New Data on Fragmentation cross section of alpha particles in water from GSI

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21st Geant4 Collaboration Meeting

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Outline

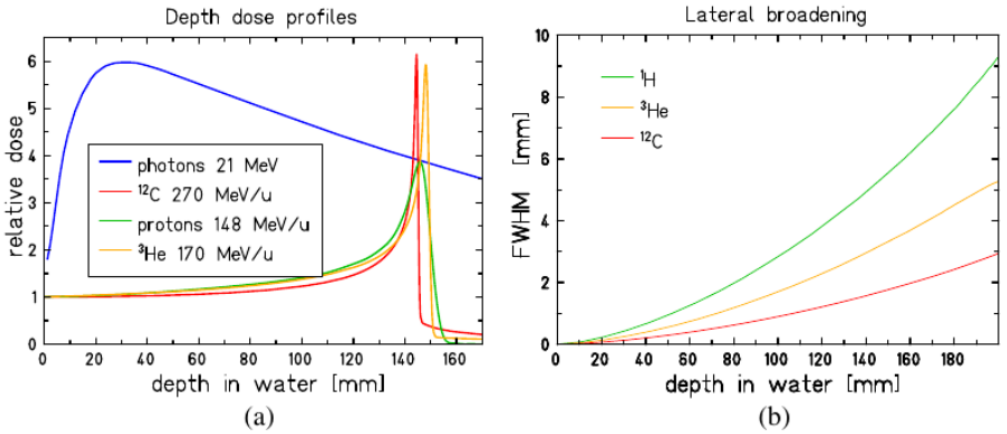
- Introduction
- Experimental setups.
  - Beam attenuation & Fragment build up.
  - Fragmentation differential cross sections.
  - Fragment kinetic energy spectra.
  - Beam scattering measurements.
- Preliminary calculations
- Outlook

Introduction

- Growing interest in assessing physical properties of helium beams at therapeutic materials and energies.
- Helium beams show intermediate physical properties when compared with proton and carbon ion beams.

  M. Krämer et al., *Med. Phys.* 43 (2016)

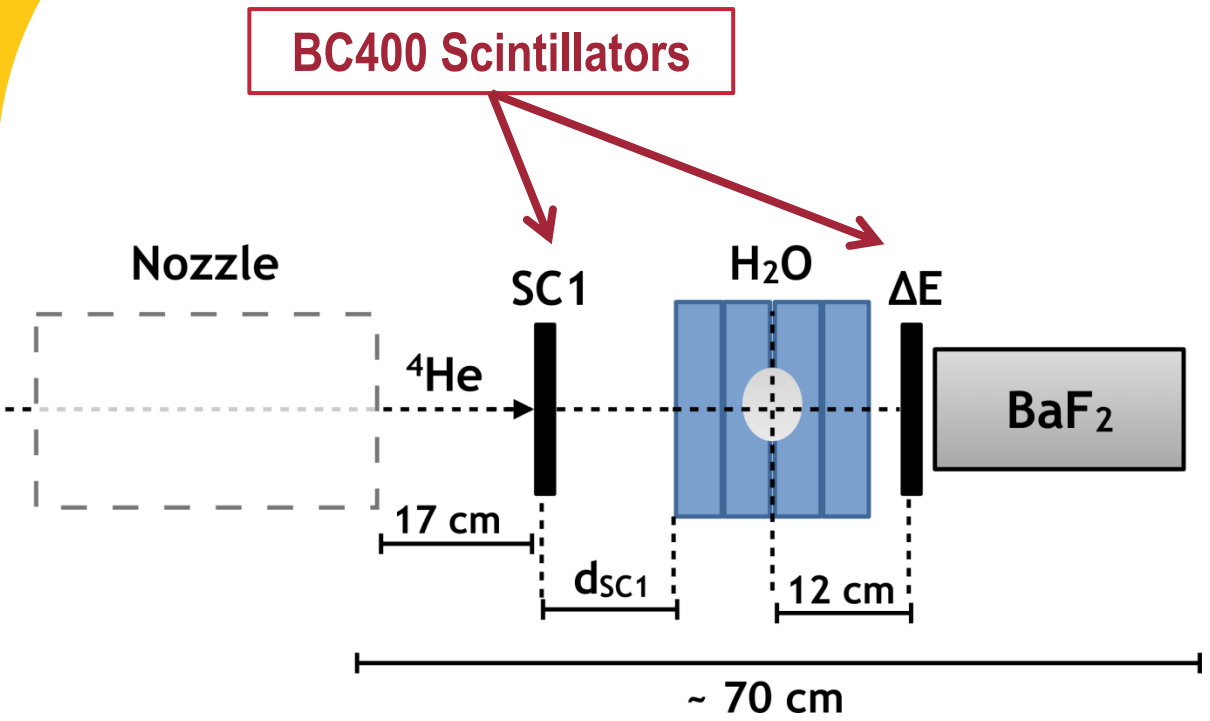
  - Lateral Spread.
  - Peak width.
  - Fragmentation tail.



- In this talk, I will briefly present the experimental Ph.D. Project finished very recently (june 2016) by Marta Rovituso at GSI, producing very interesting data to benchmark against.

Experimental Setups

Beam Attenuation & Build-up of Secondary Fragments

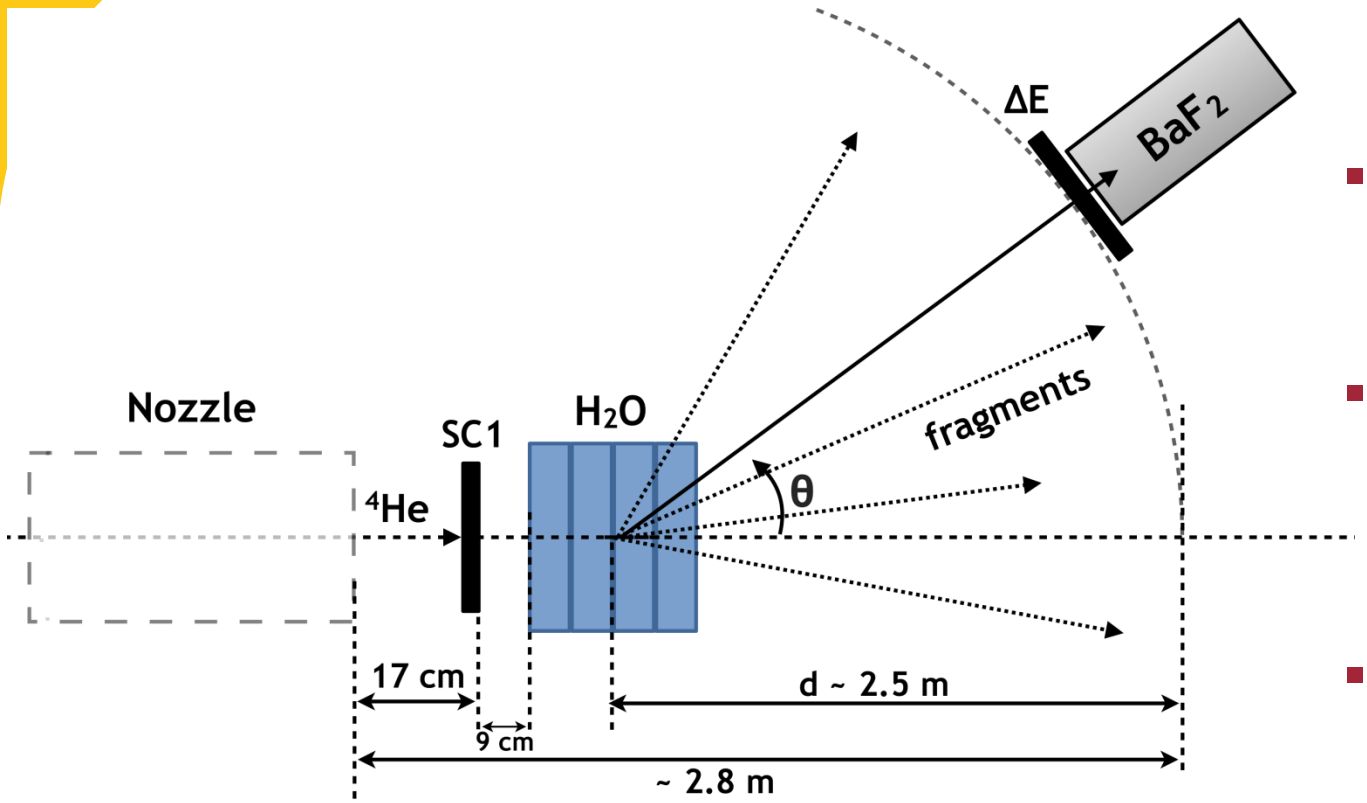


- 200 MeV/u ^{4}He beam.
- Target composed by combinations of water & PMMA flasks.
- 1-26 cm water thickness.

M. Rovituso, *Ph.D. Thesis*, TU Darmstadt (2016)
http://tuprints.ulb.tu-darmstadt.de/5566/

Experimental Setups

Angular Distribution & Kinetic Energy Spectra of Fragments



- 120 & 200 MeV/u ^{4}He beam.
- 0, 2, 4, 6, 8, 12 and 23 deg w.r.t. beam incidence direction.
- 4.28 & 13.96 cm thick water targets.

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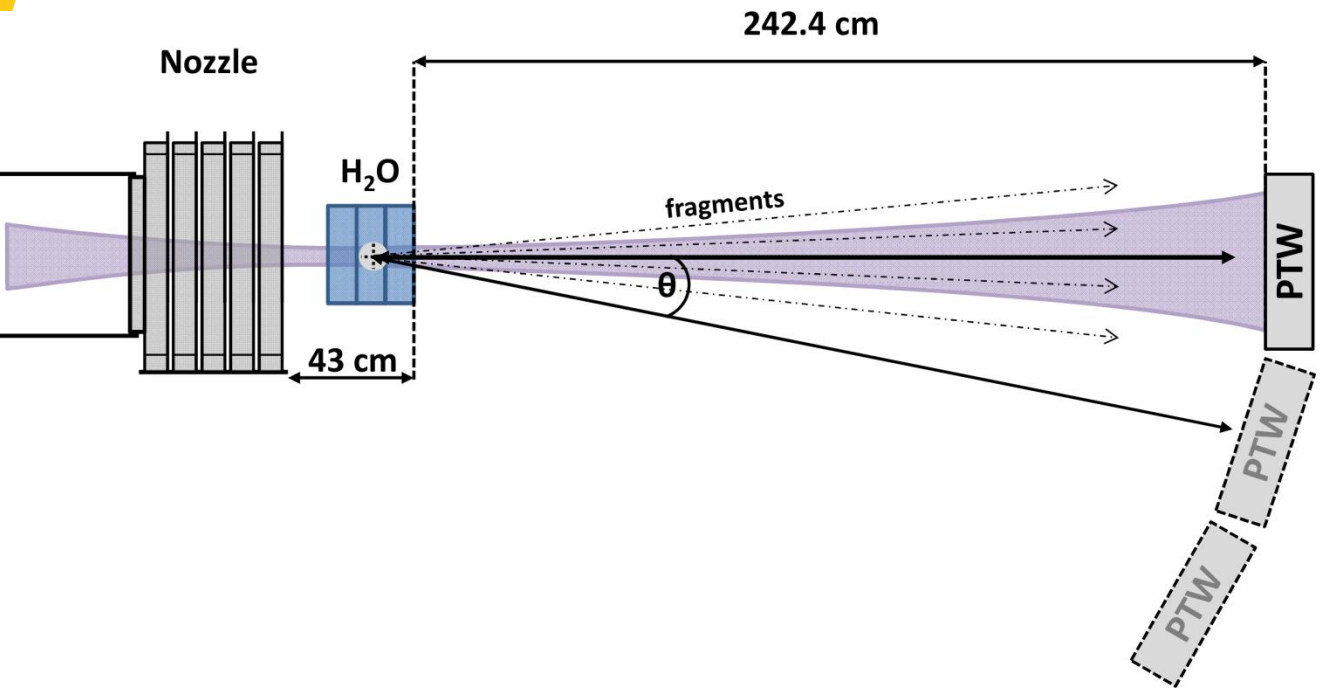
Experimental Setups

Scattering Measurements



- 120 & 200 MeV/u ^{4}He beam.
- From 0 to 20 deg.
- Both PTW 2D array detector and EDR2 films used.
- 4.28 & 13.96 cm thick water targets.

M. Rovituso, *Ph.D. Thesis*, TU Darmstadt (2016)
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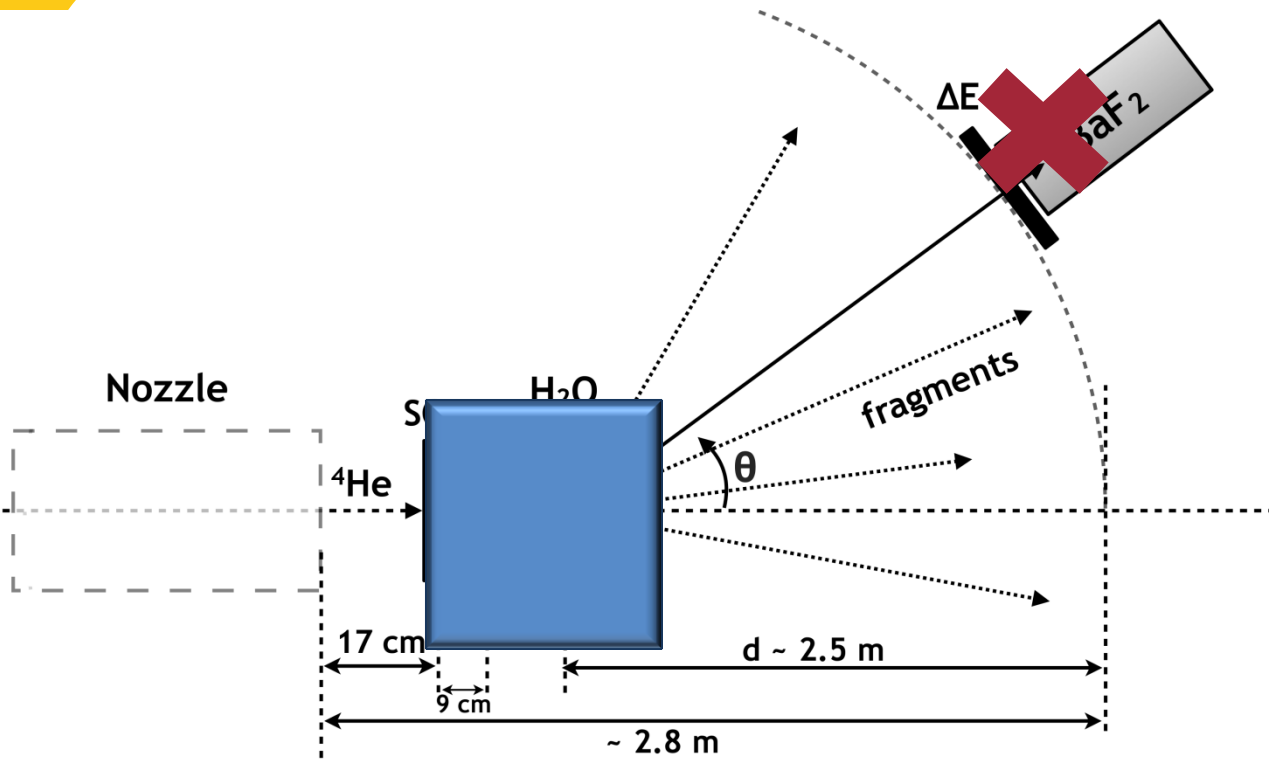
Preliminary Simulations

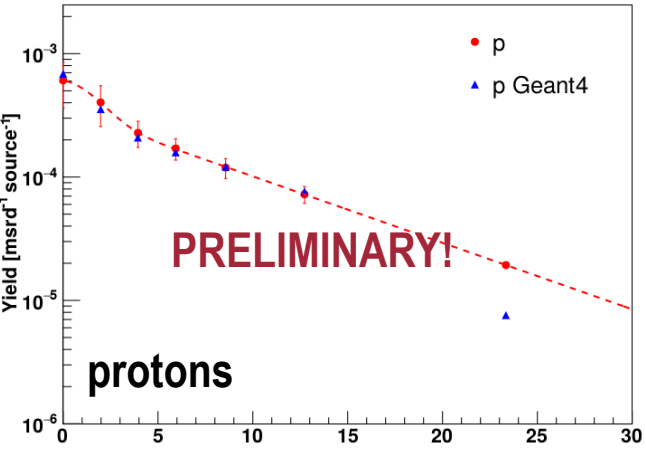
Ideal conditions – 1st order approach

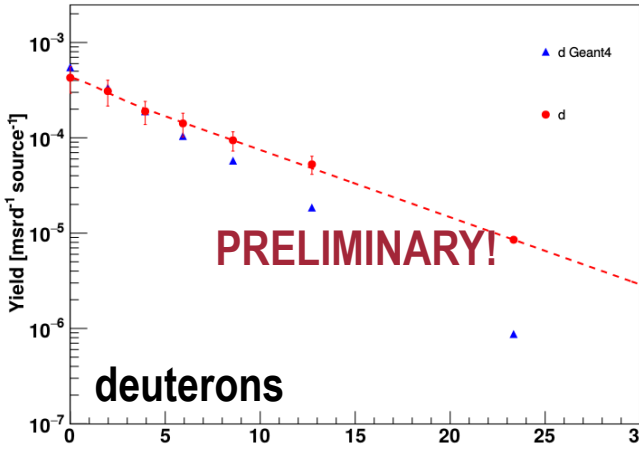


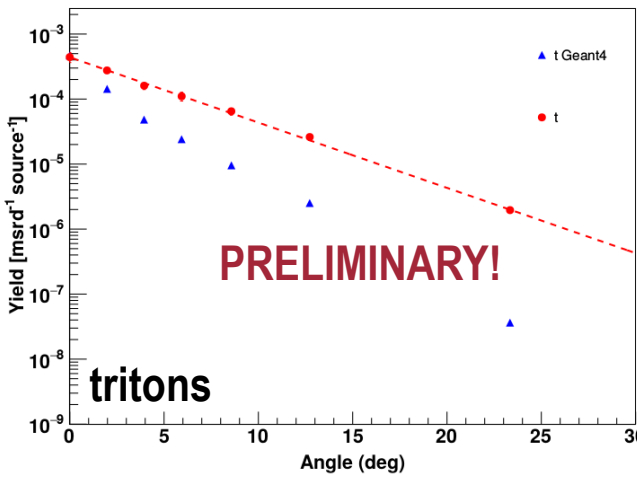
- Pure water target.
- Ideal beam parameters.
- Just scoring upon arrival to a spherical surface at the given distance.
  - Same solid angle.
  - Not actual detector geometry nor response.
- Calculations with actual geometry in progress…

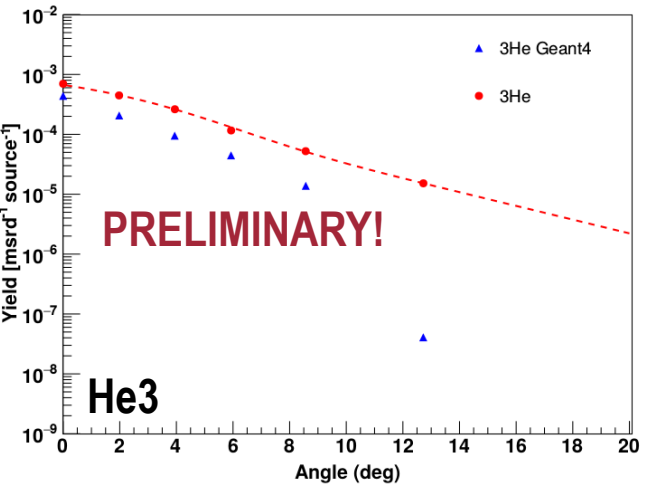
Preliminary Results

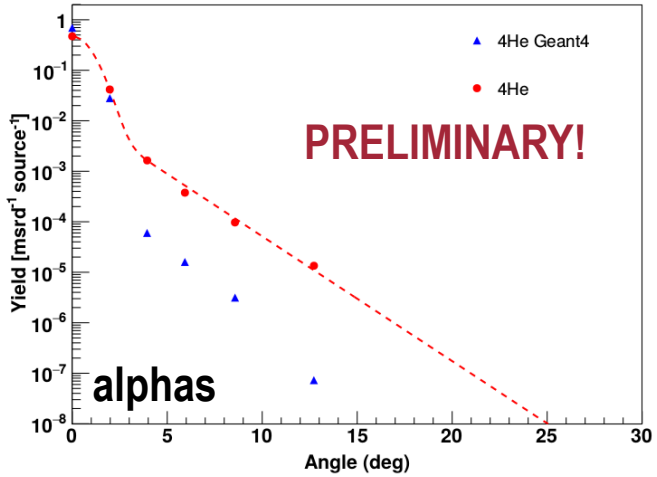
Angular Distribution of Secondary Fragments (120 MeV/u)











- v10.1.p01.
- QGSP_BIC_HP
- WEPL = 4.28 cm

- to be continued…

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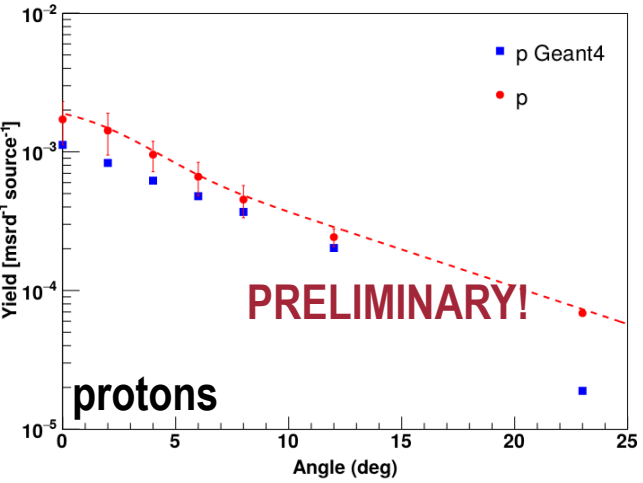
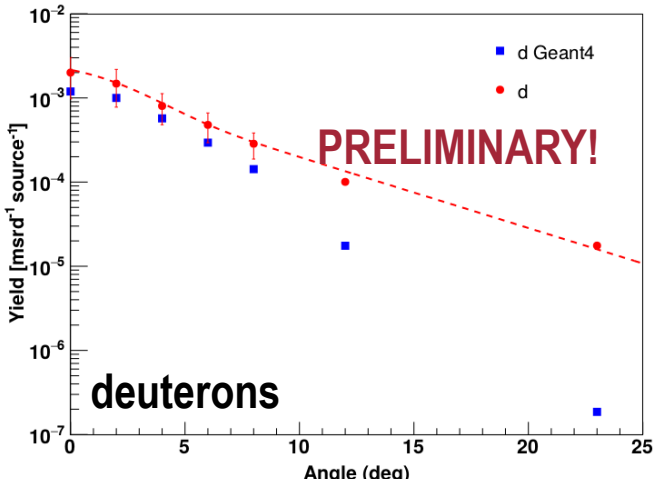
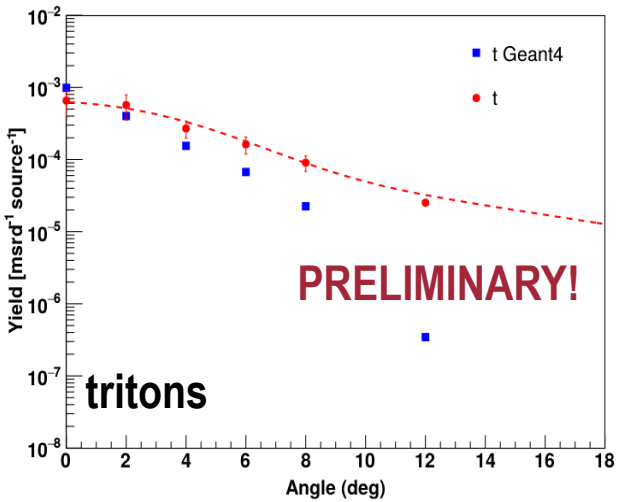
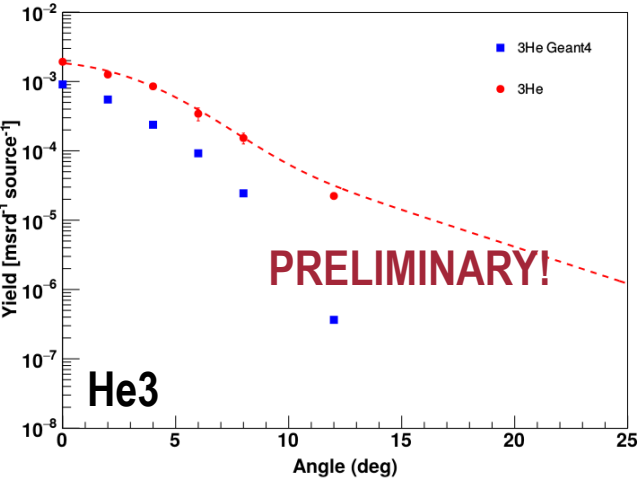
Preliminary Results

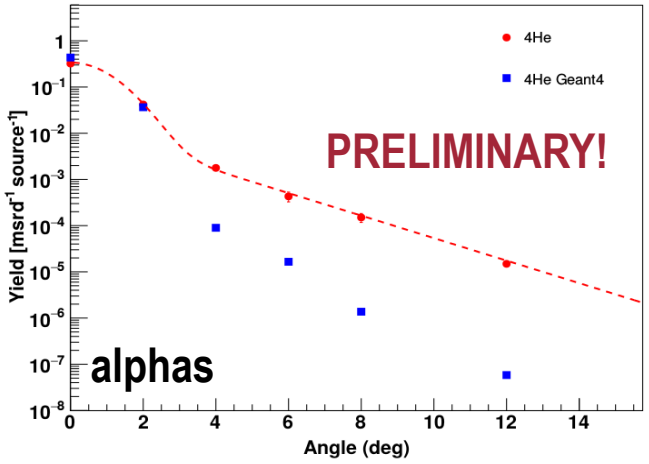
Angular Distribution of Secondary Fragments (200 MeV/u)











- v10.1.p01.
- QGSP_BIC_HP
- WEPL = 13.96 cm

- to be continued...

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Outlook

- Very recent and interesting experimental measurements to be included within G4MSBG tool.
- Paper currently under review.
- More details at Marta Rovituso's Ph:D. Thesis:
  - http://tuprints.ulb.tu-darmstadt.de/5566/

- More accurate simulations are in progress…
  - Will try as many nuclear cascade & de-excitation models as possible (BIC, QMD, INCL++, BERT…)

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Thanks for your attention