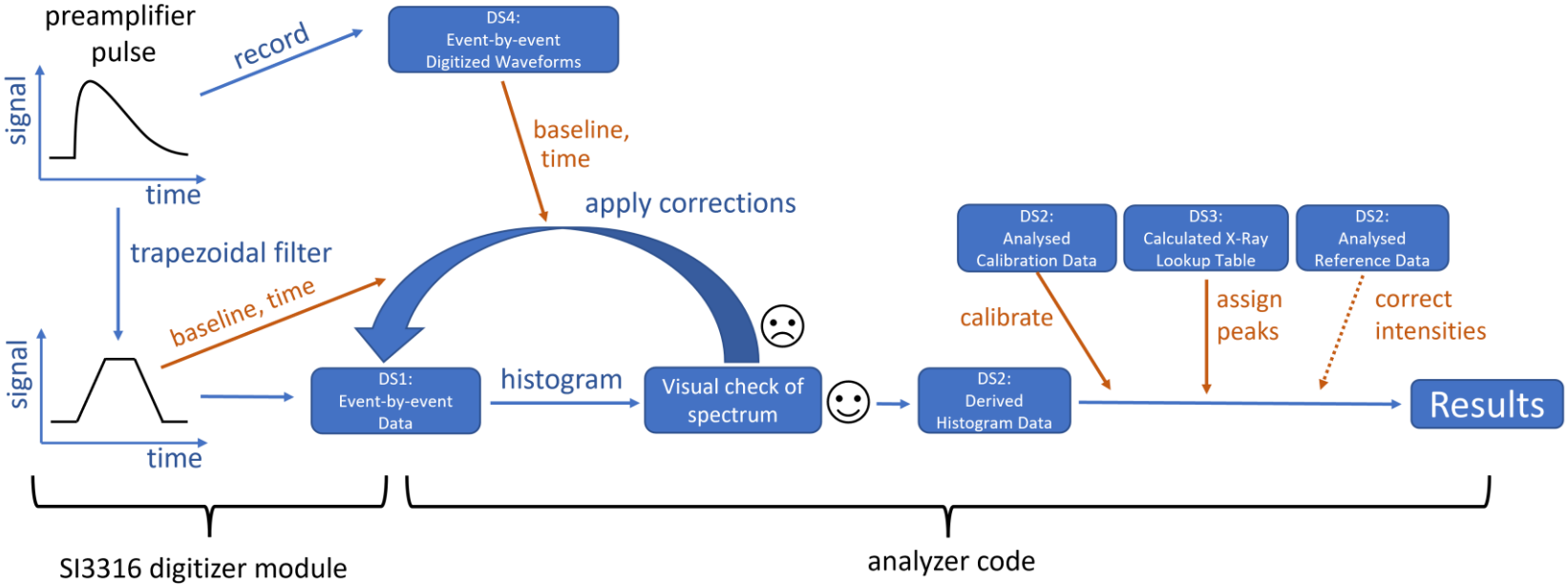


Automatized LN2 filling



Automatized data analysis

- Proposal submitted to Swiss Data Science Center (SDSC) for data scientist (50%) and post-doc (100%) to automatize current analysis
- Needs input from experiment (muonic X-Ray library)



More improvements

- **Automatized sample change**
  - e.g. linear mover with multiple samples mounted and controlled by RPi

- **Digital Twin of MIXE setup (simulation)**
  - Work started by Carlos, set up Geant4 framework
  - Will be extended to study systematic effects (e.g. attentuation of X-rays)
  - Needs input from experiment (beam spots, muon capture probabilities, intensities...)
  - Needs modelling of samples (e.g. 3D scan)

- **New detectors (Silicon Drift Detector, SDD)**
  - High energy resolution, better suitable for detecting of light elements such as Li
  - Good results achieved for Li with SDDs by the MuX collaboration

- **Improve user-friendliness of experiment in general**