Target Issues for Different Undulator Parameters

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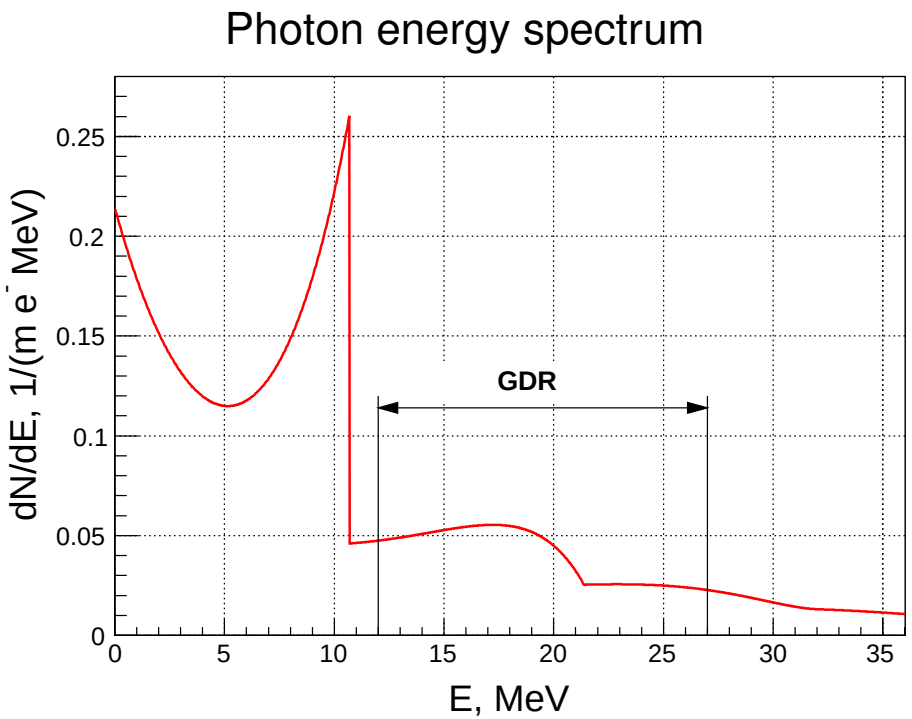
Helical Undulator. Photon Beam. Conversion Target.

e^- drive beam energy, GeV	150
K-value	1
Undulator period, cm	1
Magnetic field, T	1.07
1^{st} harmonic cutoff energy, MeV	10.7

Target compound	Ti6Al4V
Target thickness, X_0	0.4
rms size of photon beam, mm	0.7



Issues:

- Heat dissipation in target
- Target damage by neutrons
- High target activation

Can suppression of second and higher harmonics reduce neutron production?

Can increasing of photon energy help with target heat loading?

Simulation Outline and Used Tools

Fixed for simulations: 150 GeV electron drive beam energy, target compound and thickness, optical matching device.

Varied:

- undulator K value between 0.2 and 1.4 ($\lambda_u = 1$ cm)
- undulator period λ_u between 0.1 and 1.4 cm ($K = 1$)

Tools

Positron yield, neutron yield, energy deposition, target activation have been calculated by

- FLUKA

Target damage (dpa) has been estimated by combining of

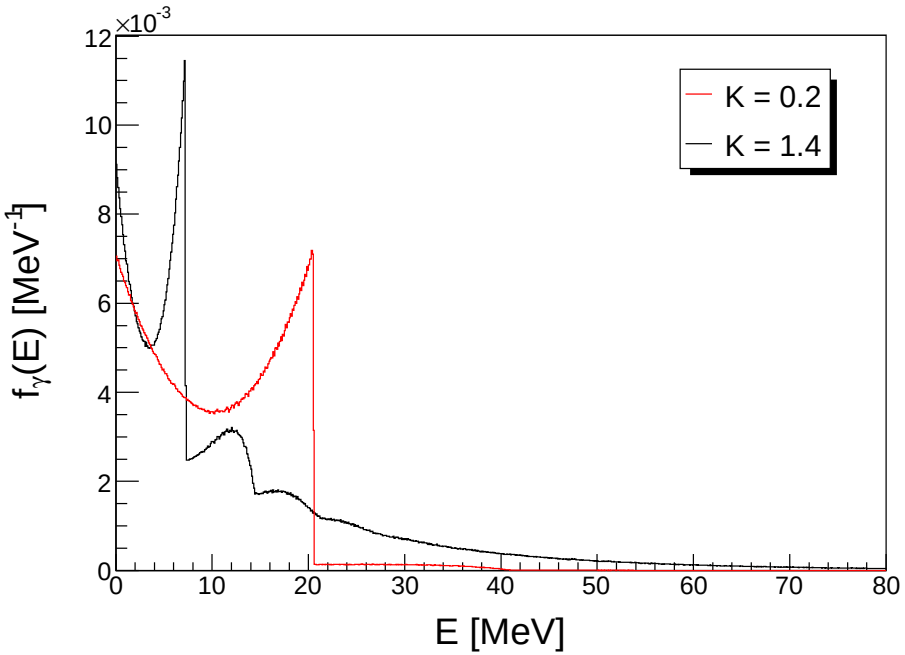
- FLUKA (neutron fluence and energy distribution) and SPECTER (displacement cross sections)

Positron capture has been calculated by

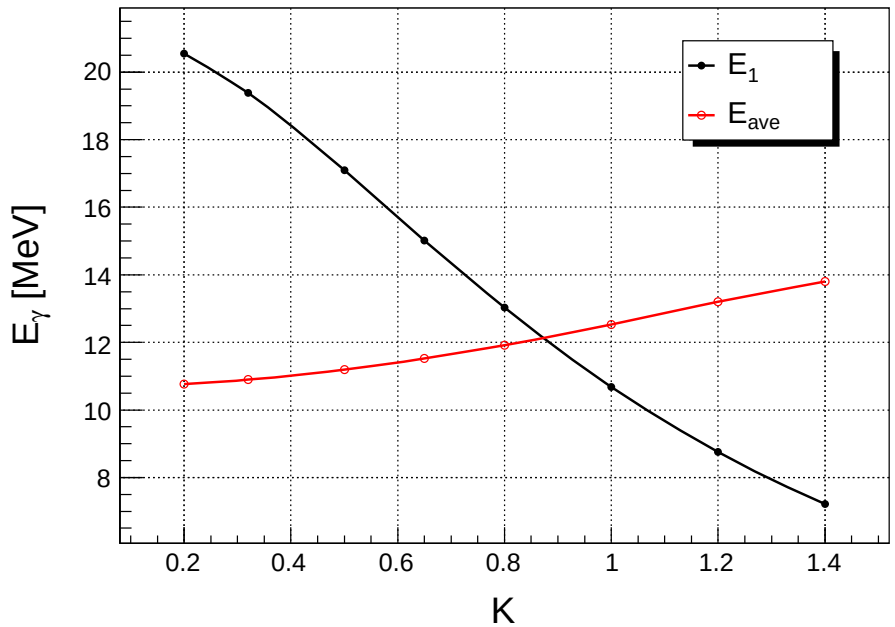
- ASTRA

Varying of K between 0.2 and 1.4 ($\lambda_u = 1$ cm). Energy of Photons

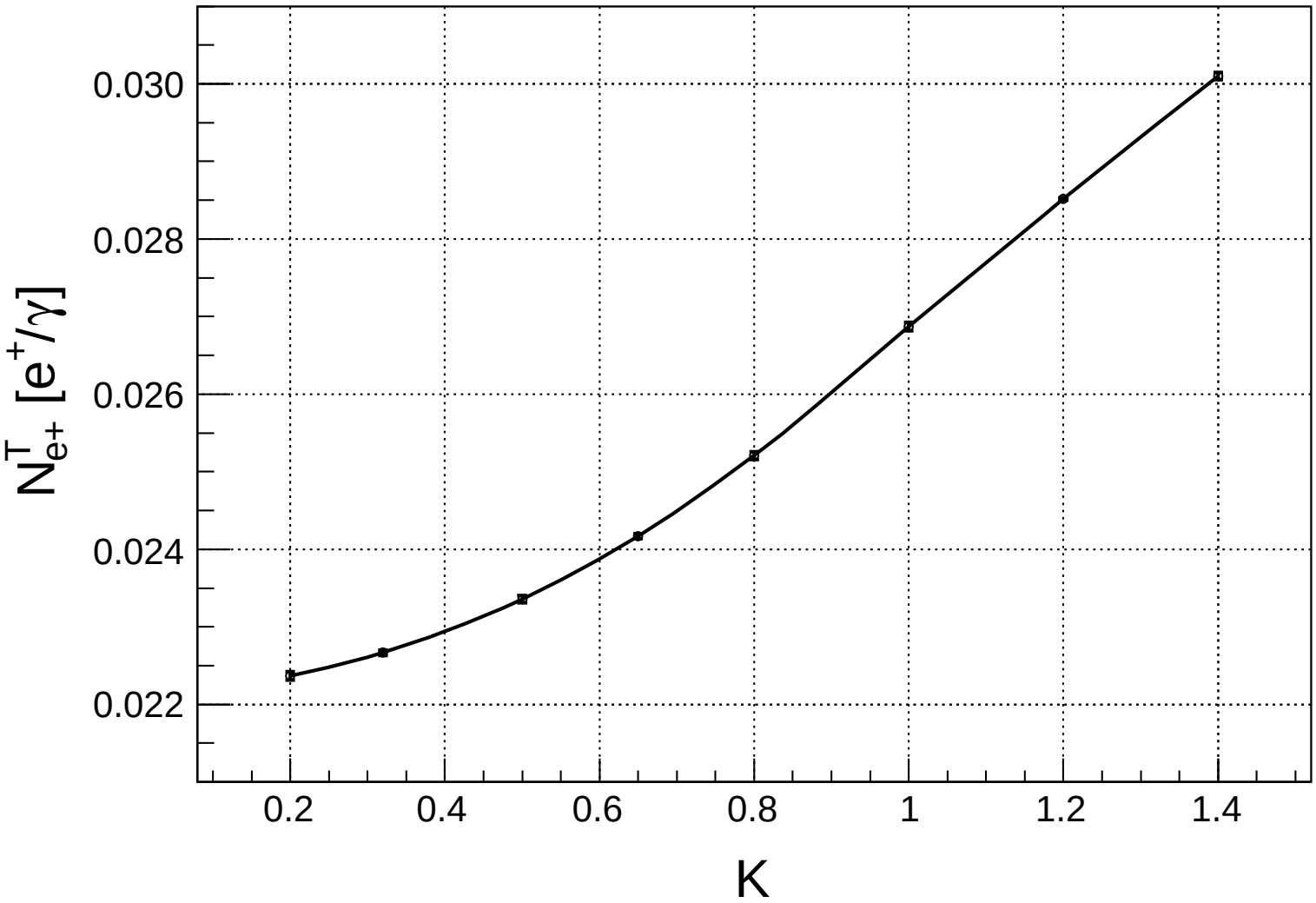
Photon energy distribution function



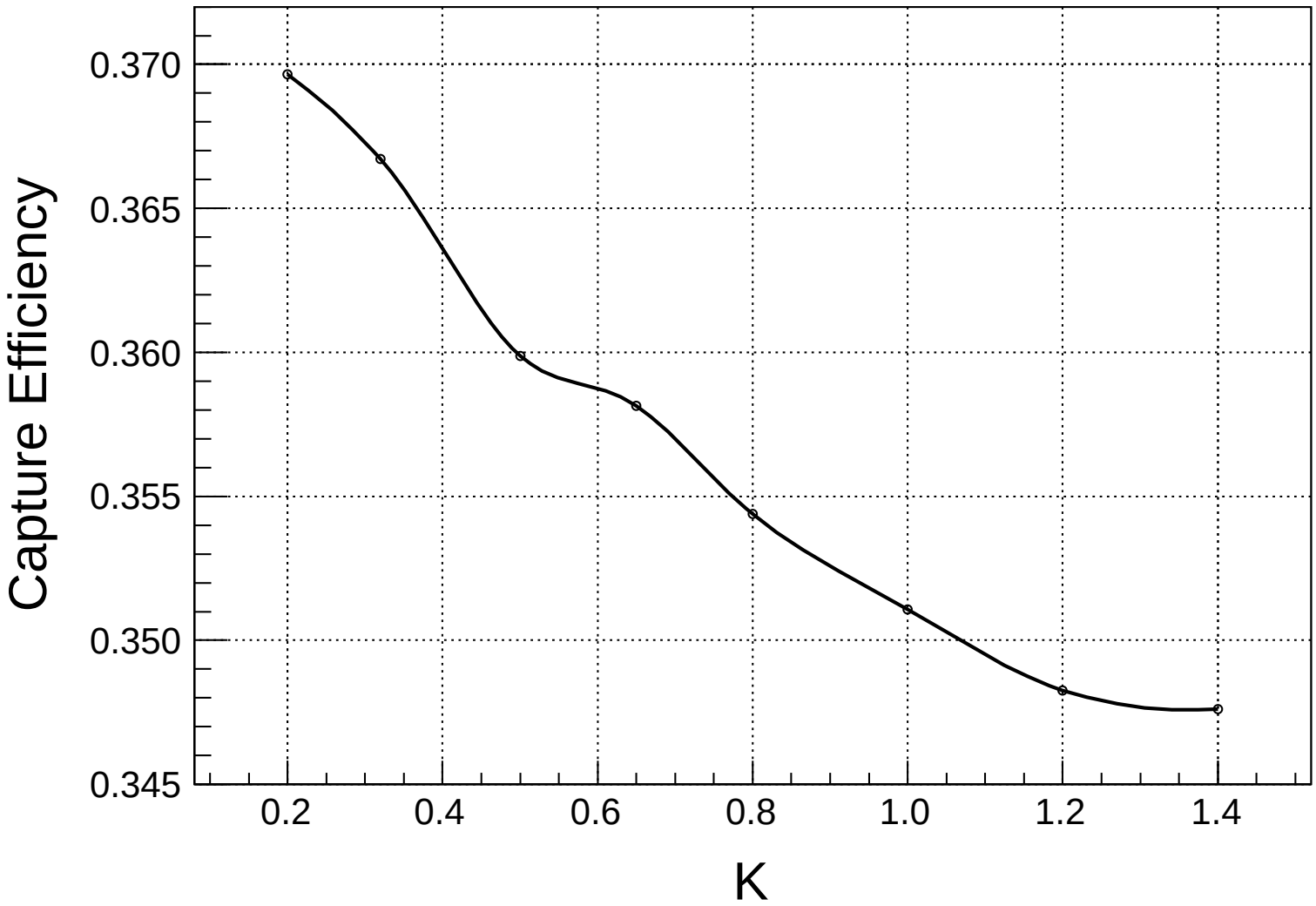
1^{st} harmonic cutoff energy and average photon energy



Number of positrons per photon after the target

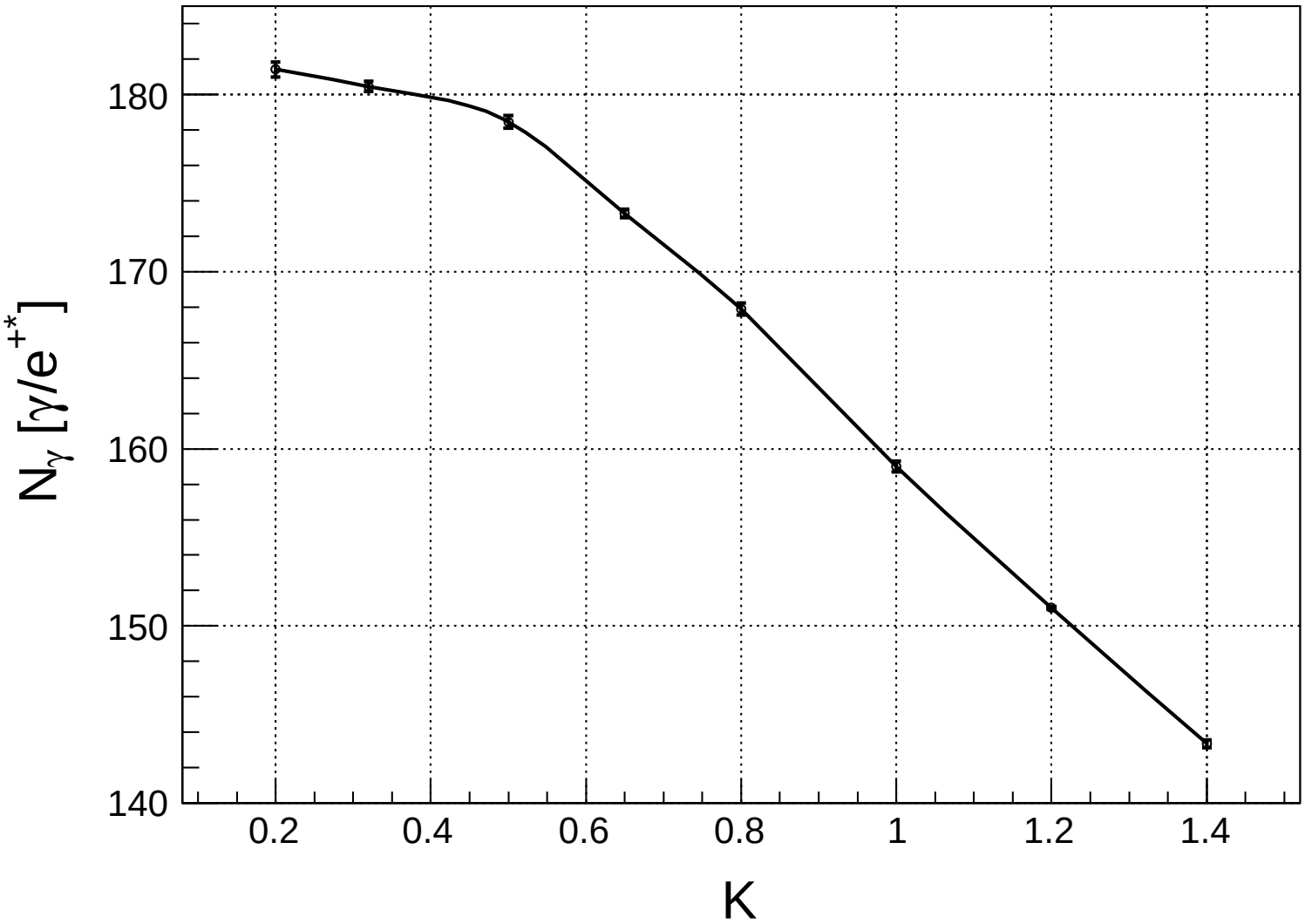


Positron Capture Efficiency



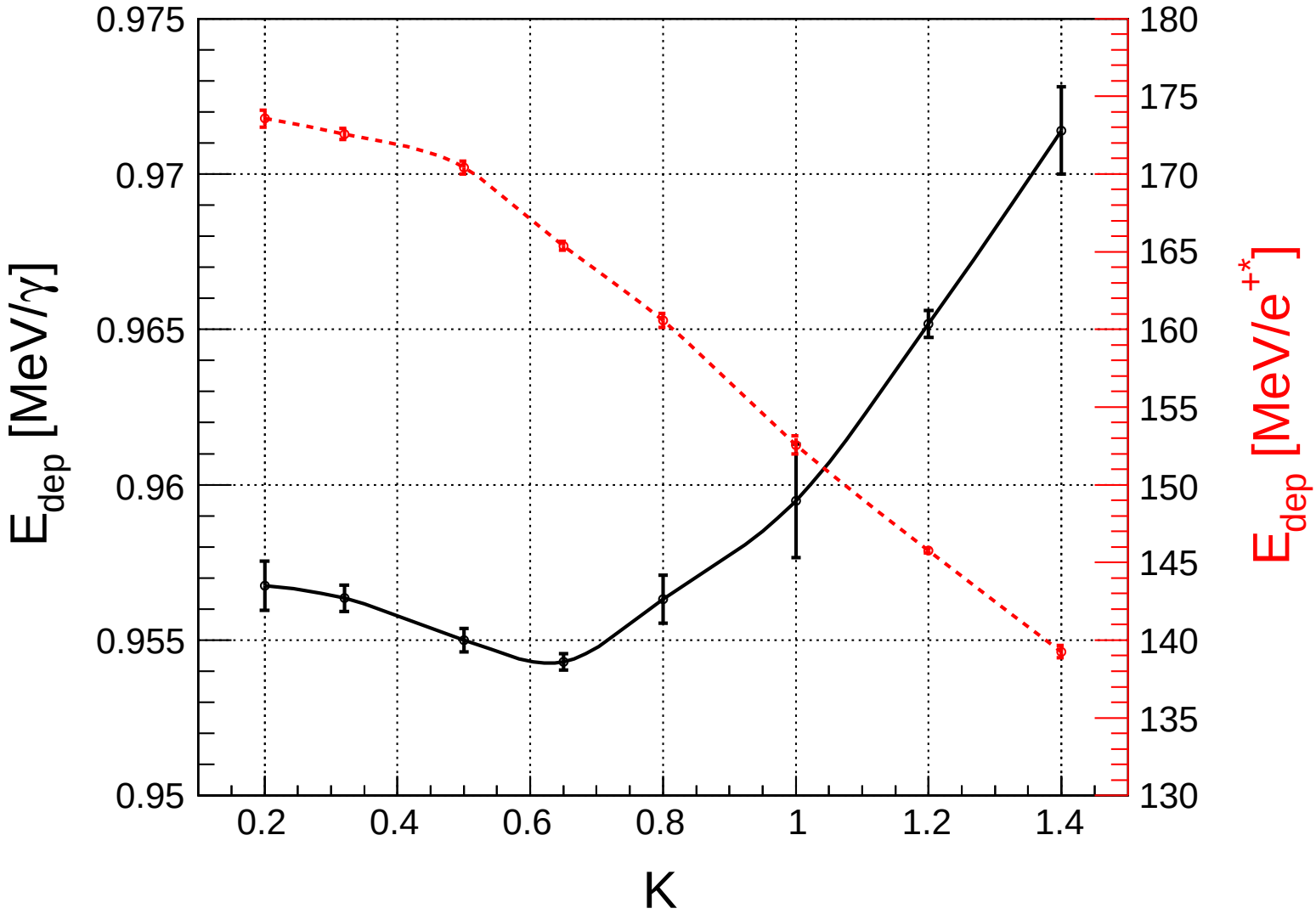
Required Number of Photons

Required number of photons per positron at IP



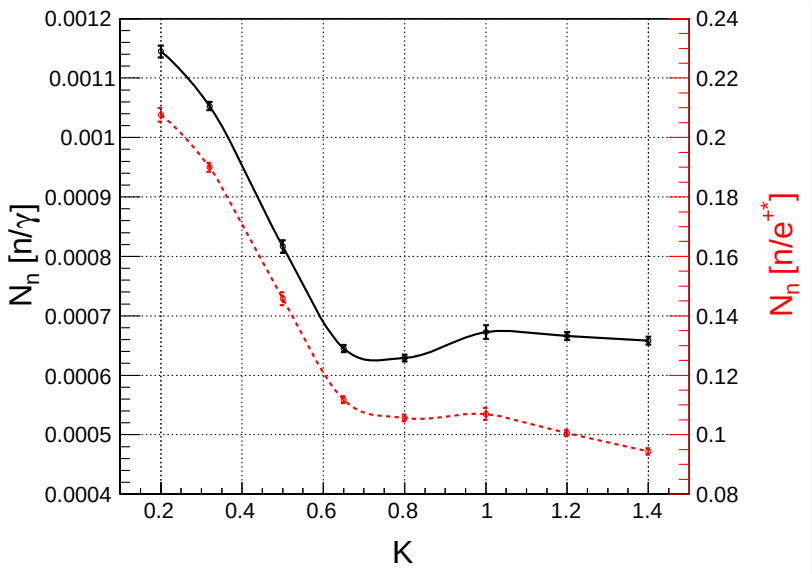
Energy Deposition in Target

per primary photon or per positron at IP

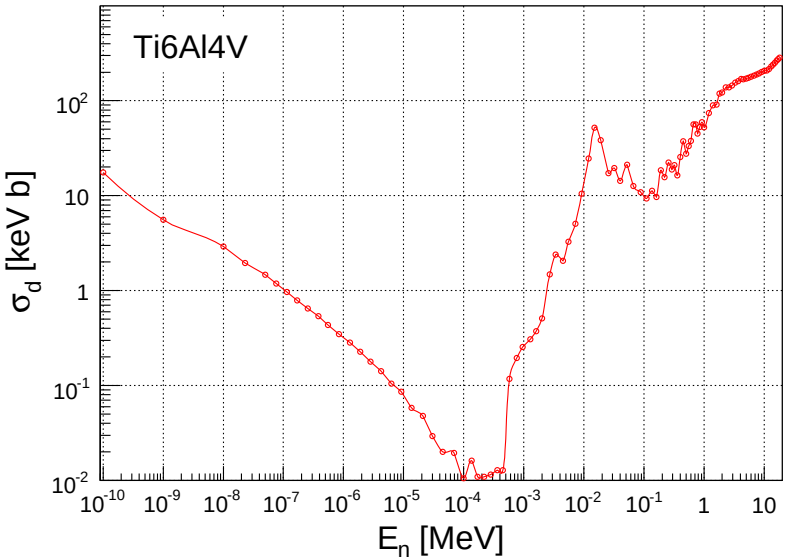


Neutron Production and Target Damage

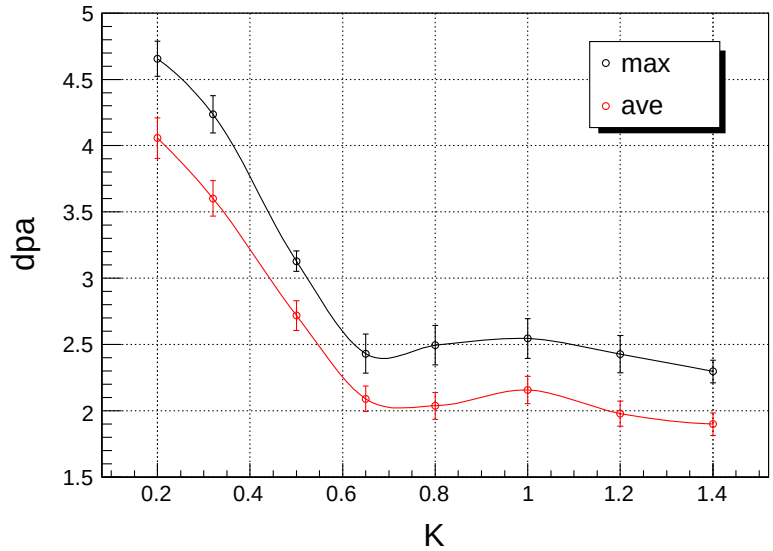
Neutron Yield



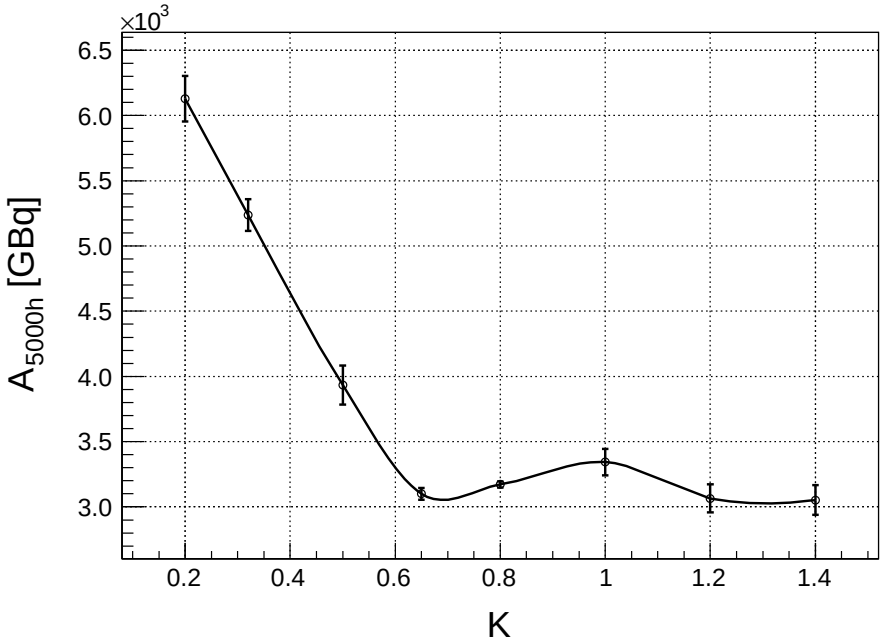
Displacement Cross Section (SPECTER)

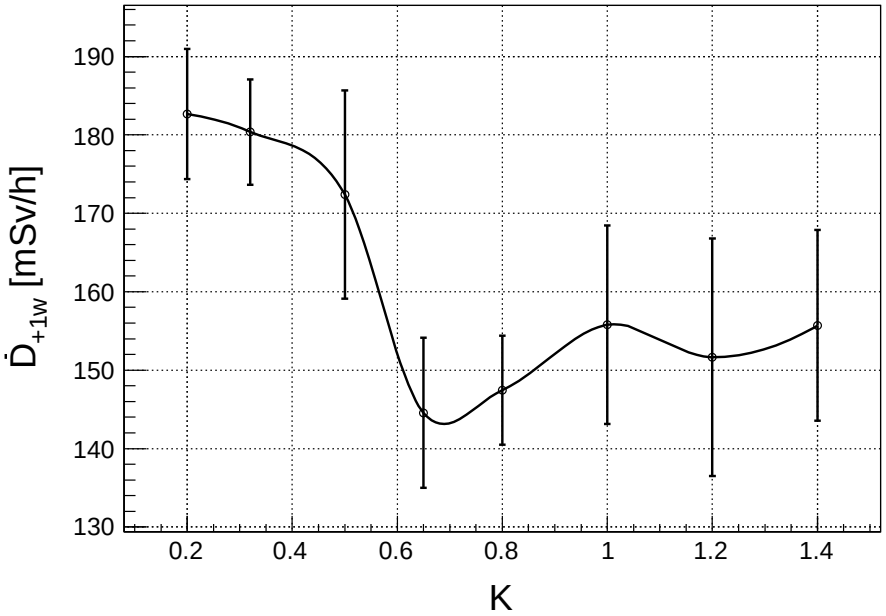


Target Damage by Neutrons after 5000 Hours of Target Irradiation



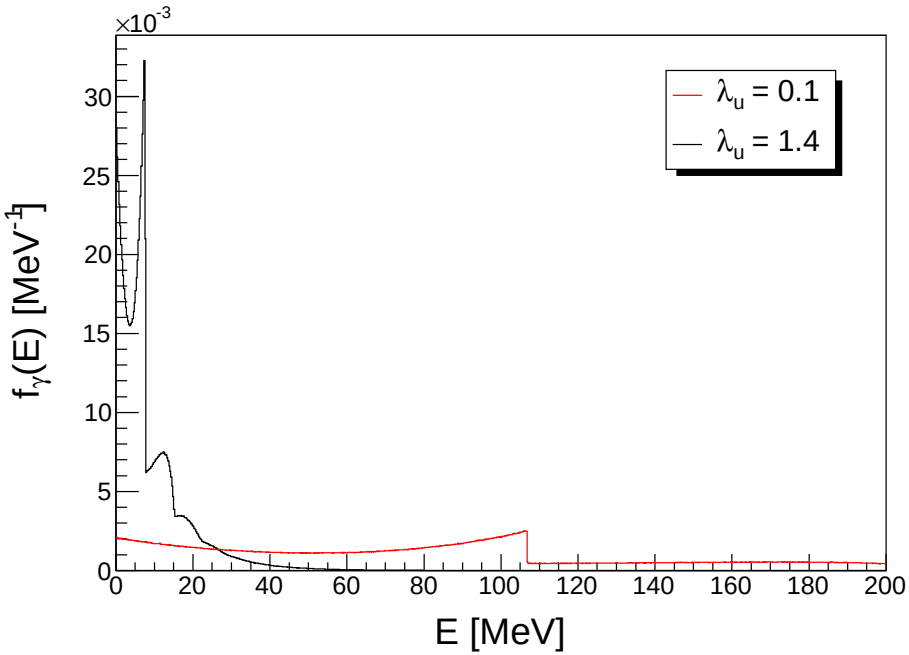
Target Activity and Dose Rate





Varying of λ_u between 0.1 and 1.4 cm ($K = 1$). Energy of Photons

Photon energy distribution function



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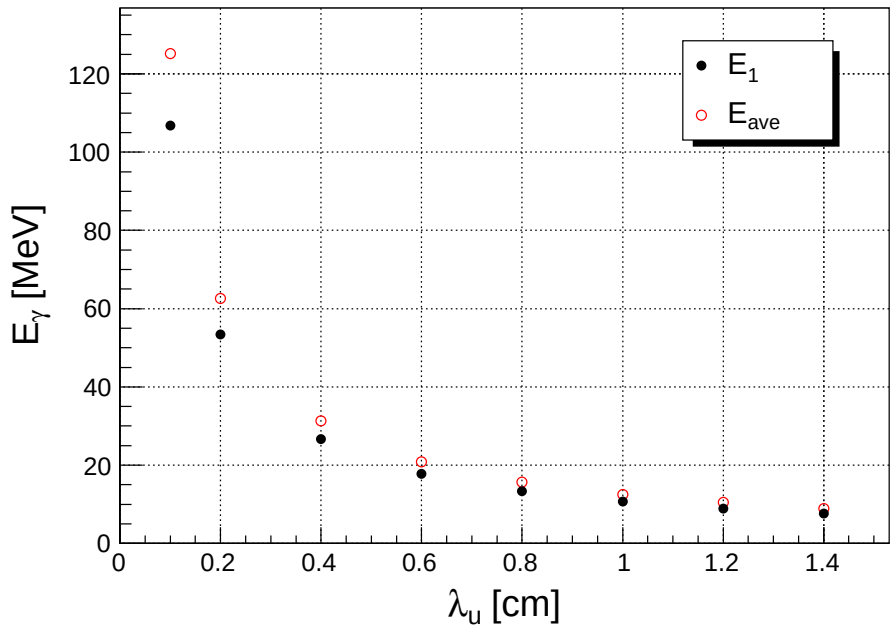
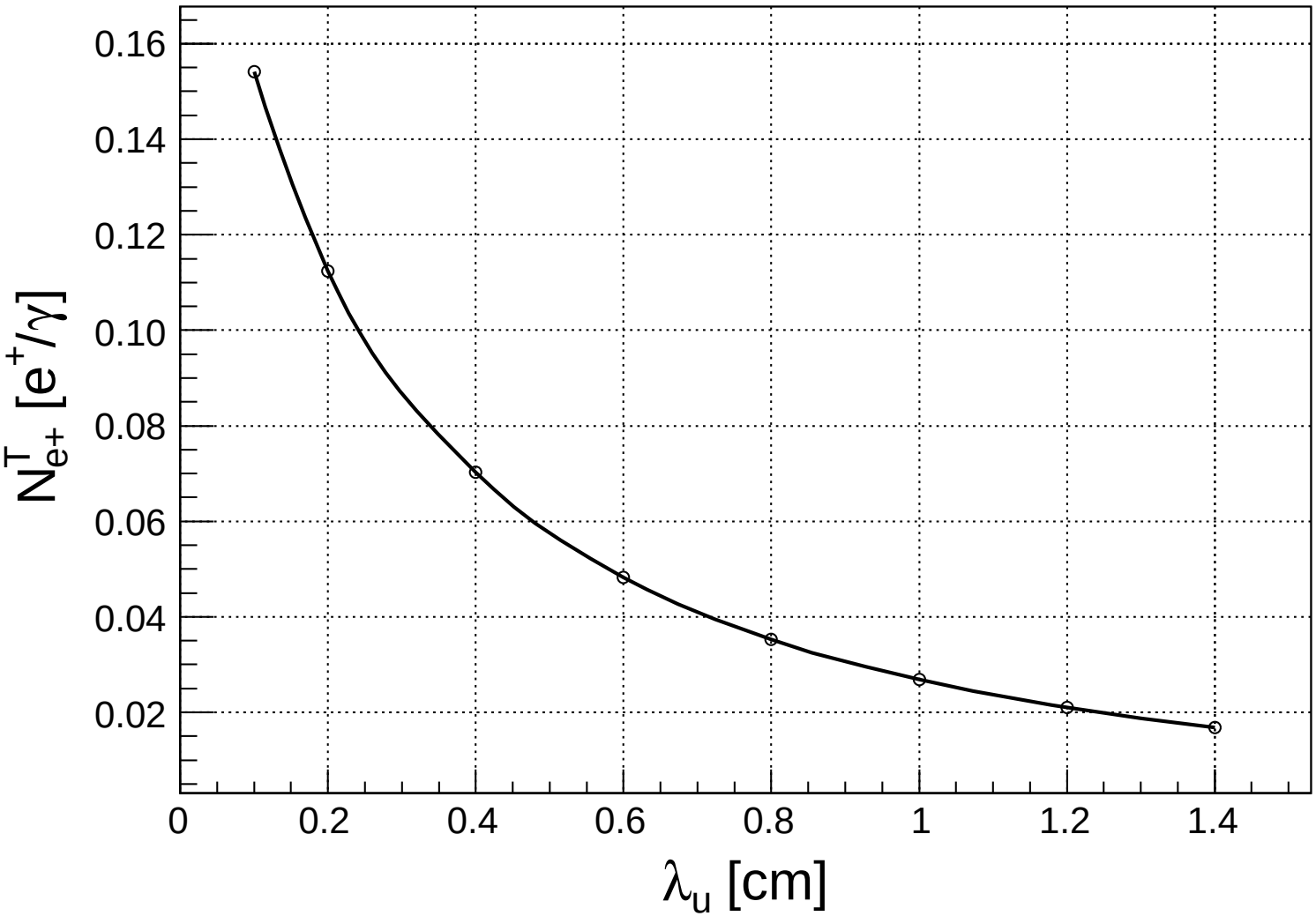


Number of positrons after the target per photon



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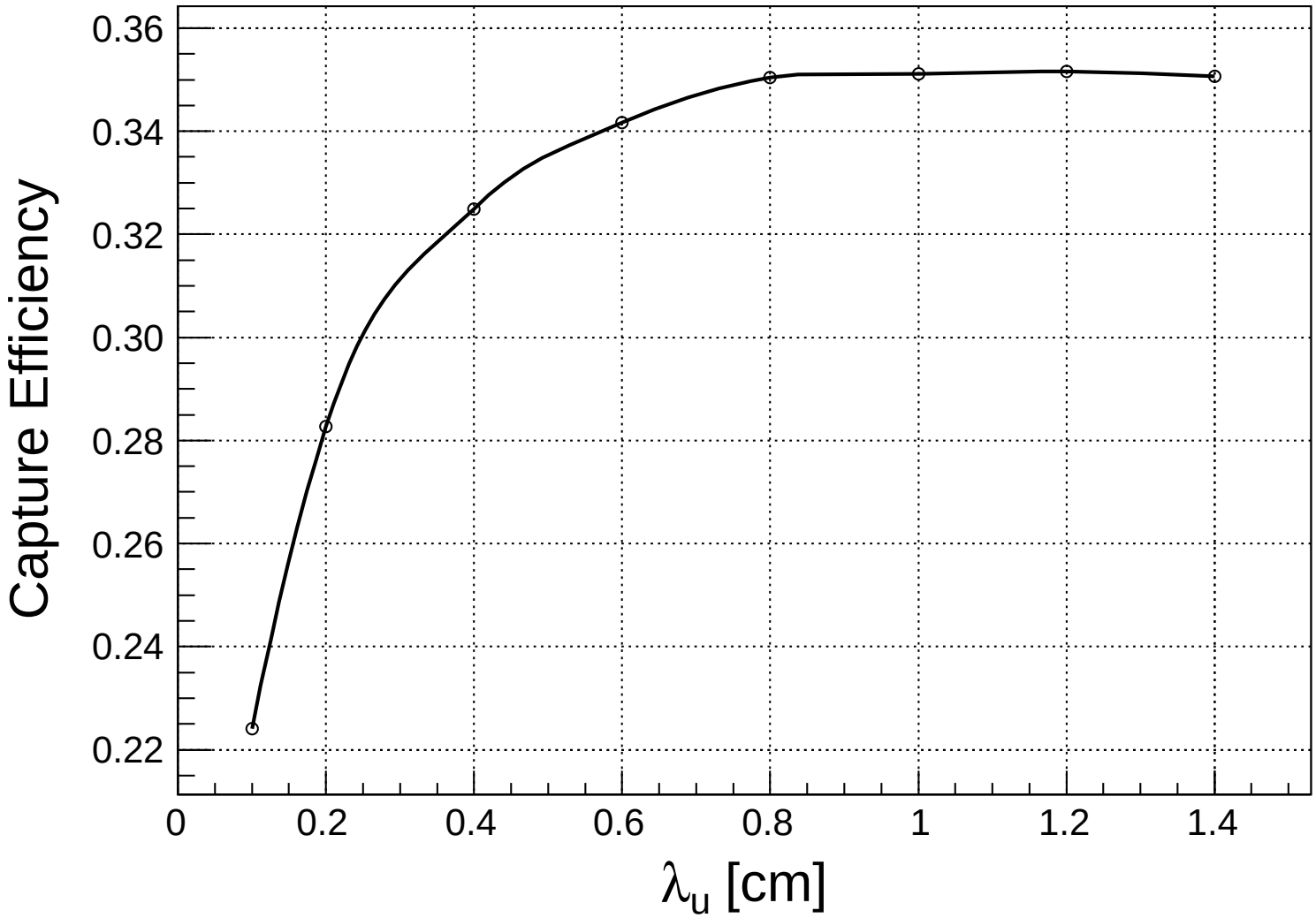
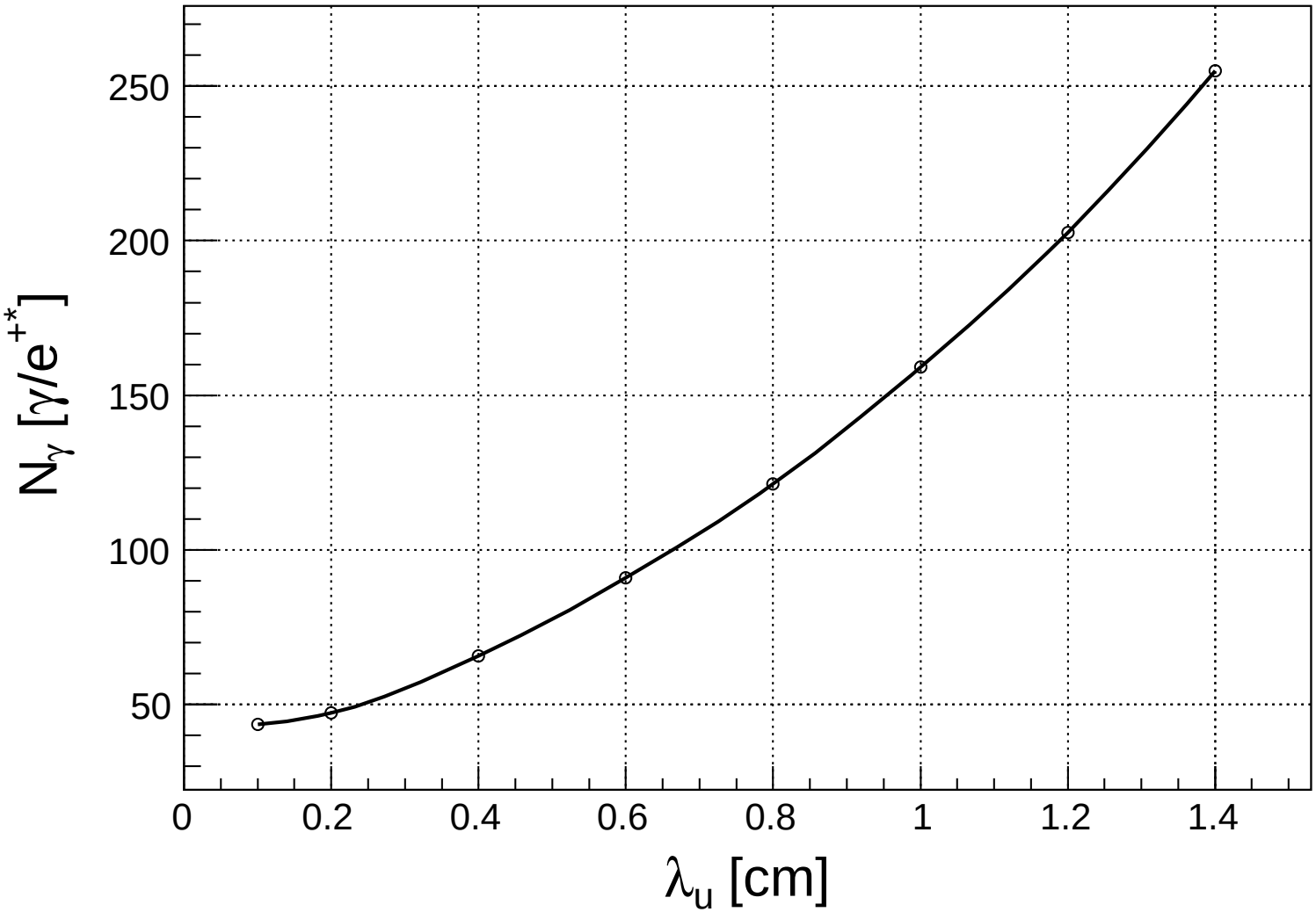


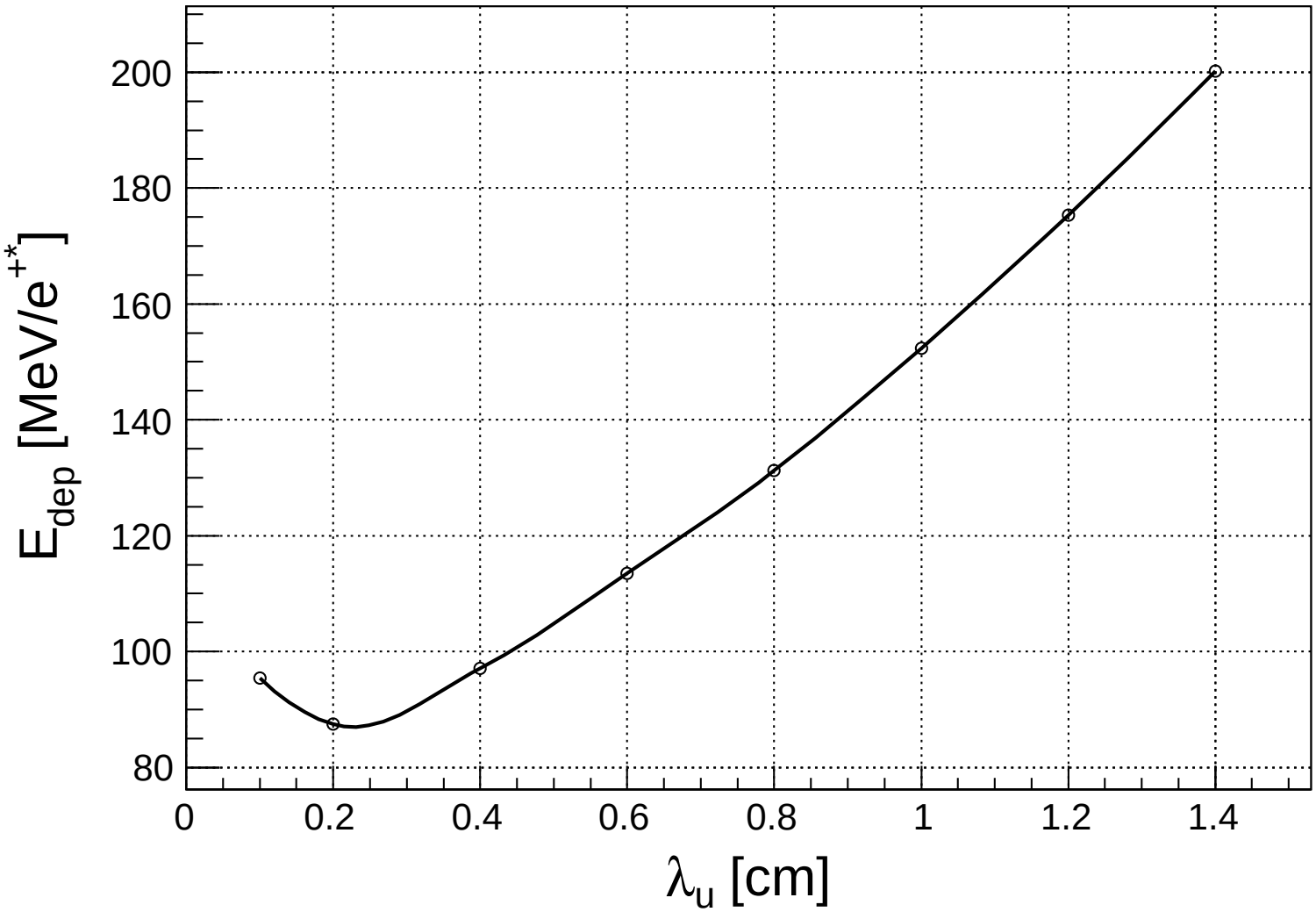
Required Number of Photons

to get one positron at IP



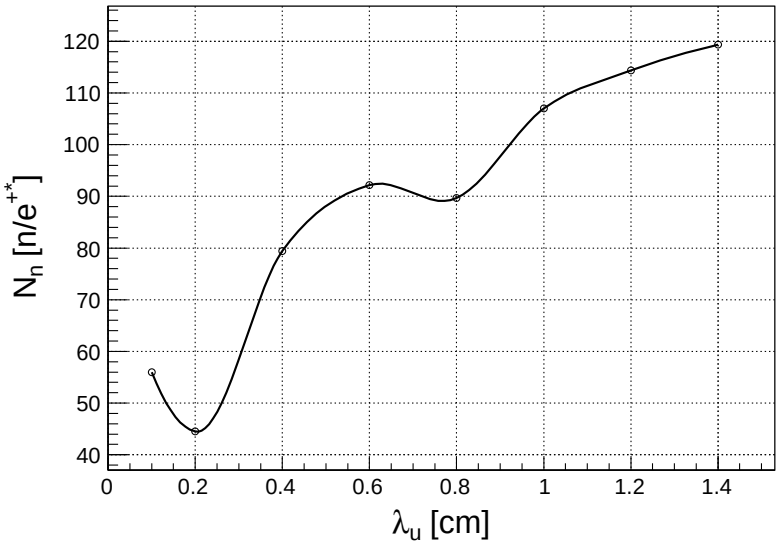
Energy Deposition in Target

per positron at IP



Neutron Production and Target Damage

Neutron Yield



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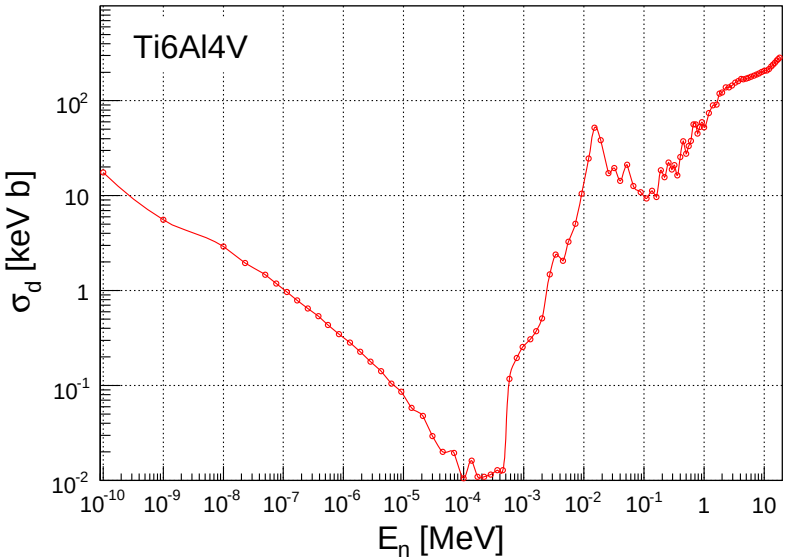

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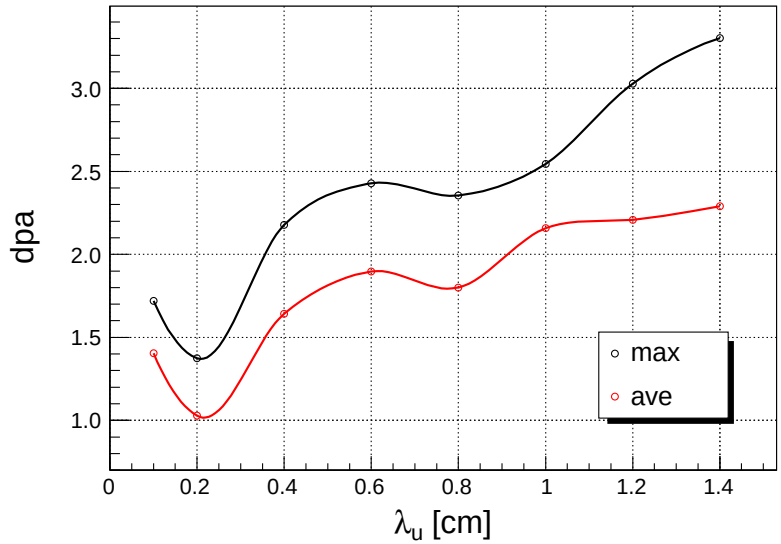

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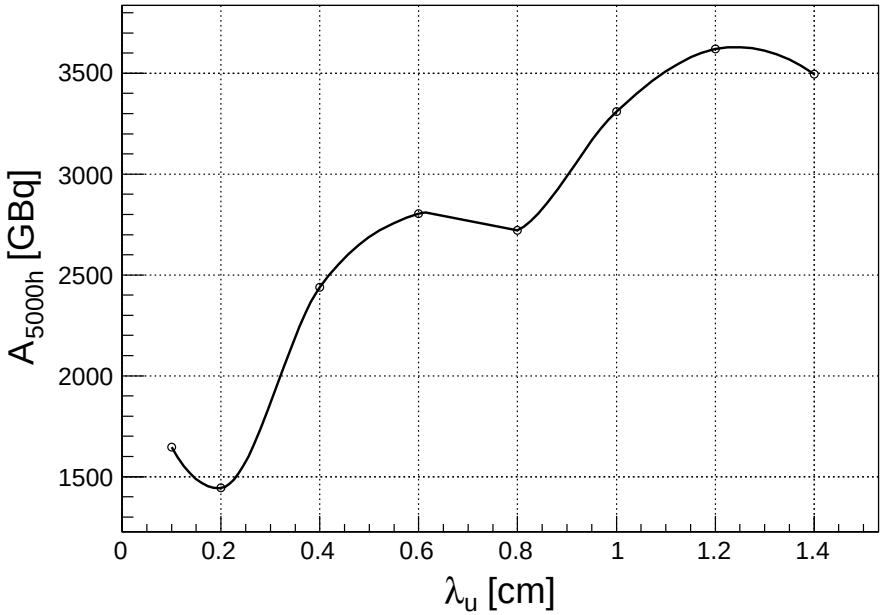

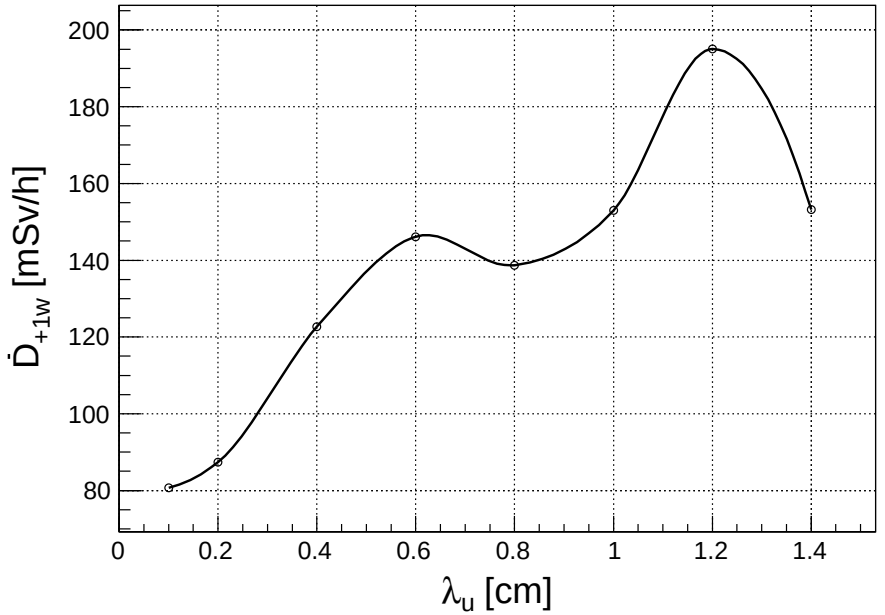

Summary and Outlook

- Smaller undulator K value results in higher energy deposition and for K below 0.6 in shorter target life time and higher target activation.
- Smaller undulator period is more effective

Future plan

- Polarization of beam will be taken into account