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Updates on DTL FCs

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Outline - 2019 highlights



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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



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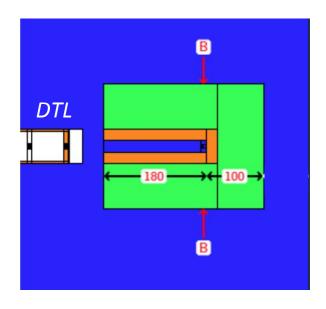
Two DTL Faraday cups:

- to stop the proton beam
- to measure the beam current

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

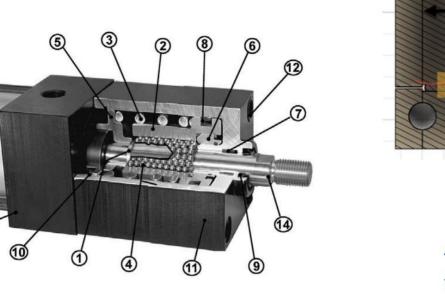
aka 'beam dump' during commissioning:DTL FC2 after DTL1 and after DTL2DTL FC4 after DTL4

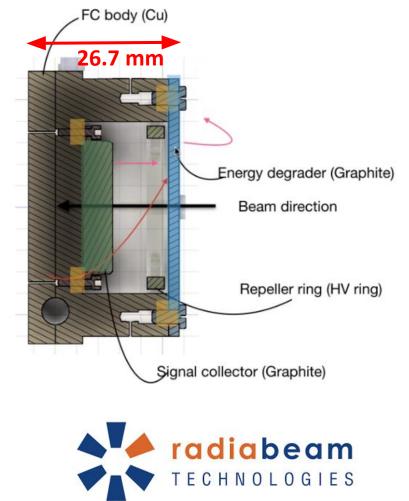


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DTL FC2 design

- Pneumatic actuator, including a
 "rod lock" mechanism, as required by ESS MPS
- RadiaBeam design in July 2019 Graphite foil and collector (1.8 g/cm³)



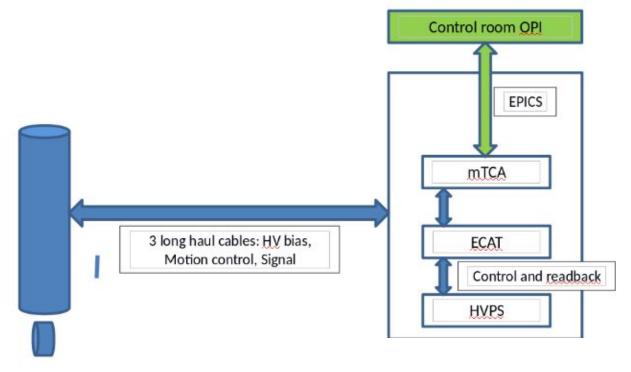




Operation and DAQ



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



Control for 3 FCs

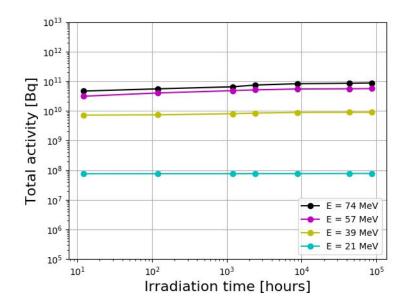


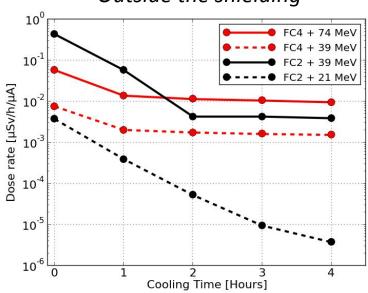
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Faraday Cup \$(SYSTEM) Beam Current * / / / 12 🛛 🖉 🖌 Rate: Placeholder: Pulse Flat Top Trace 10.0 Samples: No PV 💲 Placeholder: 9.5 PulseCounter: Placeholder: DTL2 Sampling Frequency: Placeholder: 9.0 MEBT 8.5 LEBT 8.0 Water Flow: 🔴 Voltage Bias: Engineering Move Permit: 🔴 7.5 Move In Move Out Expert Position: 7.0 6.5 6.0 Water Flow: 🔴 Voltage Bias: Engineering Move Permit: 5.5 Move In MoveOut Expert Position: 🔴 5.0 4.5 Voltage Bias: 4.0 Water Flow: Engineering Move Permit: O 3.5 Move In MoveOut Expert Position: 3.0 2.5 * 🔎 A 🕇 😥 🔍 🔍 🐼 🗛 🝬 2.0 27 1.5 00-1.0 9 0.5 4-~ 3 111 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 4 6 8 10 12 14 16 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 Time [us] lat top Pulse Region Of Interest Counter: Rate: an Max Mir Status: Dropped: No PV Trace Visibility: Max Mean Min Reset No PV System Setup Status: Current Point:

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'



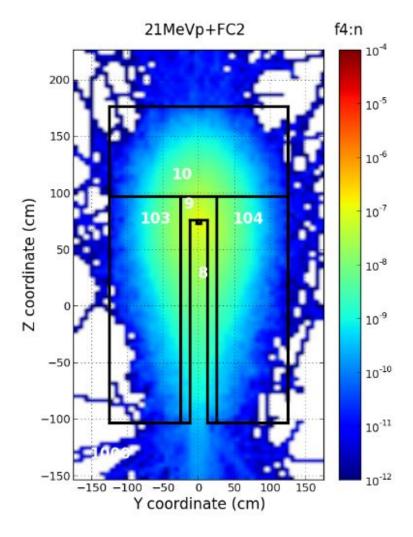
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Commissioning (ISrc - DTL1) 21 MeV + DTL FC2 = neutrons Ancillary neutron detectors

"DMSC, we have neutrons"

- Controlling the components of the instrument
- Acquiring the data from detectors & metadata 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

High limit (MeV)

21.27 + 0.8

39.11 + 0.9

73.84 + 1.2

- Amazing collaboration with RadiaBeam (US)

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

Low limit (MeV)

21.27 - 0.8

21.27 - 0.8

39.11 - 0.9

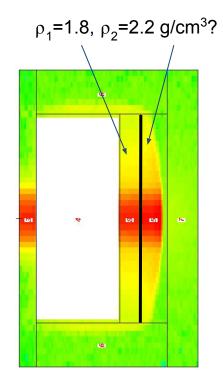
Simulations by R. Miyamoto

FC location

DTL1

DTL2

DTL4

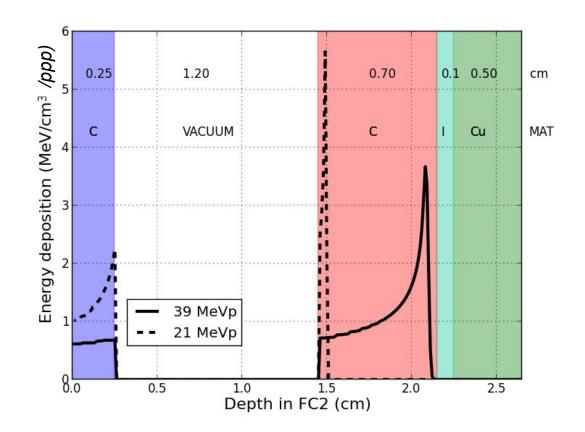






Bragg peaks location

Foil: designed to 'filter' low energy protons + scatter the beam \rightarrow reduced collector T Collector: isolated with Shapal-M Graphite density: 1.8 g/cm³ on purpose



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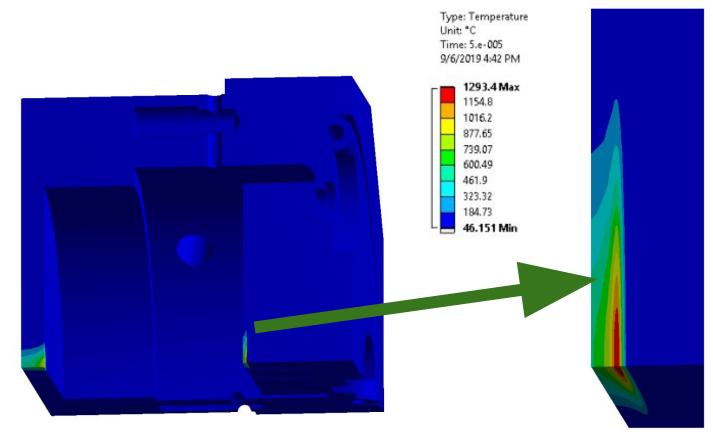
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Temperature increase



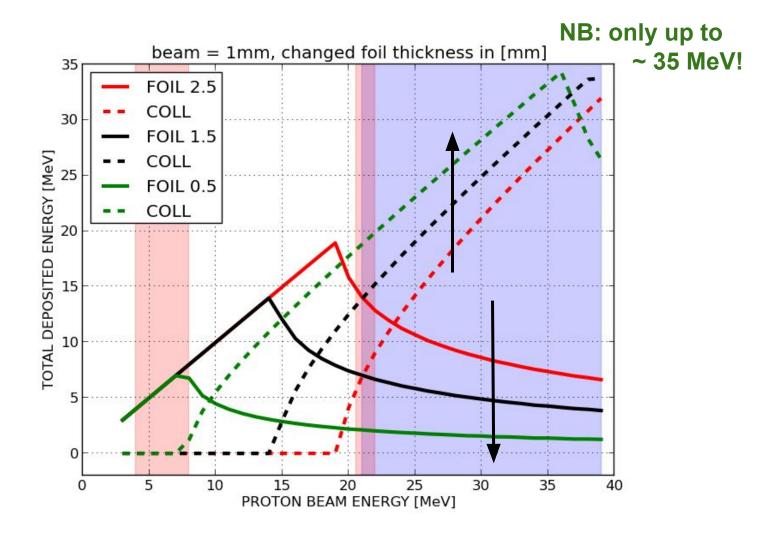
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MCNP + ANSYS >>> <u>https://confluence.esss.lu.se/display/WP7FC/2_ANSYS_2018</u> Most demanding case: 50E-6 s, 1 Hz, 62.5 mA, 21 MeV



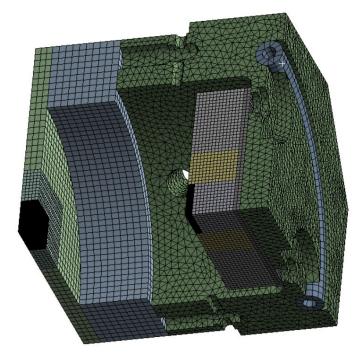
Would a thinner foil help? NO

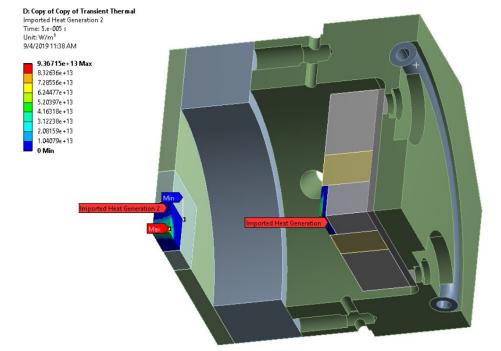














(d) Imported heat

Version#2 FC Vacuum vessel assembly



