Overview of DELight Calibrations

DELight Collaboration Meeting

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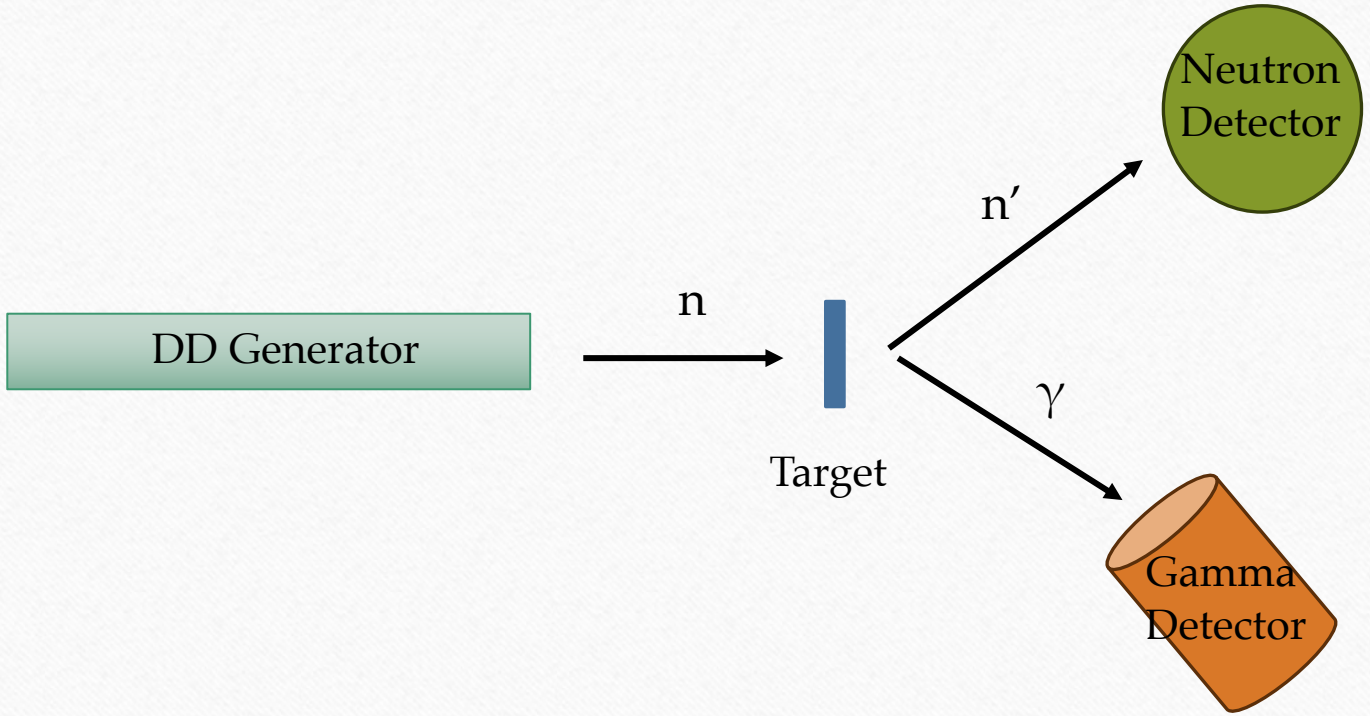
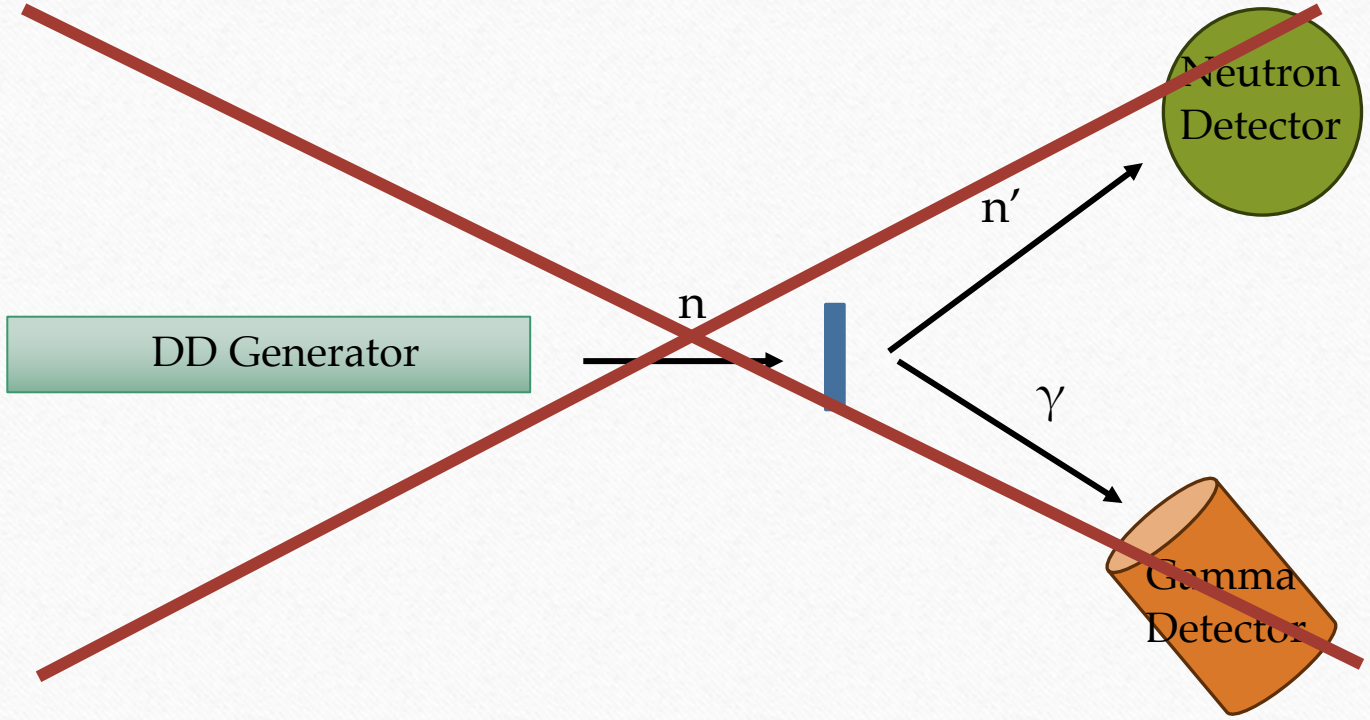
June 18, 2025

Gamma-Tagged Neutron Calibration Scheme



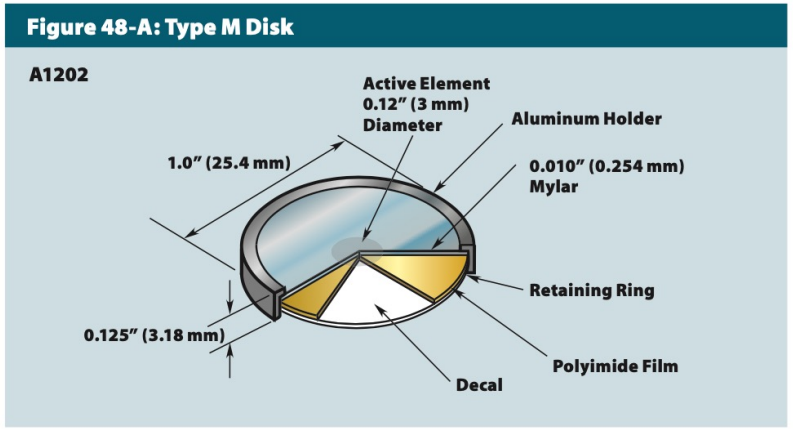
Gamma-Tagged Neutron Calibration Scheme



NOT PART OF THE PROPOSAL AND REVIEW.
CURRENTLY WORK IN PROGRESS

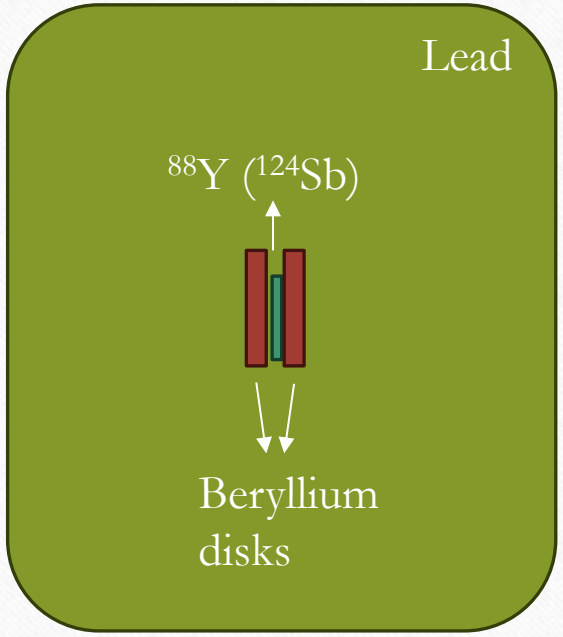
(Low Energy) ER Calibrations

Source	X-Ray Energies (keV)
^{55}Fe	5.9 (1.5)
^{57}Co	6.4, 14.4
^{109}Cd	22, 25
^{241}Am	59.5



- Quoted sources have 37 kBq of activity
- Default option is to introduce these sources into the cell via a dedicated mechanism.

NR Calibrations (Photoneutron Sources)



- ^{88}Y-Be (152 keV) ^{124}Sb-Be (24 keV)
- Quoted sources have 3.7 MBq of activity
- ~O(100) neutrons per second
- 40 cm x 40 cm x 40 cm lead shield
- 2 Be disks in 5 cm diameter x 0.2 cm height
- 3-inch by 3-inch NaI detector to measure the gamma leak rate

Characterization of Neutron Sources

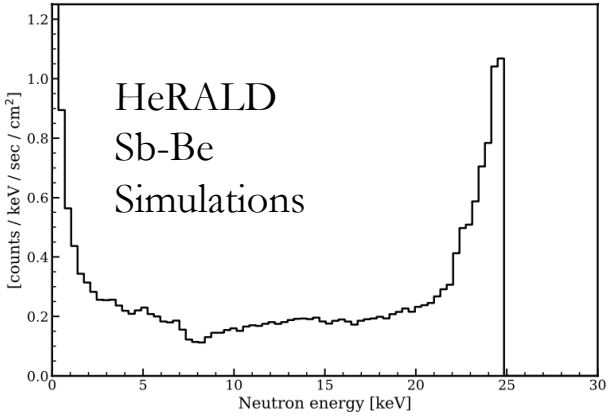
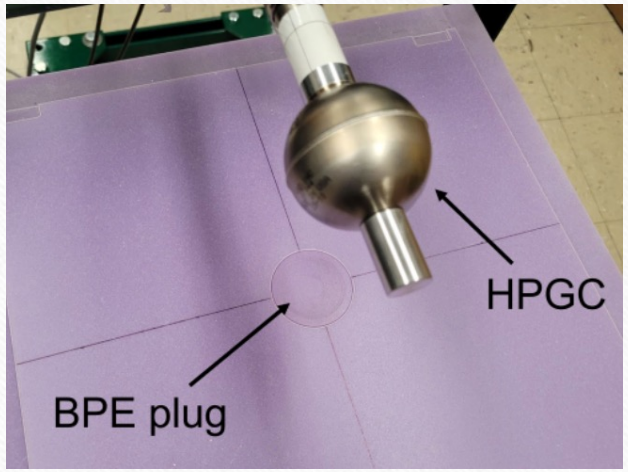


FIG. 4. The simulated neutron flux leaving the front source assembly opening, assuming a 1 GBq ^{124}Sb source. Shown here is the spectrum associated with only the 24 keV neutrons most commonly produced in ^{124}Sb decays.



PTB Neutron Beams

Reaction	$\langle E \rangle$ (MeV)
^{7}Li (p,n)^{7}Be	0.024
^{7}Li (p,n)^{7}Be	0.144
^{7}Li (p,n)^{7}Be	0.25
^{7}Li (p,n)^{7}Be	0.565
^{3}H (p,n)^{3}He	1.2
^{3}H (p,n)^{3}He	2.5
^{2}H (d,n)^{3}He	5.0
^{2}H (d,n)^{3}He	8.0
^{3}H (d,n)^{4}He	14.8
^{3}H (d,n)^{4}He	19.0

A short calibration campaign has been planned to pre-characterize hydrogen gas counter.

Phase-II (Ex-Situ) Neutron Calibration Plans

- KIT-owned ^{252}Cf source
- TU Dresden DD generator
- PTB monoenergetic neutron beams down to 24 keV

Radiation Safety Terms

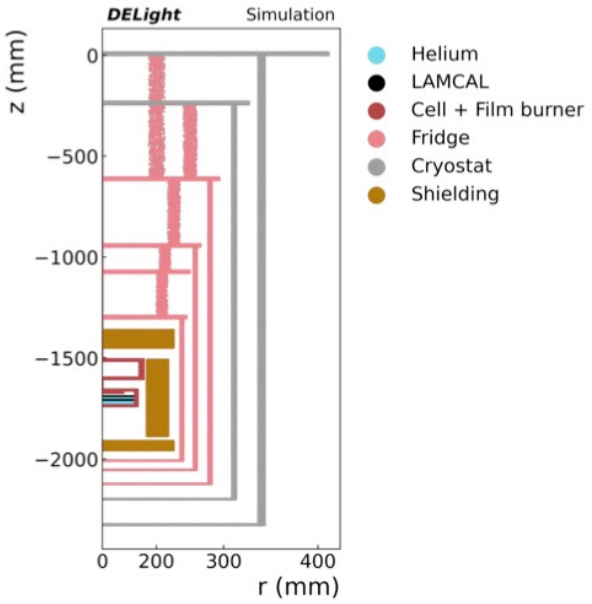
- Free limit for all sources is 1 MBq except for ^{241}Am (10 kBq).
- KIT has a special license that enables the usage of stronger sources (401/601 buildings at CN)
- It would be not so likely to use unsealed x-ray source and seal it ourselves in superfluid-tight way at KIT. We may buy a source in a special capsule from the company and perform the source insertion tests.
- Contamination standards: ^{57}Co (3 Bq/cm^2) and ^{241}Am (0.05 Bq/cm^2)

INTERNAL DISCUSSION PROMPTS

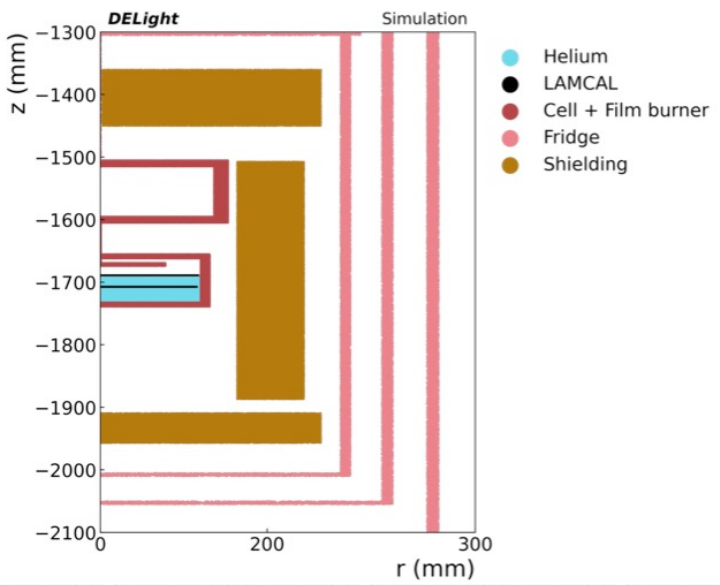
- Mechanism to insert the ER sources in the detector volume
- Arrangement of the shield structure to allow the passage of the neutrons and the placement of the gamma disk sources
- Where will be the calibration hub? KIT? UHD?

Visual Guides

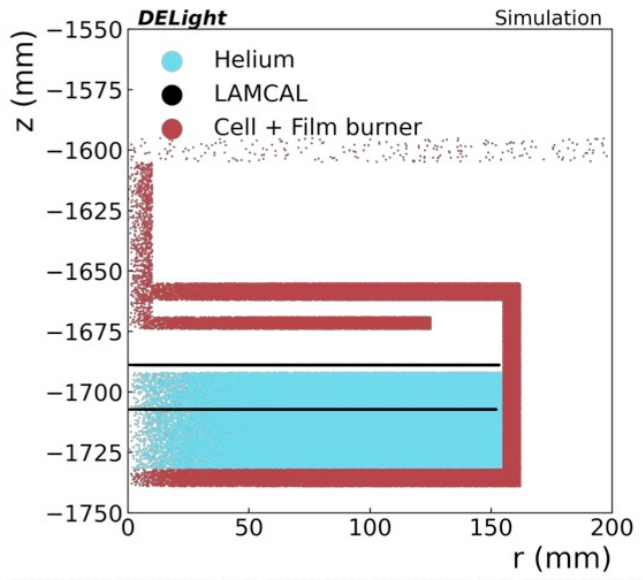
Cryostat and fridge



Shielding and film burner



Cell



BACKUP SLIDES

COSTS

5.1.2.1 Equipment up to € 10,000, Software and Consumables

The items identified below will be used to establish the phase-I calibration system. For DELight Project 6, the total calibration expense is estimated to be **39,000 €**.

- **Computing infrastructure.** See funds requested in project P5 (Data acquisition and computing). No separate computing budget is foreseen for this project P6 (Science analysis).
- **X-Ray and Gamma Sources.** For the low-energy ER calibrations, we need the following sources: ^{55}Fe (2500 €), ^{57}Co (1500 €), ^{109}Cd (1500 €), ^{241}Am (2000 €). To assemble the photoneutron sources, ^{88}Y (3200 €) and ^{124}Sb (7500 €) gamma sources are needed. The transportation expenses are 2000 €. The total amount required for this part is **20,200 €**.
- **Materials.** The photoneutron sources will include high-purity ^{9}Be disks (2300 €) and a lead shield (2500 €). The transportation cost is 200 €. The cost for the material procurement amounts to **5000 €**.
- **Detectors.** To characterize the spectra of the YBe and SbBe neutron sources, a hydrogen-filled proportional counter will be used (3500 €). The gamma leakage of the photoneutron sources will be measured with a sodium-iodide detector (2800 €), resulting in a total amount of **6300 €** for this part.
- **Other.** Prior to the characterization of the photonuclear sources, the hydrogen proportional counter must be calibrated with low-energy neutron beams. The PTB facility offers monoenergetic neutron beams at 24 keV, 144 keV and 250 keV, which will be utilized to map out the low-energy neutron response of the proportional counter. To account for the beam operations, we allocate **7500 €** for the calibration campaign.