Update on FLUKA Simulation

G.B., Y. Dong, S. Muraro, S.M. Valle

Most Recent Full Detector production (FLUKA dev. Version 2018.2)

/gpfs_data/local/foot/Simulation/newgeom_v1.0

Target 3 mm C with density 1.83 g/cm^3 as that of GSI run

10^7 primaries)

12C_C_200_1.root (^{12}C at 200 MeV/u on C)

16O_C_200_1.root (^{16}O at 200 MeV/u on C)

New public FLUKA (beta) version 2020.0

It includes all features already present in the last development version 2018.2 (not accessible to public) plus more recent additions

Used to produce GSI root-ples already available to FOOT

Some of these additions are of interest for FOOT

Immediate interest for the analysis of Emulsion Data.

A. Pastore has started testing the new release for ECC simulation: **previously the public version 2011.2x was used, which was less reliable than the dev. Version 2018 used to produce the official root-ples of electronic apparatus**

Relevant improvements in Physics Models - 1

- **Extended nd improved nuclear database.** Masses, decay channels and branching ratios have been extended n extensively revised. Many more isomers are now included in the database
- A **deuteron pre-formation production mechanism** by light nuclei has been implemented, resulting in much better predictions of excitation functions of reactions like (p,d)/(p,pn), (n,d)/(n,np) on light nuclei at low and intermediate energies.
- Full account for discrete levels, out of the (IAEA) Ripl-3 library, is now implemented in every nuclear reaction step/generator (already in dev. Version)
- **Heavy fragment evaporation up to Z_max=4, A_max=9, is now automatically activated** when the PRECISIOn default is selected (already in dev. Version)
- A simplified model for angular momentum barriers is now implemented inside the Fermi break-up de-excitation model (already in dev. Version)

Relevant improvements in Physics Models - 2

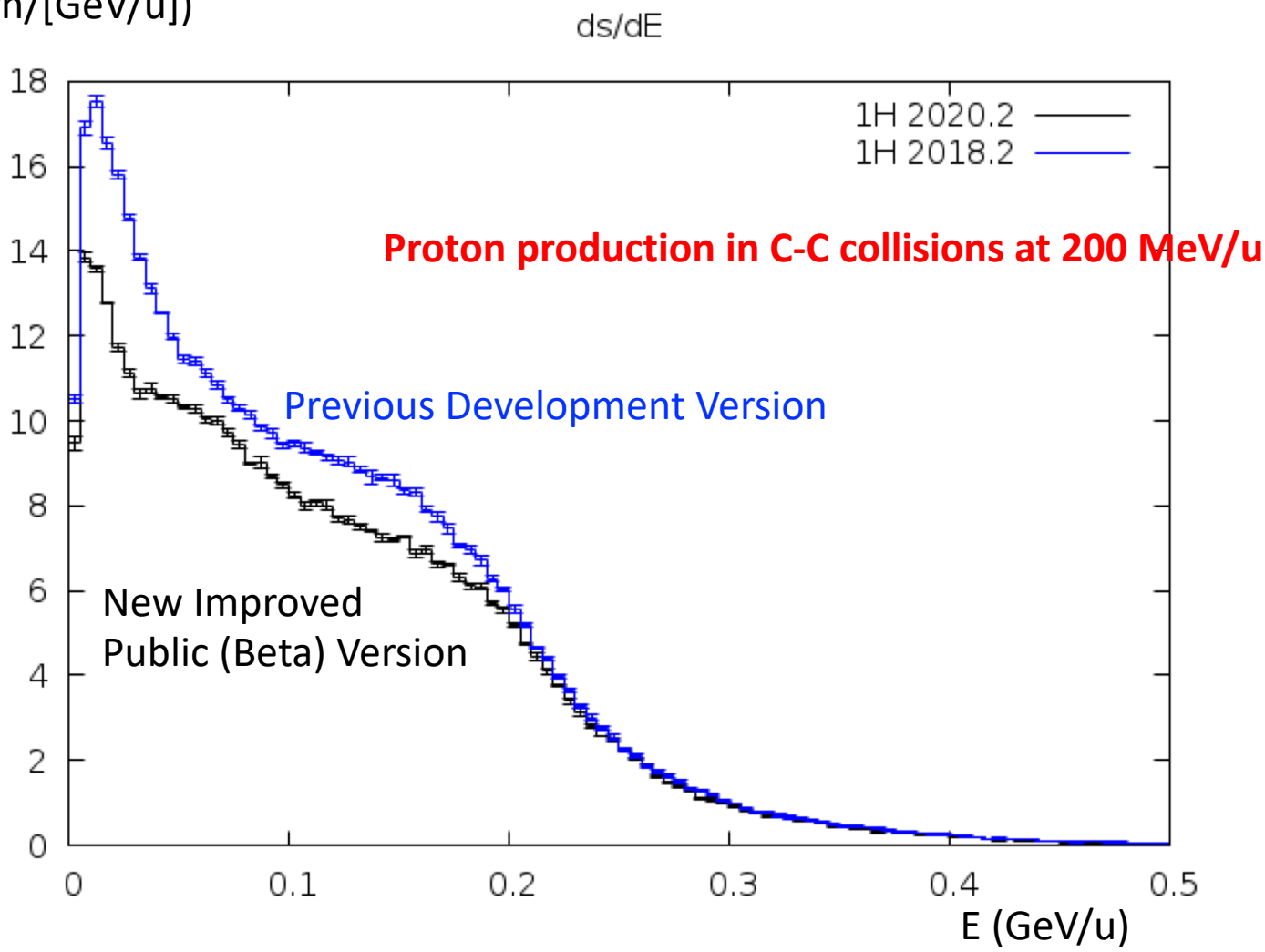
- Low Energy Neutron cross sections for several isotopes had been updated with more recent evaluations, mostly Endf/b-VIIIr0. (in part was in dev. Version)
- **A preequilibrium step, based on the PEANUT one, has been introduced in the rQMD event generator. Together with other improvements this results in significantly better reproduction of ion-ion experimental data (E>125 MeV/u)**
- A preequilibrium step, based on the PEANUT one, has been introduced in the BME event generator (E<125 MeV/u). (already in dev. Version)
- **Alpha-Nucleus cross sections for light nuclei have been updated according to the recent expreimental data,** bringing better agreement with measured attenuation curves and Bragg peaks

Change in predicted Cross Sections - 1

- The cross section for the fragment production at energies > 120-130 MeV/u change
- Most relevant changes affect protons (neutrons)

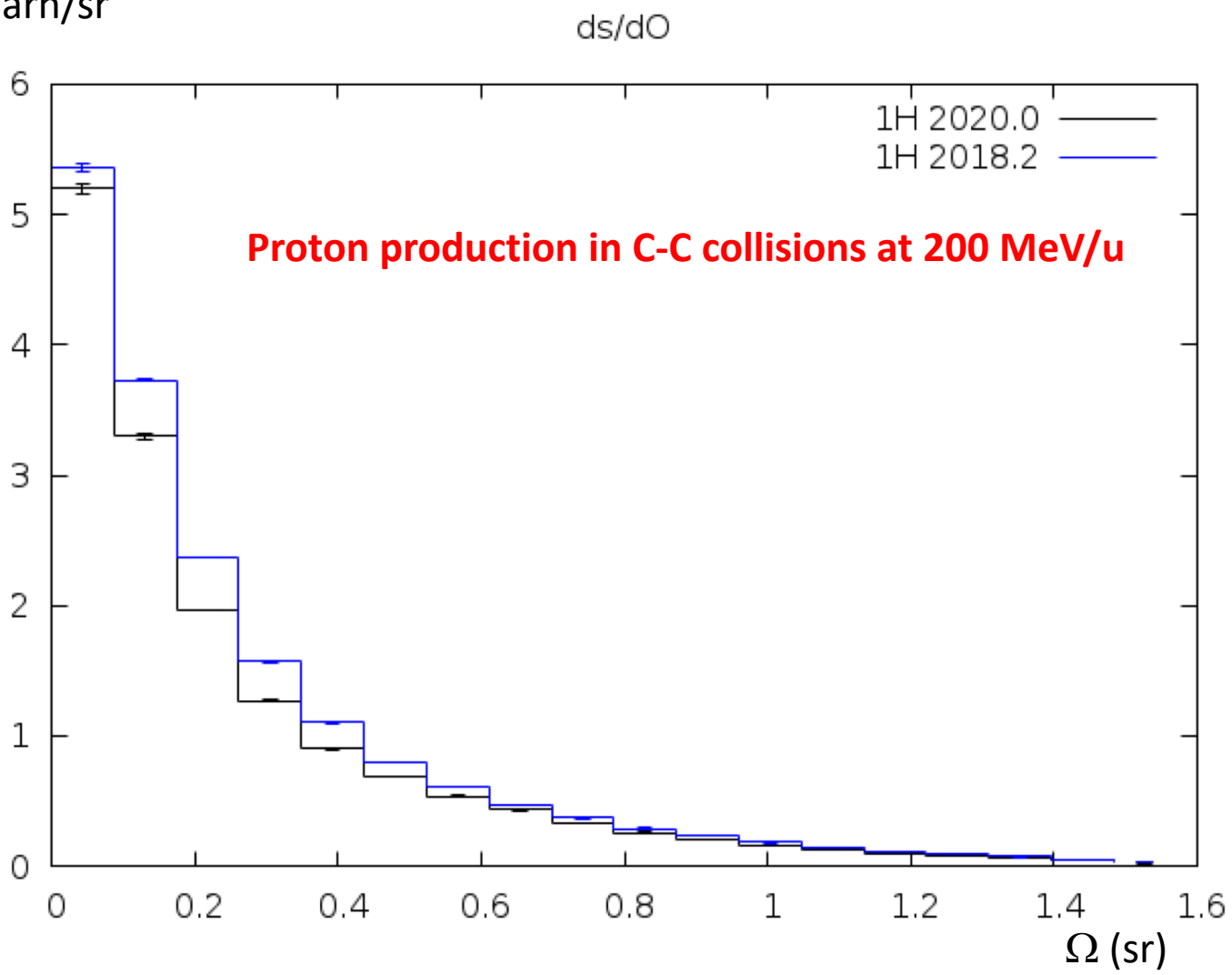
Change in predicted Cross Sections - 2

dσ/dE (barn/[GeV/u])



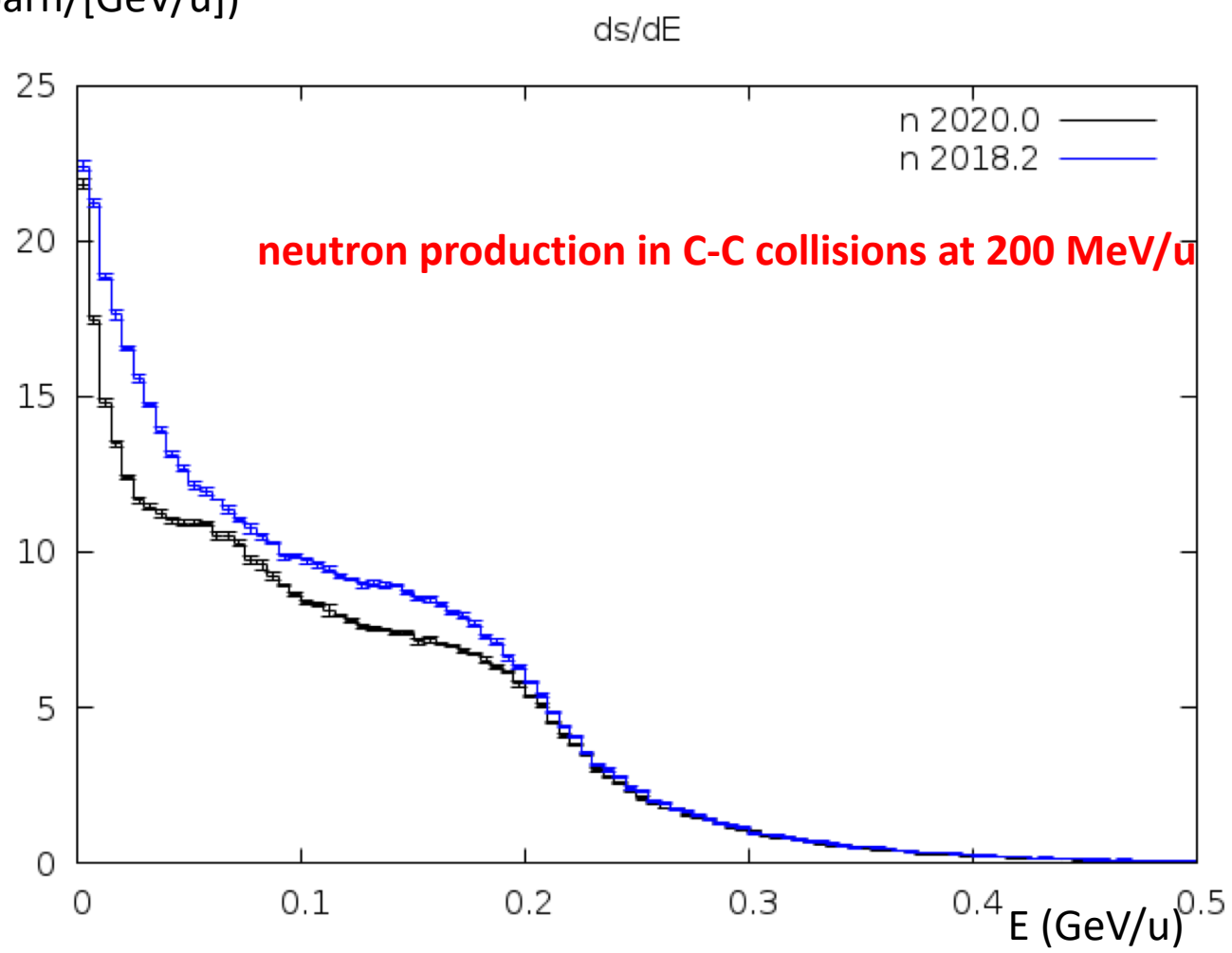
Change in predicted Cross Sections - 3

dσ/dΩ (barn/sr

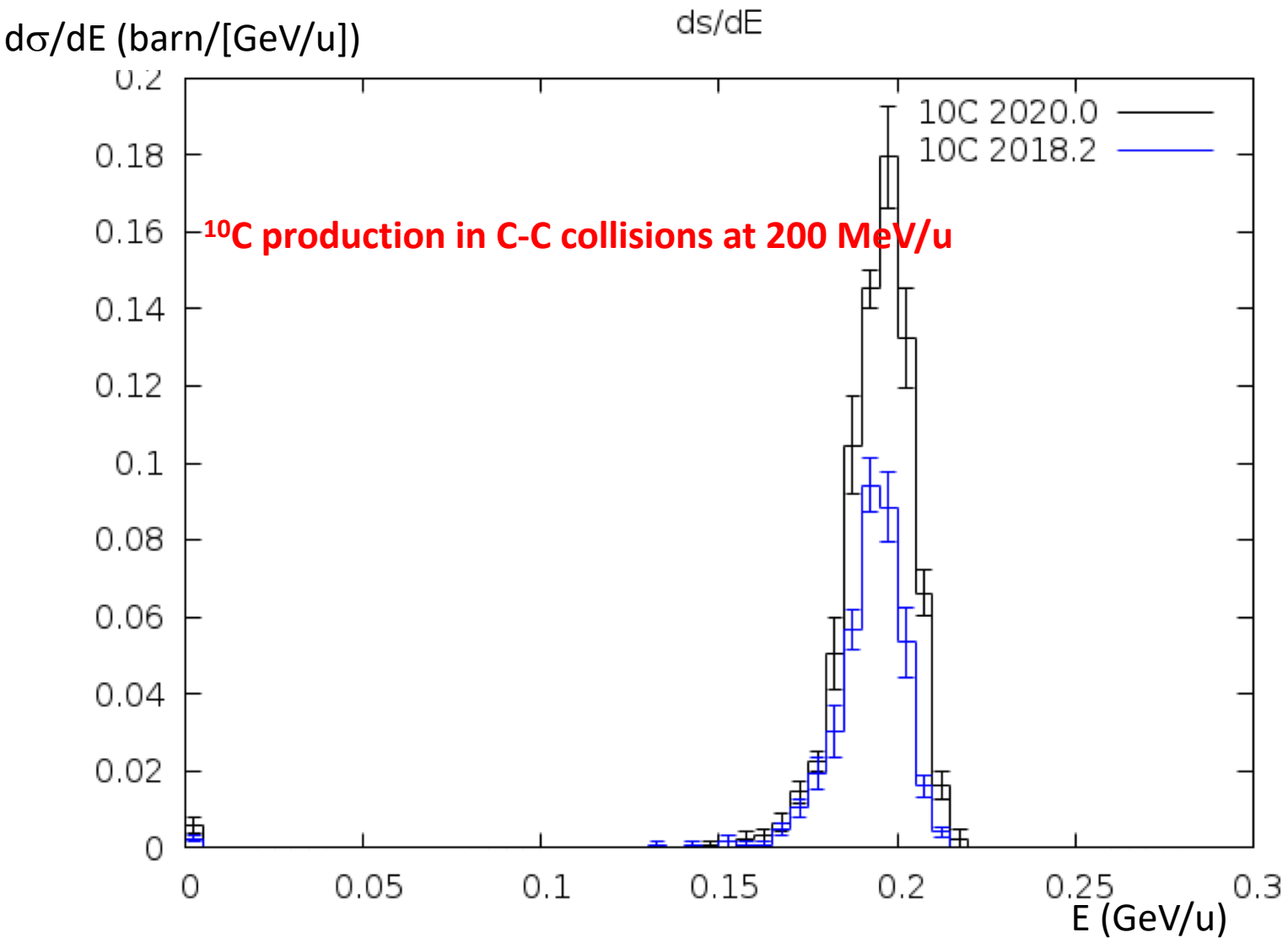


Change in predicted Cross Sections - 4

dσ/dE (barn/[GeV/u])



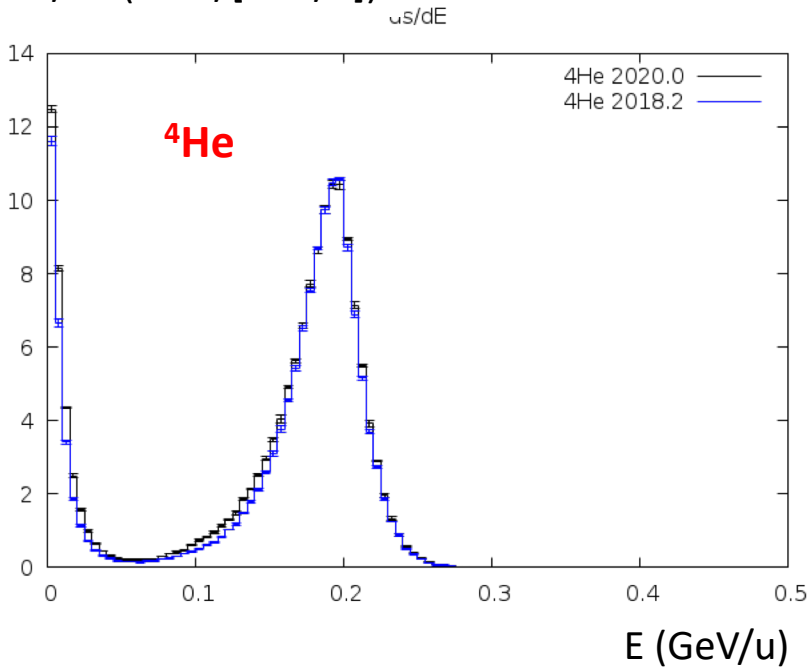
Change in predicted Cross Sections – 5



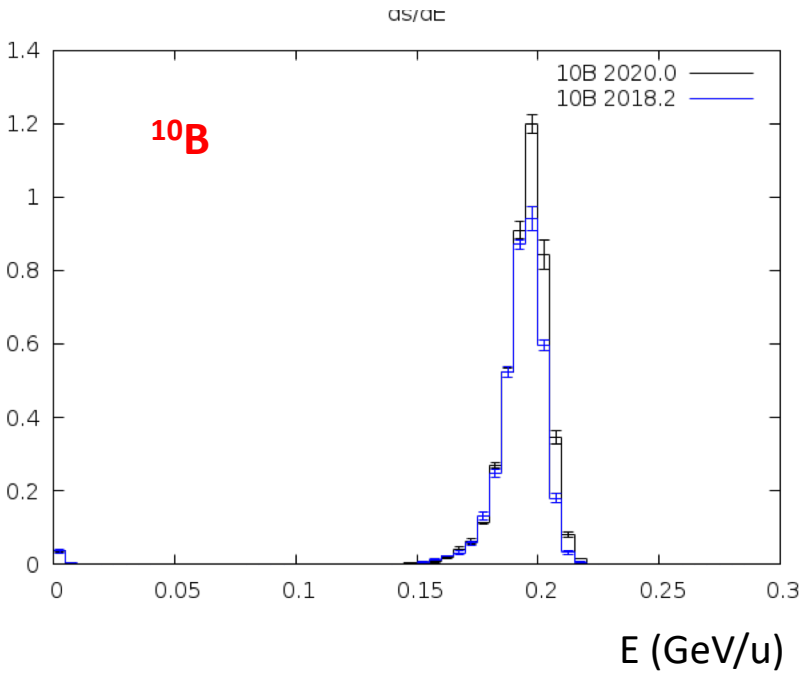
Change in predicted Cross Sections - 6

Small changes for most of all other fragments

dσ/dE (barn/[GeV/u])



dσ/dE (barn/[GeV/u])

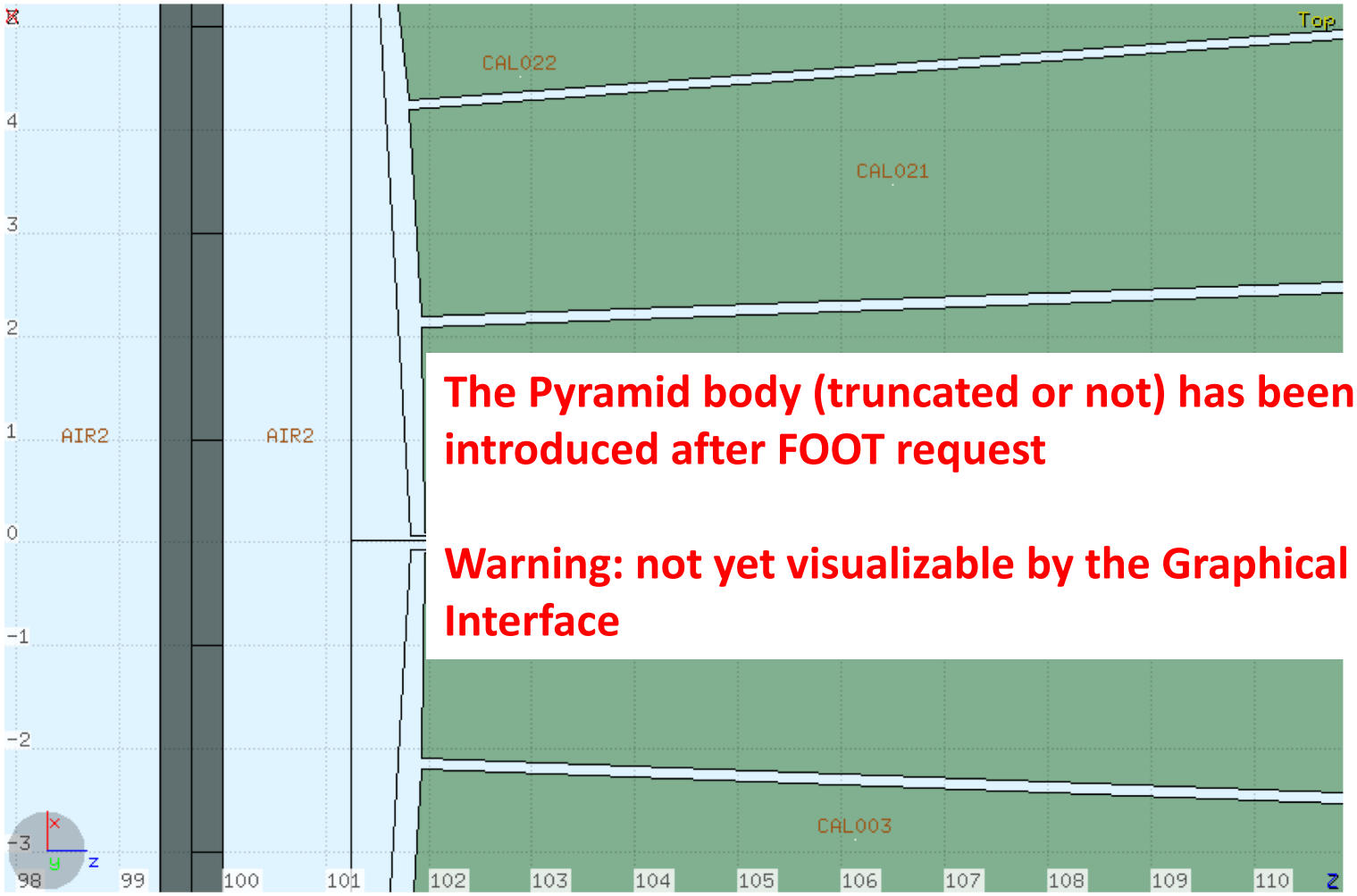


Change in predicted Cross Sections - 7

Surely the new cross sections may have an impact on the analysis of ECC, where the simulation considererd the old public version 2011.2x

If considered useful for GSI analysis of electronic apparatus (or other case study) simulations can be produced with the new version

Technical (geometry) improvement: Pyramid body



The Pyramid body (truncated or not) has been introduced after FOOT request

Warning: not yet visualizable by the Graphical User Interface