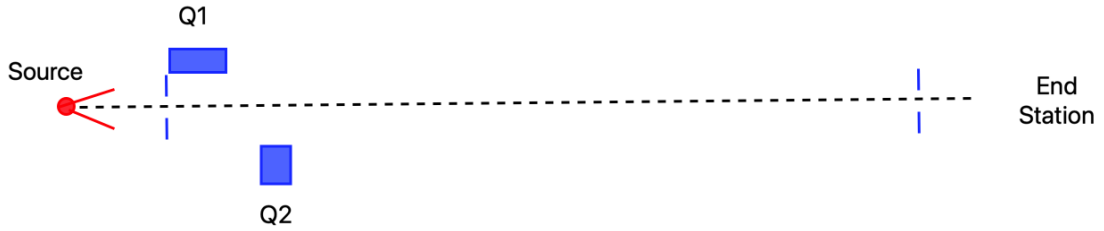
Alfredo Fernandez Rodriguez

07/04/2025

Preliminar dosimetric simulations of PoPLaR



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Simulation pipeline

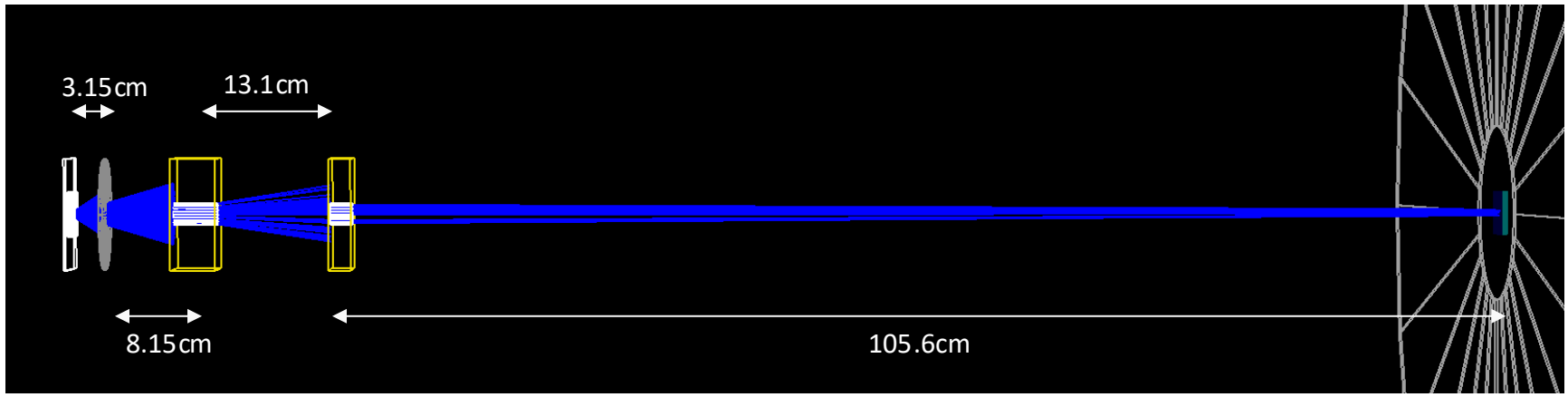
Python beamline optimisation by Josie McGarrigle

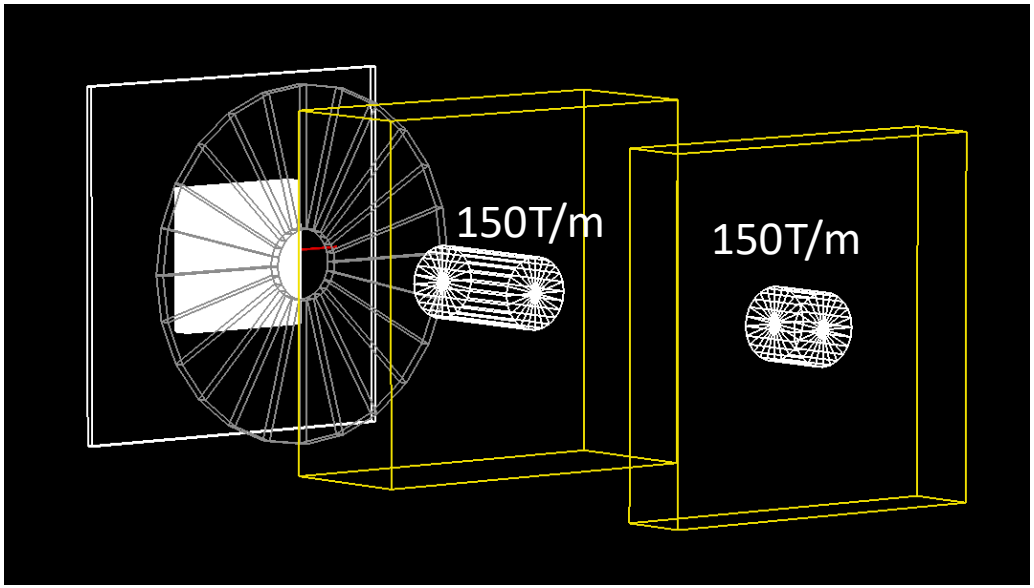
Beamline and setup reproduction in TOPAS[1]

Scoring at simplified target

[1]Topas Tool For Particle Simulation:
J Perl, J Shin, J Schümann, B Faddegon, H Paganetti. "TOPAS: an innovative proton Monte Carlo platform for research and clinical applications." Med Phys. 2012 Nov; 39(11):6818-37.
B Faddegon, J Ramos-Méndez, J Schümann, A McNamara, J Shin, J Perl, H Paganetti. "The TOPAS Tool for Particle Simulation, a Monte Carlo Simulation Tool for Physics, Biology and Clinical Research." Phys Med. 2020 Apr 02; 72:114-121. PMID: 32247964. PMCID: PMC7192305

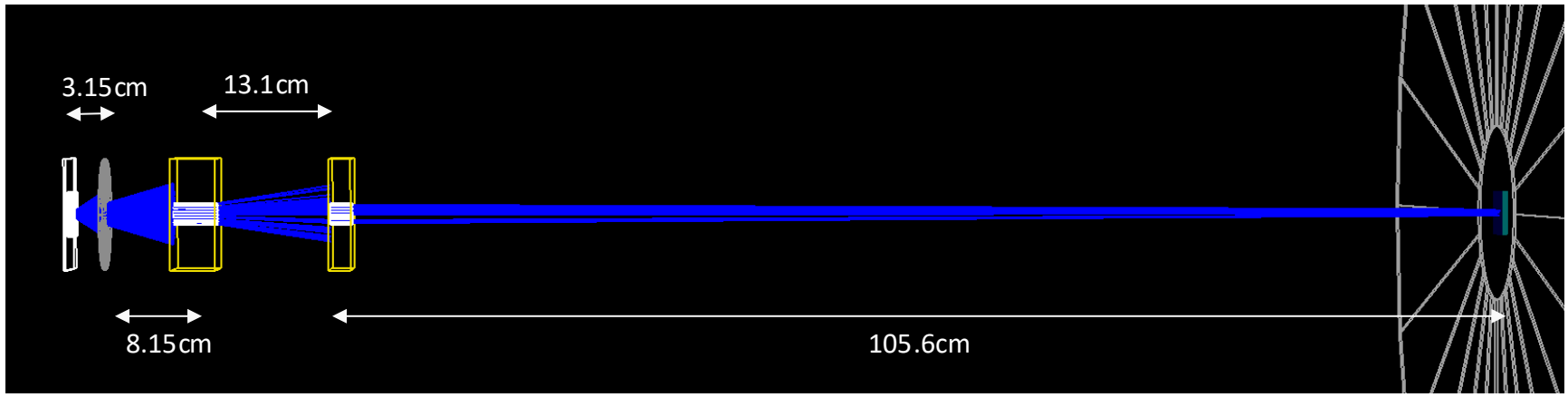
Setup desing

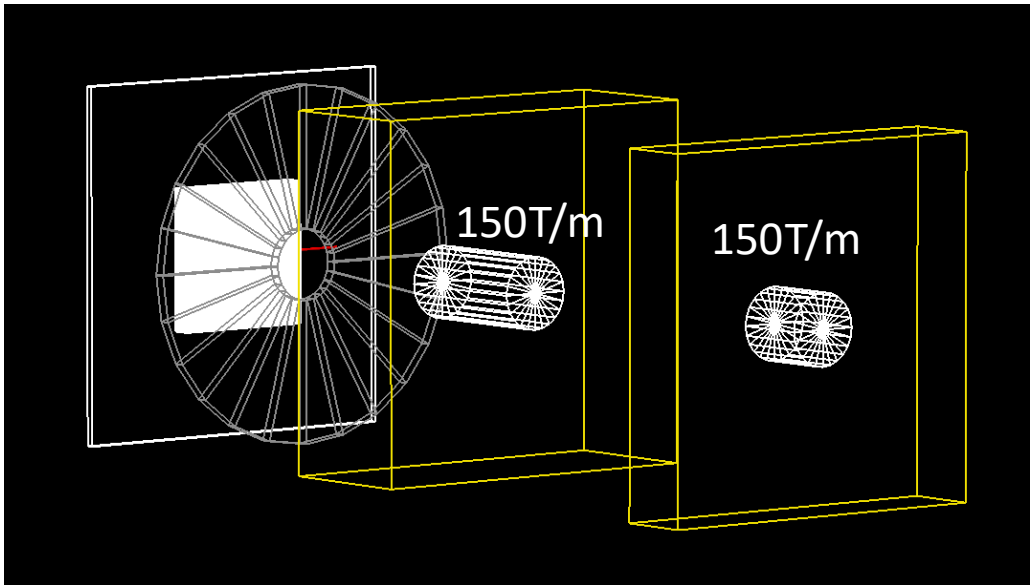




- First Collimator: R=1cm
- **First approximation:**
  - Gaussian source, peak at 10MeV
  - Target at exit of vacuum chamber (d=130cm)
  - No vacuum-air interface
  - No final collimator

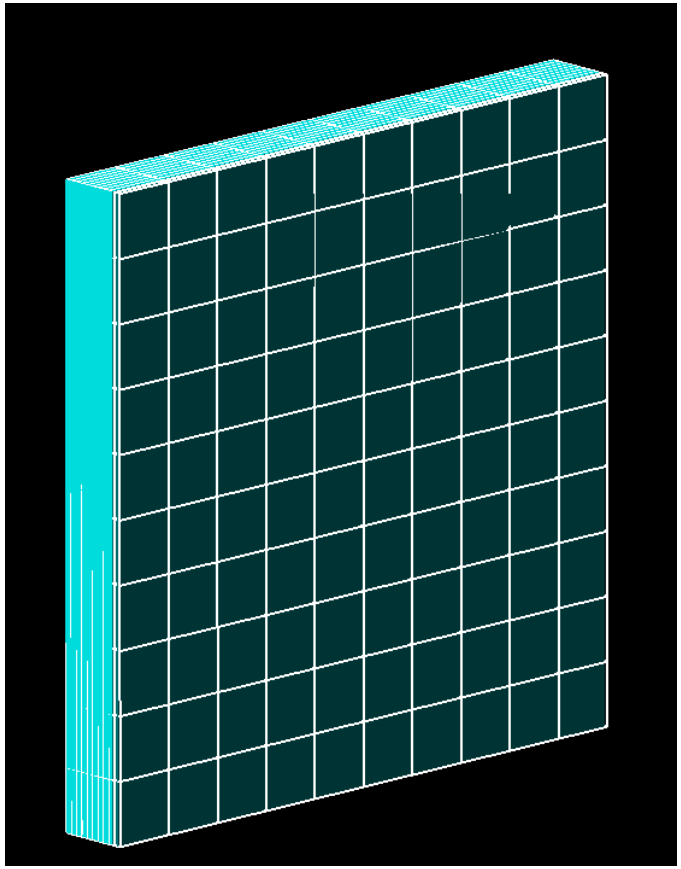
Setup desing





- First Collimator: R=1cm
- **Next approximation:**
  - Parametrization of SCAPA laser source
  - Target at 5-10cm from exit of vacuum chamber (d=135-140cm)
  - 18m radius, 10um mylar window

Scoring

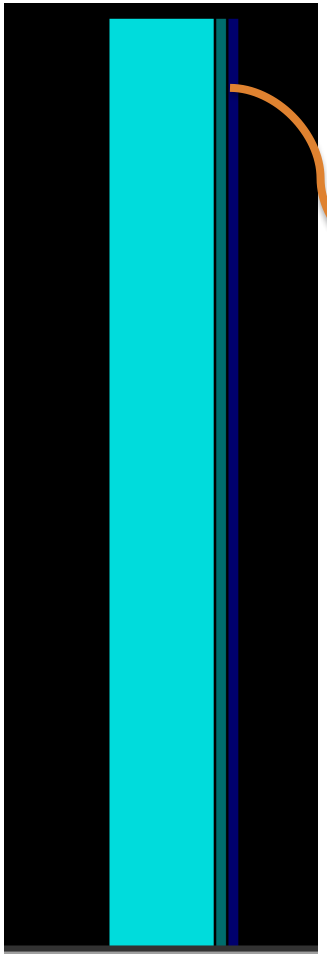


Phantom:

- 4cmx4cm surface
- 2.5um mylar
- 2mm water

Dose and LET scoring:

400x400x80 bins
0.1mmx0.1mmx25um



Phase Space scorer:

Whole recording of all particles crossing mylar front surface

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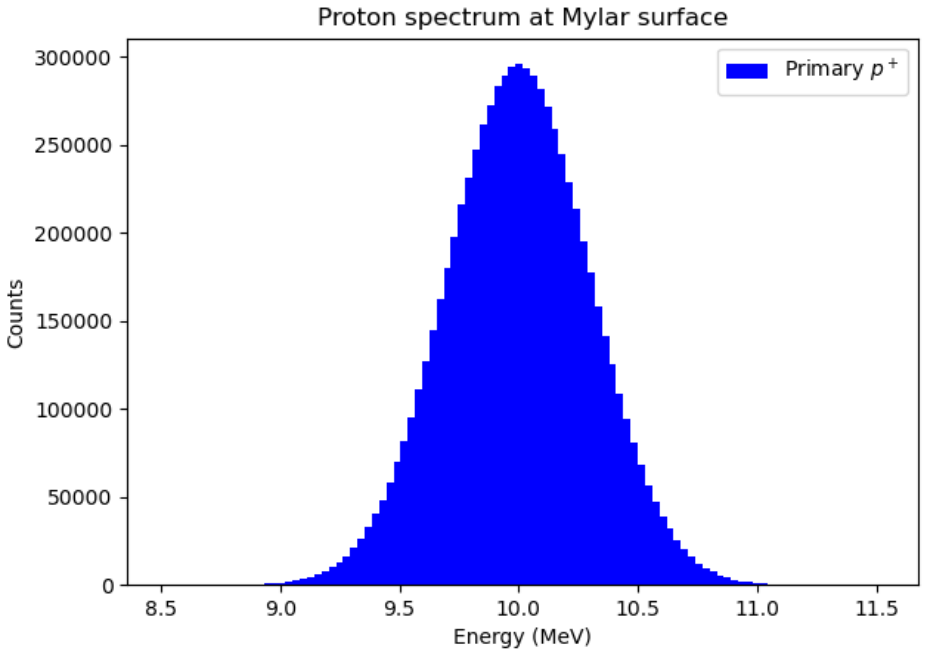
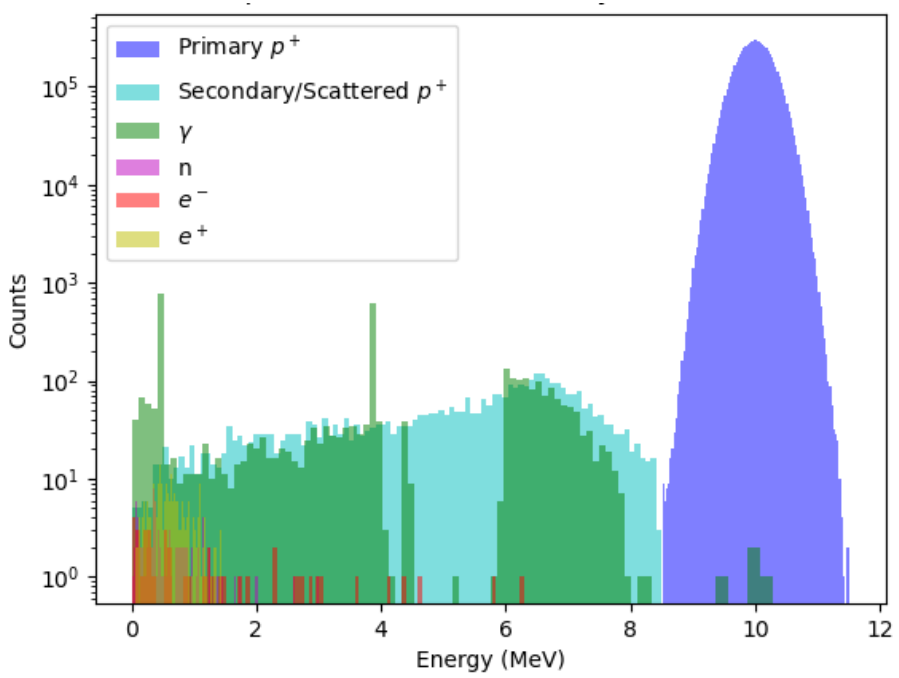
Spectra at target





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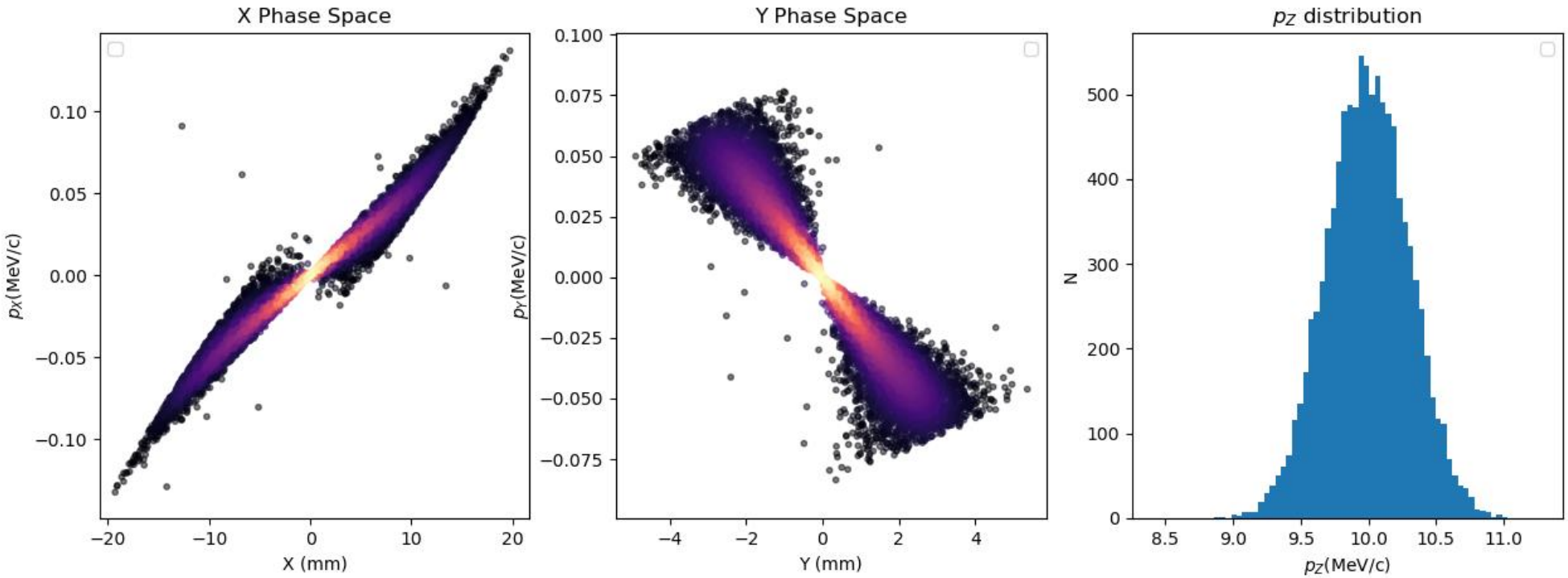
Phase space and beam profile: Primary protons



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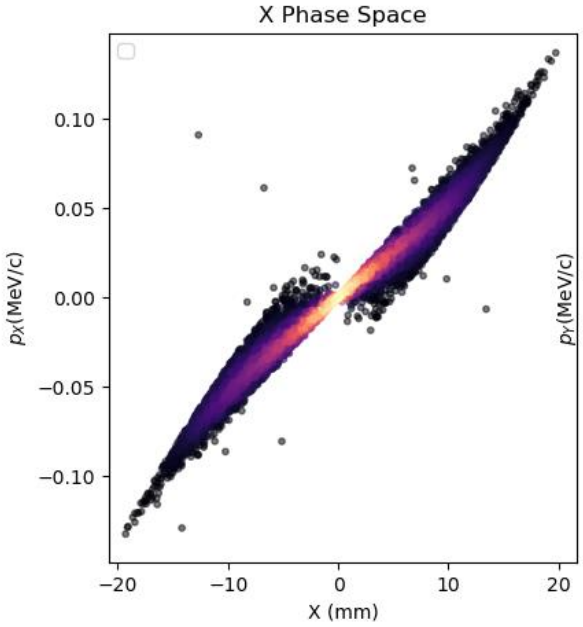
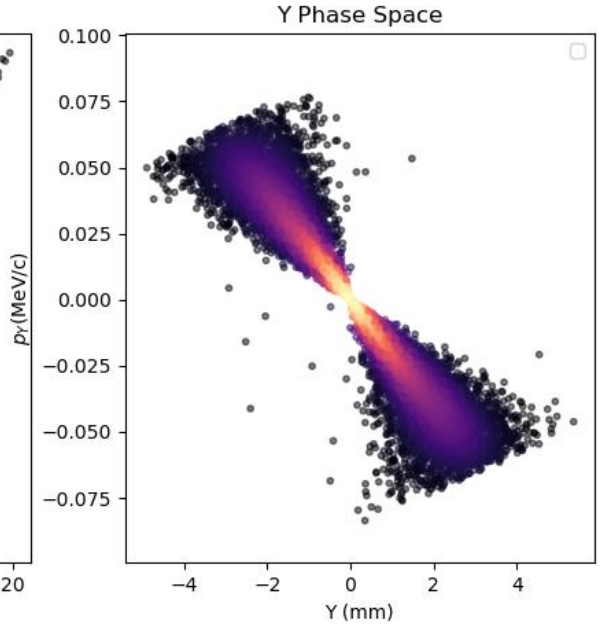
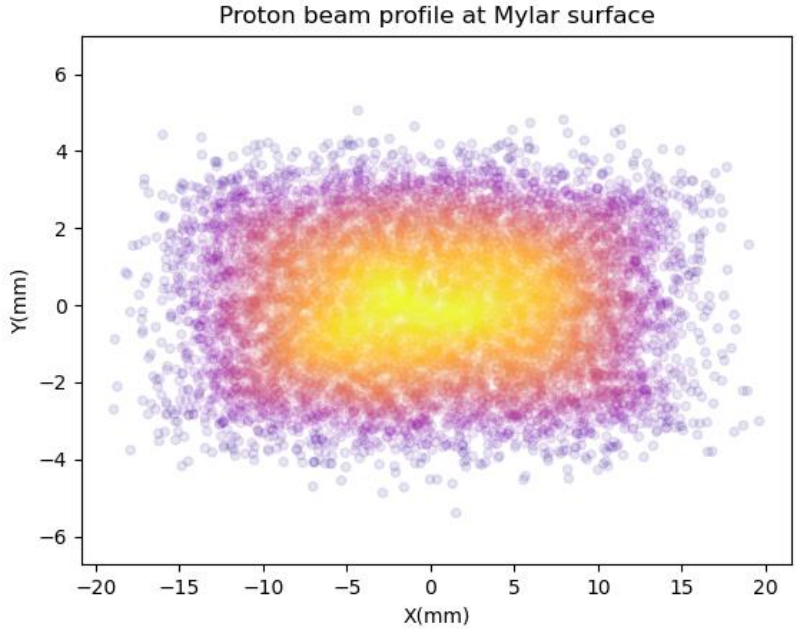
Phase space and beam profile: primary protons







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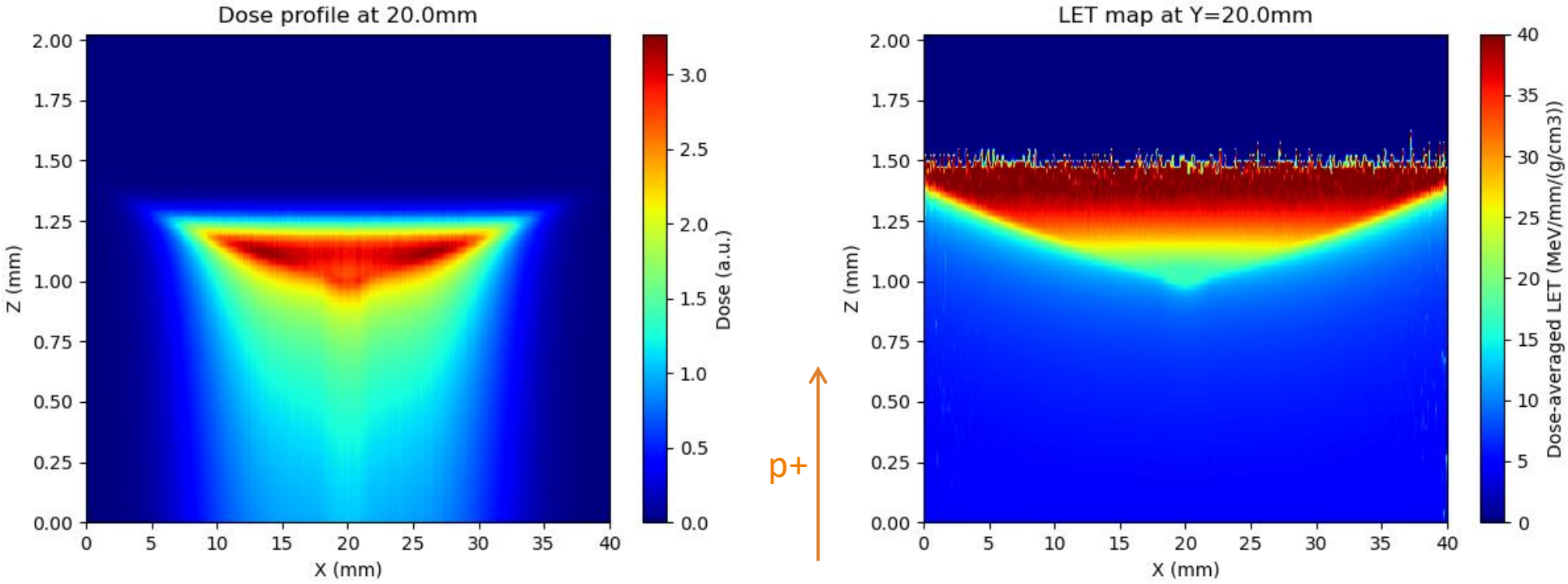
Dose and LET distributions



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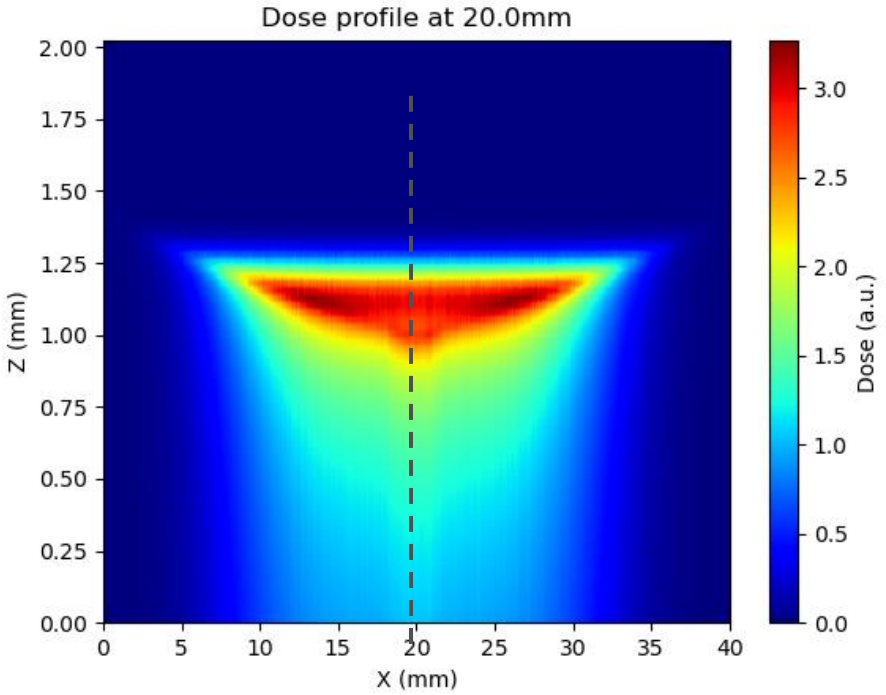
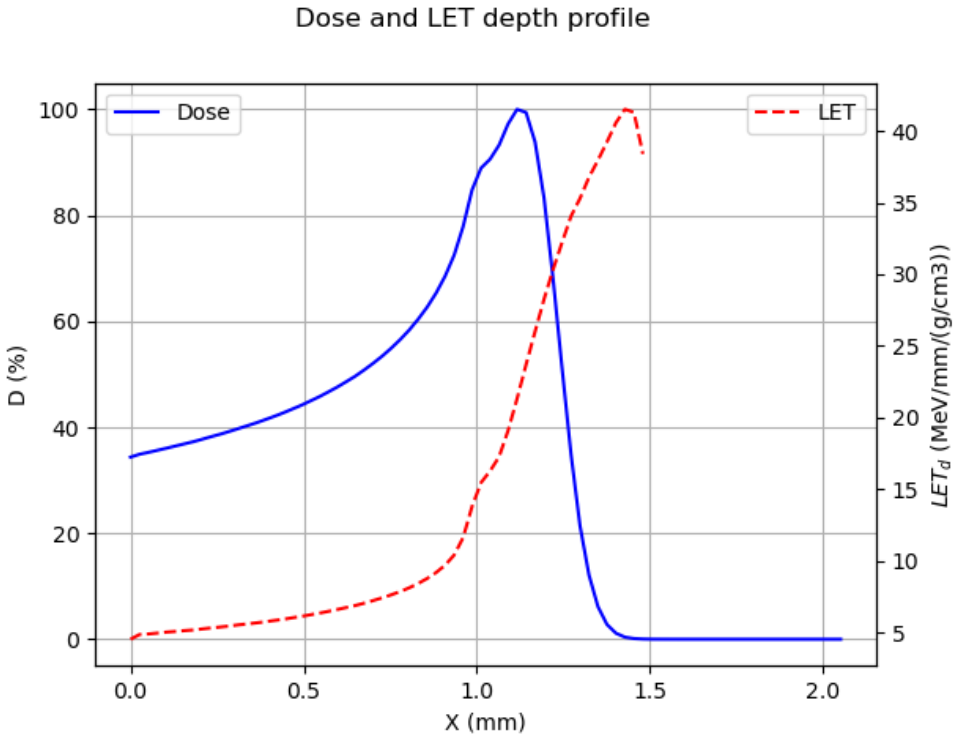
Dose and LET distributions





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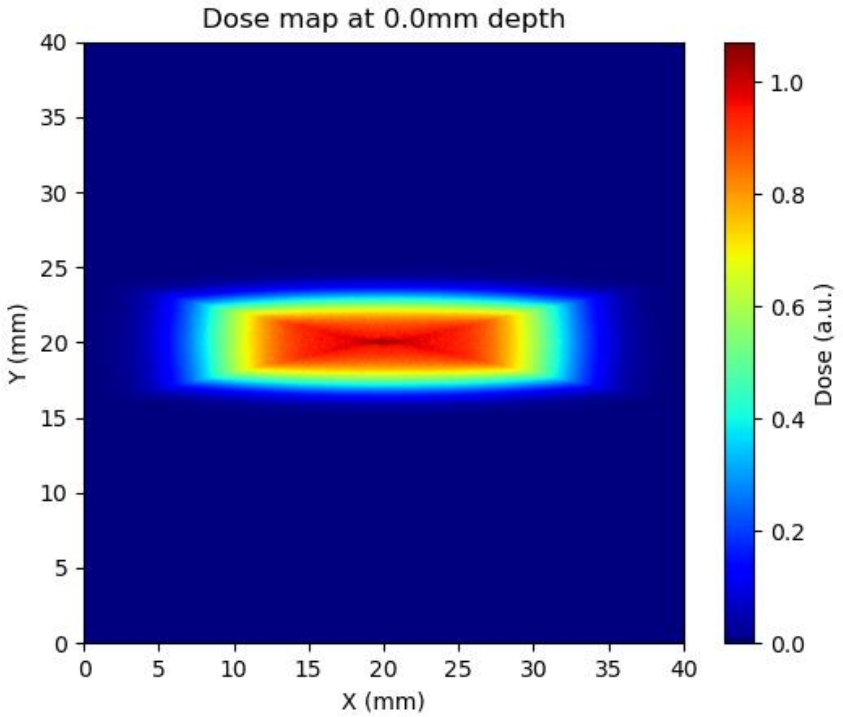
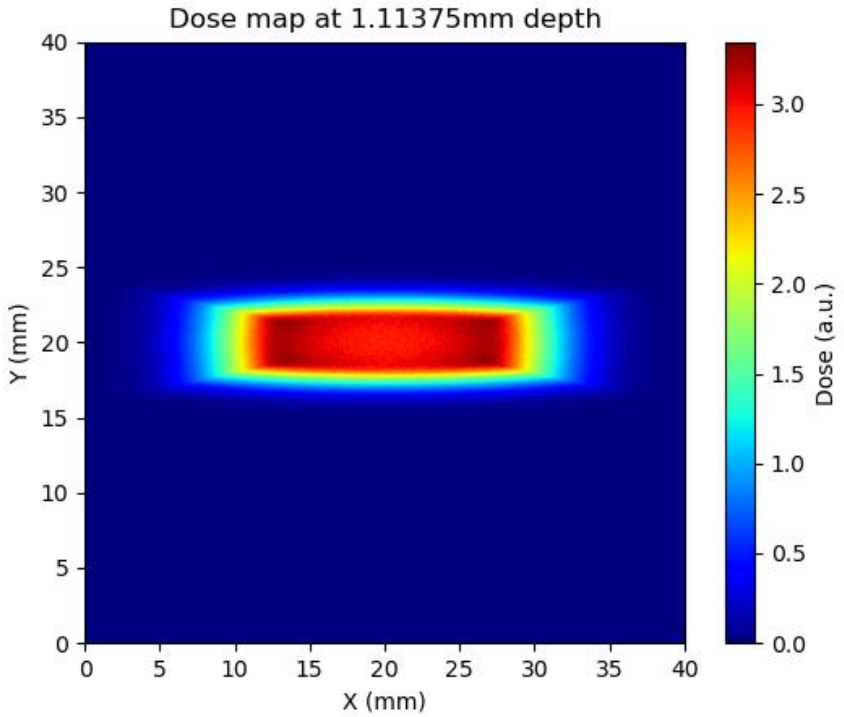
Dose and LET distributions





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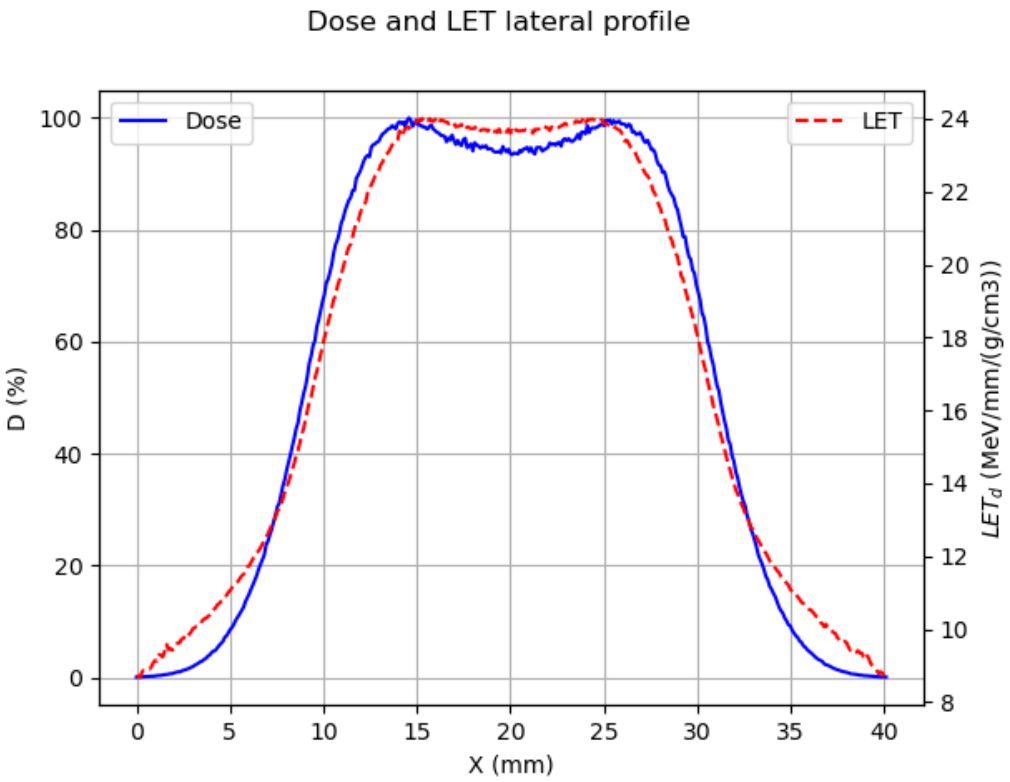
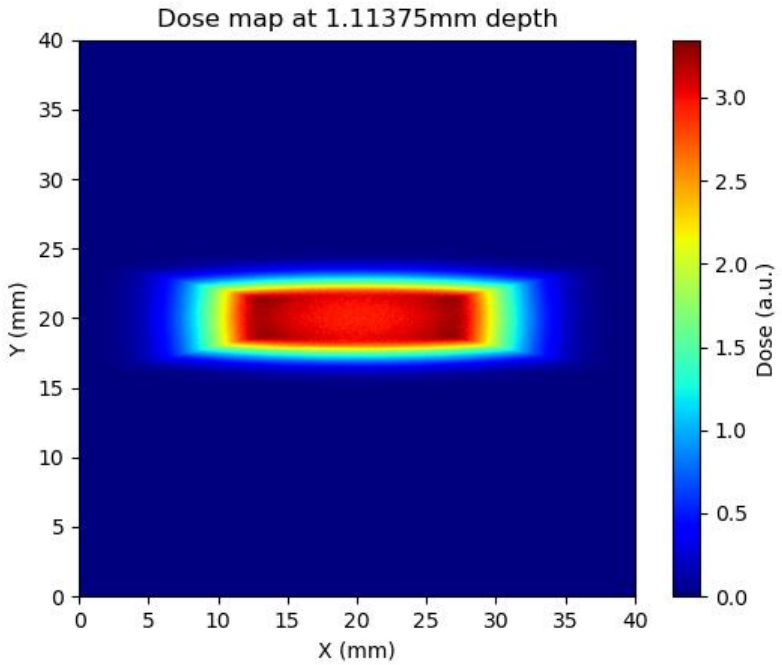
Dose and LET distributions





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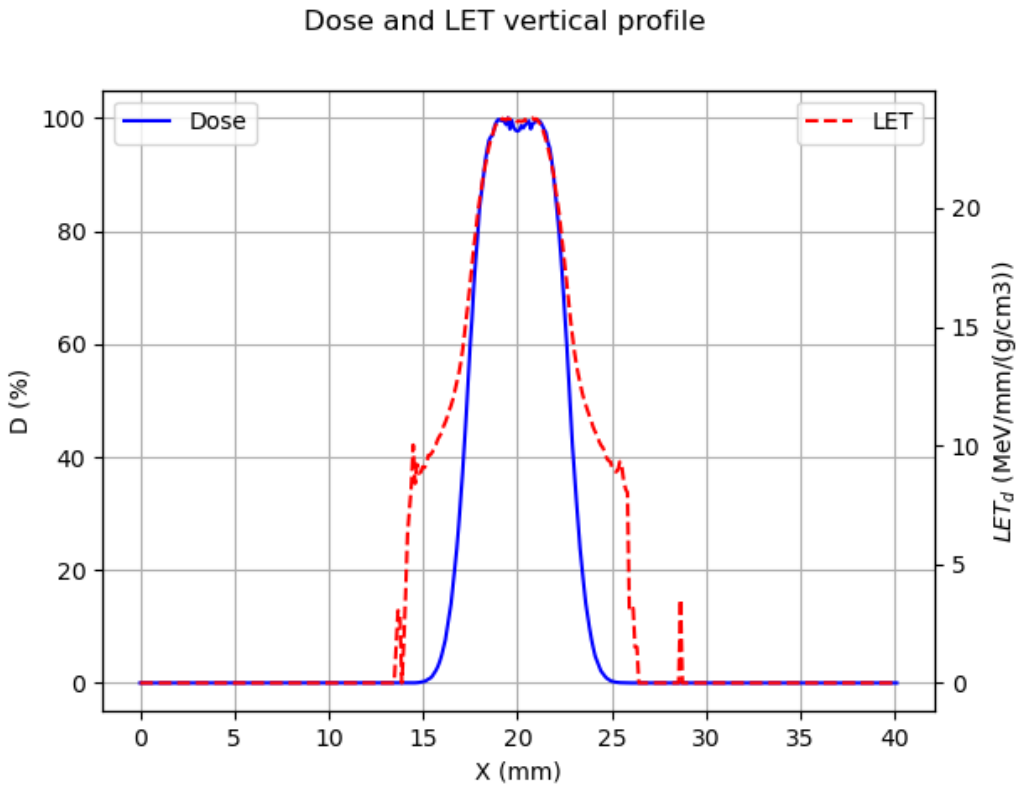
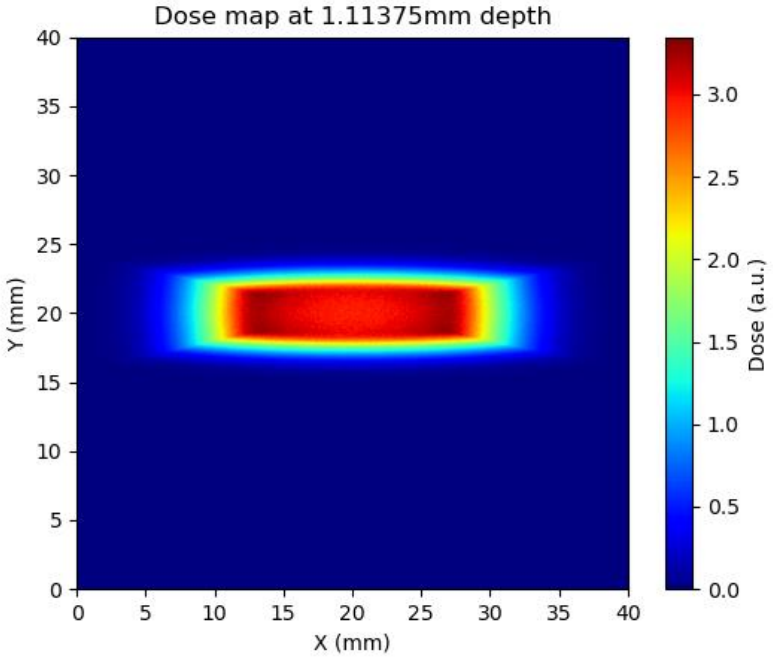
Does and LET distributions





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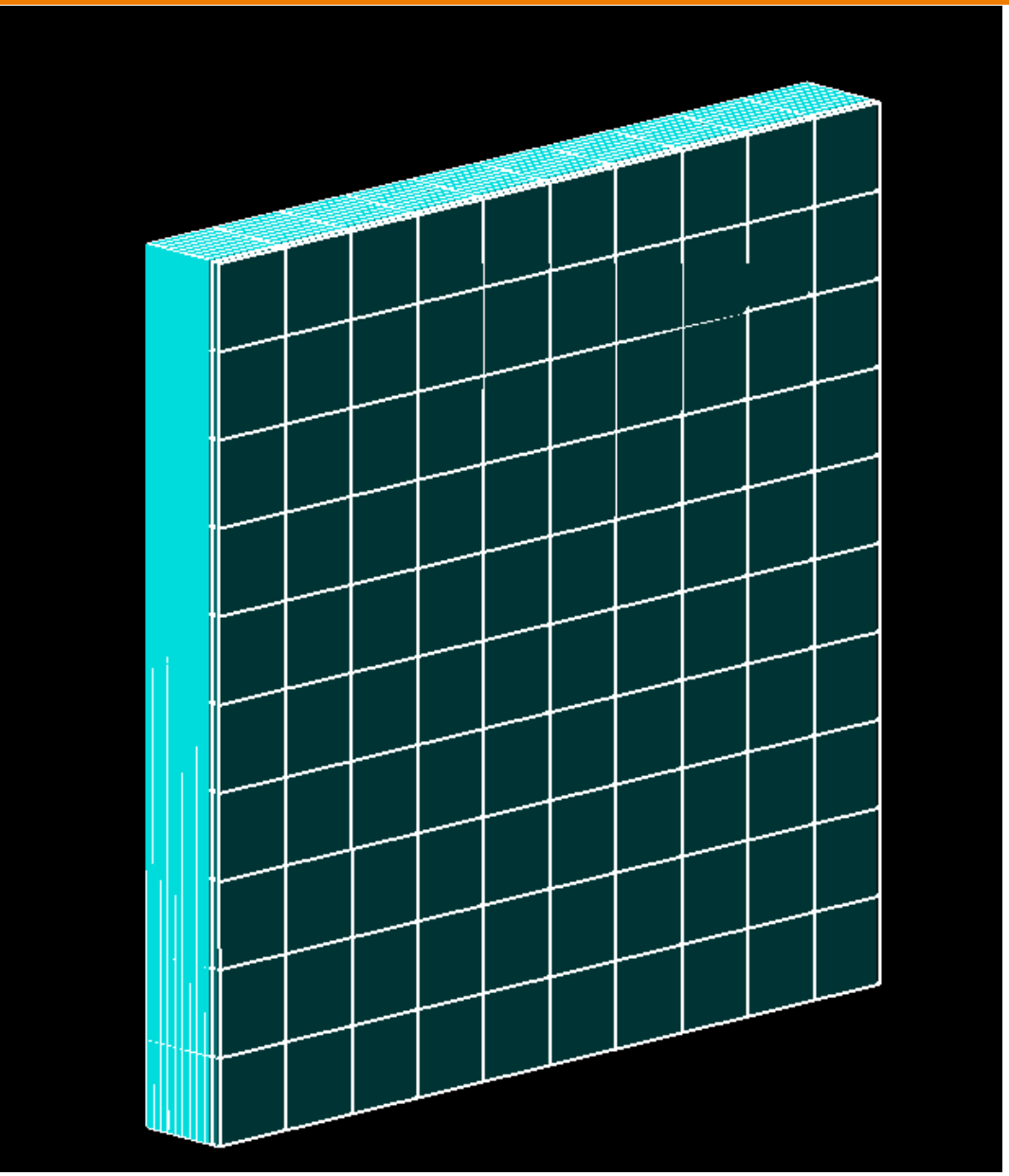
Conclusions and next steps



- We can expect a (not pristine) Bragg peak at ~1.1mm depth for a focus at 10MeV
- FWHM around 6mm in the vertical direction and 20mm in the horizontal direction
- Not important yield of secondaries in beam transport
- Simulations will be improved to better resemble the actual setup

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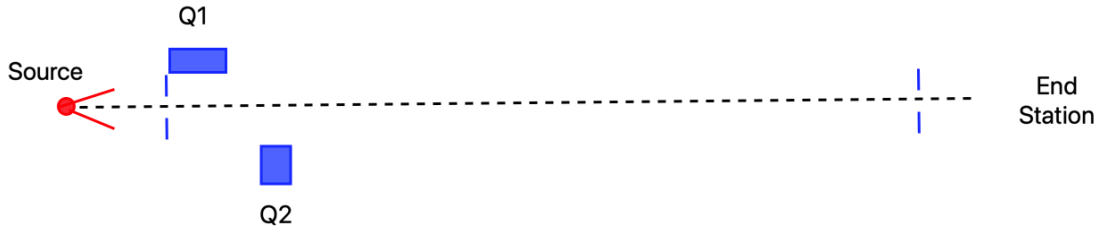

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