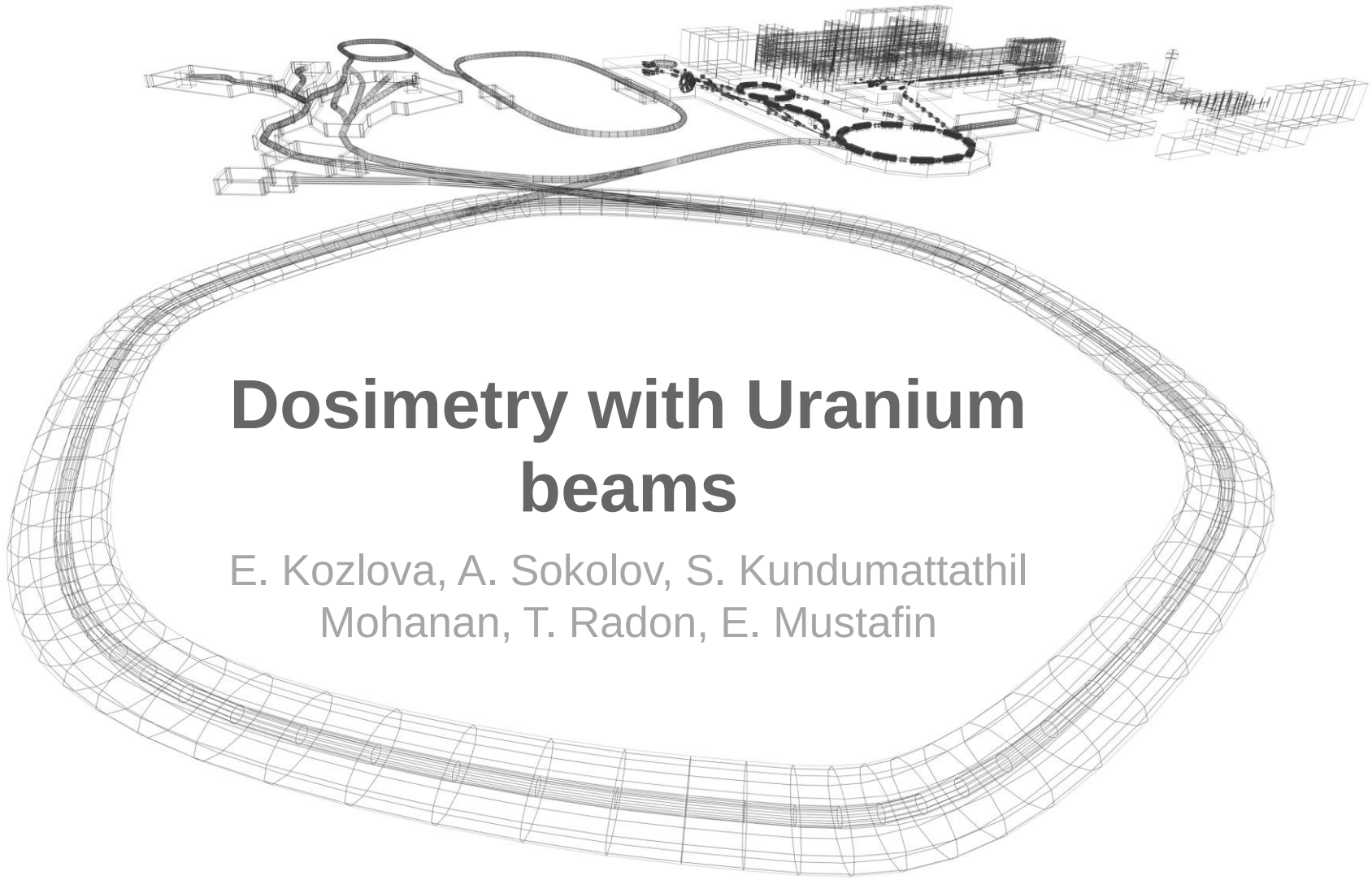
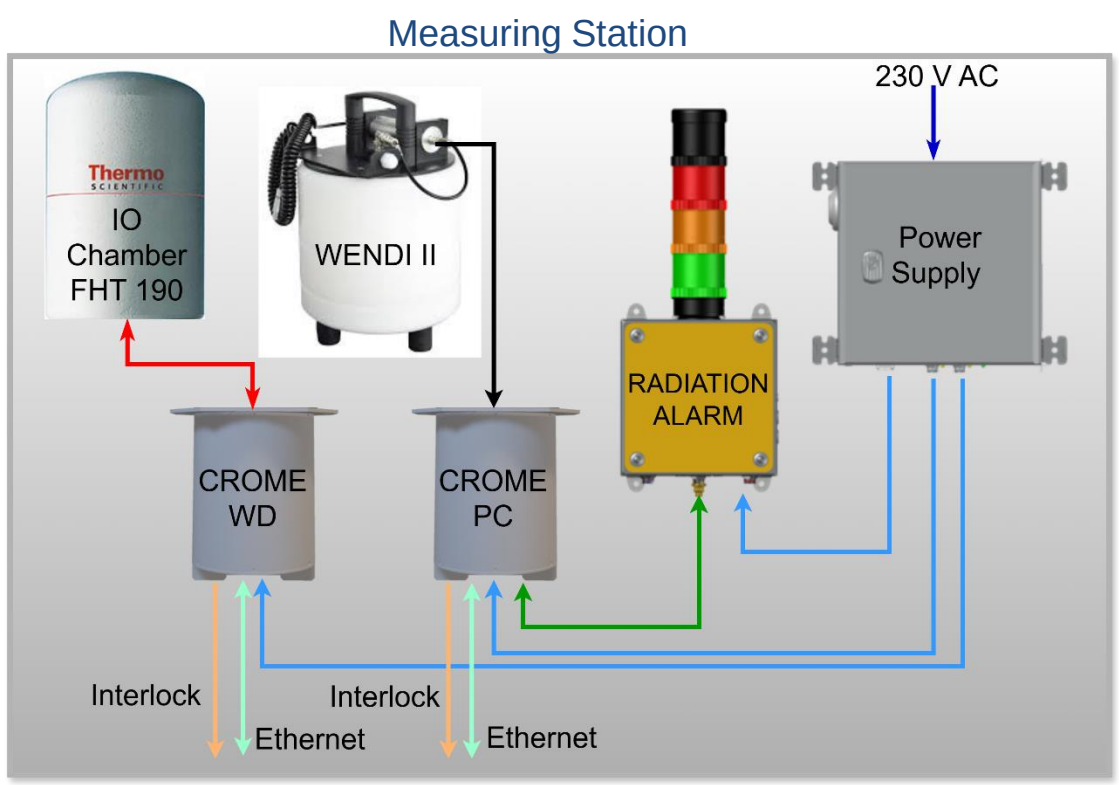


Dosimetry with Uranium beams

E. Kozlova, A. Sokolov, S. Kundumattathil Mohanan, T. Radon, E. Mustafin

CERN Radiation Monitoring Electronics (CROME) @ FAIR

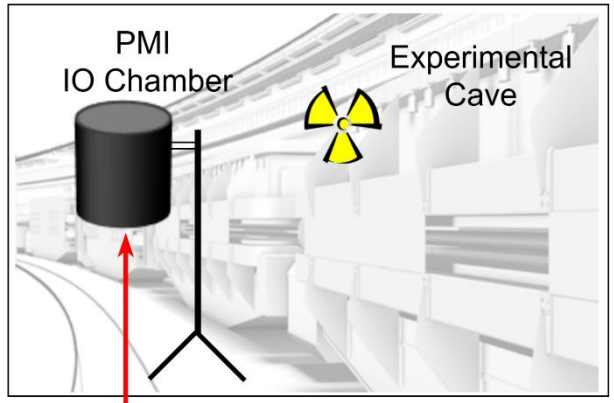


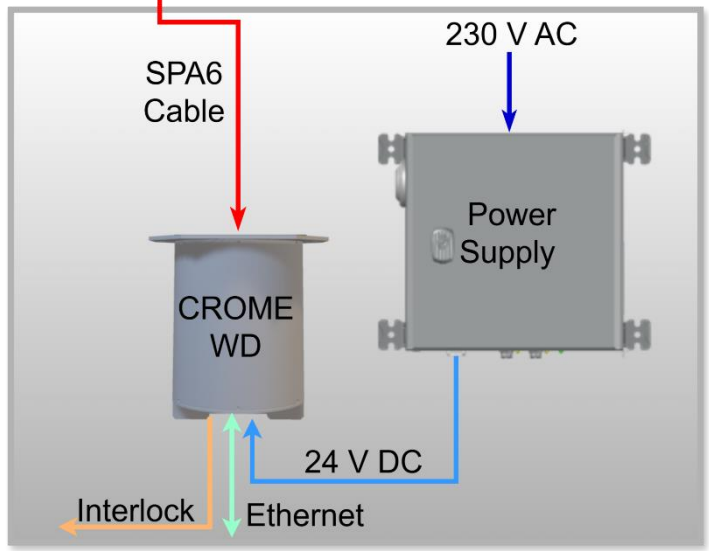
Surveyed Area
Limit: 0.5 uSv/h

Dose Monitoring

Controlled Area
Limit: 3 uSv/h

Part of Personal Access System (PAS)





PMI + CROME – were tested during Machine Studies in 2024 and approved themselfs to be the perfect candidates for dose measurements at FAIR facility

Dosimeters and Electronics

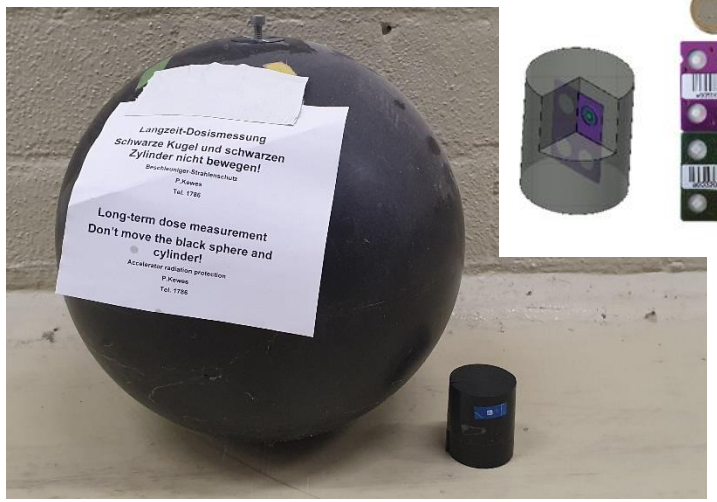
Thermo Fisher‘s active dosimeter

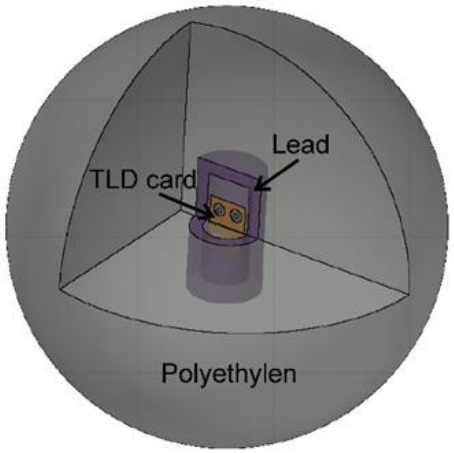
FHZ 632L-H10

FHT6020

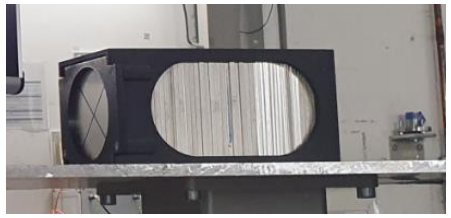
FHZ 632L-H10

GSI‘s passive dosimeters

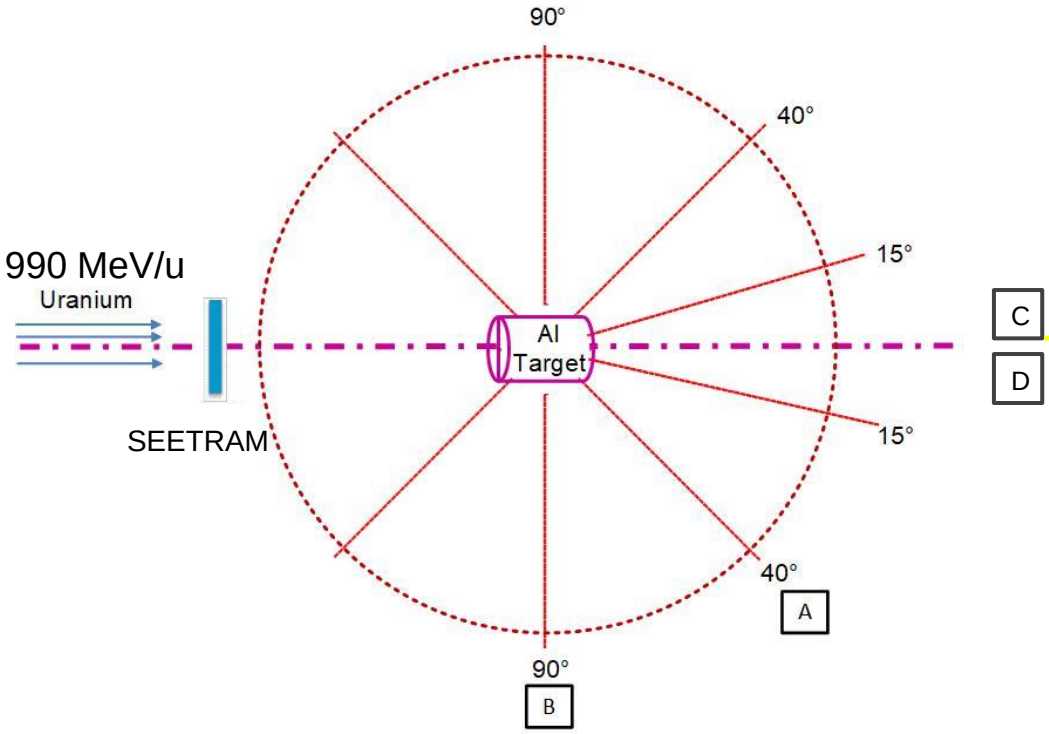


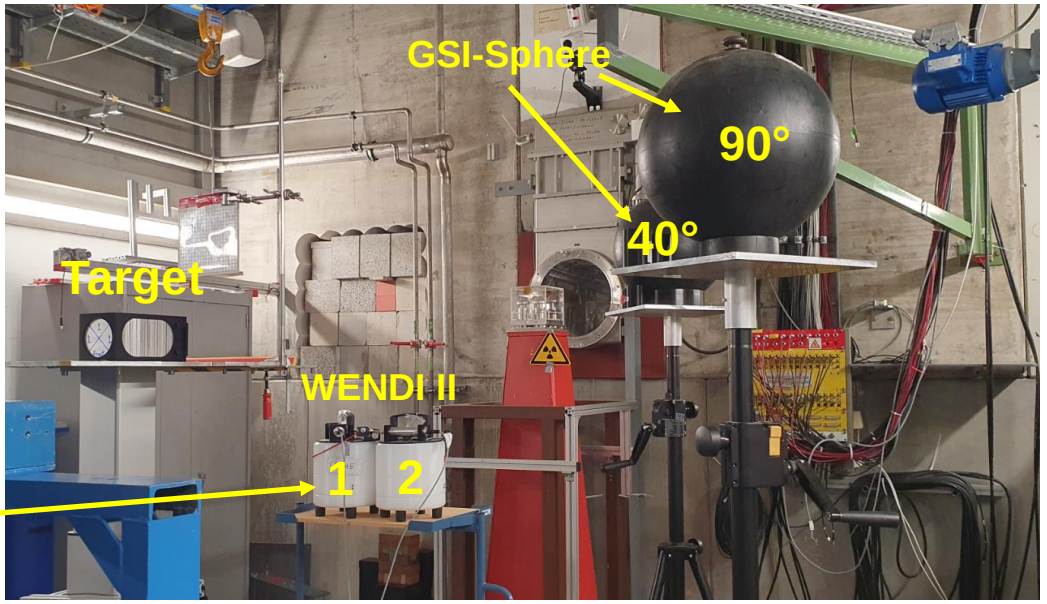


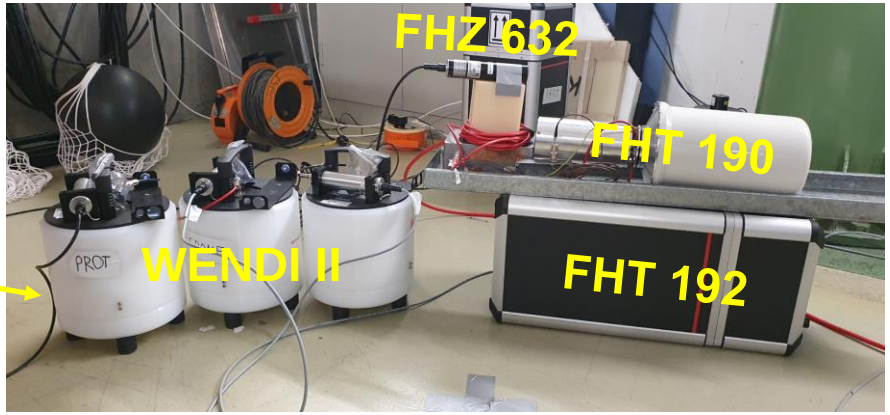
Experimental Setup



Al-Target 10x10x21.1 cm³
Set of 114 plates



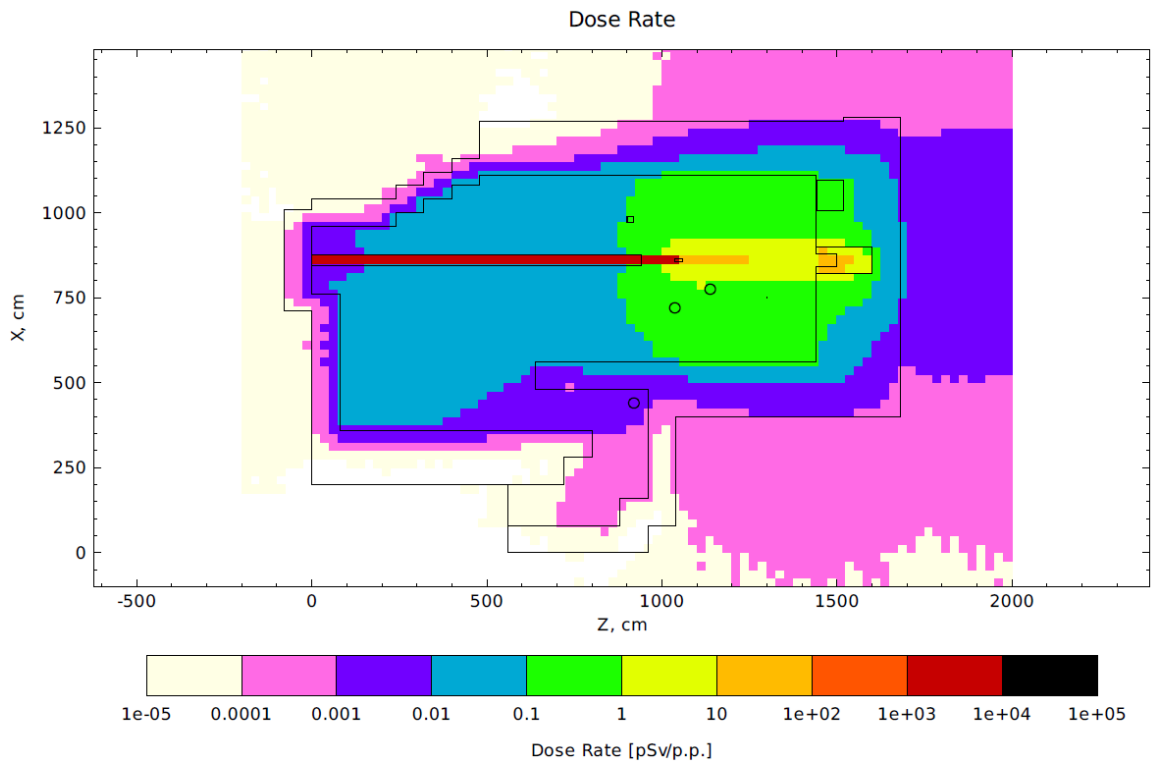




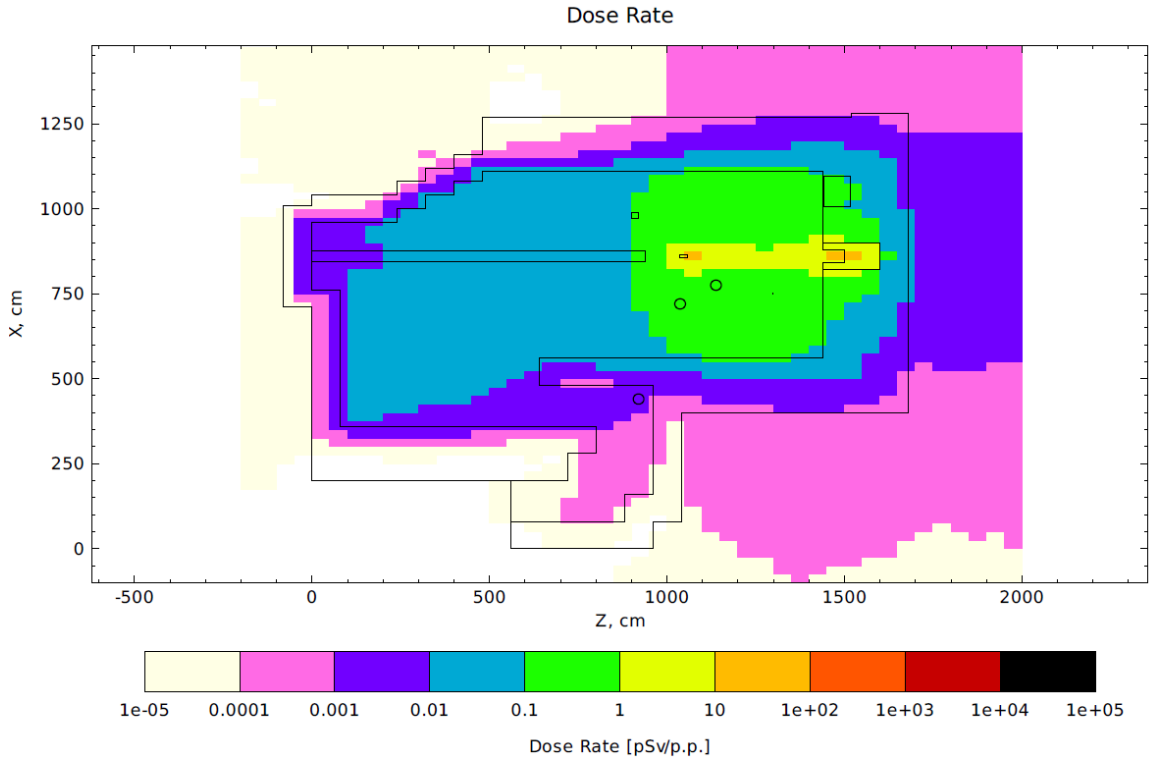
U^{+73}@ 990 MeV/u slow extracted beam.
The transmission from SIS to Cave A was about 17%.

Dose rates/FLUKA Simulations

Total ambient dose

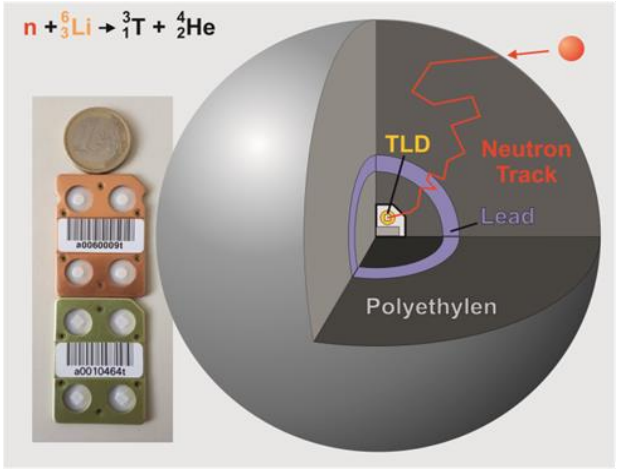


Neutron ambient dose



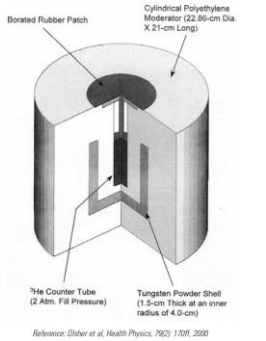
Neutron Detectors

GSI‘s passive neutron dosimeter

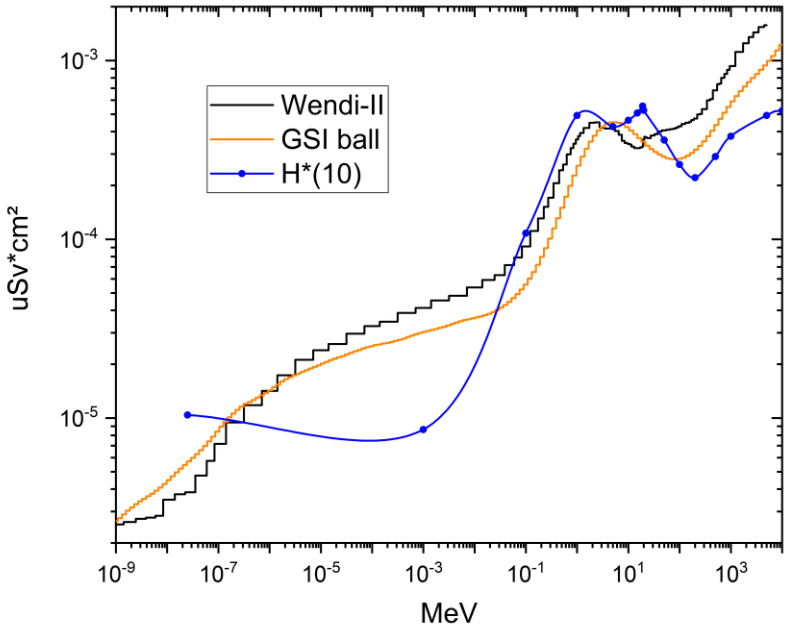


Wendi-II active dosimeter

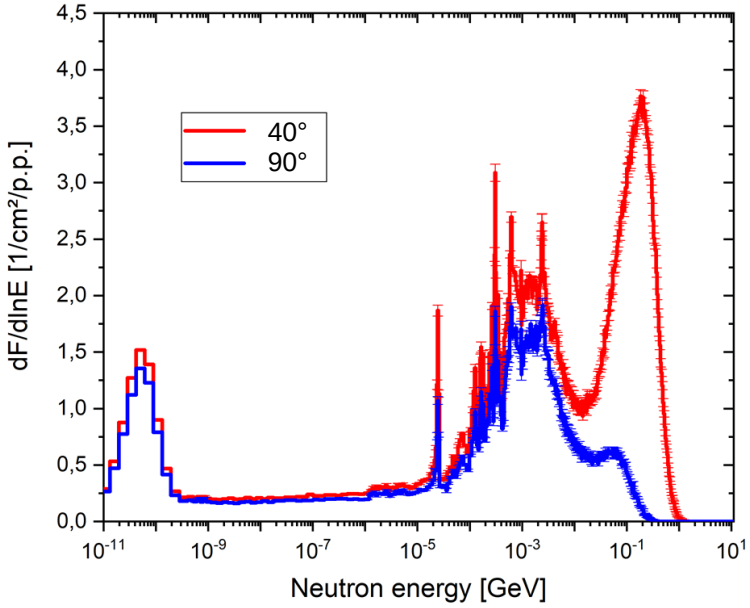
- Thermal to 5 GeV energy range according to H*(10), ICRP 74
- High sensitivity due to large He-3 tube
- Excellent gamma rejection
- Fits to FHT 6020 area monitor and FH 40 G survey meter



Response functions and neutron fluence-to-ambient dose conversion coefficients



Neutron Spectra/FLUKA Simulations



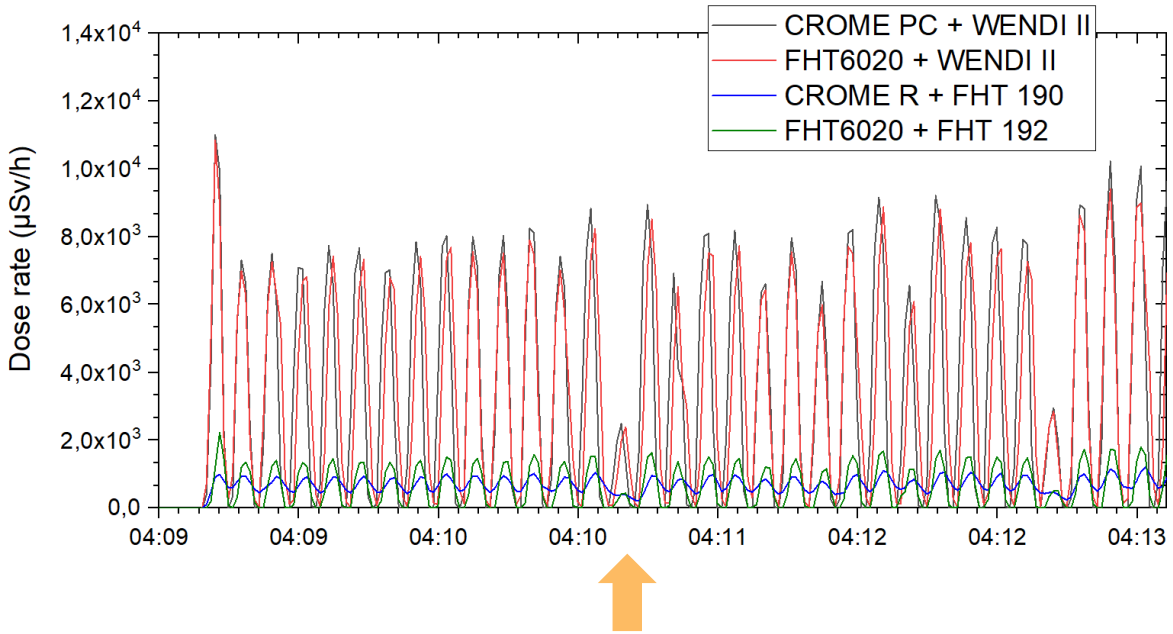
Dose Measurements and Results

Detector &Electronics	Measurements		Simulations		Ratios	
	Dose (µSv/p.p)					
	40°	90°	40°	90°	40 °	90°
CROME PC+WENDI II	6,14E-07	2,69E-07	3,67E-07	2,08E-07	**1,67**	**1,29**
FHT6020+WENDI II	6,09E-07	2,75E-07			**1,66**	**1,32**
TLD-Sphere	4,32E-07	1,87E-07			**1,18**	**0,90**

Detector &Electronics	Measurements		Simulations		Ratios	
	Dose (µSv/p.p)					
	40°	90°	40°	90°	40 °	90°
CROME R+FHT190	3,78E-07	6,26E-08	2,58E-07	3,33E-08	**1,46**	**1,88**
FHT6020+FHT192	2,06E-07	6,81E-08			**0,80**	**2,04**
CROME PC+FHT192	1,02E-07	3,69E-08			**0,40**	**1,11**
	Behind the Target					
	Pos1	Pos2	Pos1	Pos2	Pos1	Pos2
TLD-Cylinder	4,83E-07	3,94E-07	4,37E-07	3,87E-07	**1,11**	**1,02**
TLD-Cylinder PRO	3,91E-07	4,40E-07	3,84E-07	4,43E-07	**1,02**	**0,99**
FHT6020+FHZ632	1,83E-07		3,84E-07		**0,48**	
CROME PC+FHZ632		1,32E-07		3,87E-07		**0,34**

Dose Measurements and Results

5 s spill length 2 s off

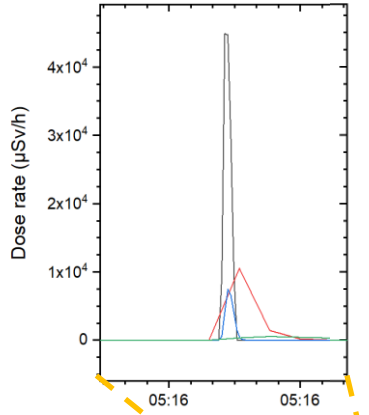


Total dose:

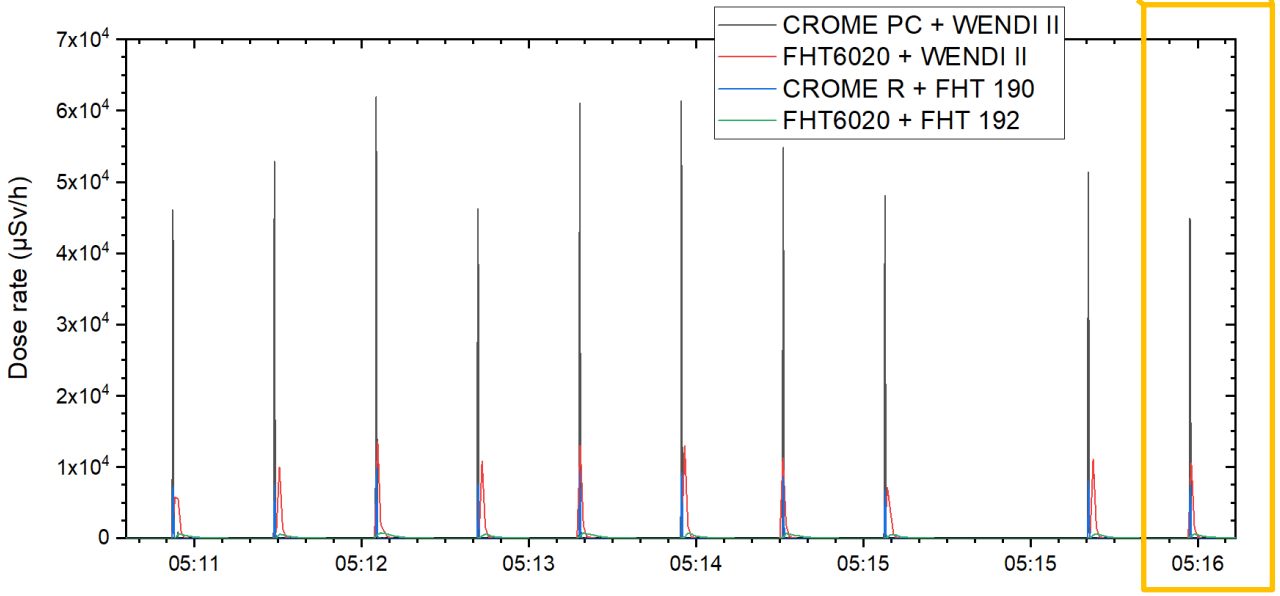
CROME PC + WENDI II = 758 µSv
FHT6020 + WENDI II = 713 µSv
CROME R + FHT 190 = 136 µSv
FHT6020 + FHT 192 = 147 µSv

Total dose:

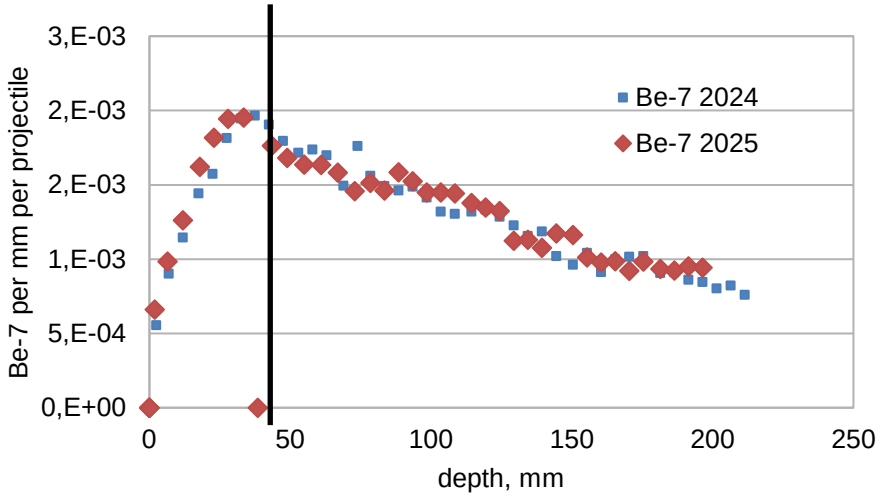
CROME PC + WENDI II = 38 µSv
FHT6020 + WENDI II = 37 µSv
CROME R + FHT 190 = 7,7 µSv
FHT6020 + FHT 192 = 8,1 µSv

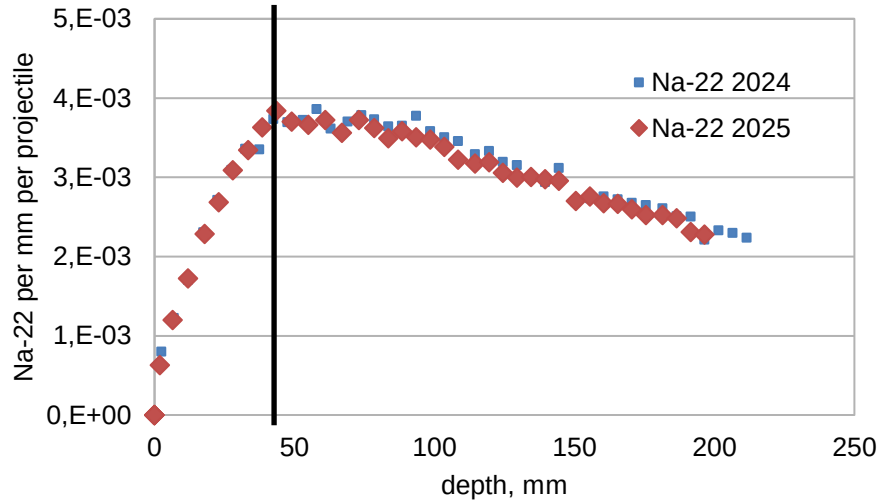


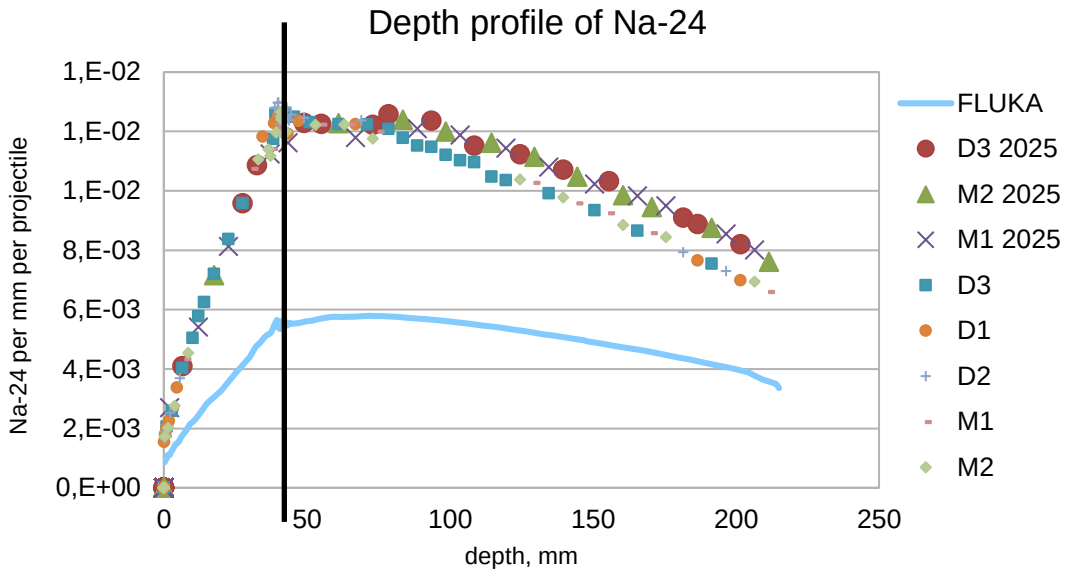
0.5 s spill length 30 s off

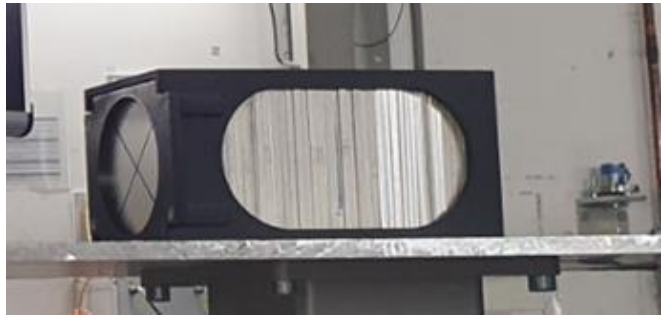


Depth profiles of some residual nuclides produced in the activated Al target









Five different gamma detectors were used to measure the gamma spectra of the foils

E. Mustafin

Summary

- Different dosimeters were tested in „classical GSI“ radiation field from 990 MeV/u uranium beam hitting the Al-target, different spill lengths and intensities were used. The irradiation was done with slow extracted beam.

- The measured with different devices dose rates were compared between each other

- Additional comparison of the measurements was done with the FLUKA simulation results

- The **Wendi-II** - neutron dosimeter, **FHT190**/FHT192 – ion chamber, FHZ 632L-10 – proportional counter tube and **new CROME Prototype** showed reliable results and approved themselfs to be the perfect candidates for dose measurements at **FAIR facility**

- The **next step** is to **qualify** the **various combinations of detectors and electronics** at pulsed radiation fields produced with a **fast extracted beam**. In this case, all possible scenarios will be covered and the measuring detector systems will be fully characterized.

Thank you very much for your attention and support during the experiment, and for providing us with the beam!