Updates on DTL FCs

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Beam Instrumentation Forum

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Outline - 2019 highlights

1 DTL FC2 design

2 Operation and DAQ

3 Control (.opi)

4 Activation, dose and shielding calculations

5 Rehearsing for ‘Beam on Target’

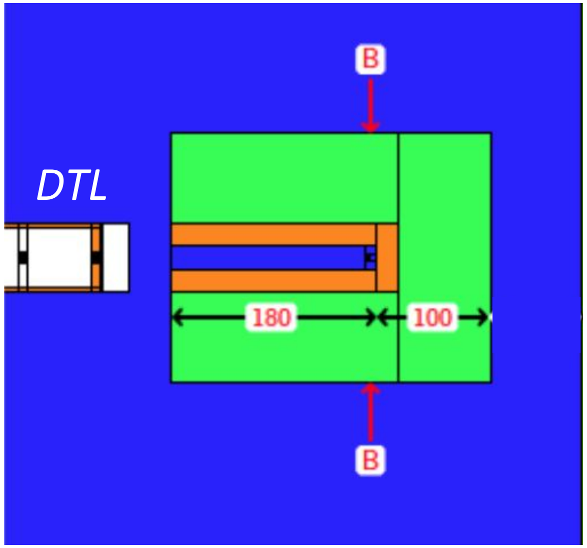
DTL Faraday cups: goals

Two DTL Faraday cups:
- *to stop the proton beam*
- *to measure the beam current*

aka ‘beam dump’ during commissioning:
- *DTL FC2 after DTL1 and after DTL2*
- *DTL FC4 after DTL4*

Final destination(s):
DTL IT2 and IT4

	DTL2	**DTL4**
Proton energies	21 - 39 MeV	39 - 74 MeV
Peak power	2.43 MW	4.63 MW
Average power	120 W	324 W

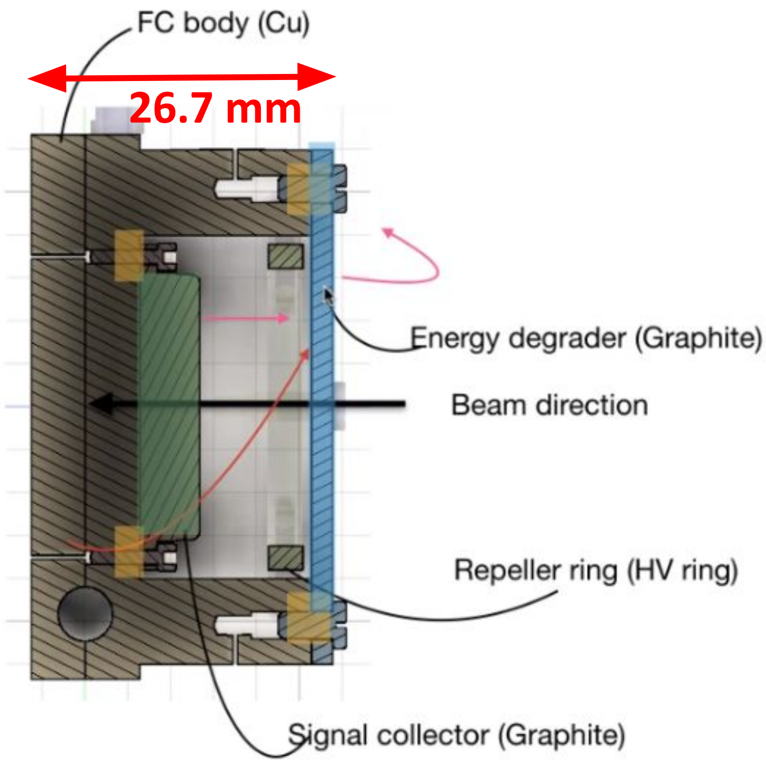


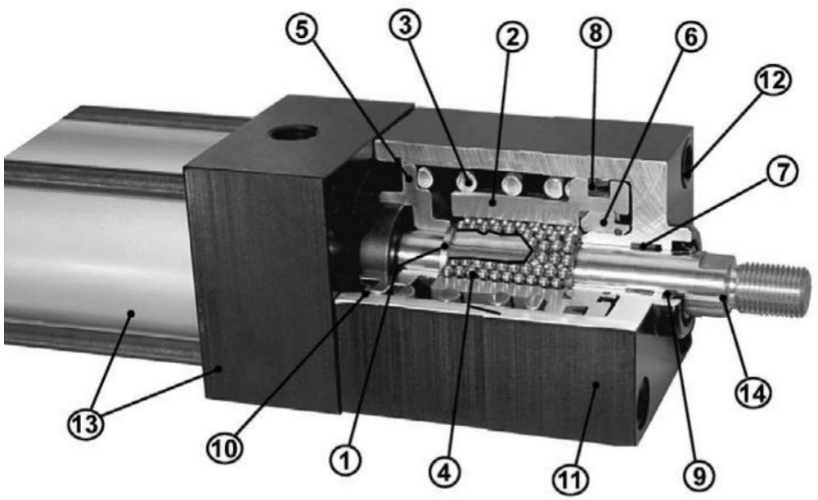
DTL FC2 design

EUROPEAN SPALLATION SOURCE

- Pneumatic actuator, including a "rod lock" mechanism, as required by ESS MPS

- RadiaBeam design in July 2019
Graphite foil and collector (1.8 g/cm^3)

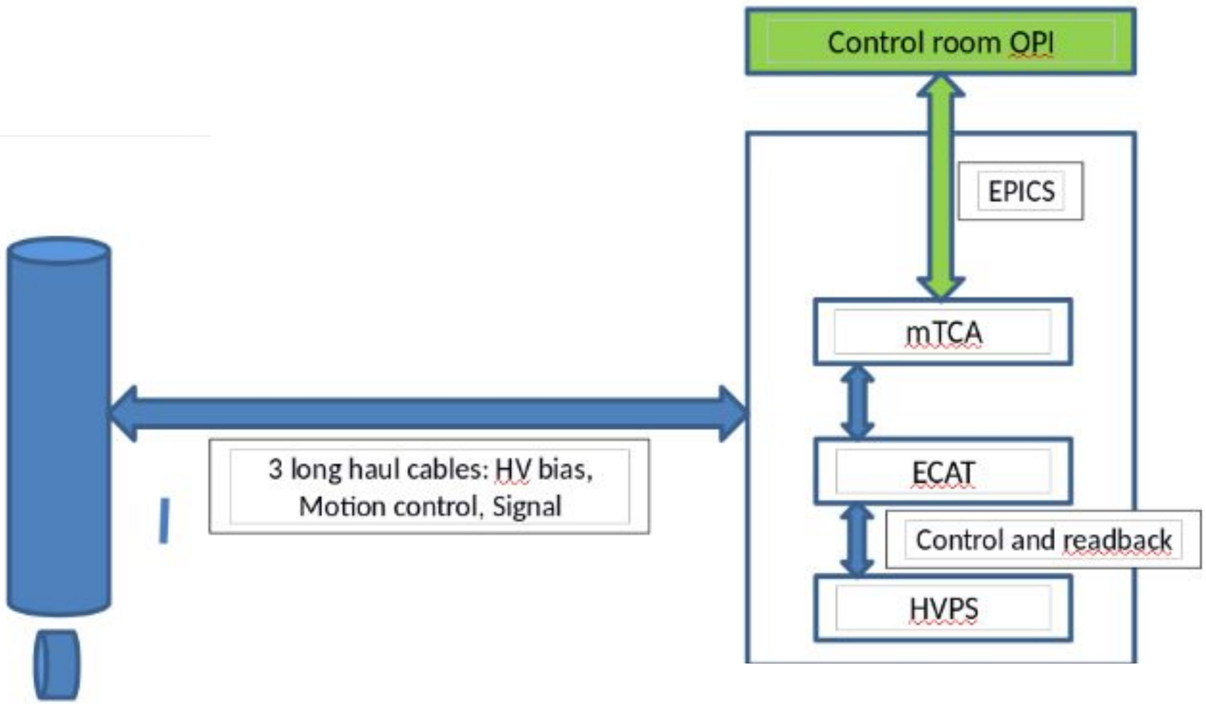




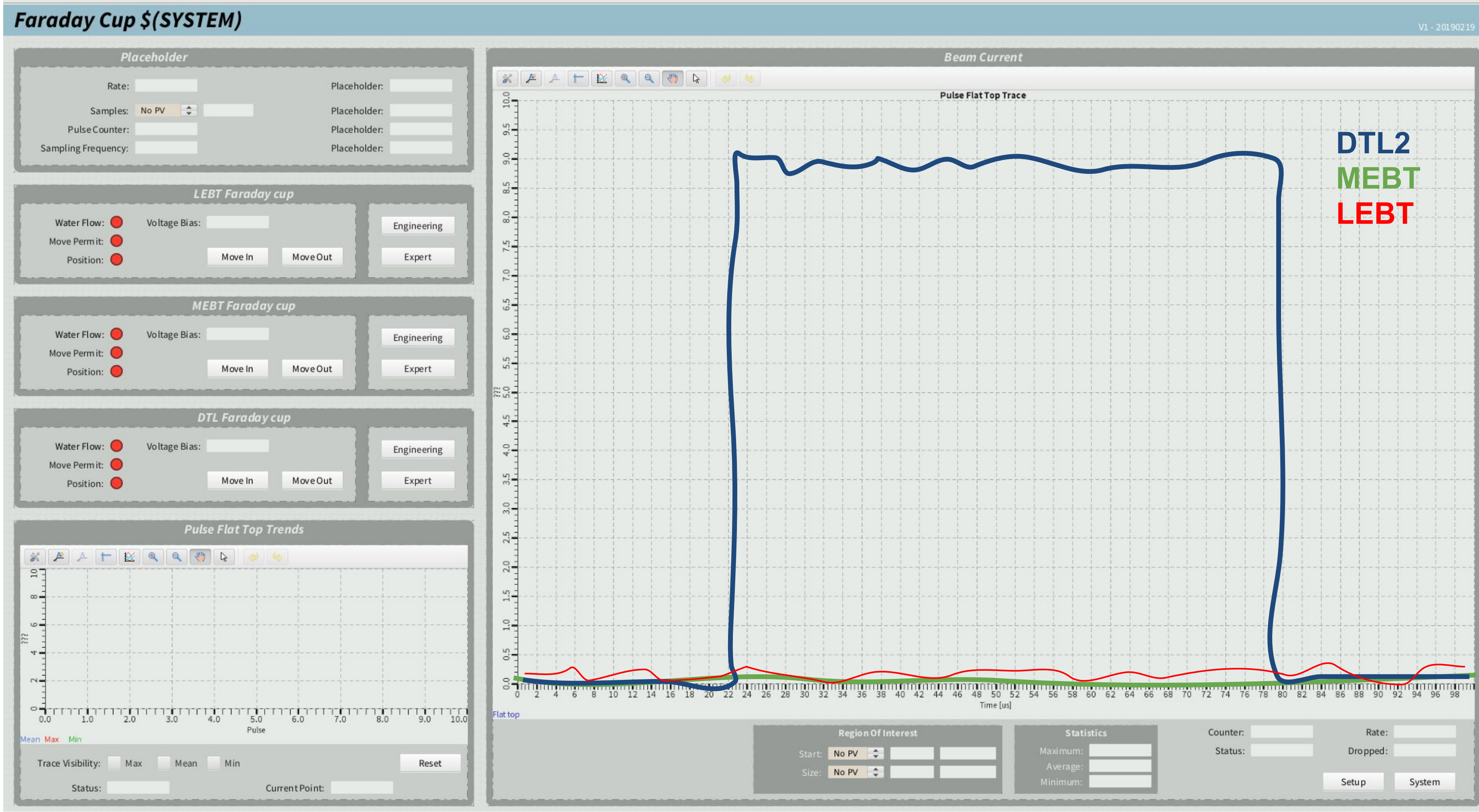
radiabeam TECHNOLOGIES

Operation and DAQ

- Based on LEBT FC, same FE
- Cable length = max. 62 meters
+ Differential current measurements with upstream BCM (TBD)



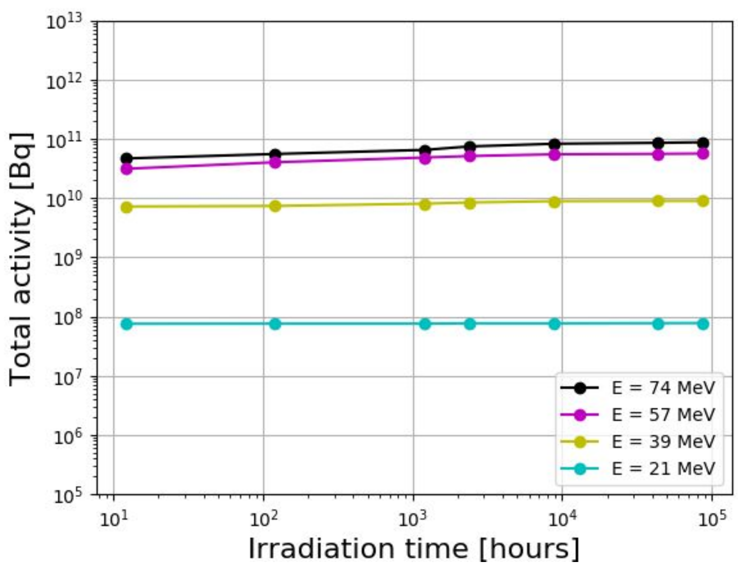
Control for 3 FCs



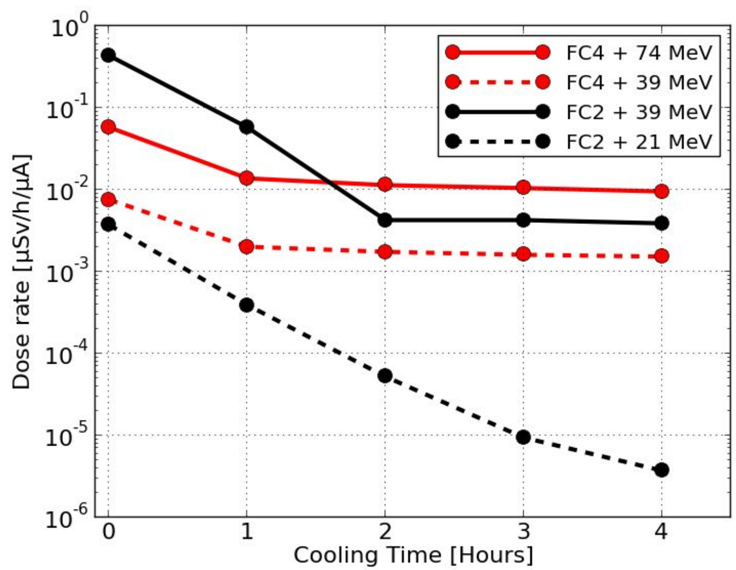
Activation, dose and shielding

- MCNP and ANSYS for Energy deposition (last but one BIF)

- CINDER90 for activation calculations: ESS-0342474
- CINDER90/MCNP dose at contact: ESS-1157535
- Shielding calculations: ESS-0136227



Outside the shielding

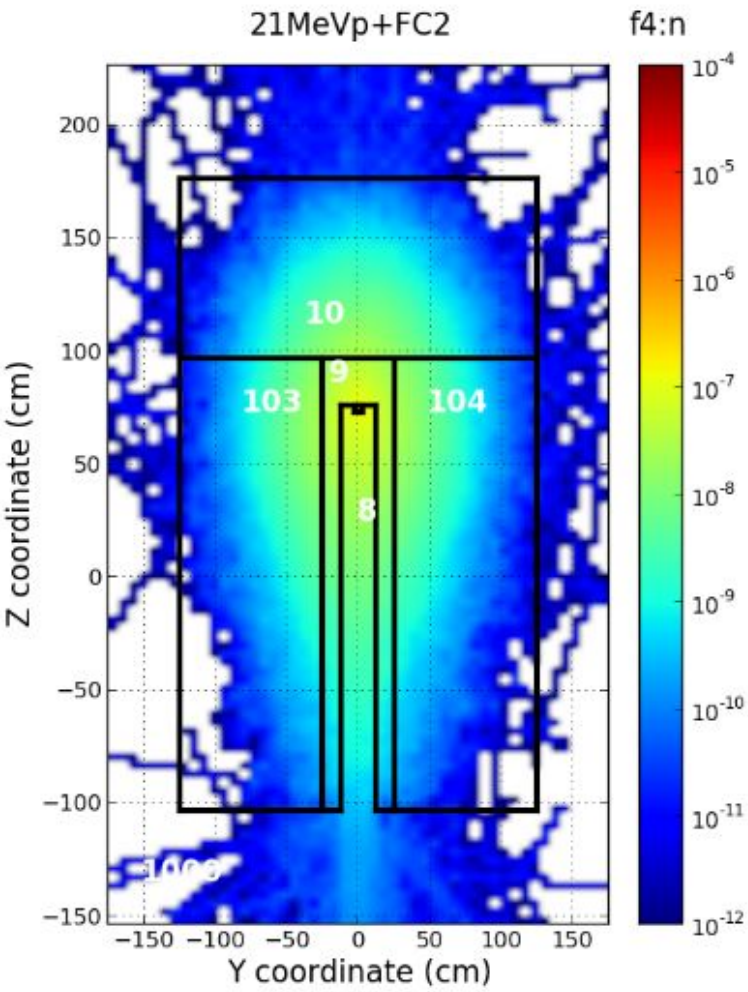


Rehearsing for ‘beam on target’

Commissioning (ISrc - DTL1)
21 MeV + DTL FC2 = neutrons
Ancillary neutron detectors

“DMSC, we have neutrons”

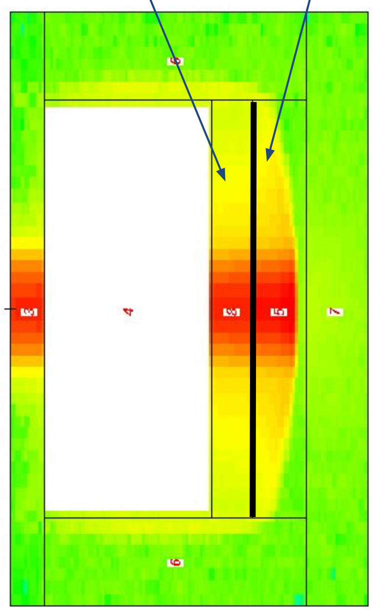
- Controlling the components of the instrument
- Acquiring the data from detectors & meta-data from instrument/samp. env. etc.
- Streaming the data (publish/subscribe)
- Recording/archiving/cataloguing the data
- Carrying out the data reduction



Acknowledgments

- Progress based on the accumulated experience from the LEBT FC operation
- Special thanks to: Clement, Tommy, Tom, Rick, Rafael, Dirk, Luca, James, and the DMSC
- Amazing collaboration with RadiaBeam (US)

ρ_1=1.8, ρ_2=2.2 g/cm^3?



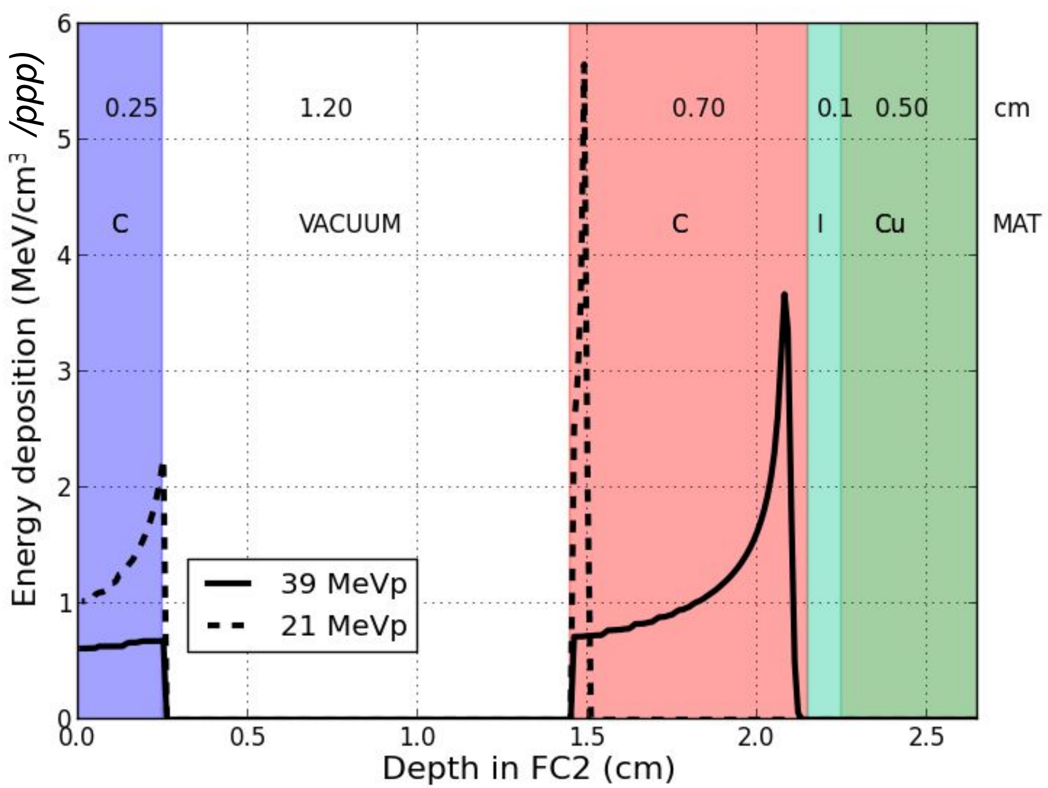
- Breaking news: BP revised the min/max beam energies

FC location	Low limit (MeV)	High limit (MeV)
DTL1	21.27 - 0.8	21.27 + 0.8
DTL2	21.27 - 0.8	39.11 + 0.9
DTL4	39.11 - 0.9	73.84 + 1.2

Simulations by R. Miyamoto

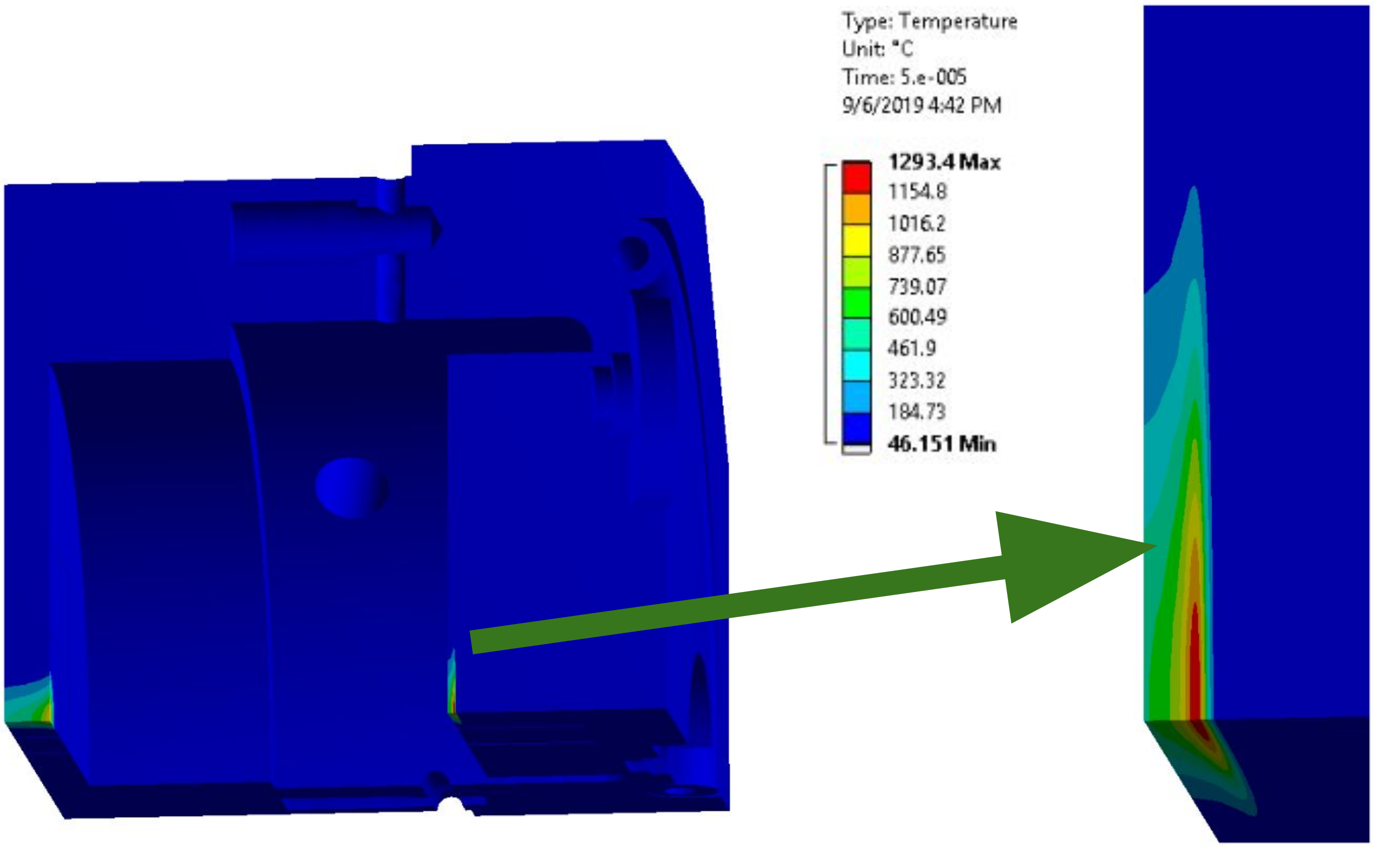
Bragg peaks location

Foil: designed to 'filter' low energy protons + scatter the beam → reduced collector T
Collector: isolated with Shapal-M
Graphite density: 1.8 g/cm^3 on purpose



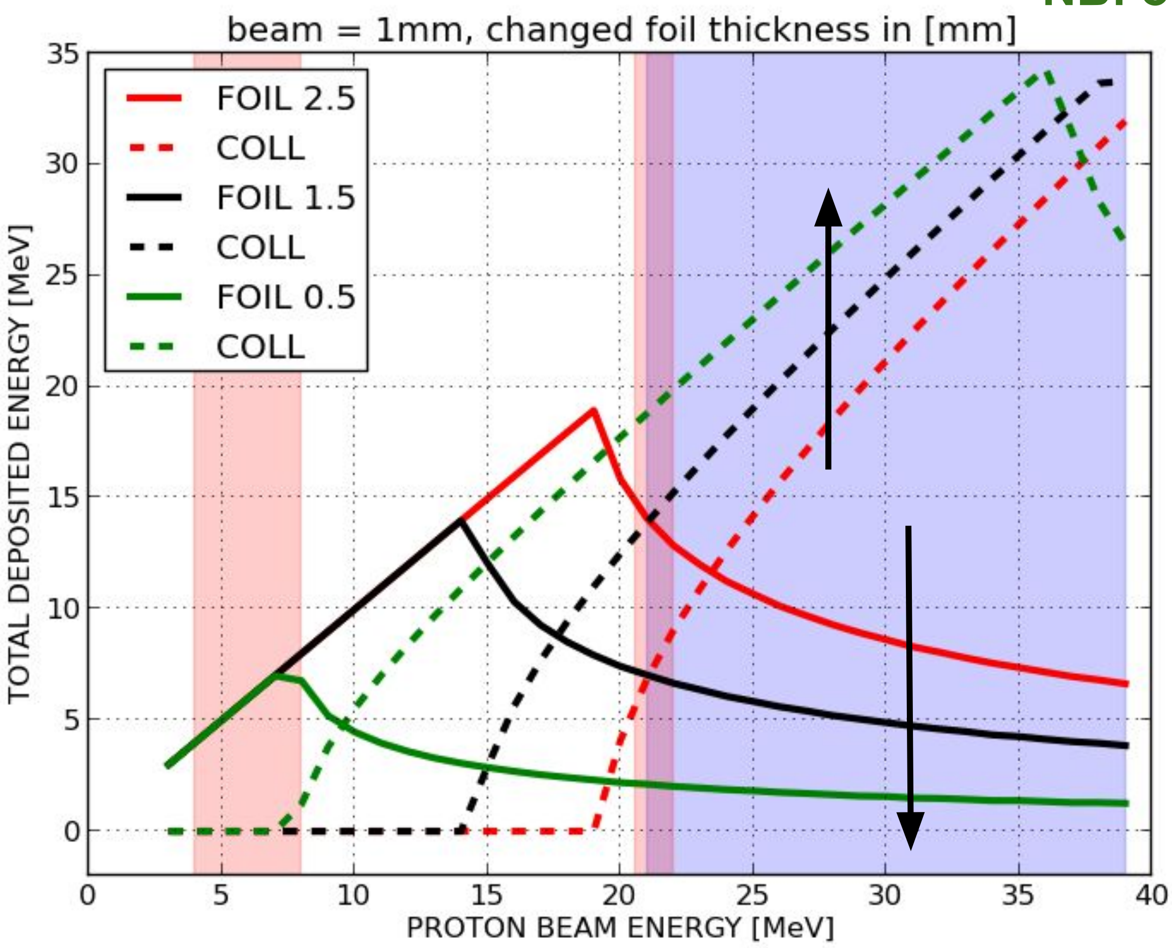
Temperature increase

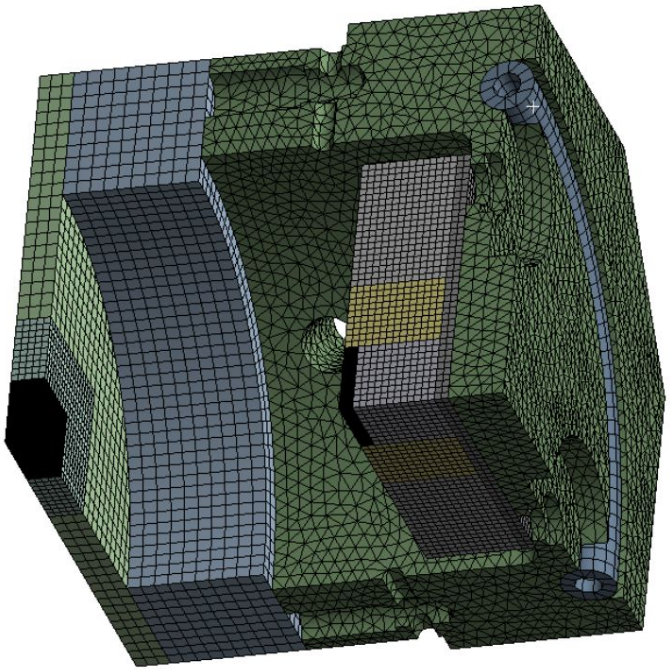
MCNP + ANSYS >>> https://confluence.esss.lu.se/display/WP7FC/2_ANSYS_2018
Most demanding case: 50E-6 s, 1 Hz, 62.5 mA, 21 MeV



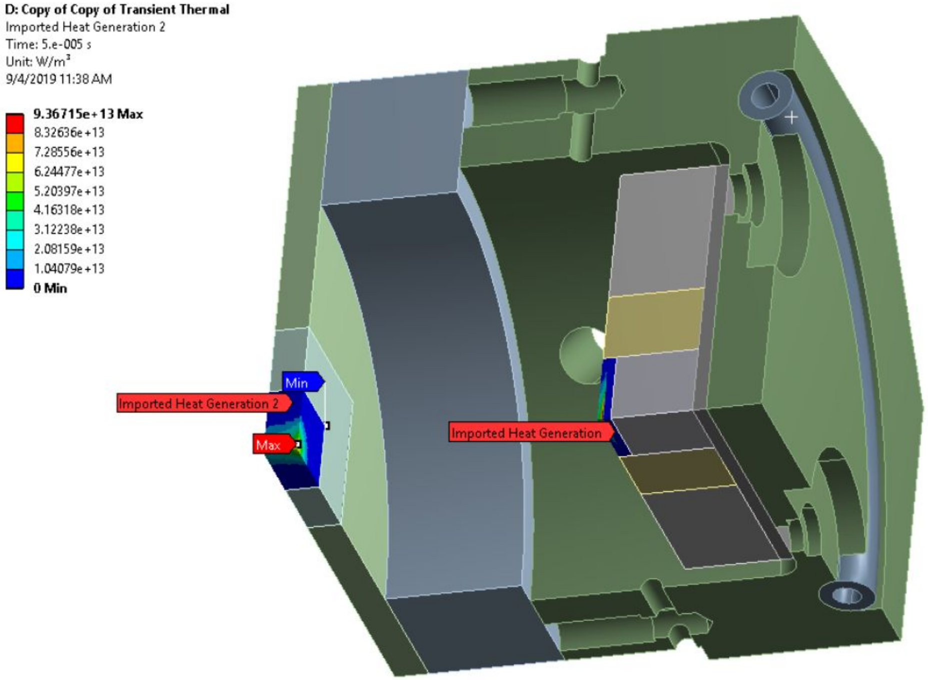
Would a thinner foil help? NO

NB: only up to ~ 35 MeV!





(c) Mesh



(d) Imported heat

Version#2 FC Vacuum vessel assembly

INFN Torino