Flat moderator and beyond

Other flat features

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for the neutronics team

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Outline

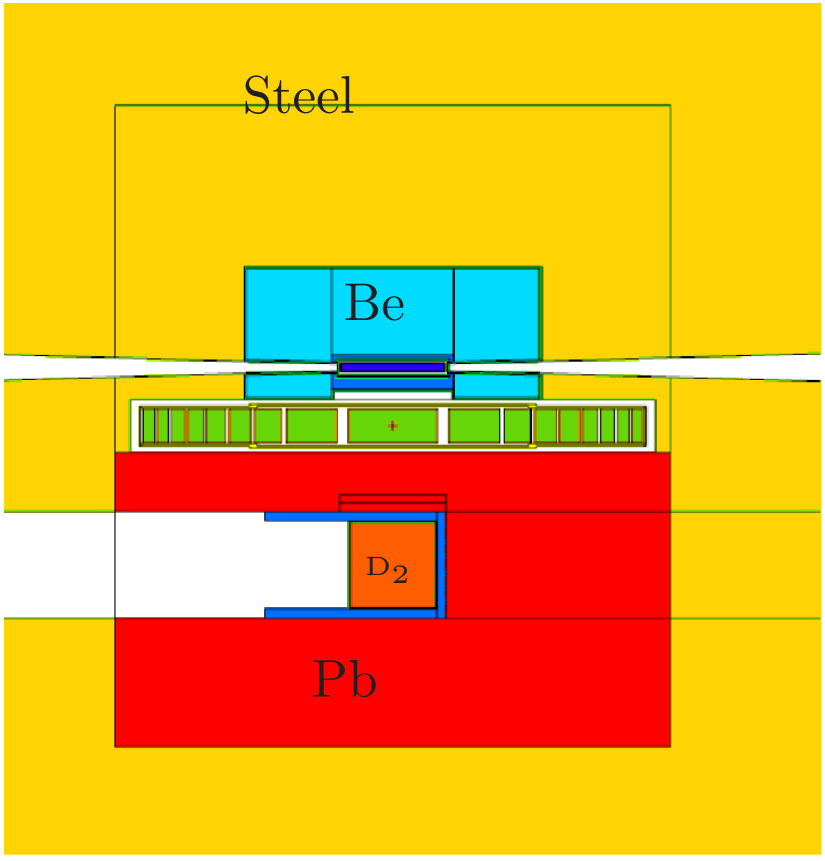
Through-going tube and Lead reflector

Pinhole projections

High energy background

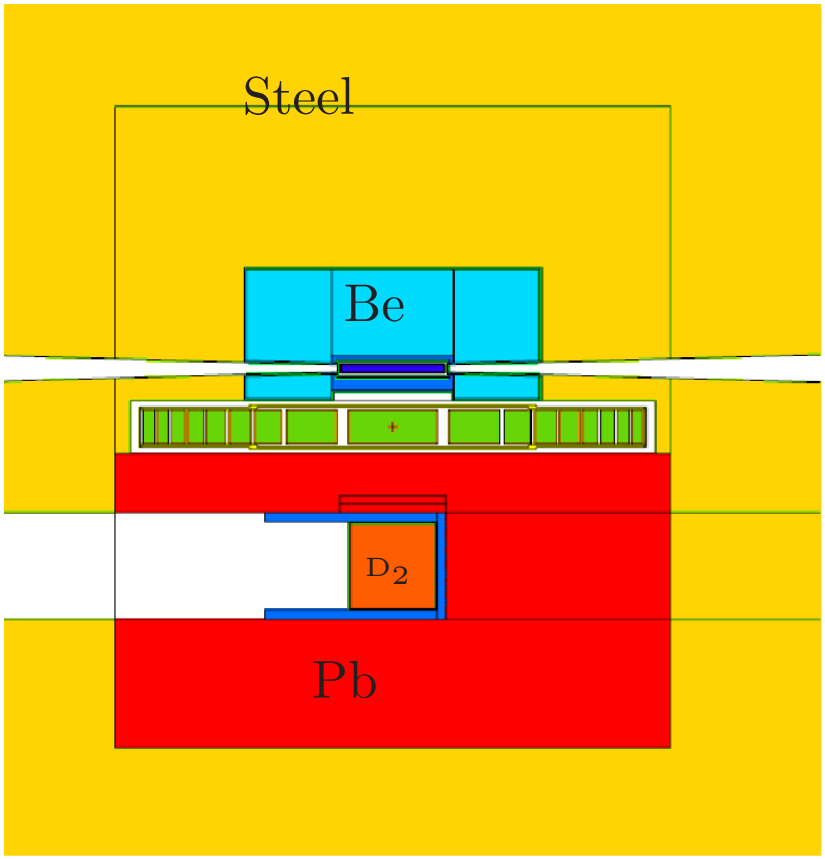
Outline

A possible scenario for maximal performance



- One (flat) moderator on the top
  - Easier extraction of MR plug
- Lead reflector at the bottom
  - Pb compensates for the loss from having a 240° openings
  - Less Be
- A through-going tube at the bottom with a large D_2 moderator for high intensity flux for fundamental physics studies.

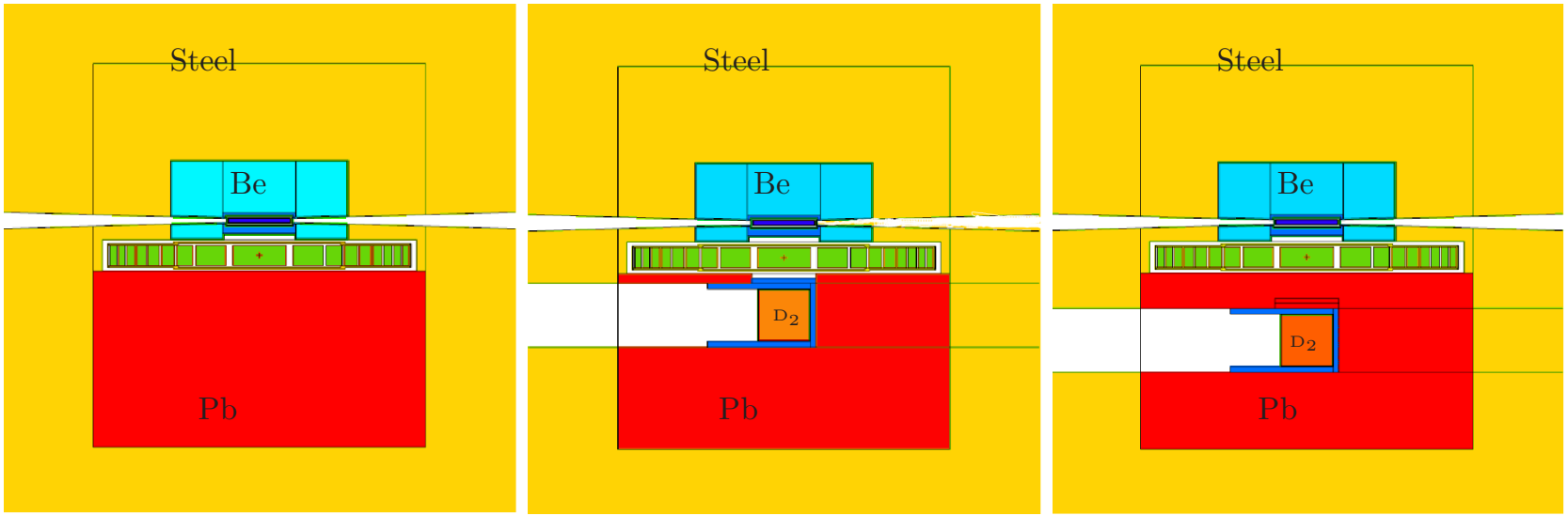
Lead reflector pool



- Advantages of using Lead as outer reflector:
  - Reflect fast neutrons without slowing down
  - Increase cross talk between above and below the target (= effectively bigger reflector)
- Calculated 10 % effect with respect to steel

Esben Klinkby *et al*
Voluminous D_2 source for intense cold neutron beam production at the ESS
arXiv:1401.6003

Trough going tube



Case	$A \times B$ [n/sr/s]
TDR H_2 - 12 $cm \times 12$ cm	1.17×10^{15}
1a D_2 - 25 $cm \times 20.6$ cm	4.27×10^{15}
1b D_2 - 25 $cm \times 20.6$ cm	2.85×10^{15}

Table 2: Neutron guide extraction cross-section multiplied by the integrated cold (0-5 meV) brightness from the deuterium (D_2) moderator in the various studied cases. For comparison, the same parameter is shown for the ESS baseline case (TDR - Technical Design Report [5]). The relative statistical uncertainties are all ~0.1%.

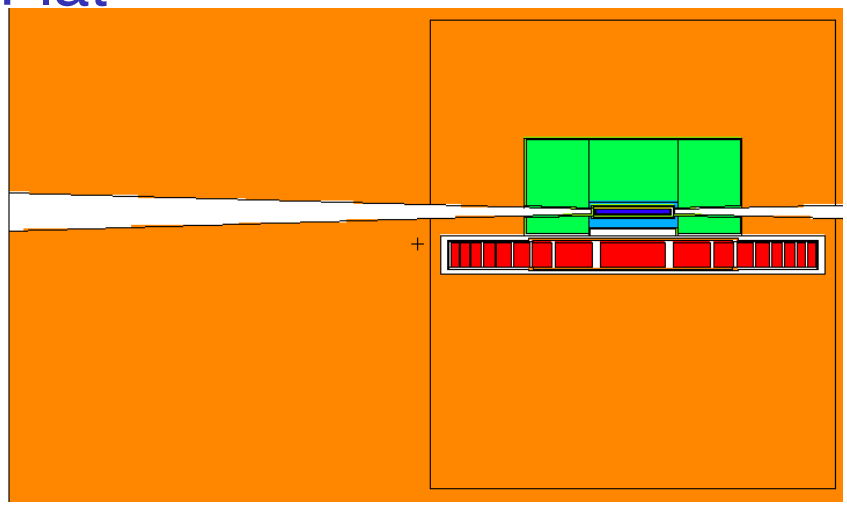
- A D_2 moderator gives $\times 3$ the TRD flux (12×12 moderator)

Outline

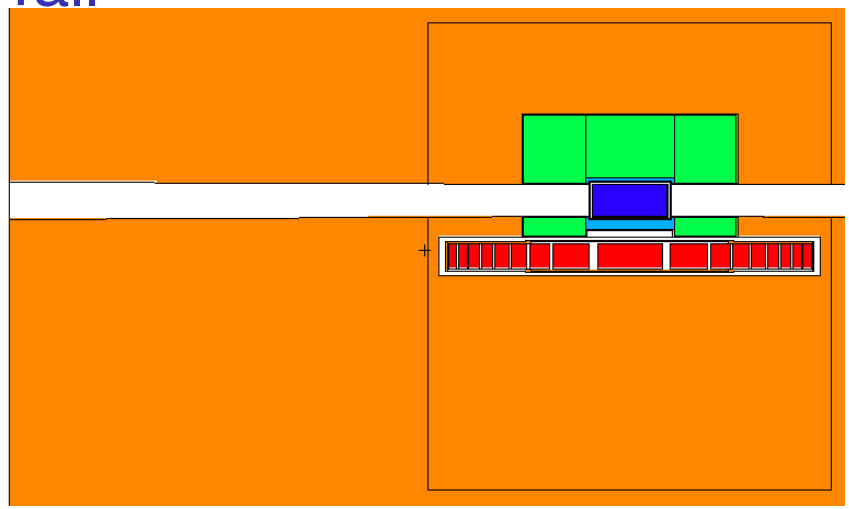
Pinhole projections

Geometry

Flat



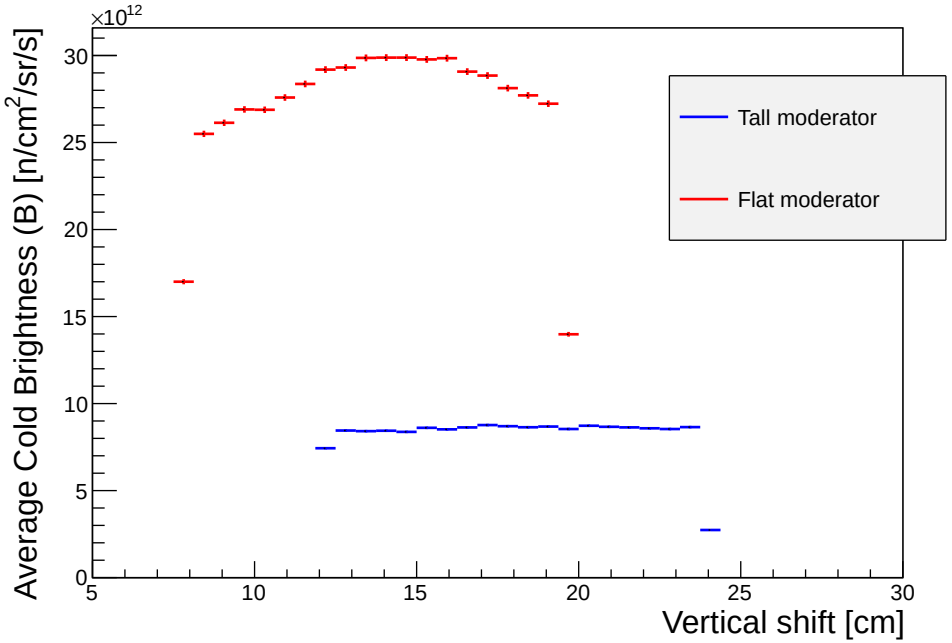
Tall



Vertical shift

Cold brightness with a $3 \times 3\,\mathrm{cm}^2$ guide moved vertically

Effect of mispositioning of a guide in vertical direction

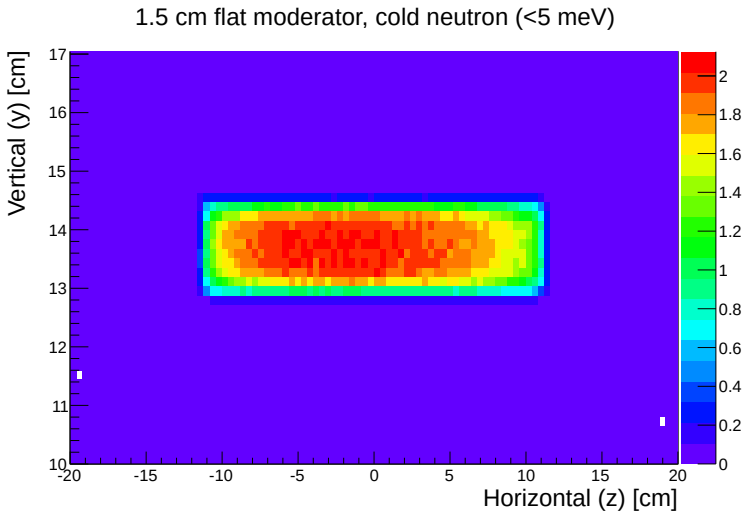


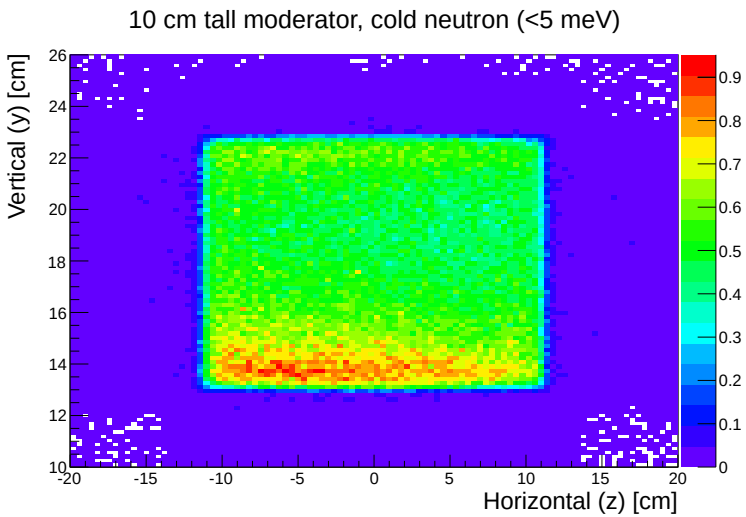
- Tall moderator distribution is flat $\Rightarrow$ not directional
- Flat moderator shows directionality
- Flat moderator also gives tolerance: a guide can be off by a couple of cm

Pinhole projections

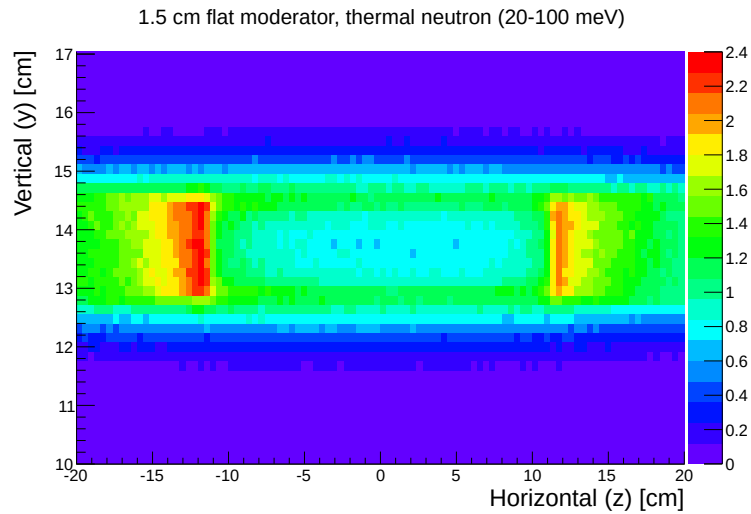
Moderator image as seen from the neutron gude entrance

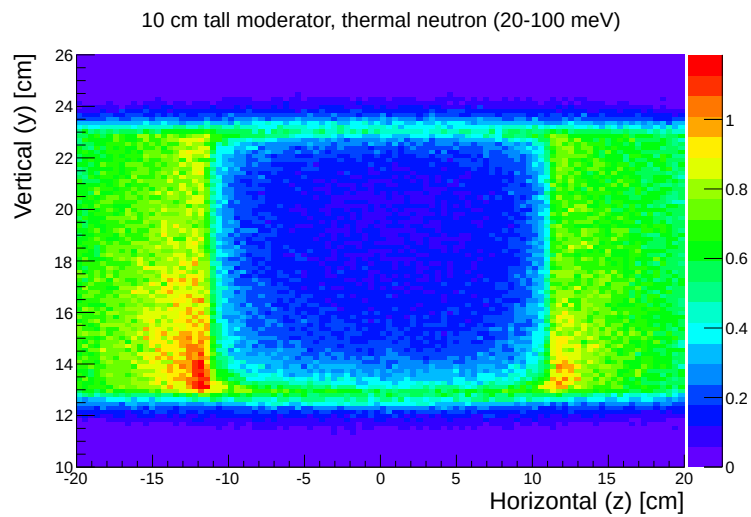
Cold neutrons ($\lambda \gtrsim 4$ Å)





Thermal ($0.9 \lesssim \lambda \lesssim 2$ Å)

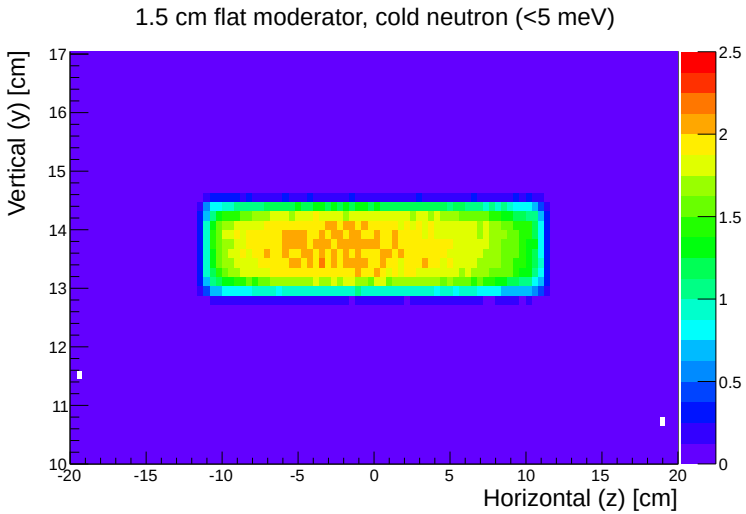


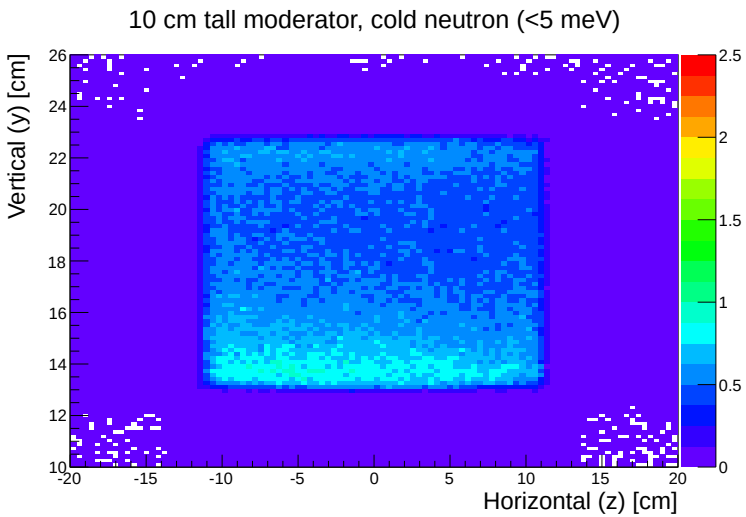


Pinhole projections

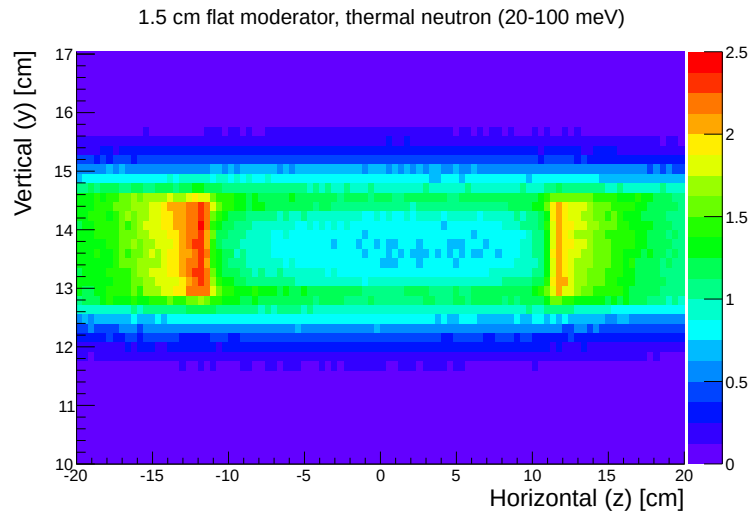
Moderator image as seen from the neutron gude entrance (same color scale)

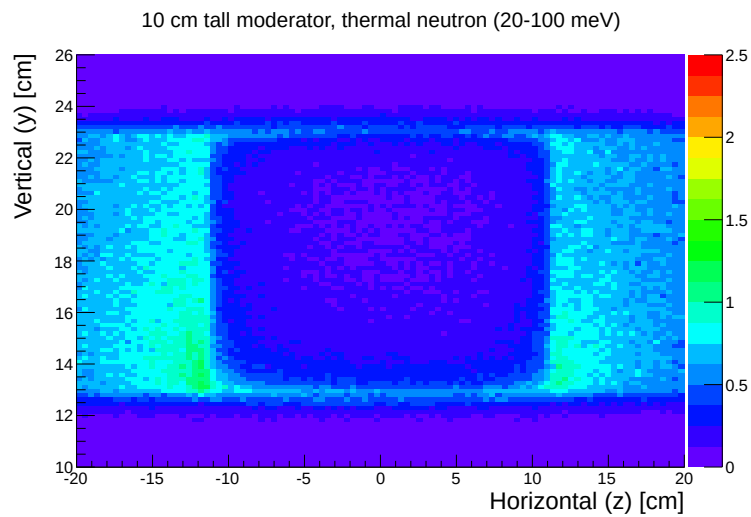
Cold neutrons ($\lambda \gtrsim 4$ Å)





Thermal ($0.9 \lesssim \lambda \lesssim 2$ Å)

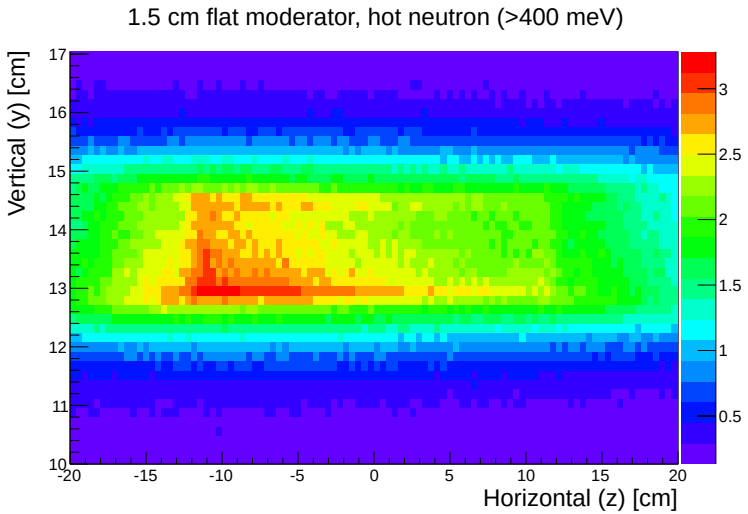


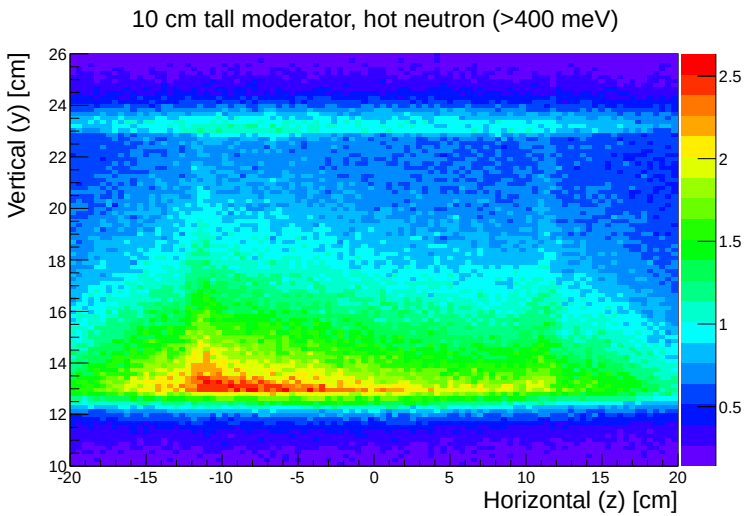


Pinhole projections

Moderator image as seen from the neutron gude entrance

Hot neutrons ($\lambda \lesssim 0.45$ Å)





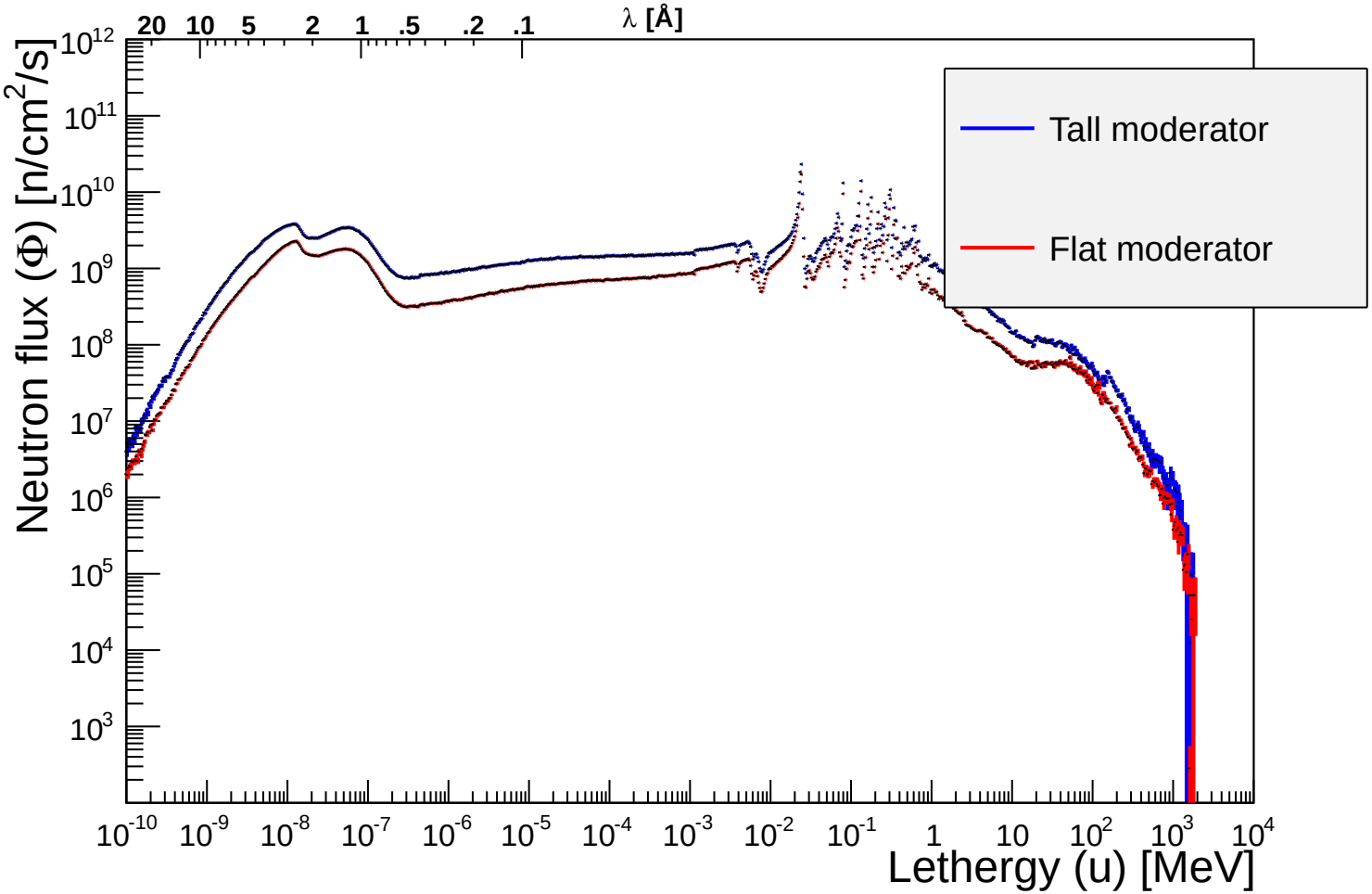
Outline

High energy background

Work is in progress
but there are first results. . .

High energy background (only neutrons)

High energy flux at guide entrance ⟵ all neutrons

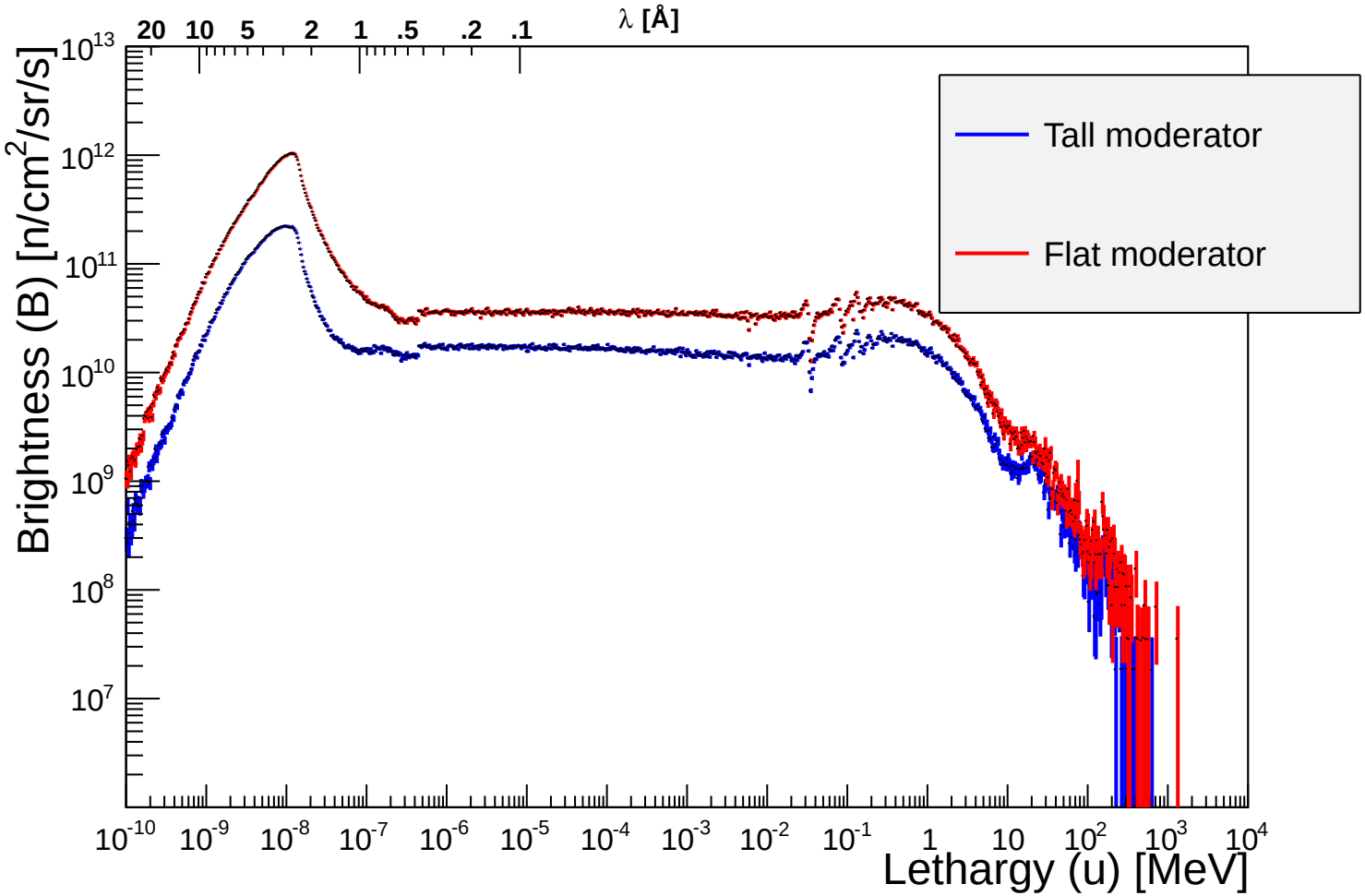


no collimator used

$$u = \frac{dN}{d \log E} = E \frac{dN}{dE}$$

High energy background (only neutrons)

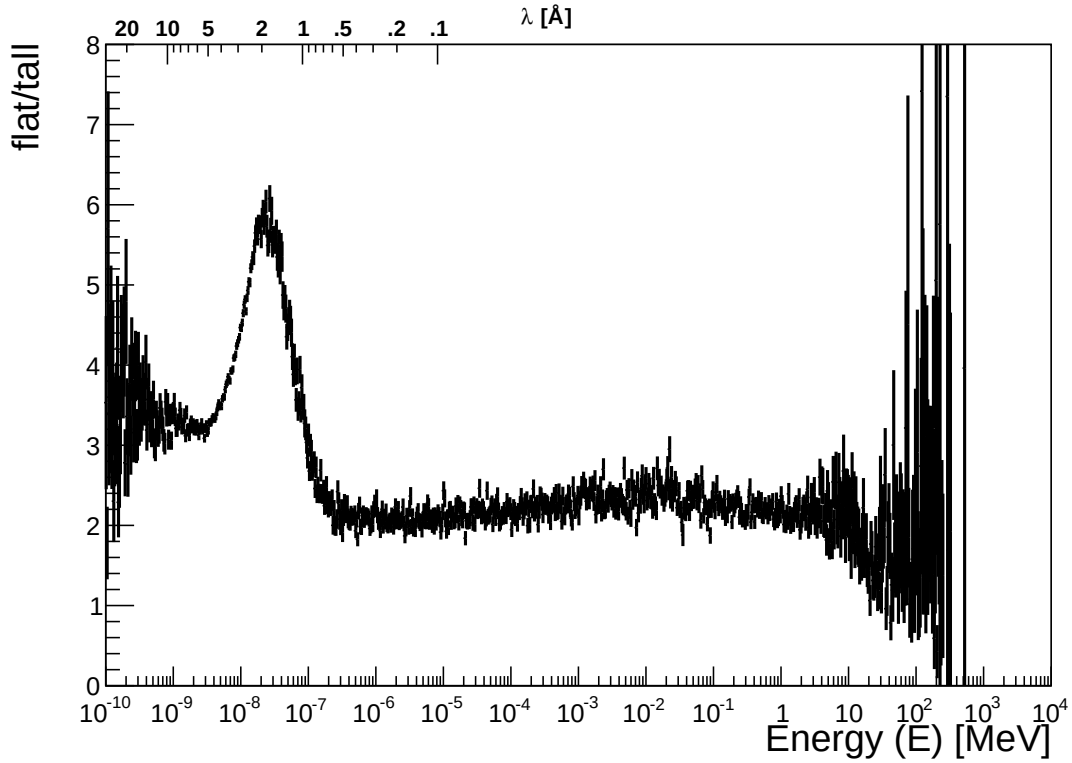
High energy brightness at guide entrance



collimator views the moderator side surface

High energy background (only neutrons)

High energy brightness at guide entrance: flat over tall ratio



- Flat moderator gives more high energy background than the tall one,
- But it also performs better, so the signal-to-noise ratio is bigger.

Bibliography I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arXiv:1401.6003 2014

Thank you