Semi-microscopical nuclear model of fragmentation processes at 95 MeV/A

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Experimental measurements at GANIL

Double differential ^{12}C fragmentation cross sections:

- Beam energy 95 MeV/A
- Thin targets: H, O, C, Al, Ti and PMMA
- ^{1}H to ^{12}C fragments identification at emitted angles from 0 to 43°

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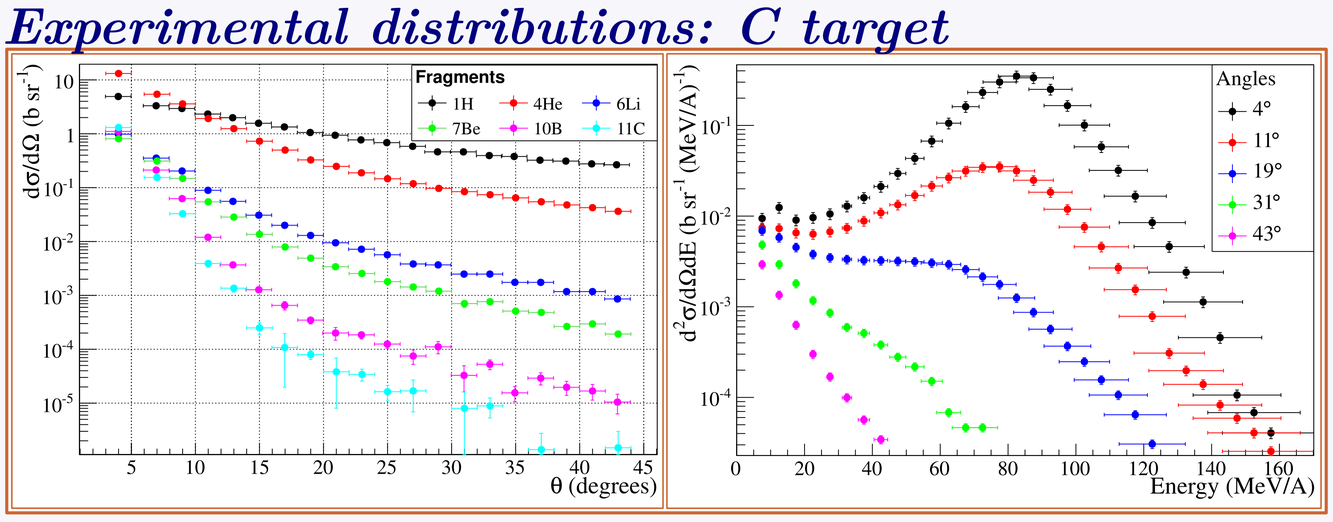
Data in free access on: http://hadrontherapy-data.in2p3.fr

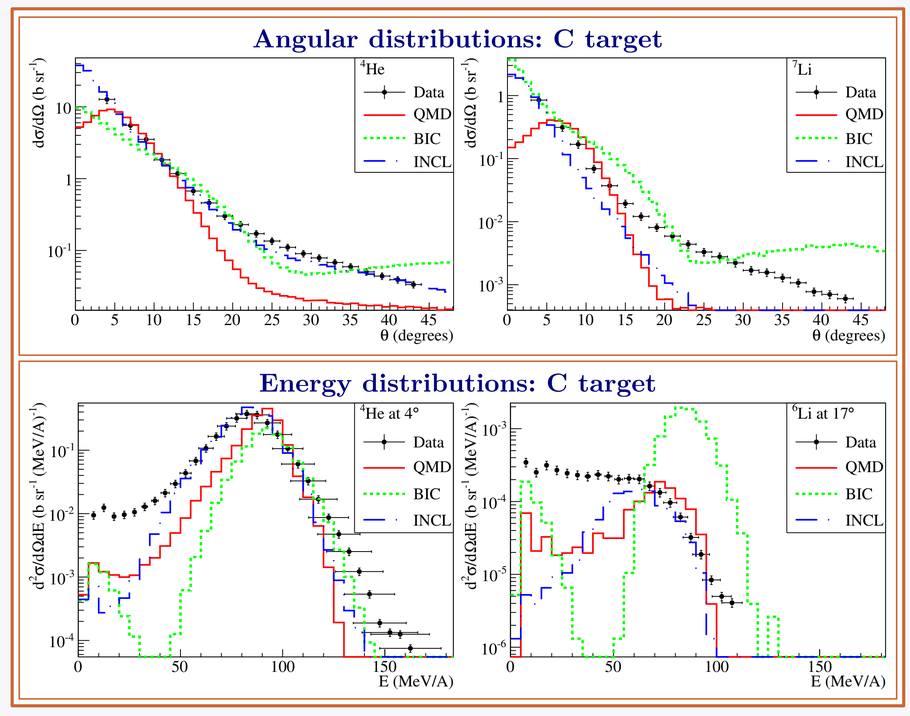
Experimental distributions: C target



GEANT4 Simulations

Benchmark of the GEANT4 nuclear models:

- Three entrance channel models:
  - BIC (*G4BinaryLightIonReaction*)
  - QMD (*G4QMDReaction*)
  - INCL++
- Fermi break-up de-excitation model



➡ **Large discrepancies for the three models**

A new semi-microscopical model

Ingredients

Global approach:

- No dynamical evolution
- The whole calculations performed in *p*-space
- Geometrical approach based on the participant-spectator picture

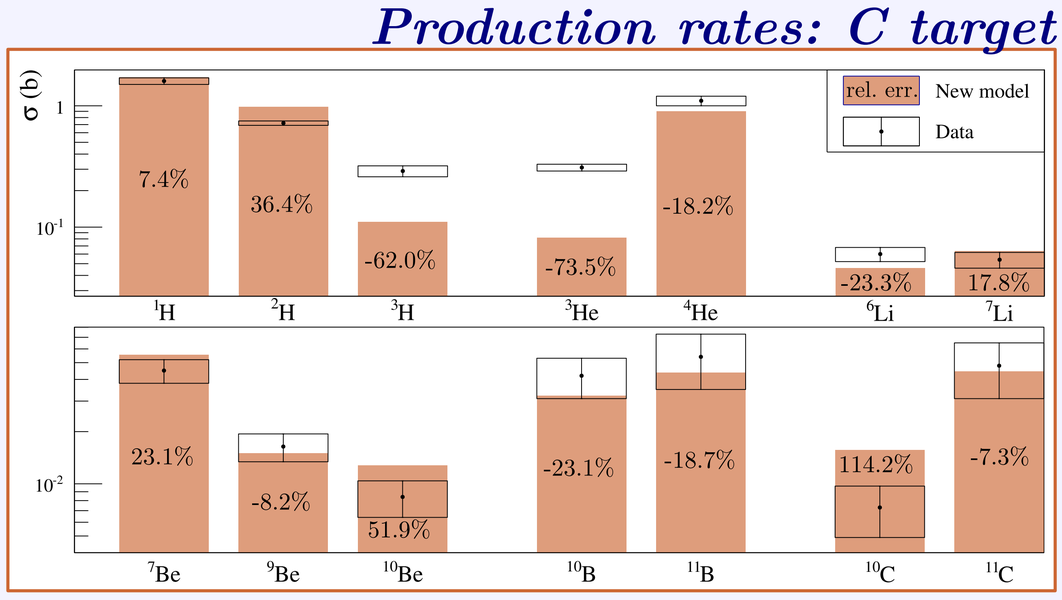
Entrance channel modelisation:

- Number of participants obtained from overlapping volume ratio
- Hard n-n scatterings between participants at a rate defined as the only free parameter
- Random coalescence in the overlap-region under constraints in velocity space
- Excitation energies computed assuming thermal population of discrete levels
- Energy conservation by random nucleon exchange between any species

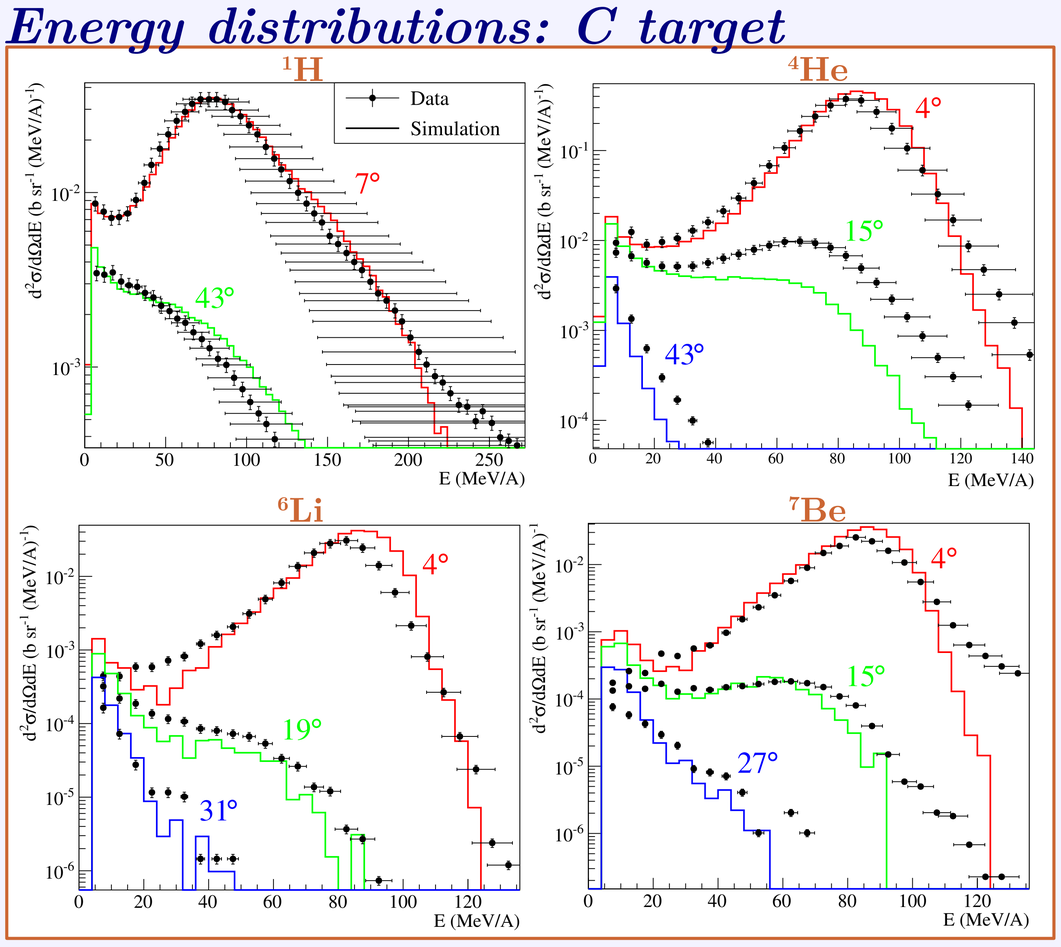
Fermi break-up de-excitation:

- N-body decay calculation
- Decay channel chosen by Monte-Carlo sampling following micro-canonical weights
- Kinematical quantities calculated according to n-body phase-space distribution

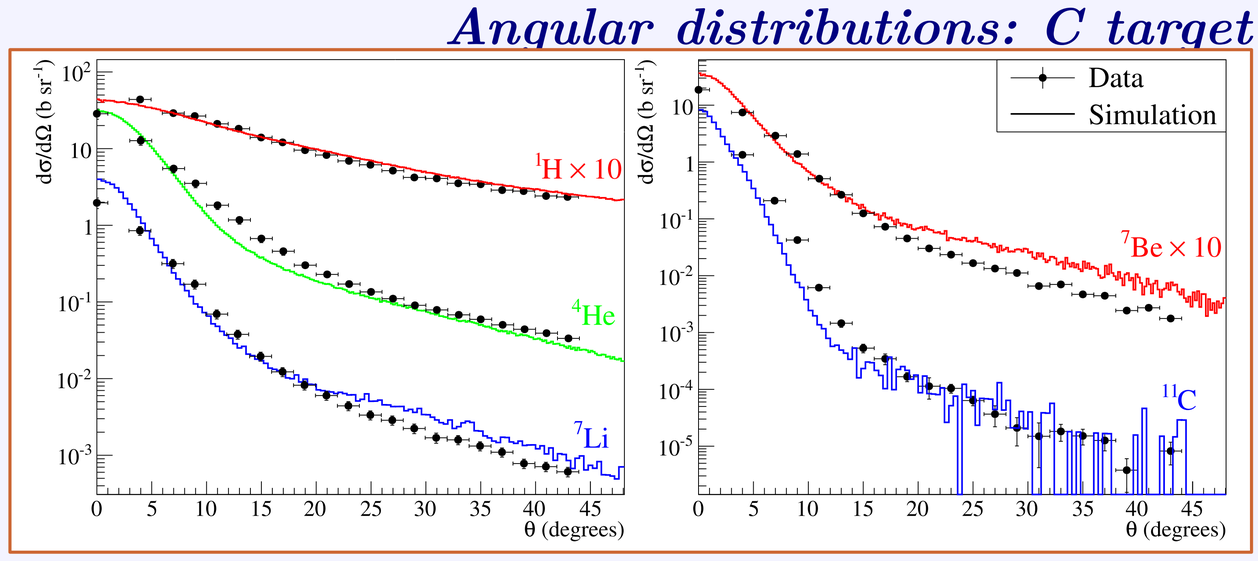
Production rates: C target



Energy distributions: C target



Angular distributions: C target



Conclusions and Perspectives

Conclusions:

- Good data reproduction for both angular and energy distributions
- Overestimation of ^{10}Be and ^{10}C ⟶ Underestimation of A=3 species

Perspectives

- Extrapolation of discrete energy levels with a continuum approximation
- Extend the comparisons to other targets and beam energies