Neutron irradiation area at HZDR

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Neutron radiation measurements needs

From Mu2e-doc-2853:

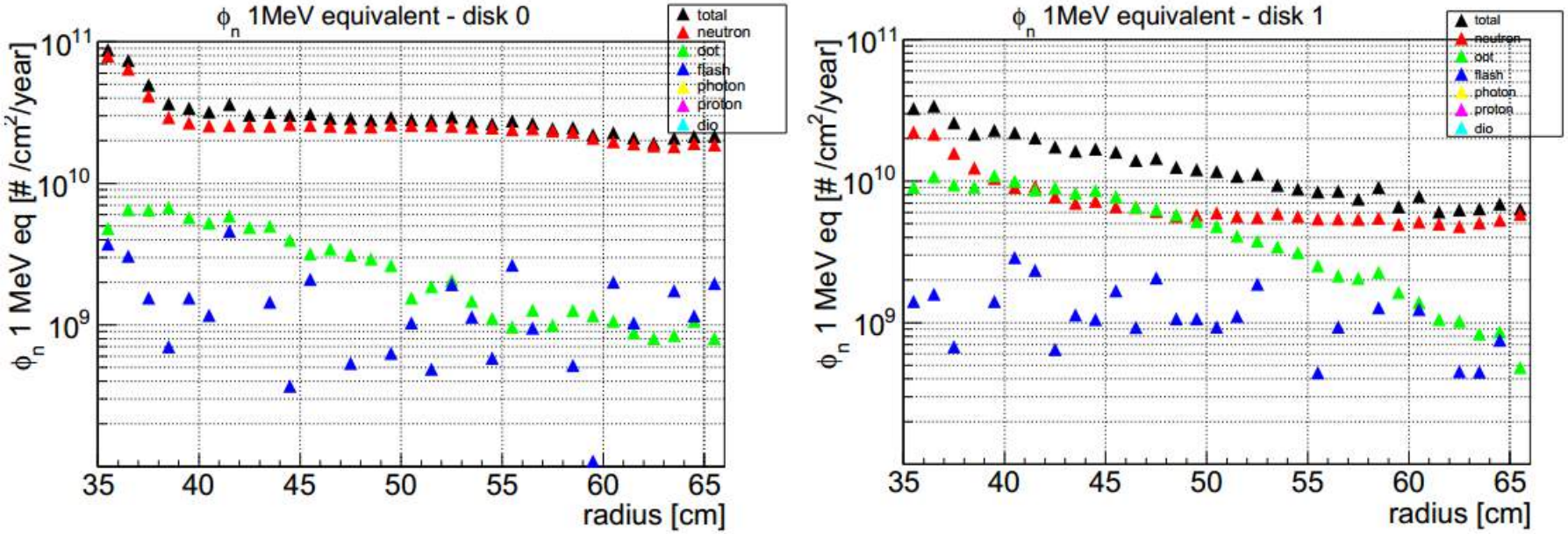


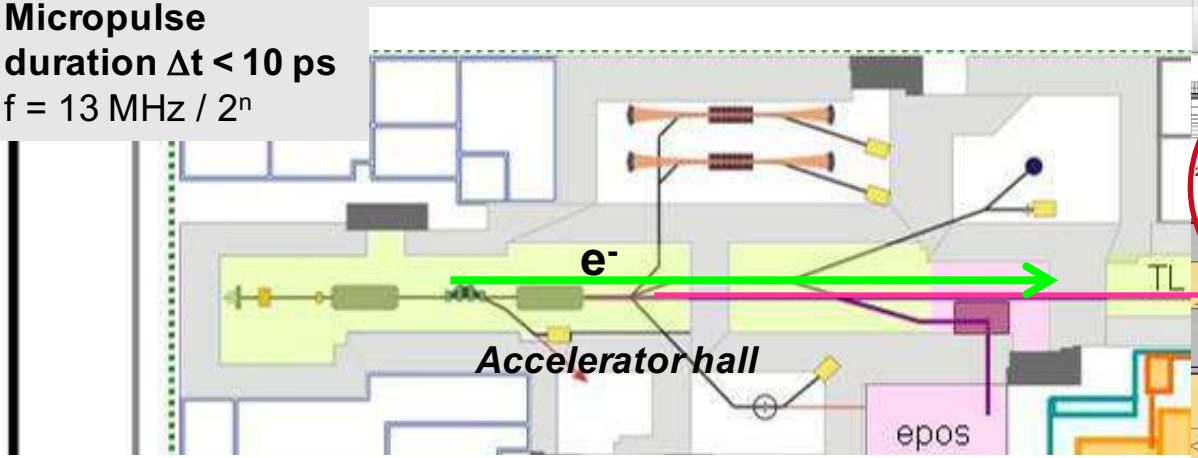
Figure 12: 1 MeV-equivalent Neutron flux as a function of the radial position at the back face of the front (left) and back (right) disk. The backgrounds representing less than 1% of the total flux are not drawn

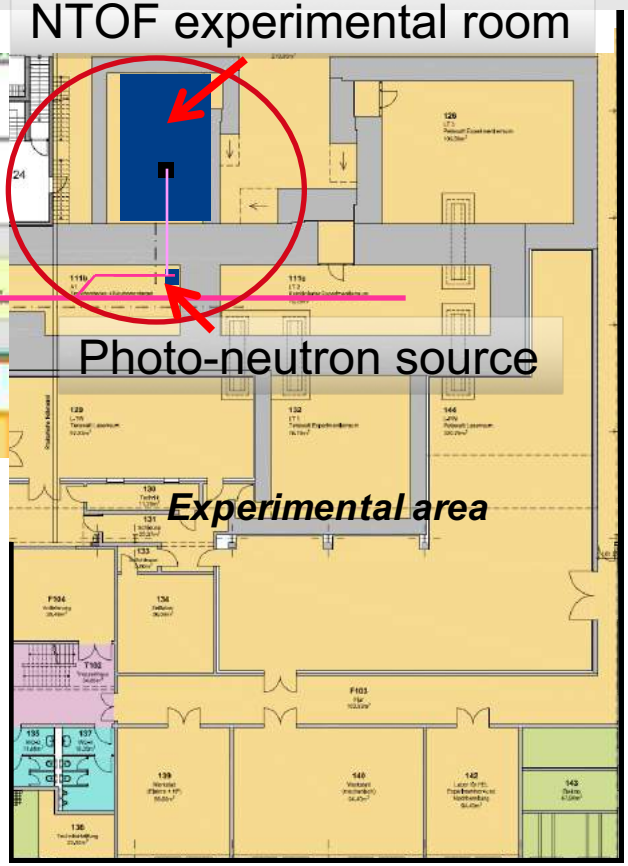
A statistics of $3 \cdot 10^{11}$ neutrons, possibly in the MeV region, is needed

nELBE at ELBE (Electron linear accelerator with high Brilliance and low Emittance)

HZDR
HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

$E_e \leq 40$ MeV
$I_e \leq 1$ mA
Micropulse duration $\Delta t < 10$ ps
$f = 13\ \text{MHz} / 2^n$





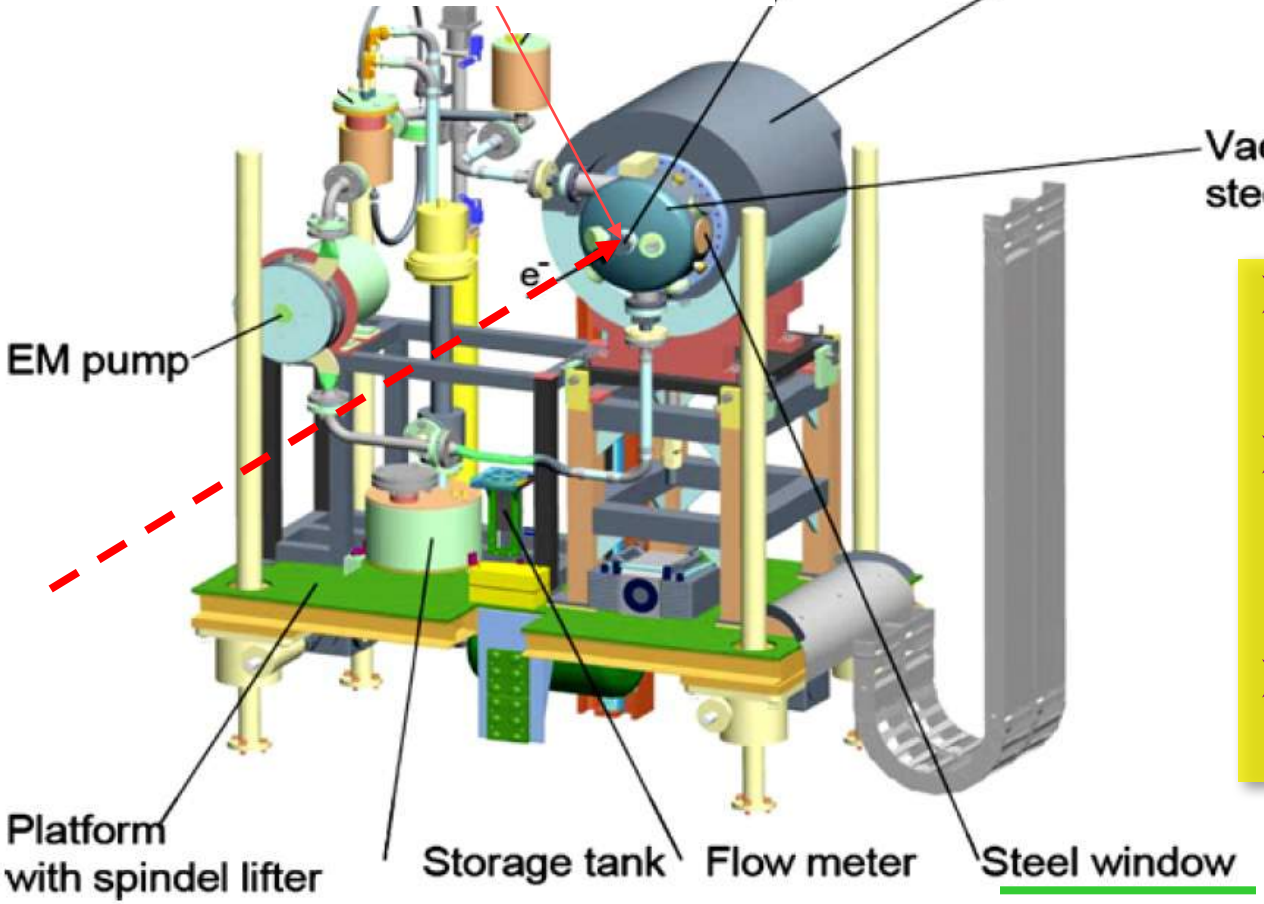
National Center for High-Power Radiation Sources

- Multiple secondary beams (neutrons, photons, positrons)
- nELBE: Neutron Time-of-Light Facility for Transmutation Studies and Nuclear Physics measurements
- X-ray source using Laser-Compton-Backscattering
- High-Power Laser (PW) for Ion Acceleration

HZDR photo-neutron beamline

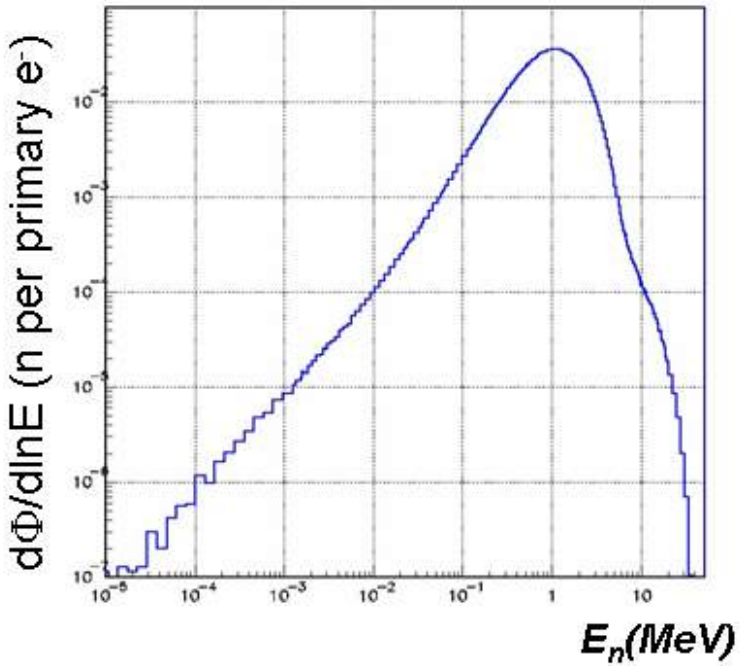
Radiator: 1.12 cm lead

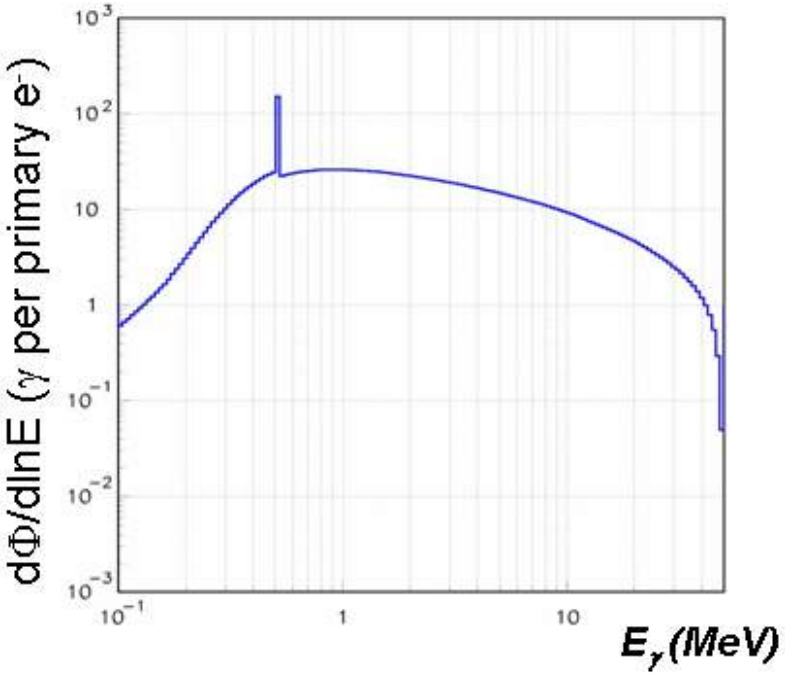
Channel in Mo, 0.5 mm thick



- Electron beam power up to **40 kW**
- Power density in the neutron radiator up to **25 kW/cm³**
- *Liquid lead circuit* for heat transport

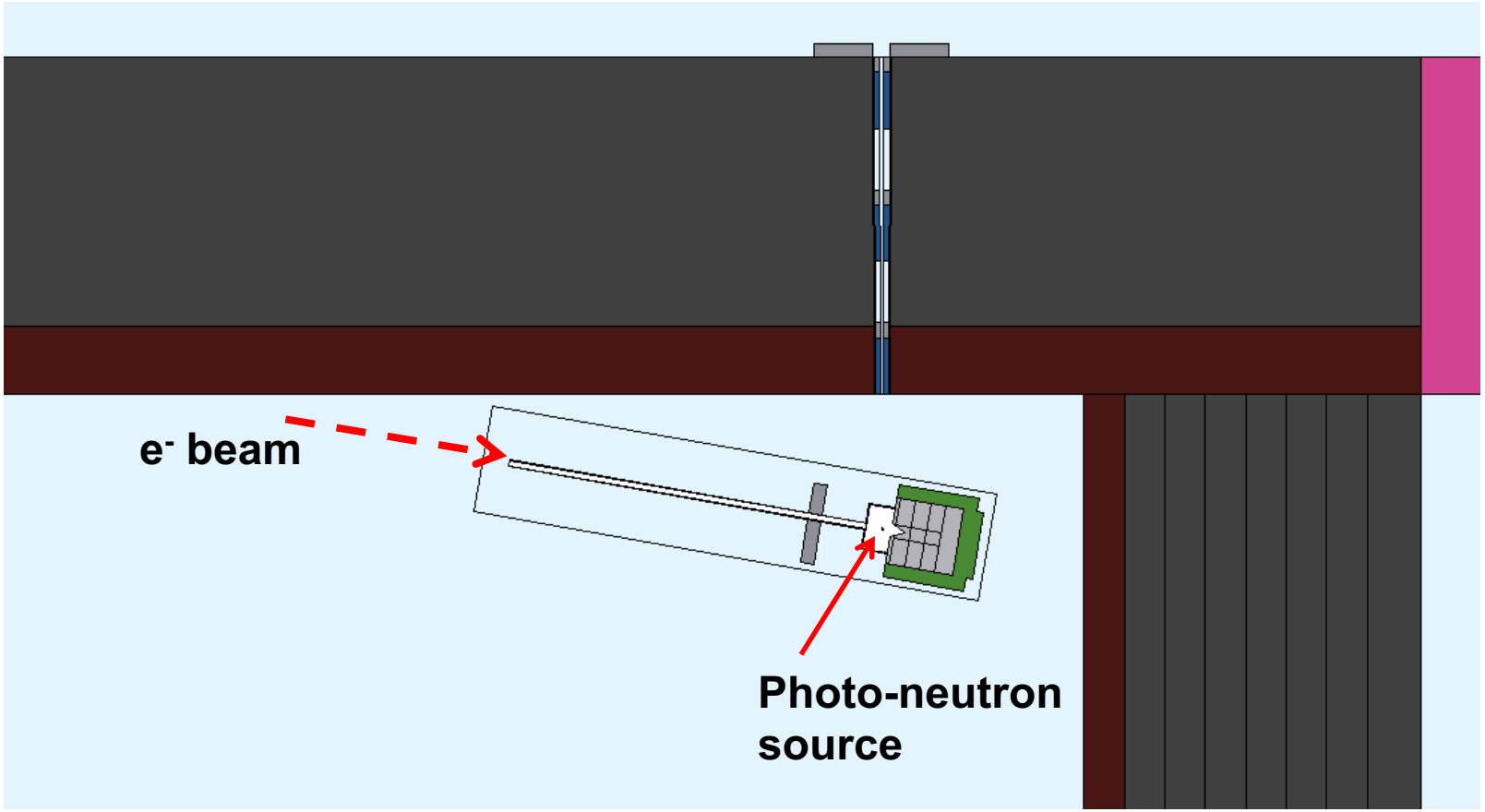
Source strength





Electron Energy (MeV)	Neutron Yield [n/e$^-$] (FLUKA sim.)	Source Strength [n/s] @1 mA (FLUKA sim.)
30	3.108 10^{-3}	1.94 10^{13}
40	4.51 10^{-3}	2.81 10^{13}
50	5.67 10^{-3}	3.54 10^{13}

Optimizing the irradiation position



	90	95.5	100	105	110	115
$n_{yield}/$ [illegible]	2.17 10^{-3}	2.39 10^{-3}	2.53 10^{-3}	2.78 10^{-3}	2.92 10^{-3}	3.14 10^{-3}

HZDR photo-neutron beamline

@ **1 m** , **100 µA** e⁻ current and 30 MeV e⁻ energy:

1.54 10⁷ n cm⁻² s⁻¹

To accumulate $3 \cdot 10^{11}$ n/cm2 only ≈**5.4 h** are needed

To suppress the gamma radiation a local Pb shielding can be used, without problematically losing neutron flux