PAUL SCHERRER INSTITUT

PSI

Ἑστία

Estia

EUROPEAN SPALLATION SOURCE

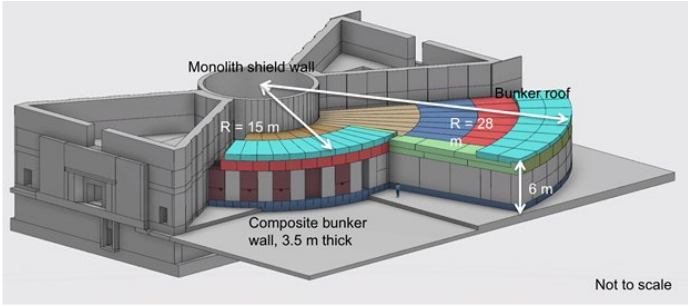
Artur Glavic :: Paul Scherrer Institut

Low-loss in-Bunker Beam Monitor of ESTIA

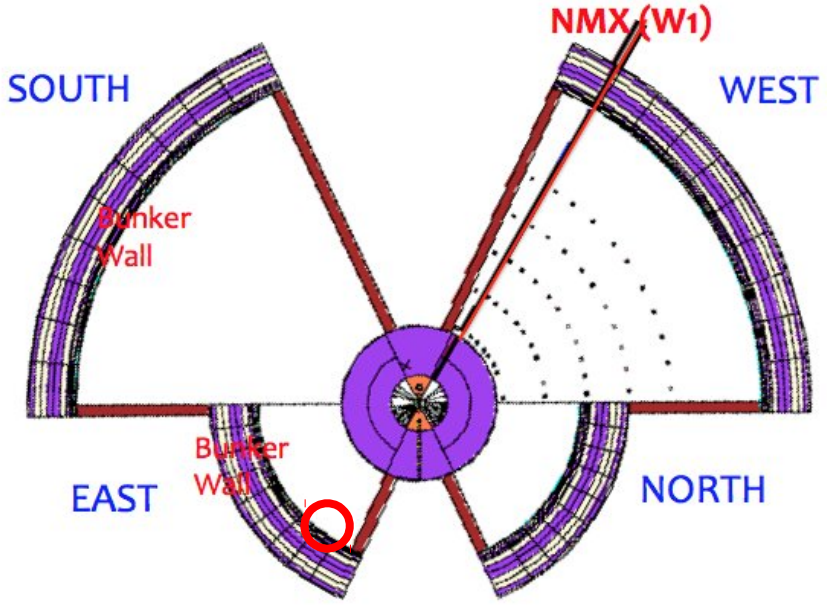
IKON 15 – Detector Session

11.09.2018 – ESS Lund

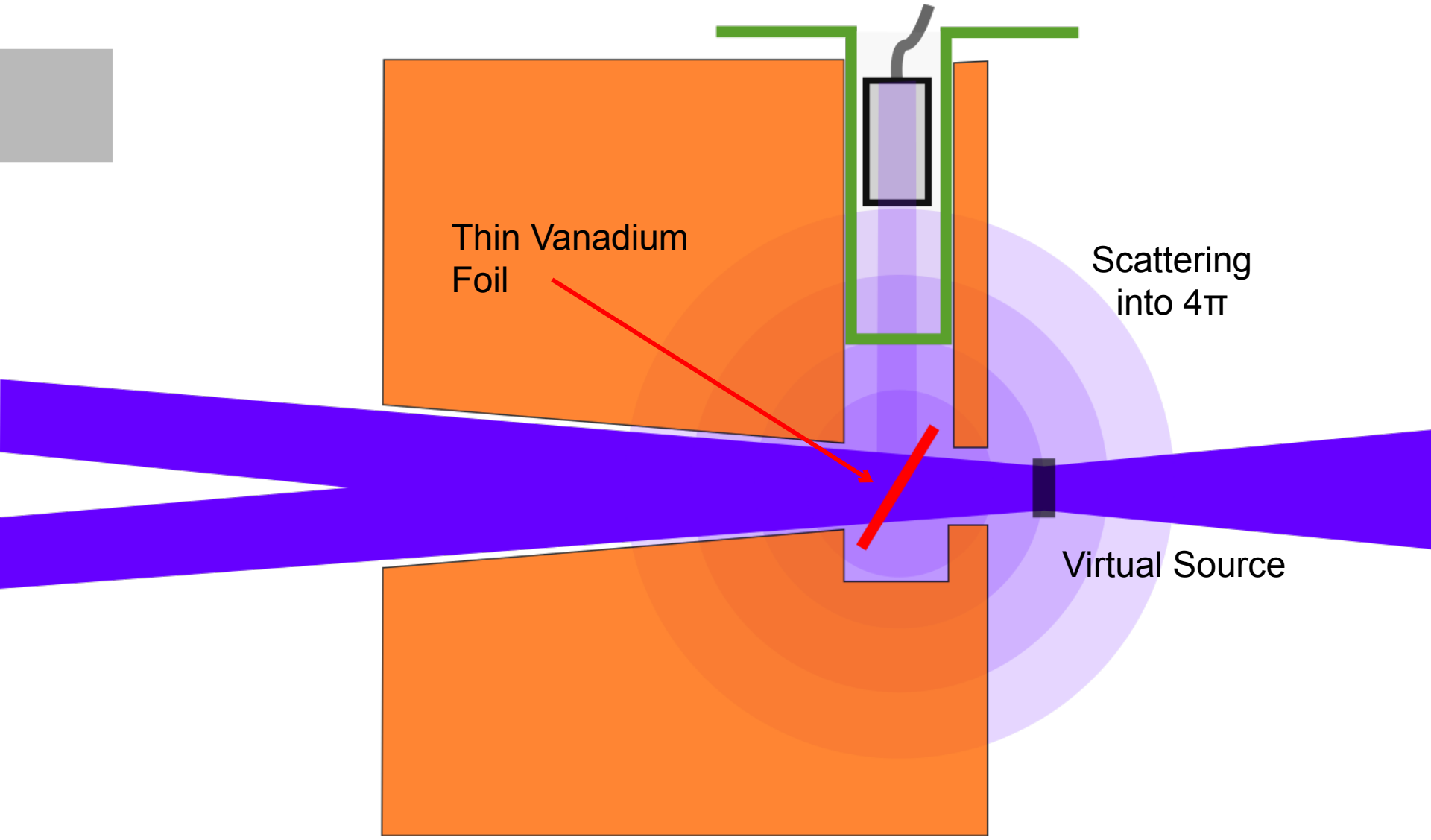
Estia Monitor Goals / Challenges



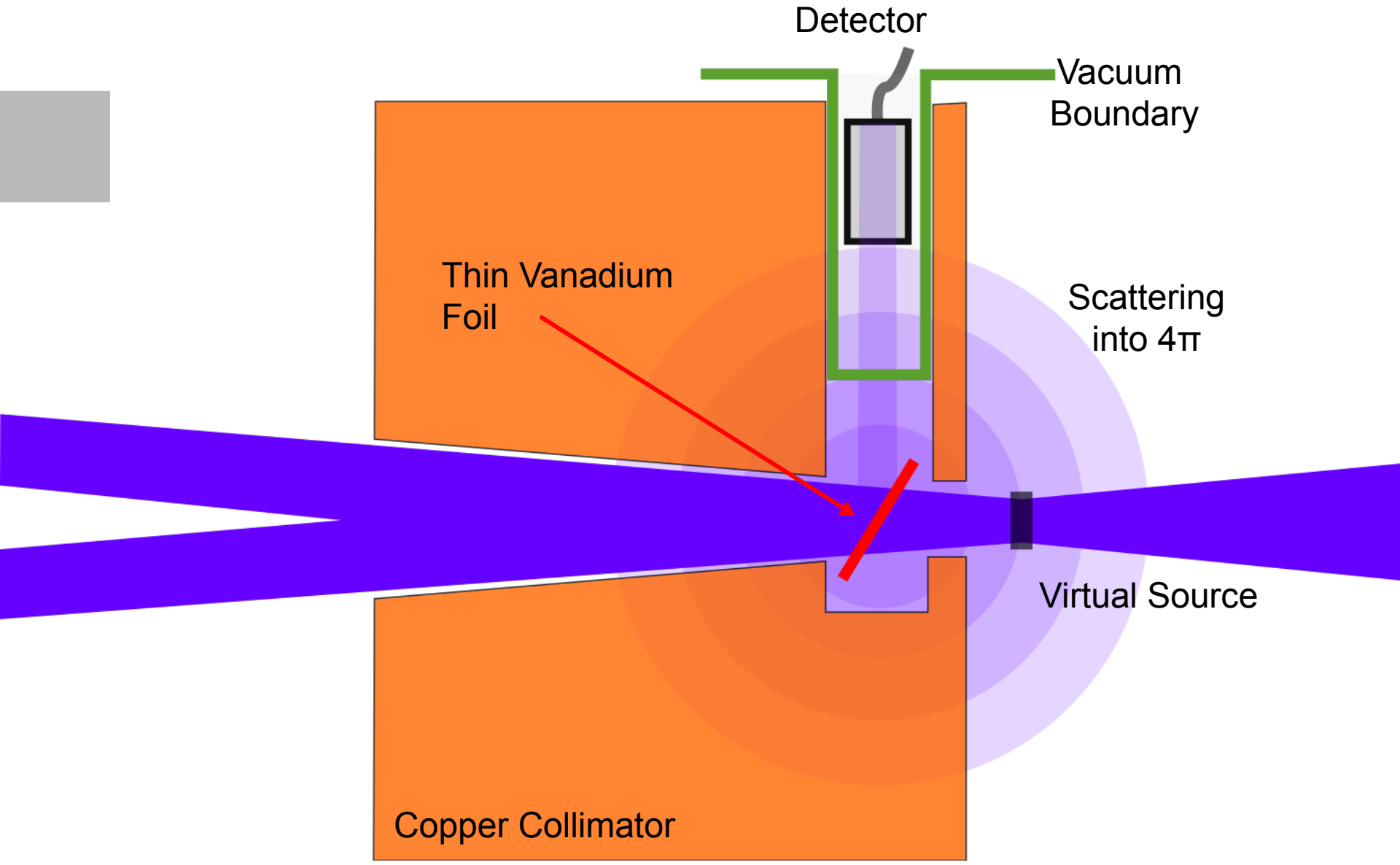
- All beam is in vacuum, avoid as much loss as possible
- High radiation environment (γ + n)
  - S/N due to background
  - Activation for maintenance
- Limited Access
- Large neutron flux
- Limited Budget



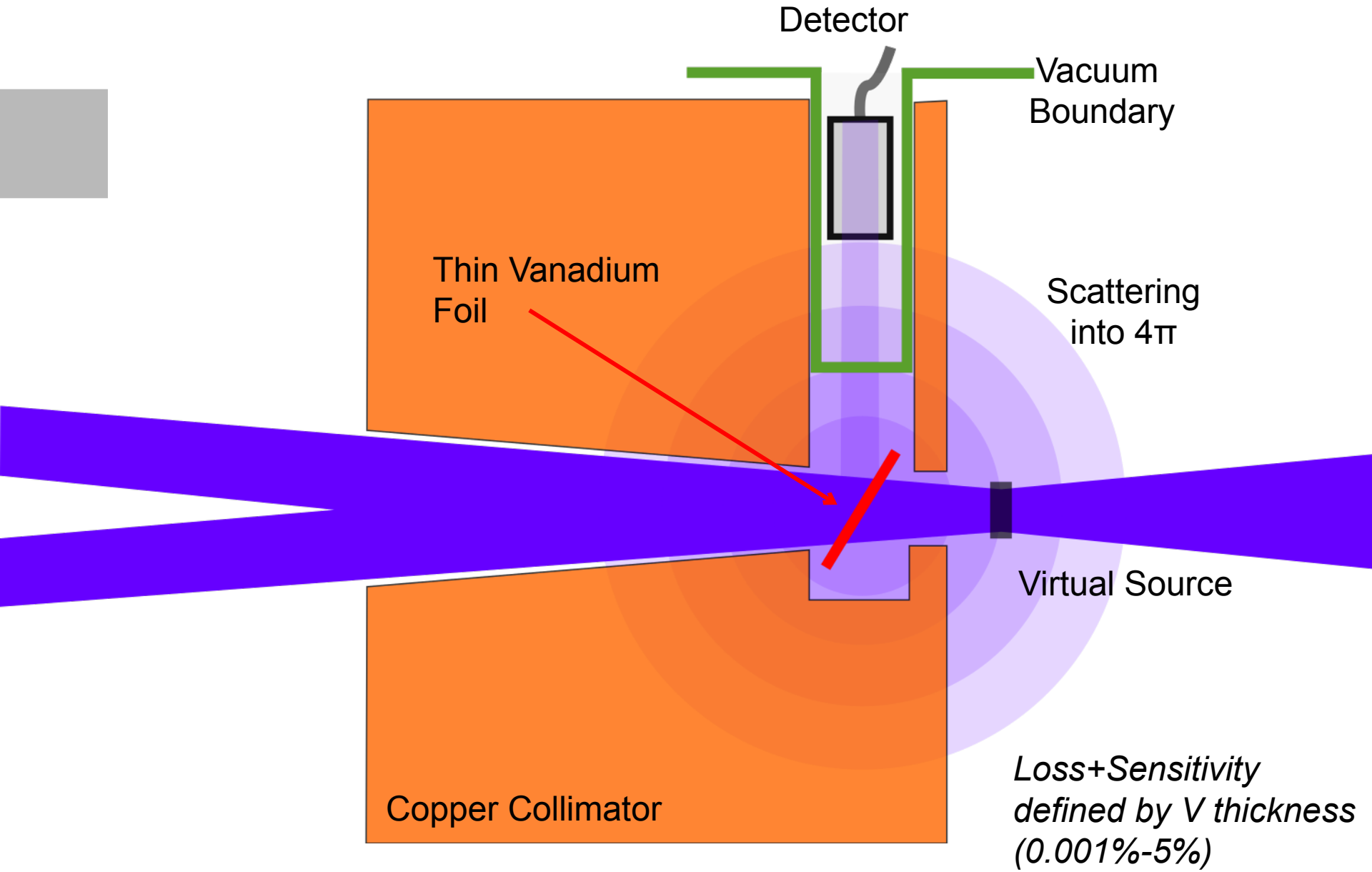
General monitor concept



General monitor concept

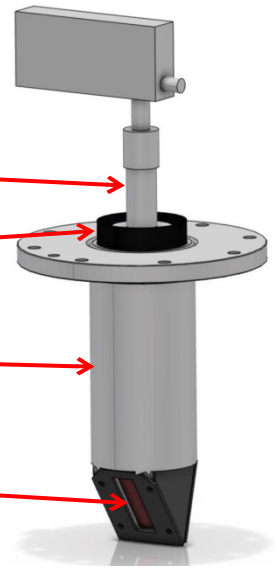


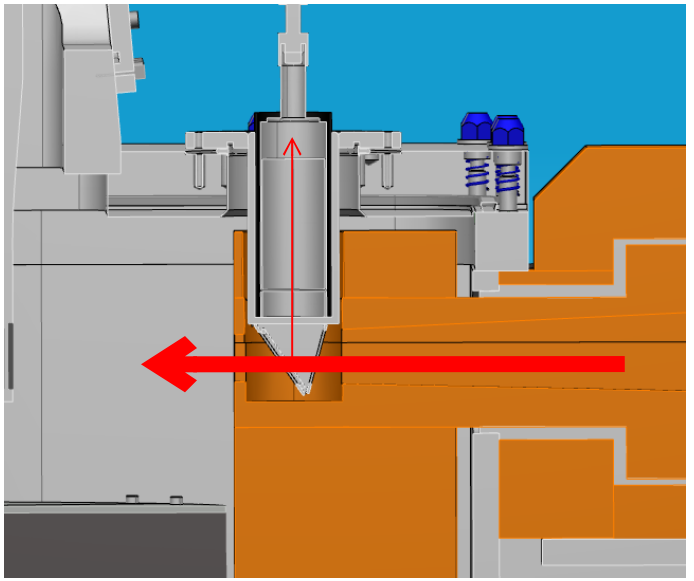
General monitor concept



Detailed implementation

- B10 based proportional counter (Al-frame)
- Thick borated shielding
- Al-Vacuum flange + tube with Al-window
- Framed V-foil within B-Al box





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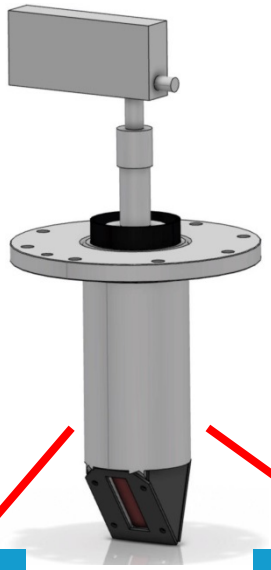
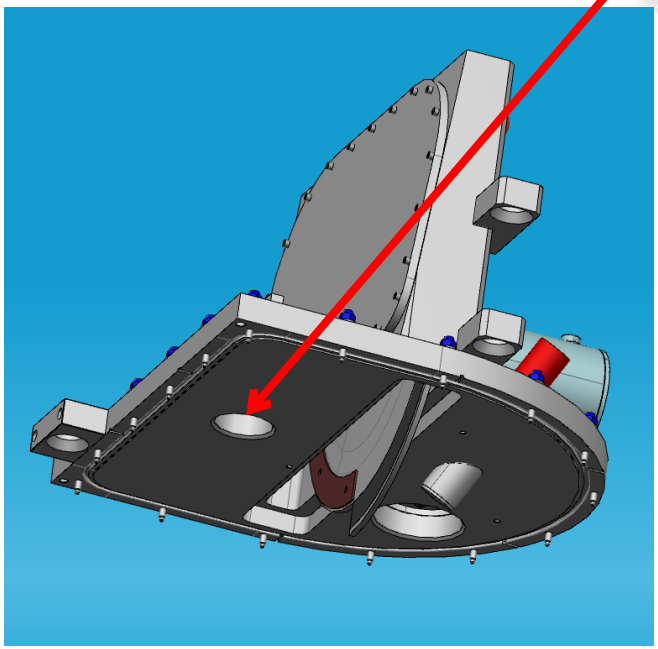
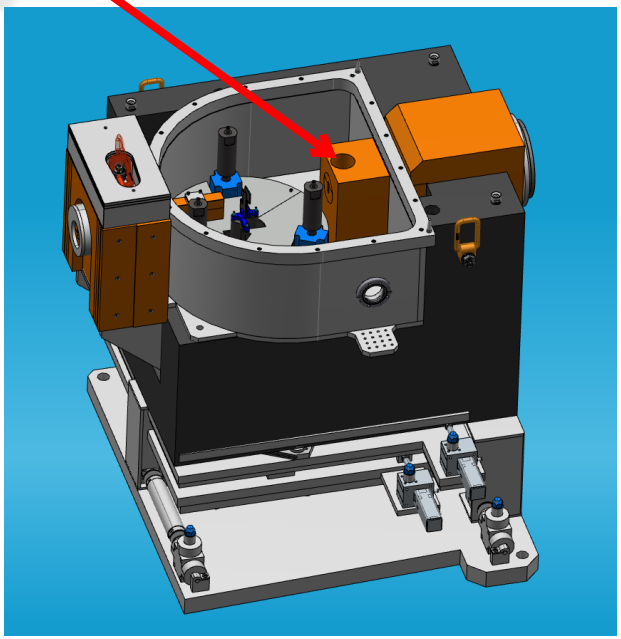


Extracted together with chopper for maintenance

Surrounded by Cu shielding





Expected Performance

- Neutron flux in Estia beam: 3.8e10 n/s @ 5MW
- Scattering from V-foil:
  xs_V=5.08 barn ; V_{UC}=13.827 Å³ ; d=10µm
  $\Omega = xs_V \cdot d / V_{UC}$ = 1.4e7 n/s

In incoherent scattering, scattered neutrons do not have a phase relationship. This happens because of the difference in scattering length of different elements even different isotope of the same element have different magnetic ordering, will have different scattering length.

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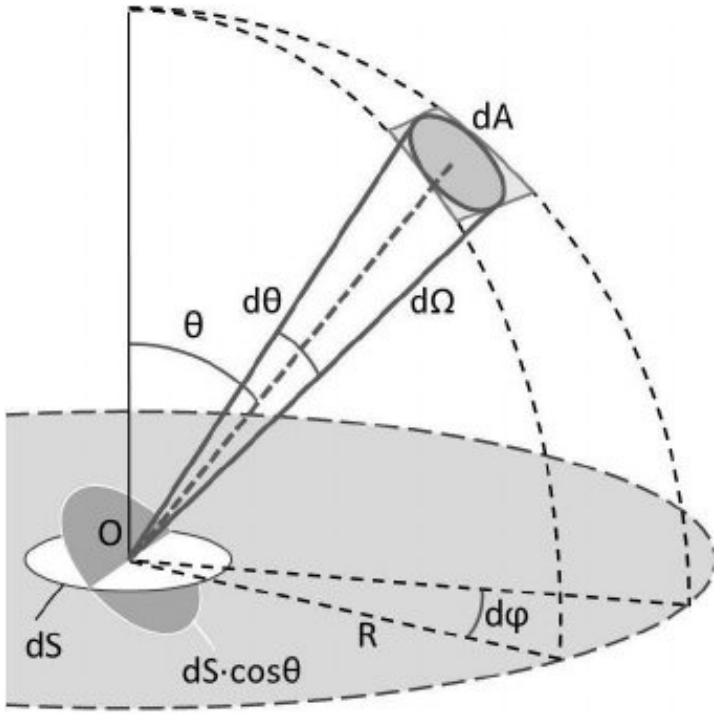
- Coverage of 0.5” detector at 100mm: 1.0e-3
- Efficiency ~60%@4Å
- Effective rate:
  8’500 cps



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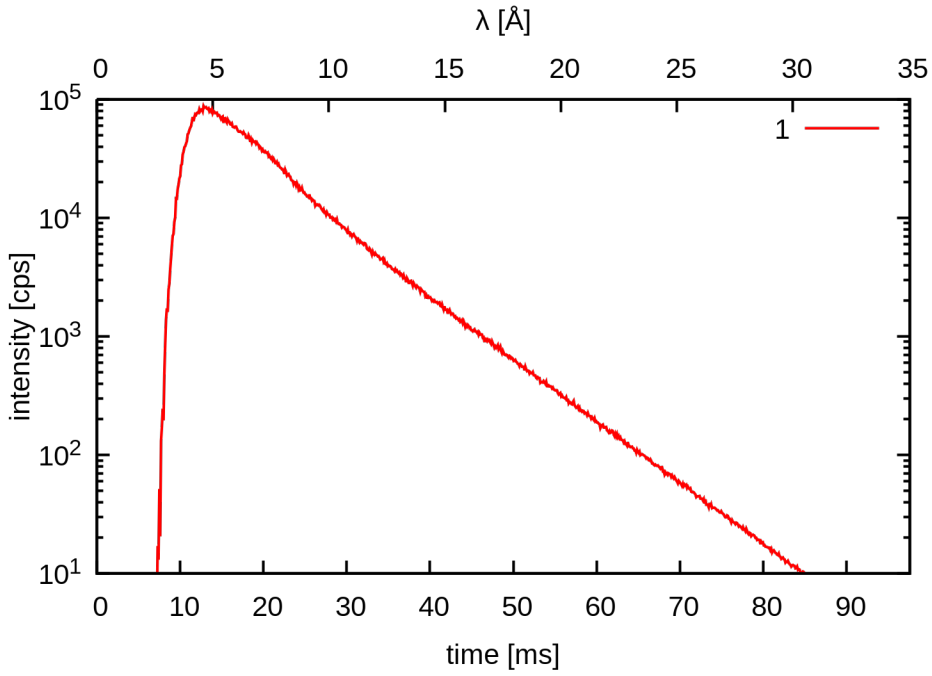
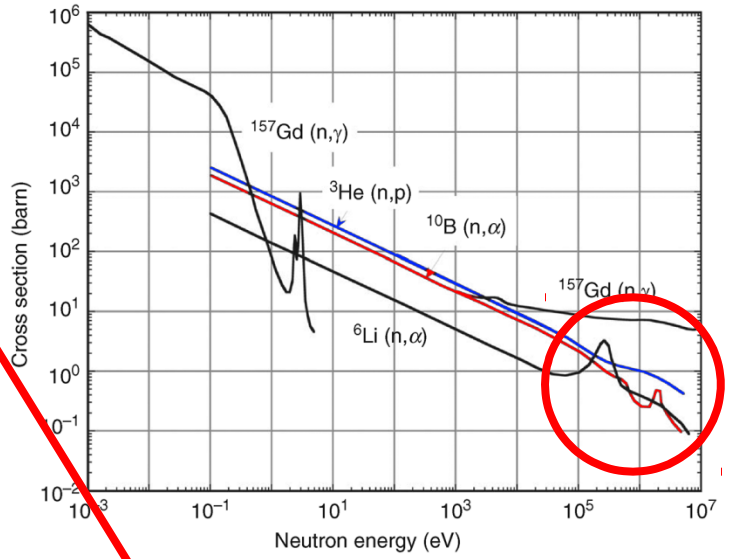
- Coverage of 0.5” detector at 100mm: 1.0e-3
- Efficiency ~60%@4Å
- Effective rate:
  8’500 cps
  (McStas: 12’000 cps)

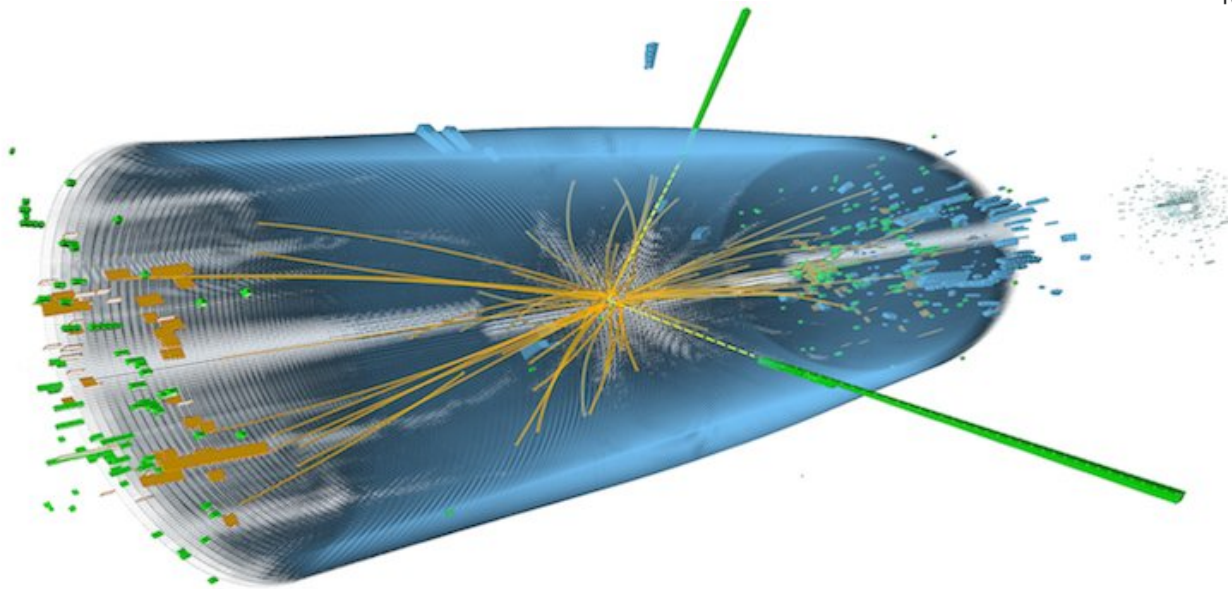
- Adjustable with V-foil
  & detector size/distance
  (x0.02 – x5000)

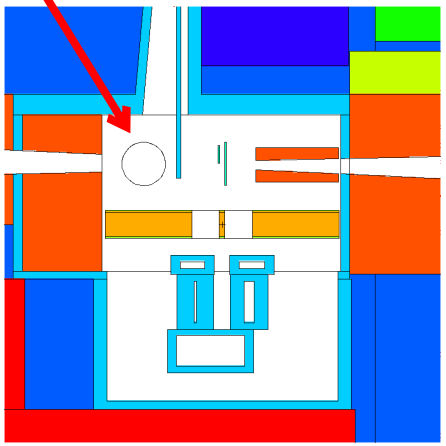


Expected Performance

- Signal level 1e4 cps
- Fast neutron flux <3e5 n/s/cm²
  => 10 cps (sensitivity 1e-5)







Expected Performance

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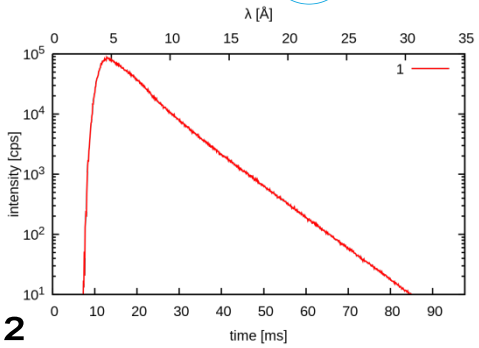
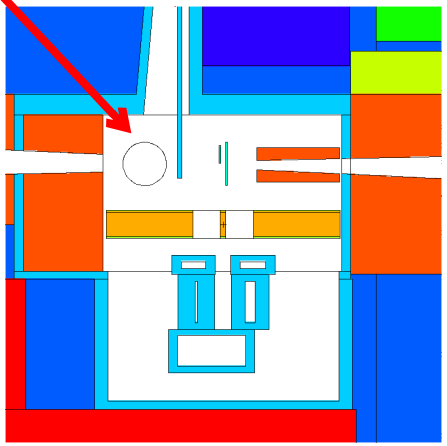
- Gammas from VS+chopper <3e6 γ/s/cm²
  => 1cps (sensitivity <1e-7)





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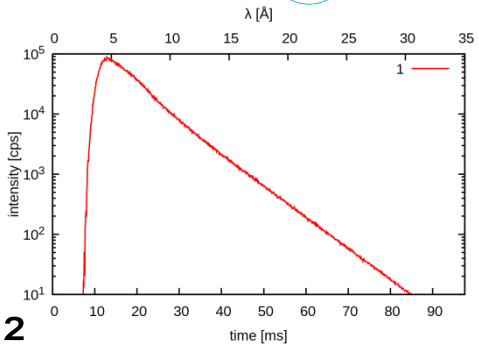

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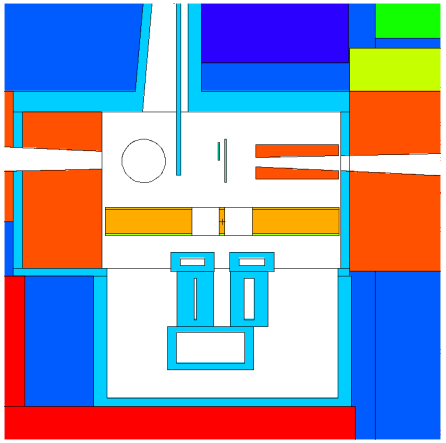
  => 10 cps (sensitivity 1e-5)
- Gammas from VS+chopper <3e6 γ/s/cm²
  => 1cps (sensitivity <1e-7)

- Expected SNR: ~1'000:1
  (Actually better as fast neutron pulse at different time)

- Low losses, <0.1%
- Low activation as only small amount of material in the beam



Ἑστία Estia

Ἑστία/Hestia:

- Greek goddess of the hearth (Latin “focus”)
- Firstborn of the Olympian gods
- 1st ESS reflectometer

Thanks to everybody involved making this progress possible


Estia

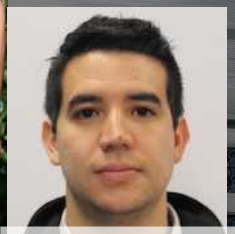
Questions?

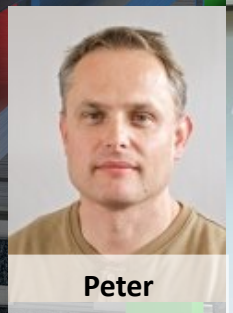

Artur Glavic

Sven Schütz


Uwe Filges

Jochen Stahn


Federico Rojas


Peter Heimgartner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