

CWI-TU/e seminar on pulsed discharges
on 4 November 2013, CWI Amsterdam

Modeling hard X-ray emission from long sparks

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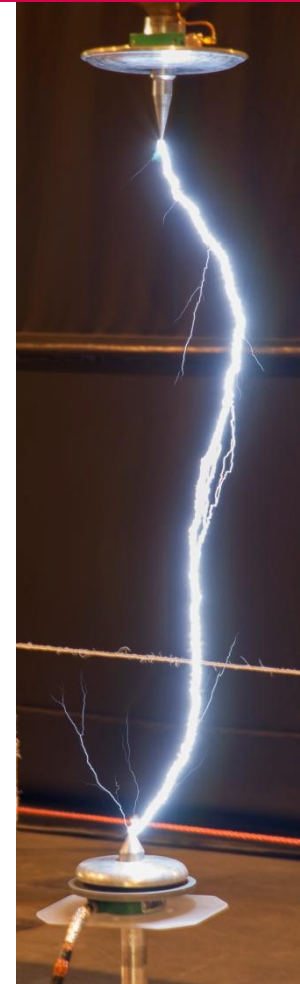
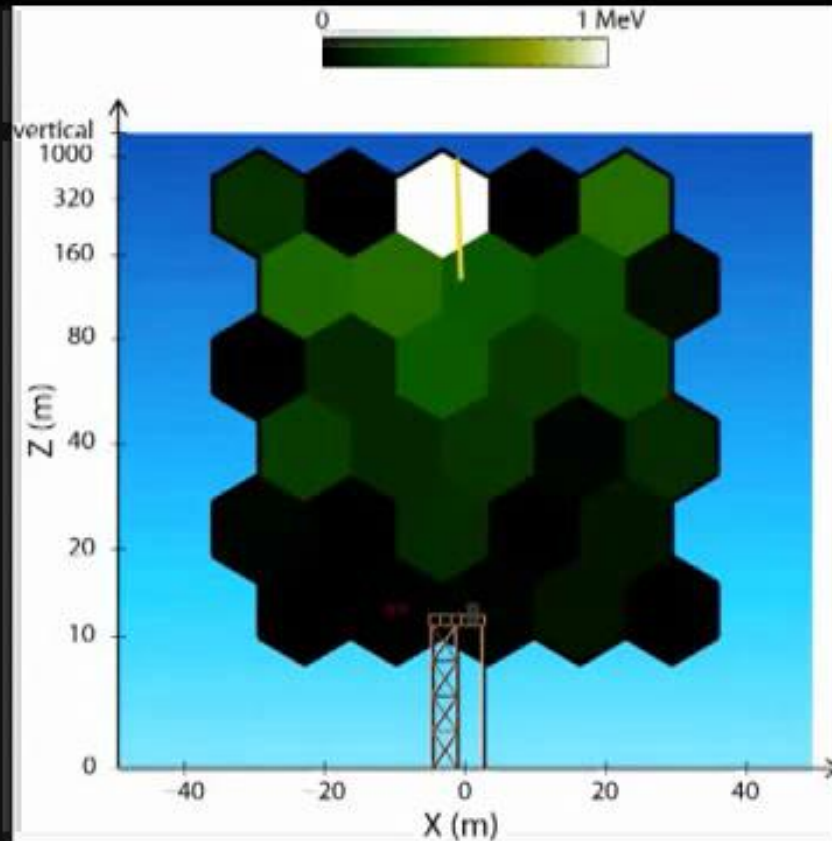


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Technische Universiteit
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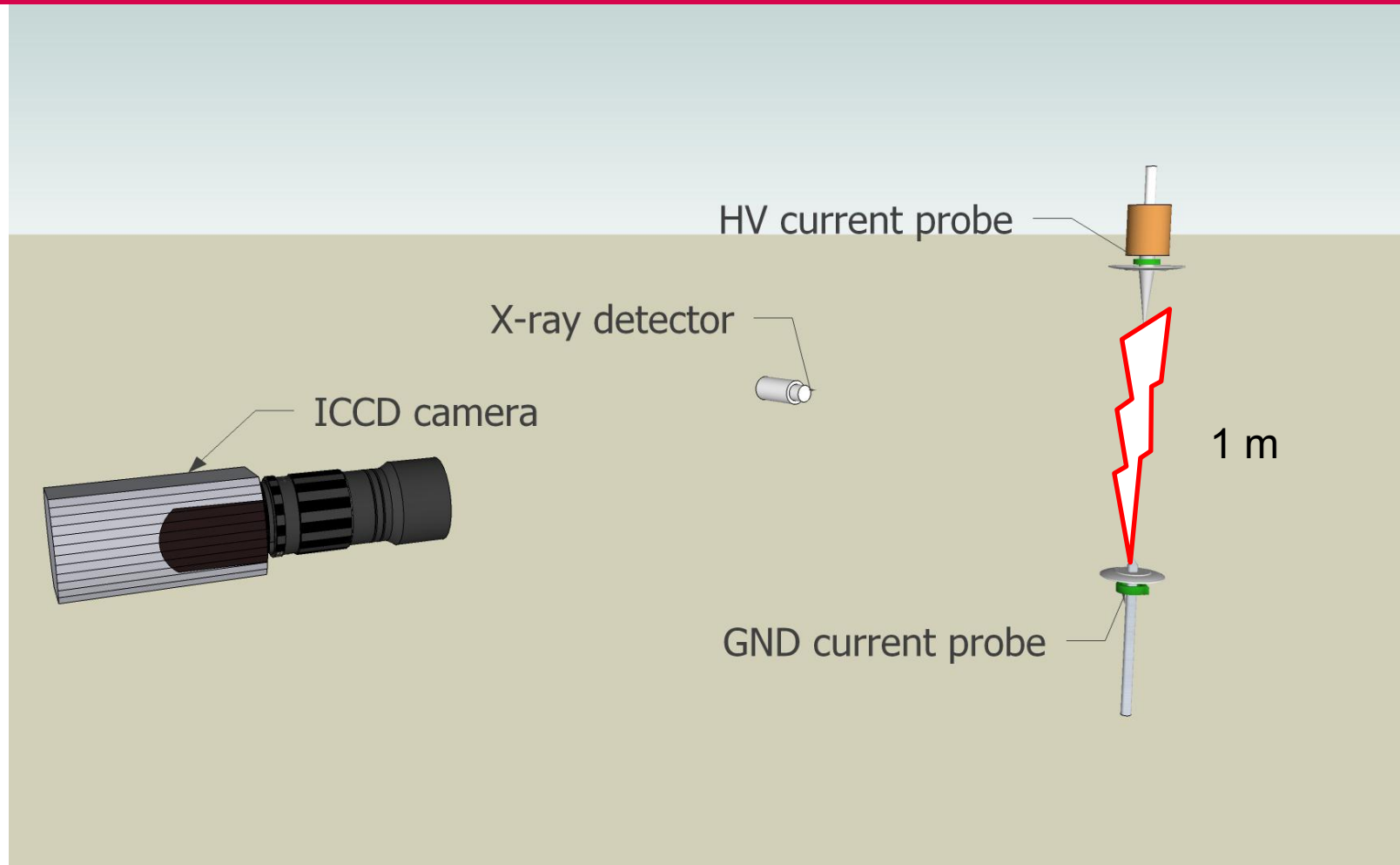
Where innovation starts

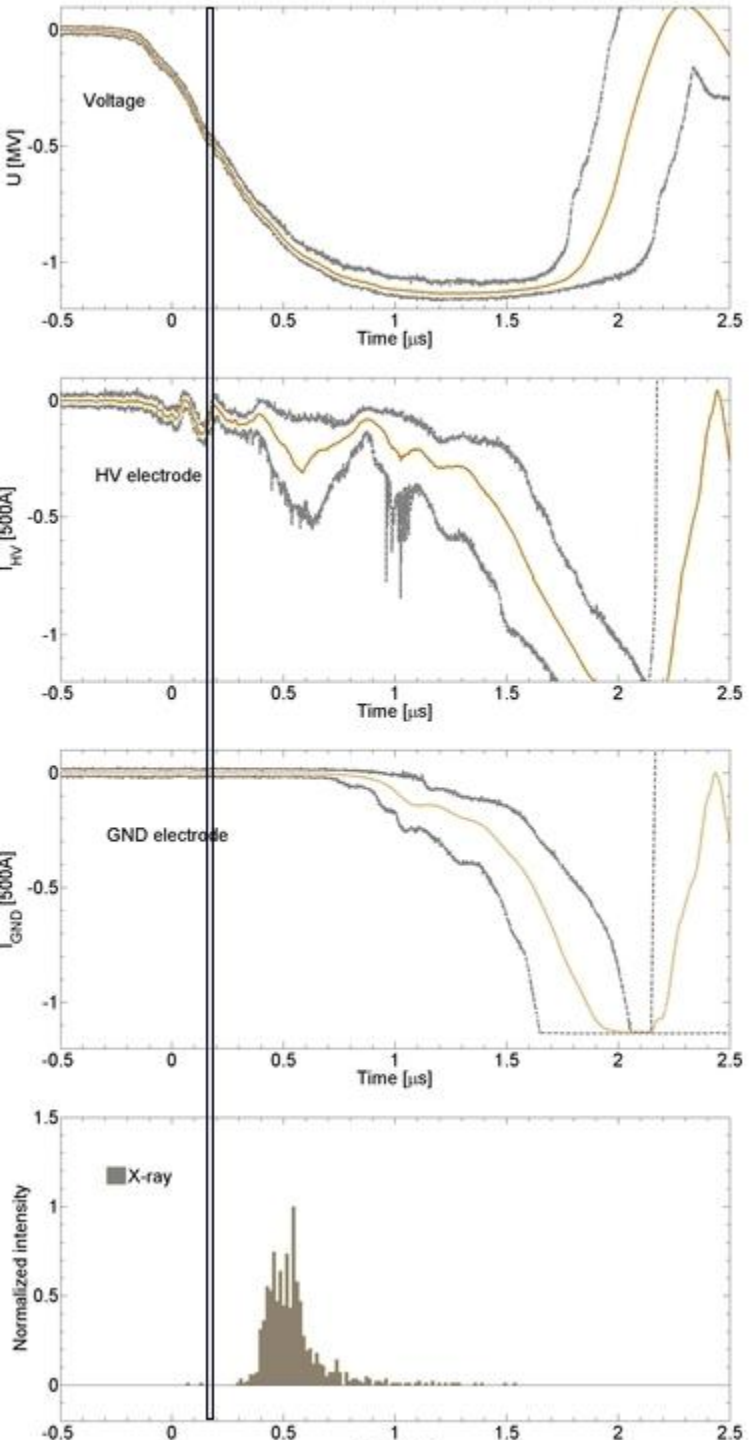
X-rays from lightning leader



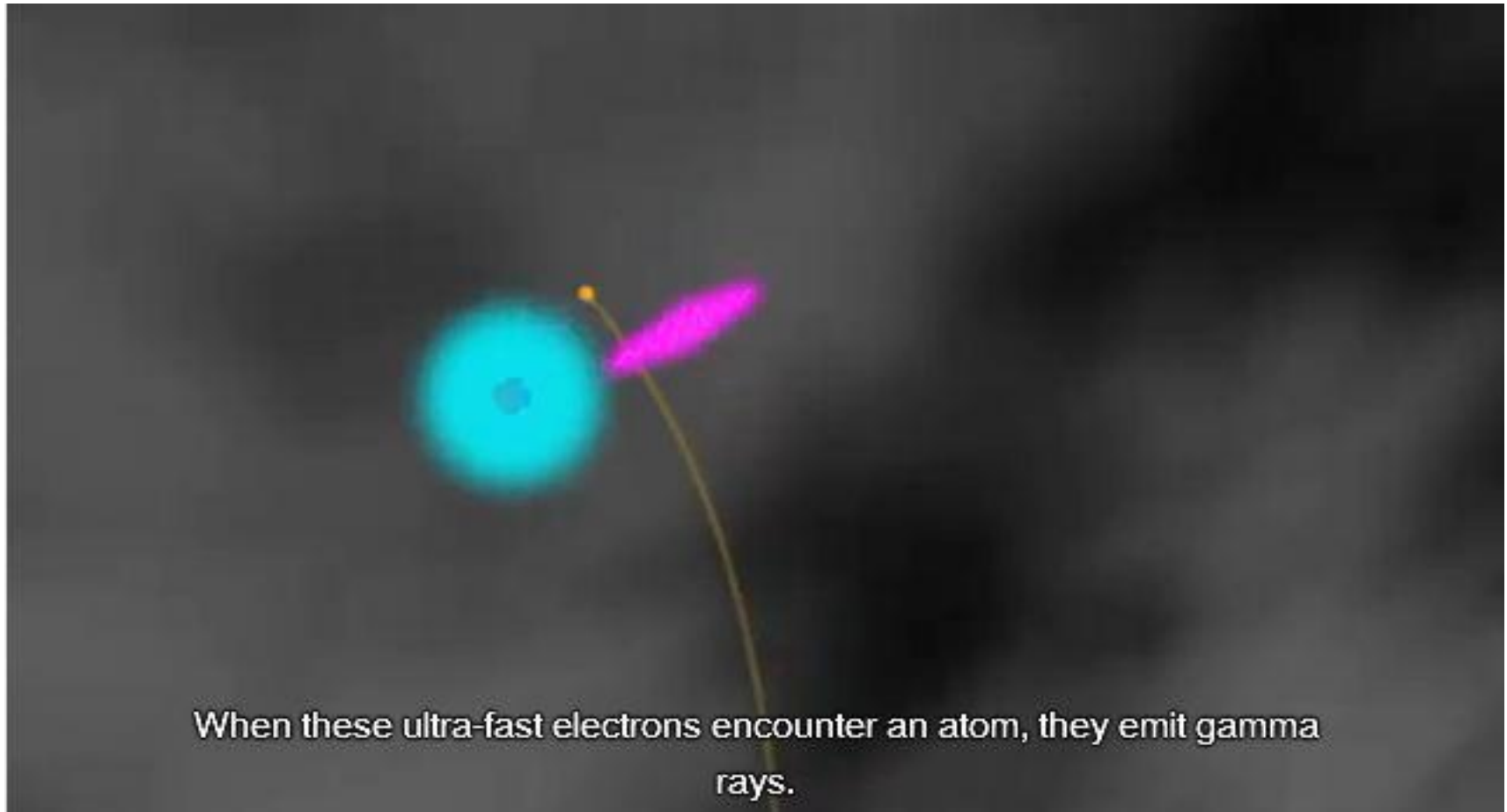
Dwyer, J. R., et al,
High-speed X-ray images of triggered lightning dart leaders,
J. Geophys. Res., 116, D20208, doi:10.1029/2011JD015973.

Setup

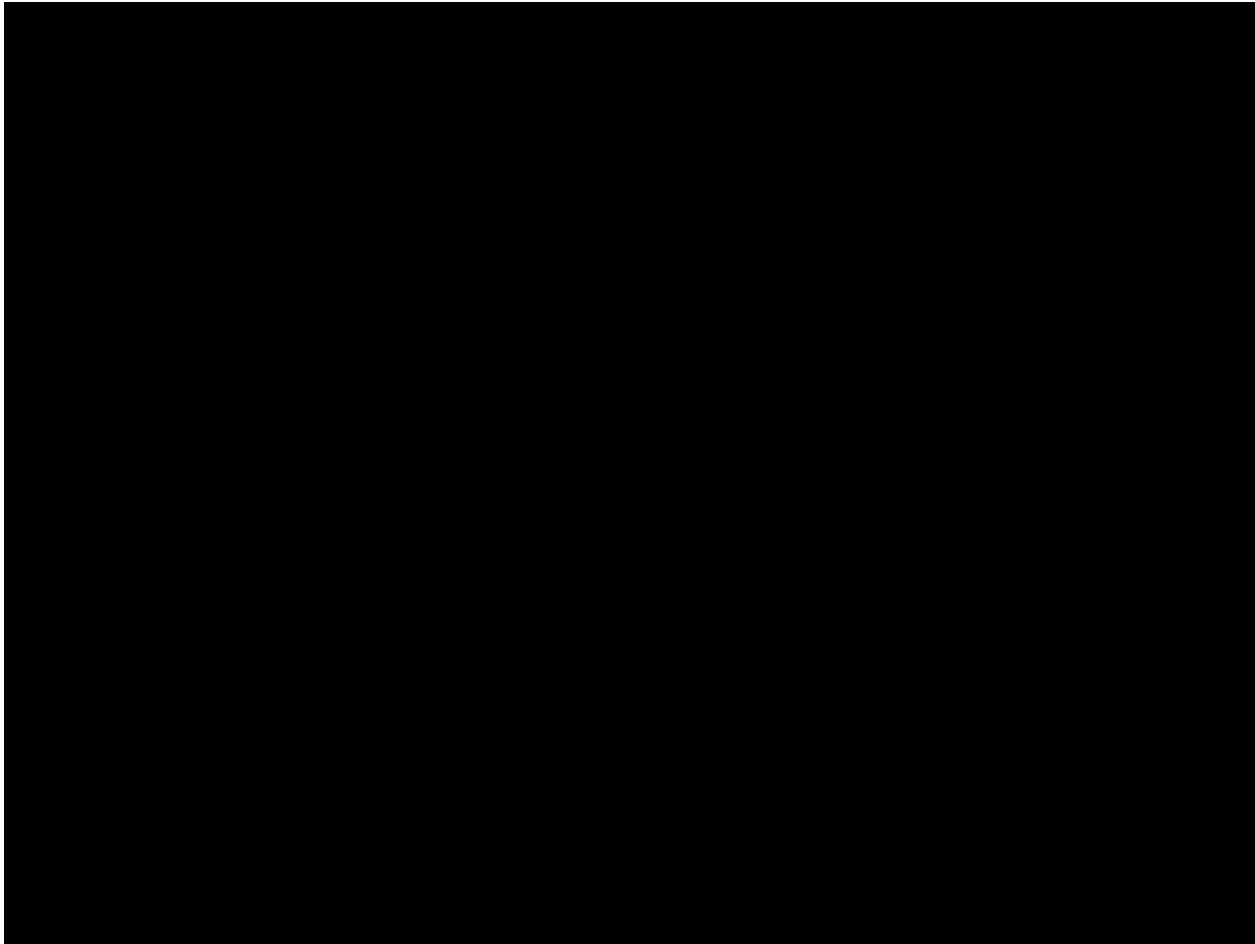




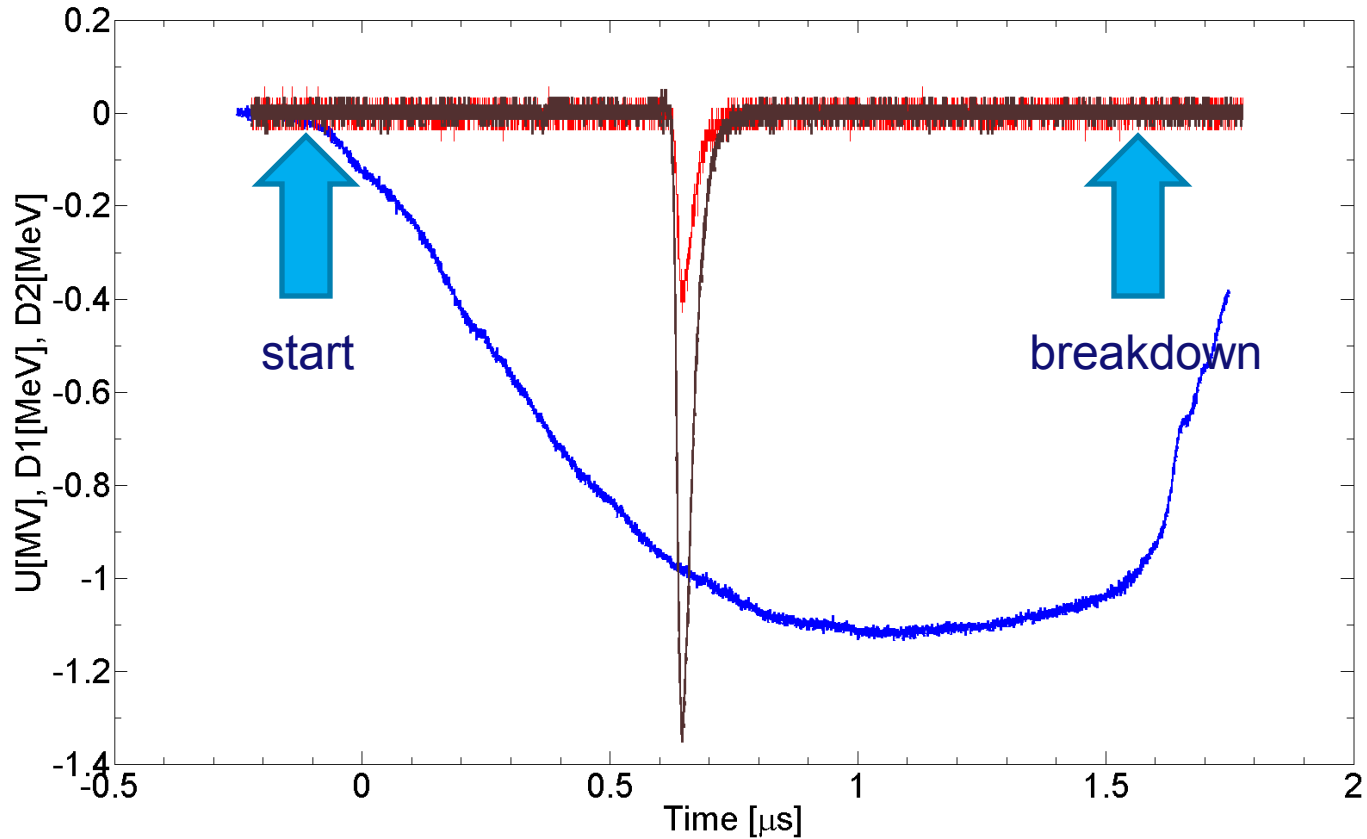
Bremsstrahlung



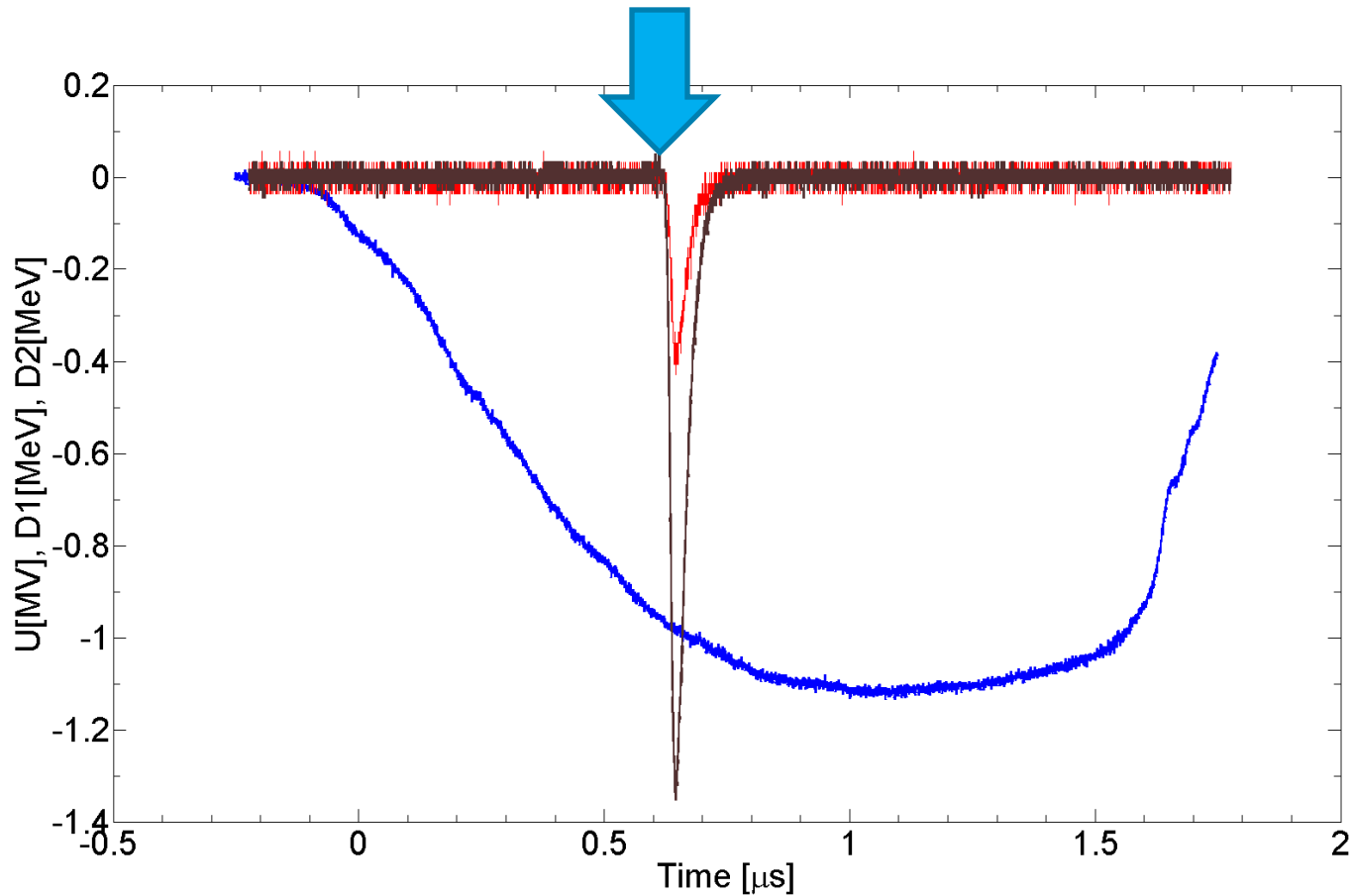
LaBr₃(+Ce) scintillation detector



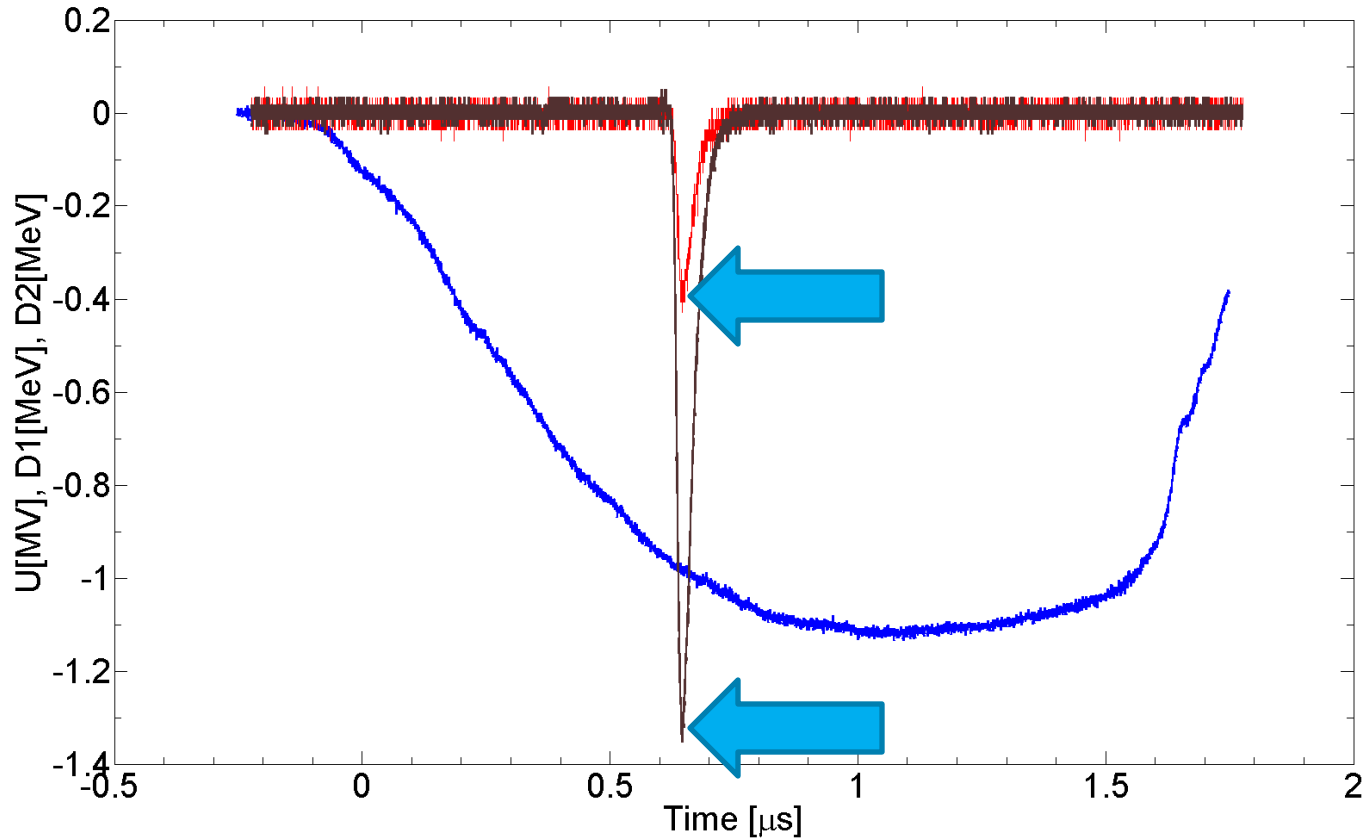
X-ray burst



X-ray burst



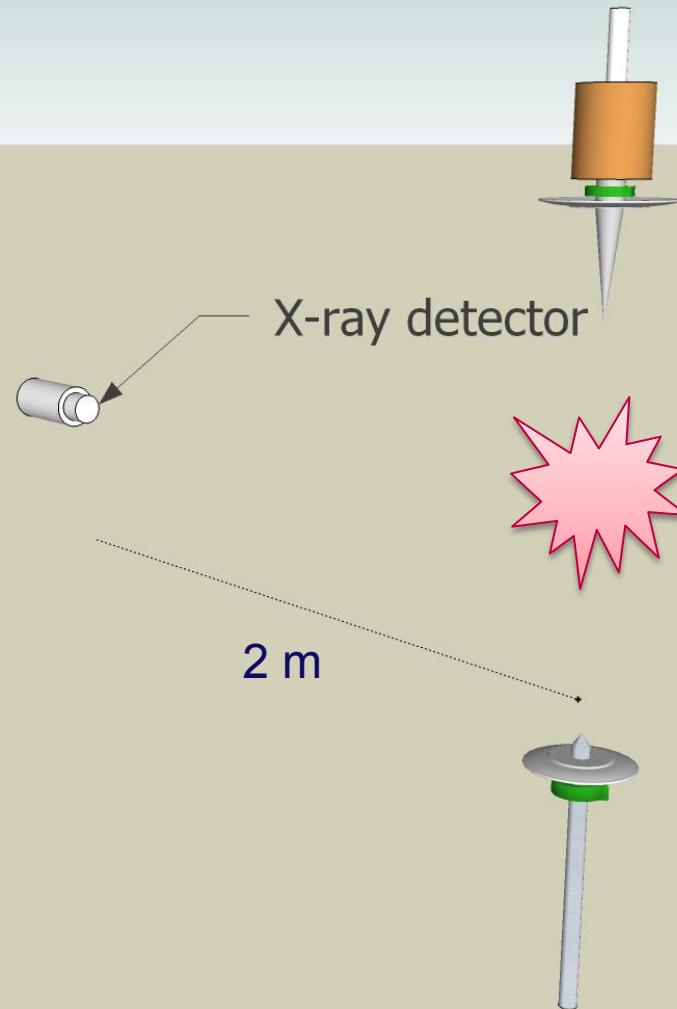
X-ray burst



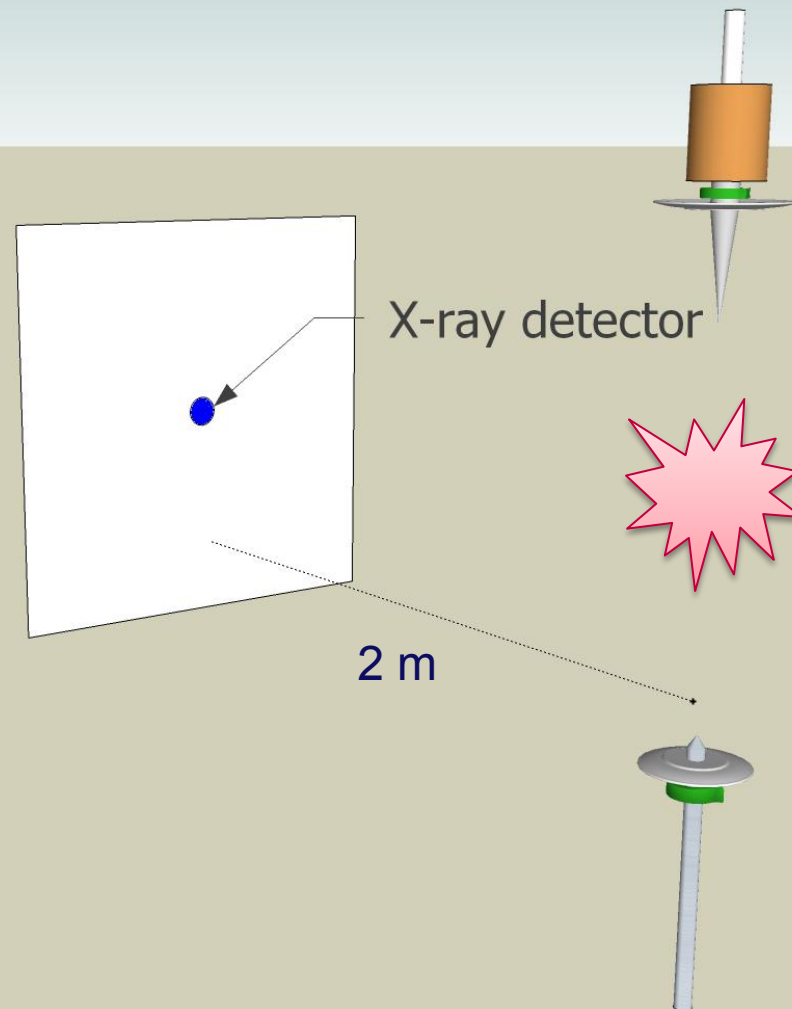
Problem

- **Unknown amount of initial photons (electrons)**
- **Spectrum**
- **Spatial distribution (level of anisotropy)**

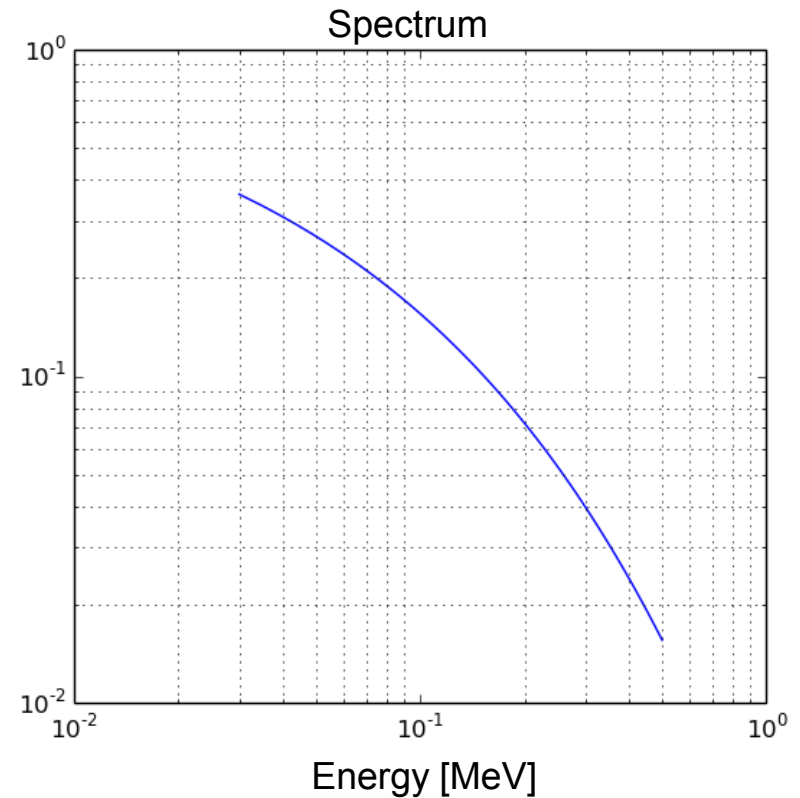
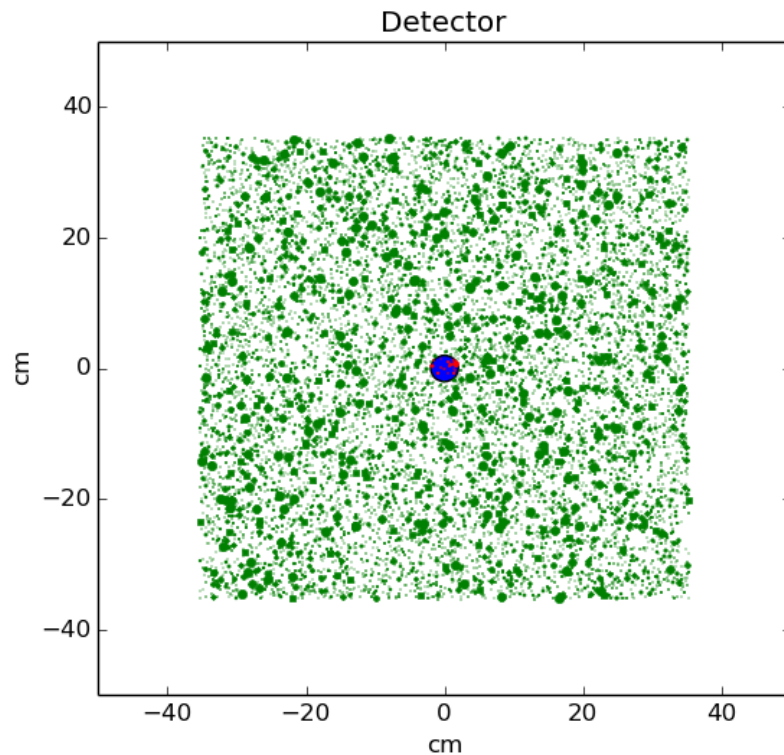
Simulation setup



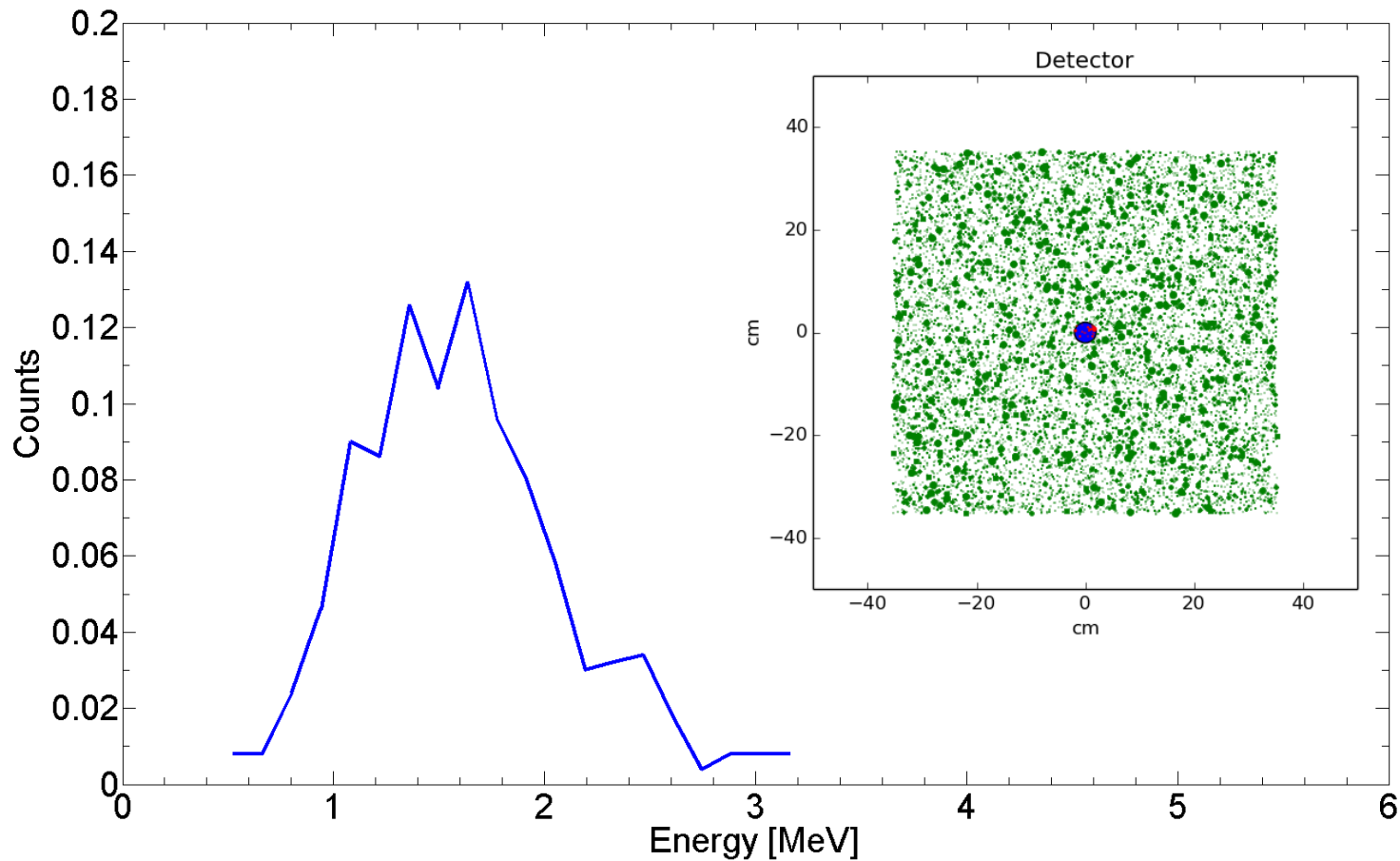
Simulation plane



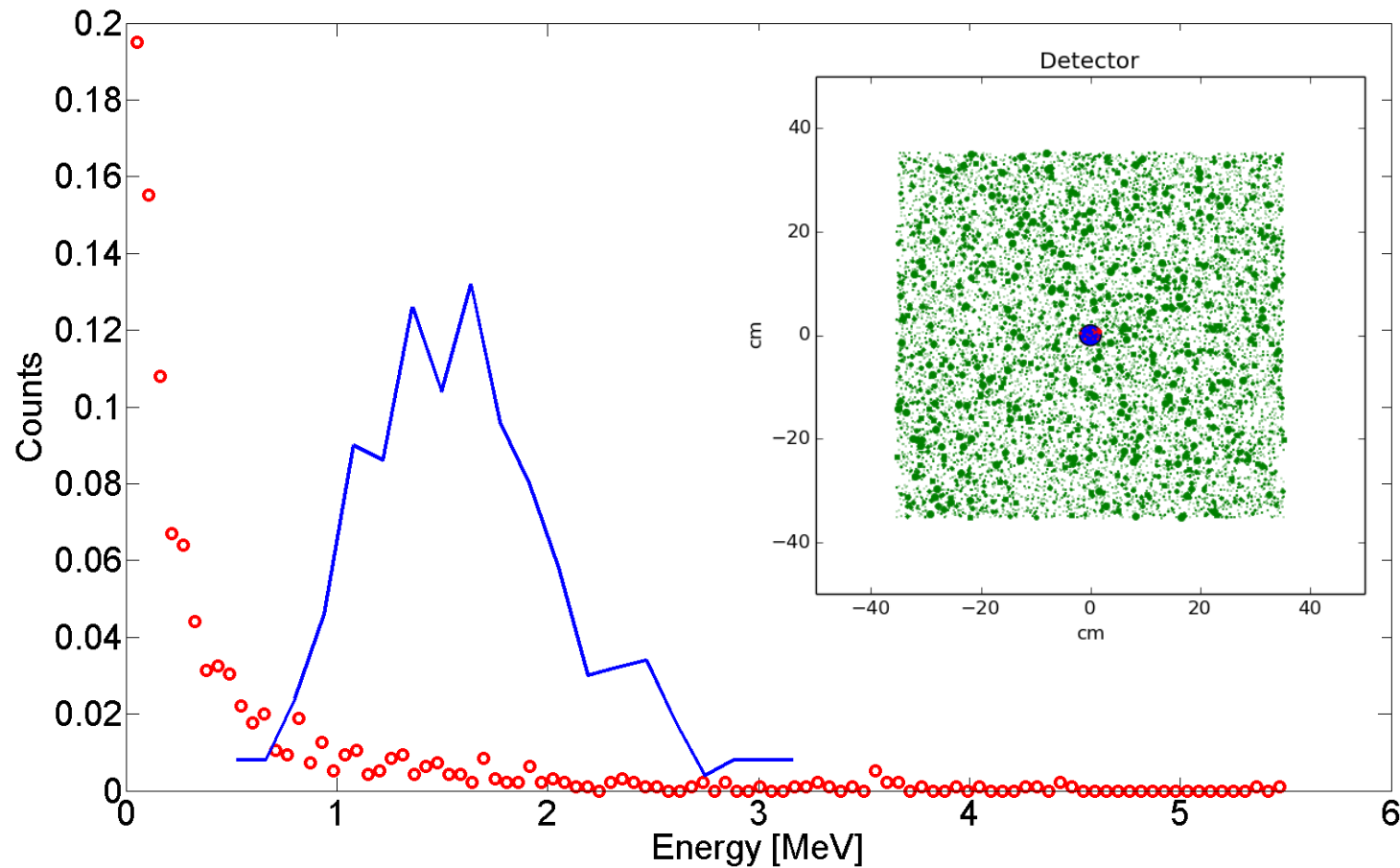
Isotropic, $8 \cdot 10^5$ photons



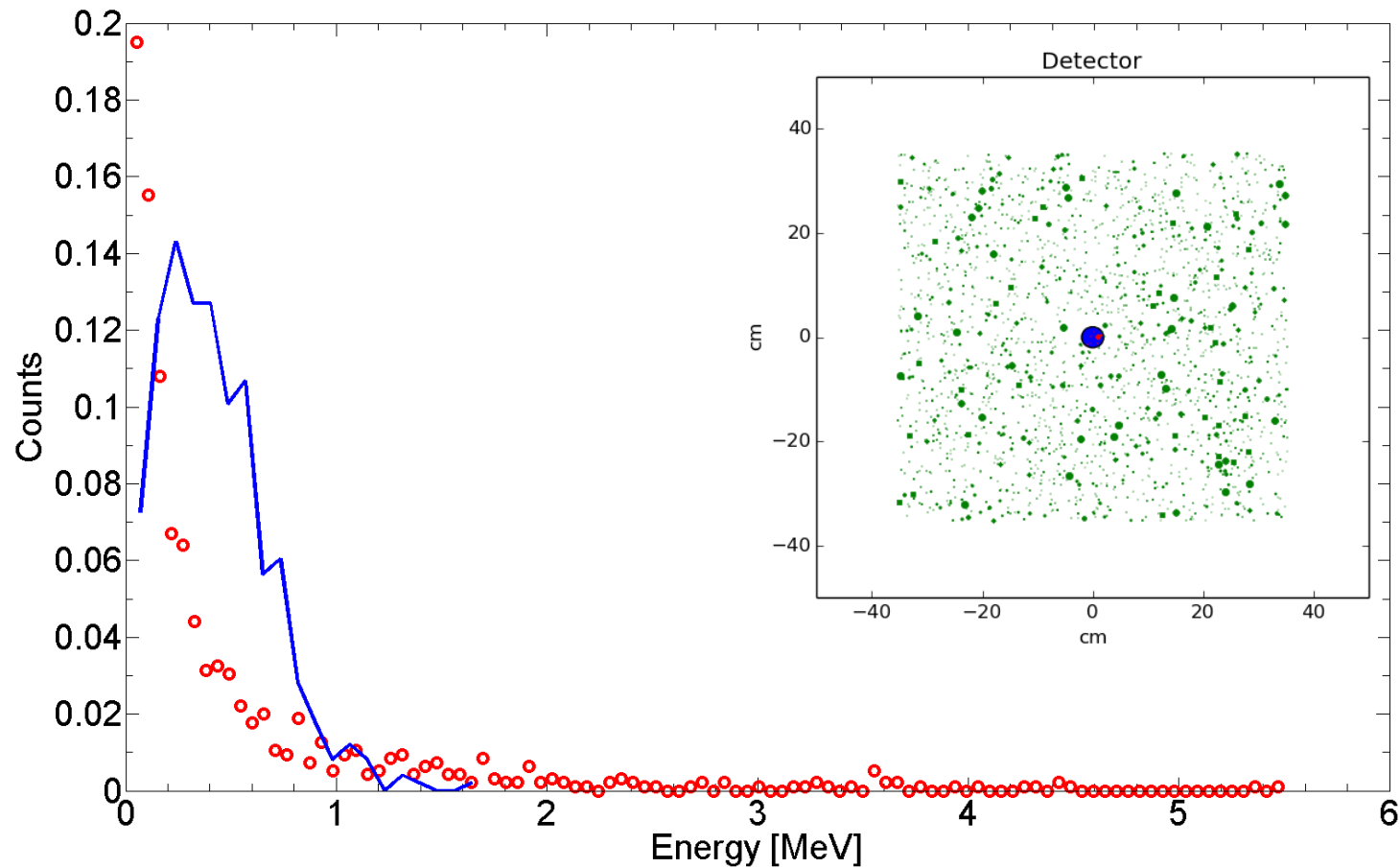
Isotropic, $8 \cdot 10^5$ photons



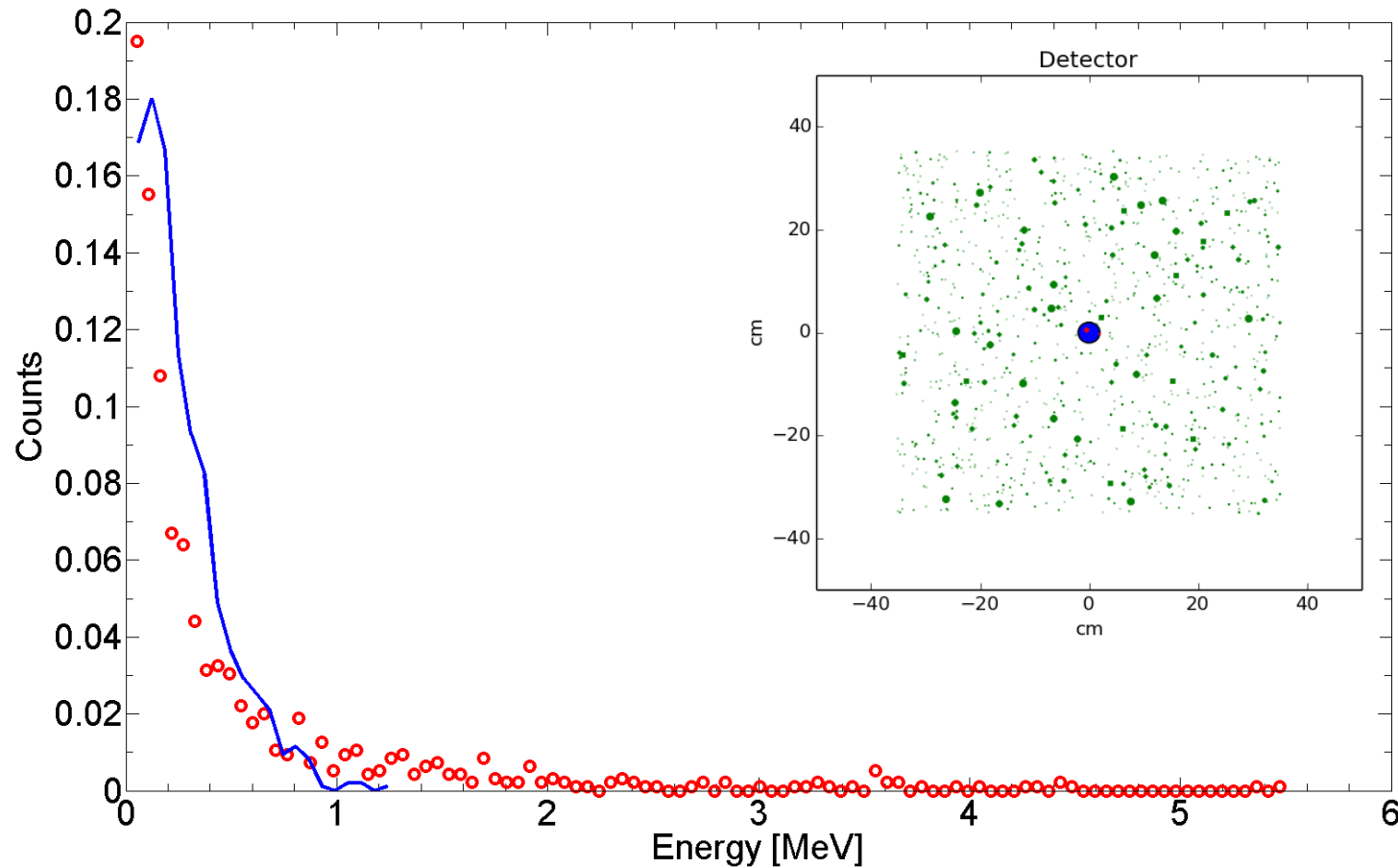
Isotropic, $8 \cdot 10^5$ photons



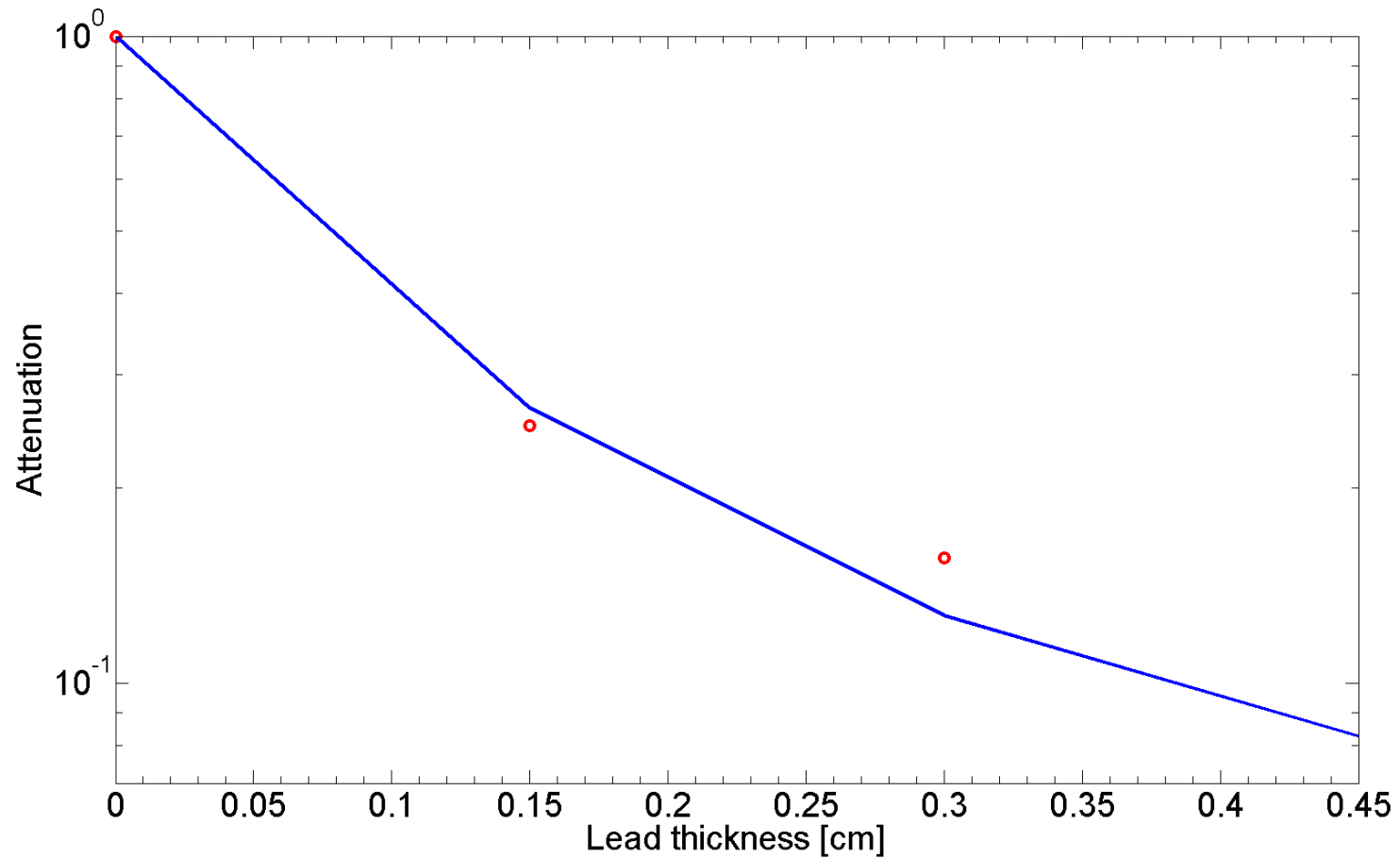
Isotropic, $2 \cdot 10^5$ photons



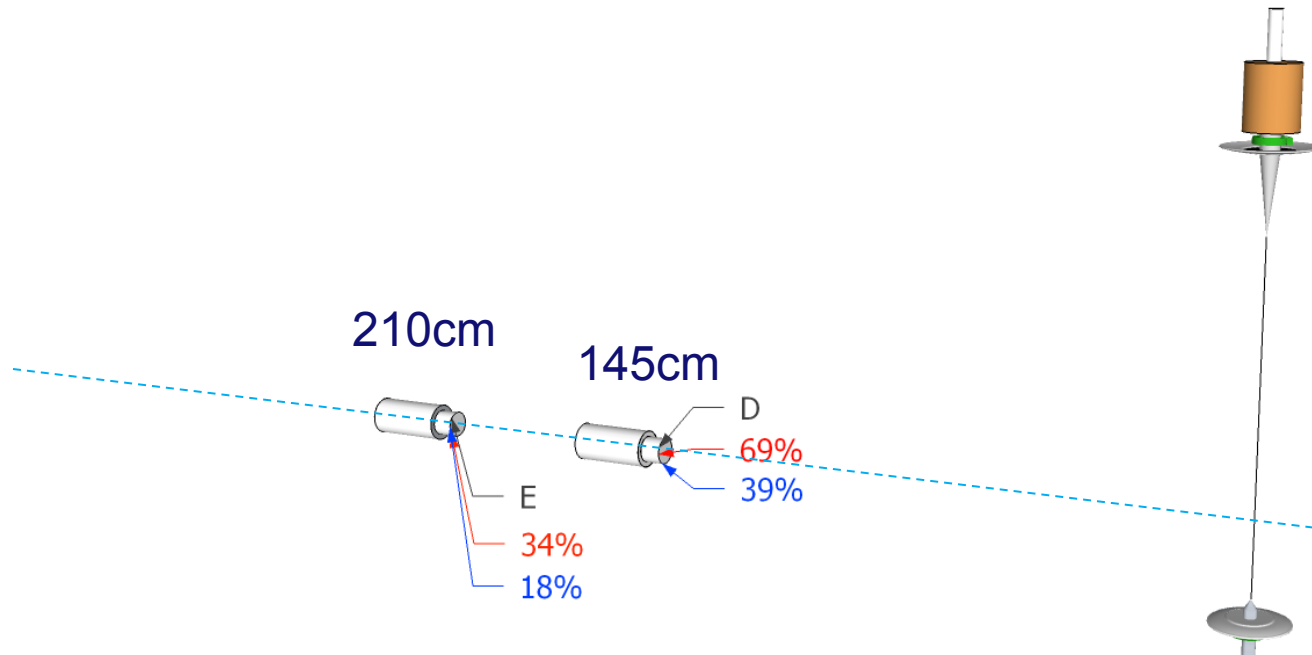
Attenuation, $1 \cdot 10^5$ photons



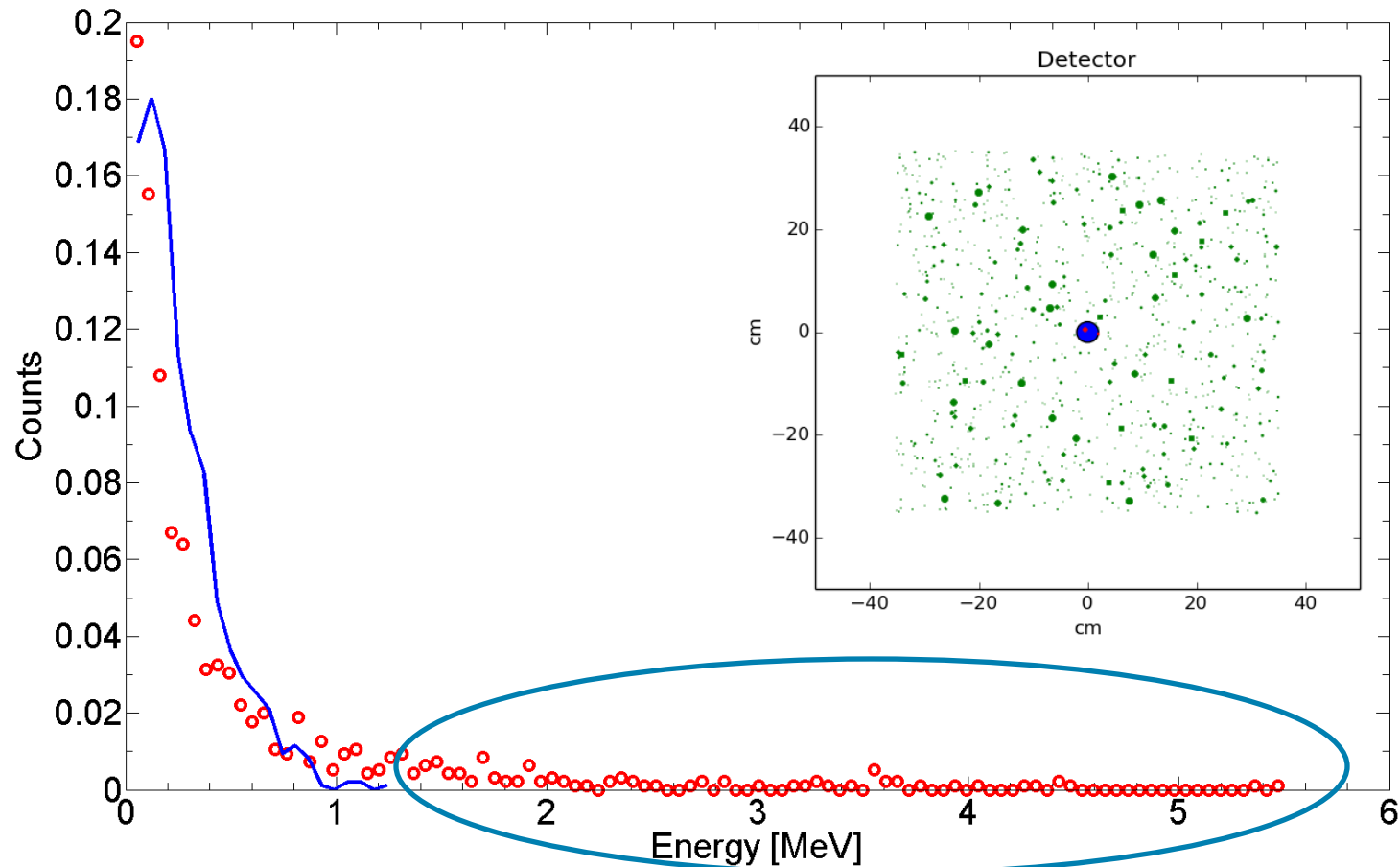
Attenuation, $2 \cdot 10^5$ photons



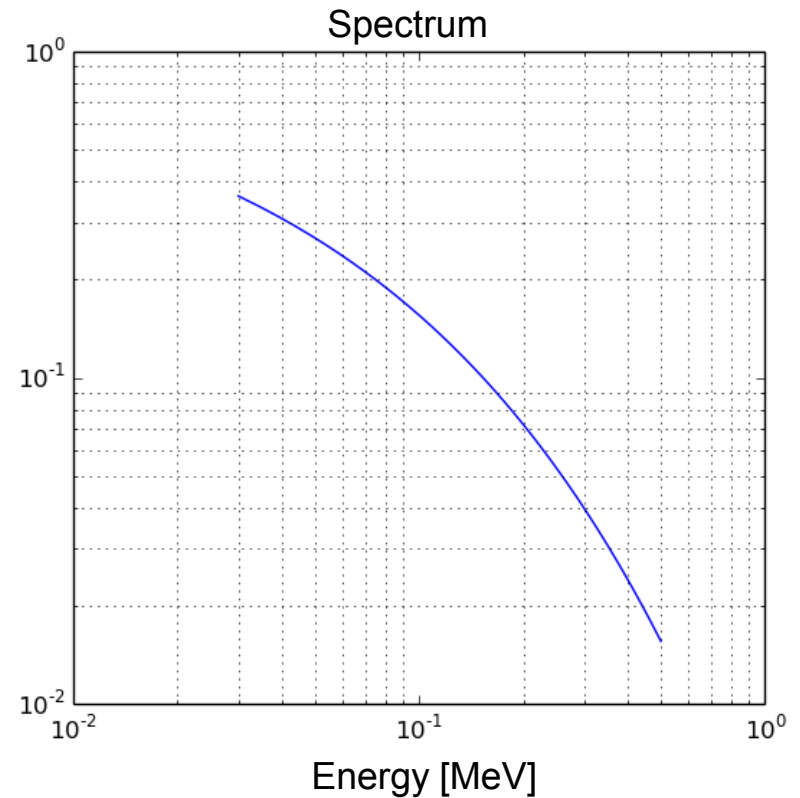
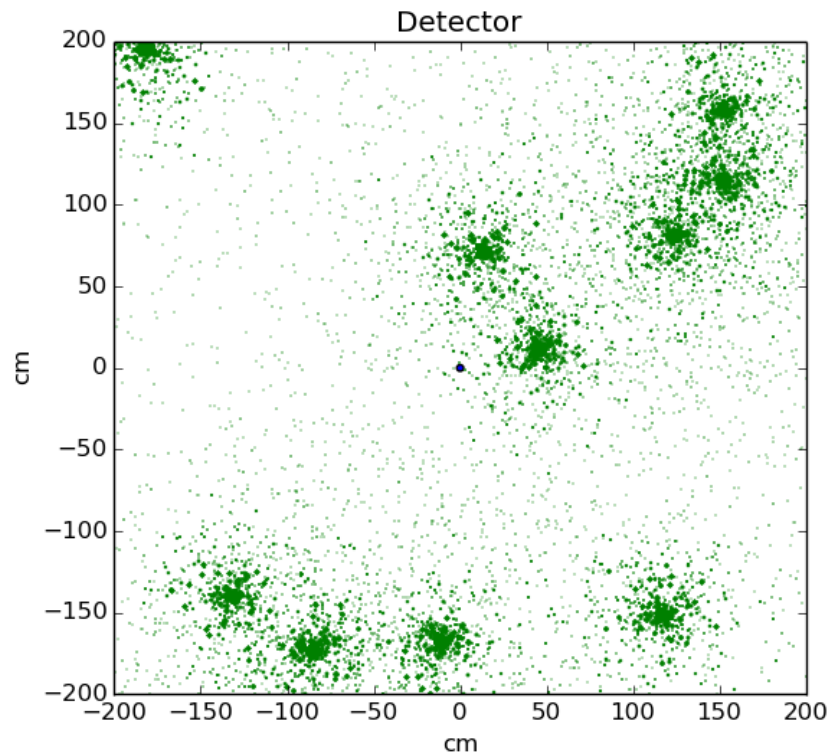
Isotropic source



Attenuation, $1 \cdot 10^5$ photons



To beam, or not to beam?



Conclusions

- **Bremsstrahlung model**
- **Best fit achieved with:**
 - **Isotropic source**
 - **$(1 - 2) \cdot 10^5$ initial photons in 4π**
- **Work in progress**