

Muon Induced Isotopes in Multiple Targets

Geant4/FLUKA Simulation Comparison

AARM Collaboration Meeting at Fermi National Lab

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Motivation

- Very little information about muon induced reactions underground
- There is data available on cosmogenic isotope production

Kamland and Borexino (motivated by ^{11}C production)

- Our task is to compare predictions of Geant4 and Fluka

Because of the complexities in predicting isotope production rates and the large variation in the production rates, an agreement with data and between the codes by a factor of 2 is acceptable

Geometry of Simulation

Targets of Interest:

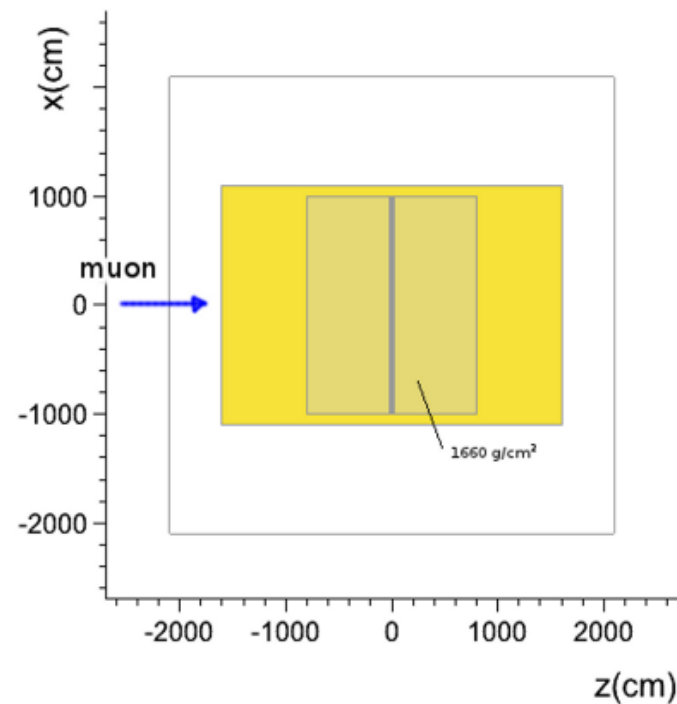
Liquid Scintillator
Water
Calcium Carbonate
Greenstone
Iron
Lead

Interested Muon

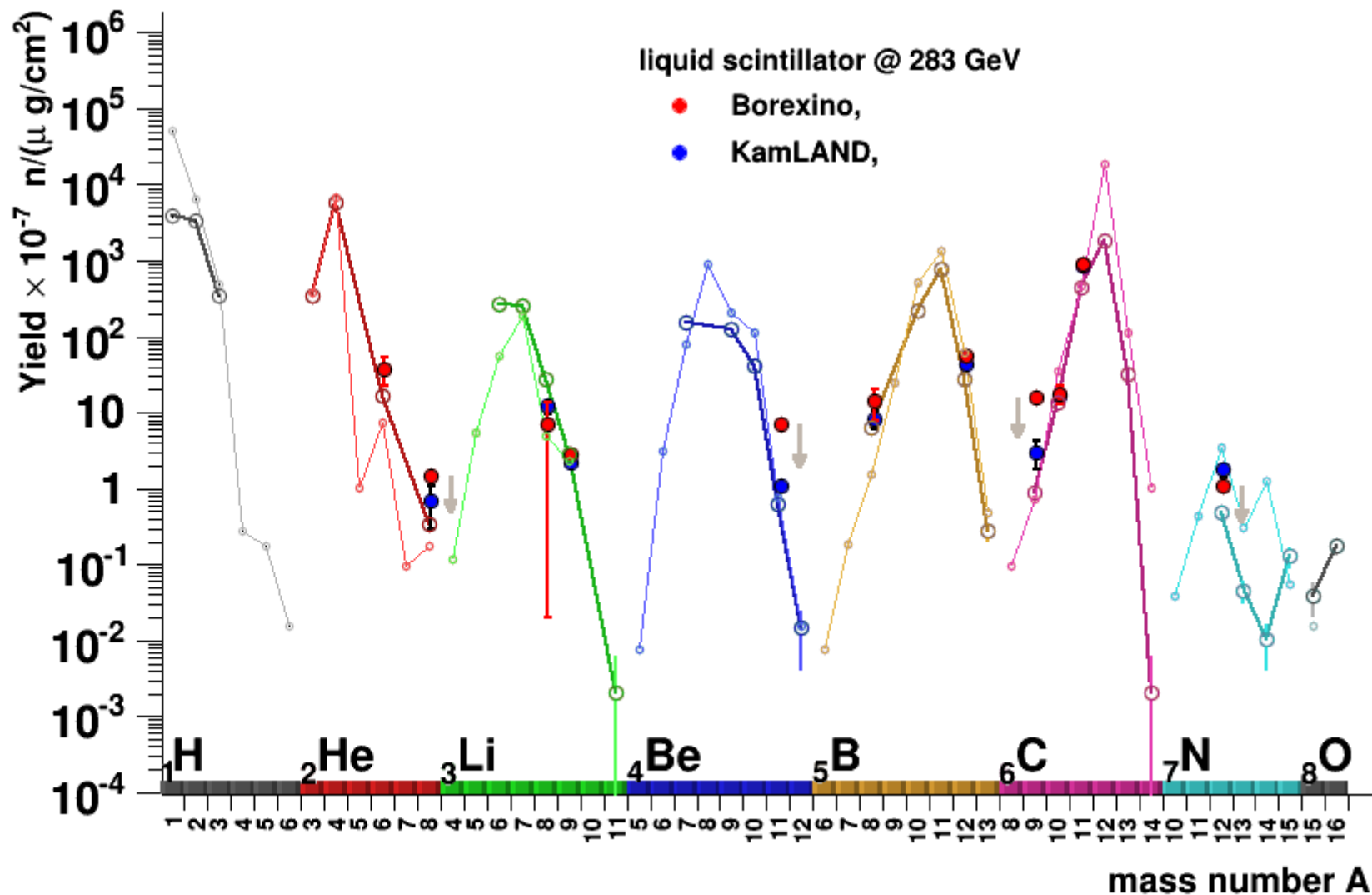
Energies:

30 GeV
100 GeV
200 GeV for Greenstone
280 GeV
1 TeV

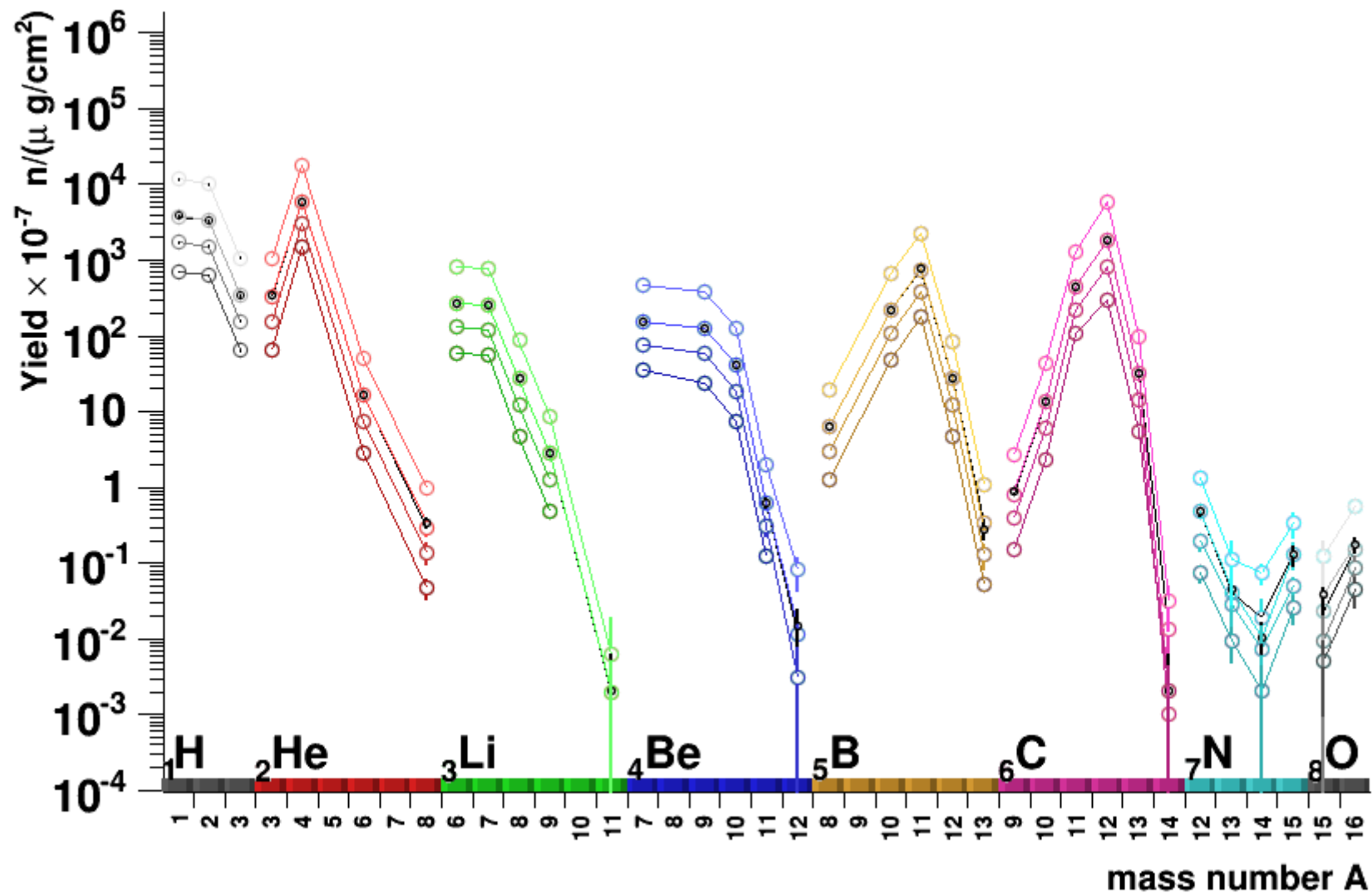
cylindrical, along Z axis, with total length = 3200 g/cm^2



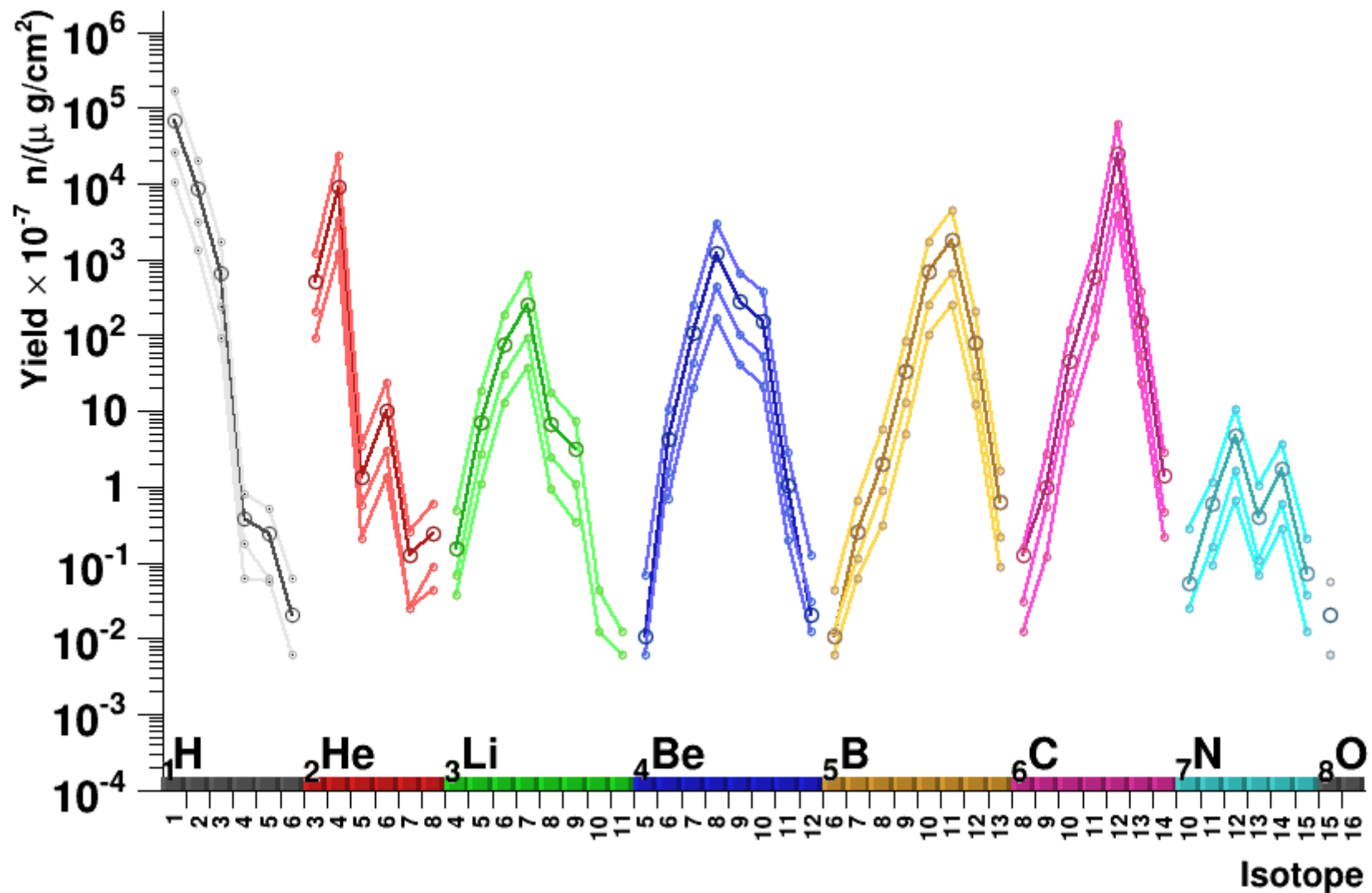
Fluka/Geant4 Liquid Scintillator @ 280 GeV



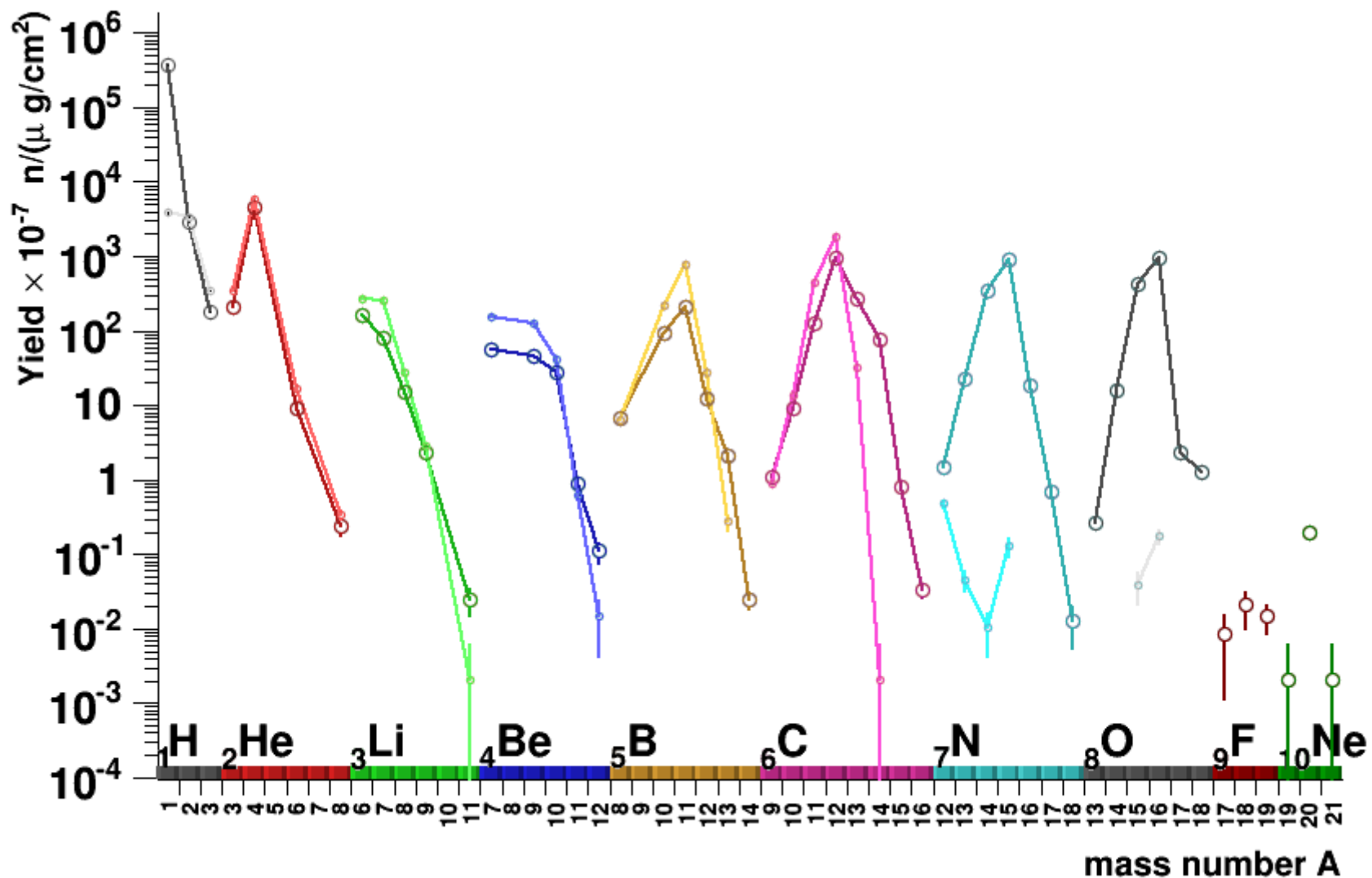
Liquid Scintillator @ All Energies for Fluka



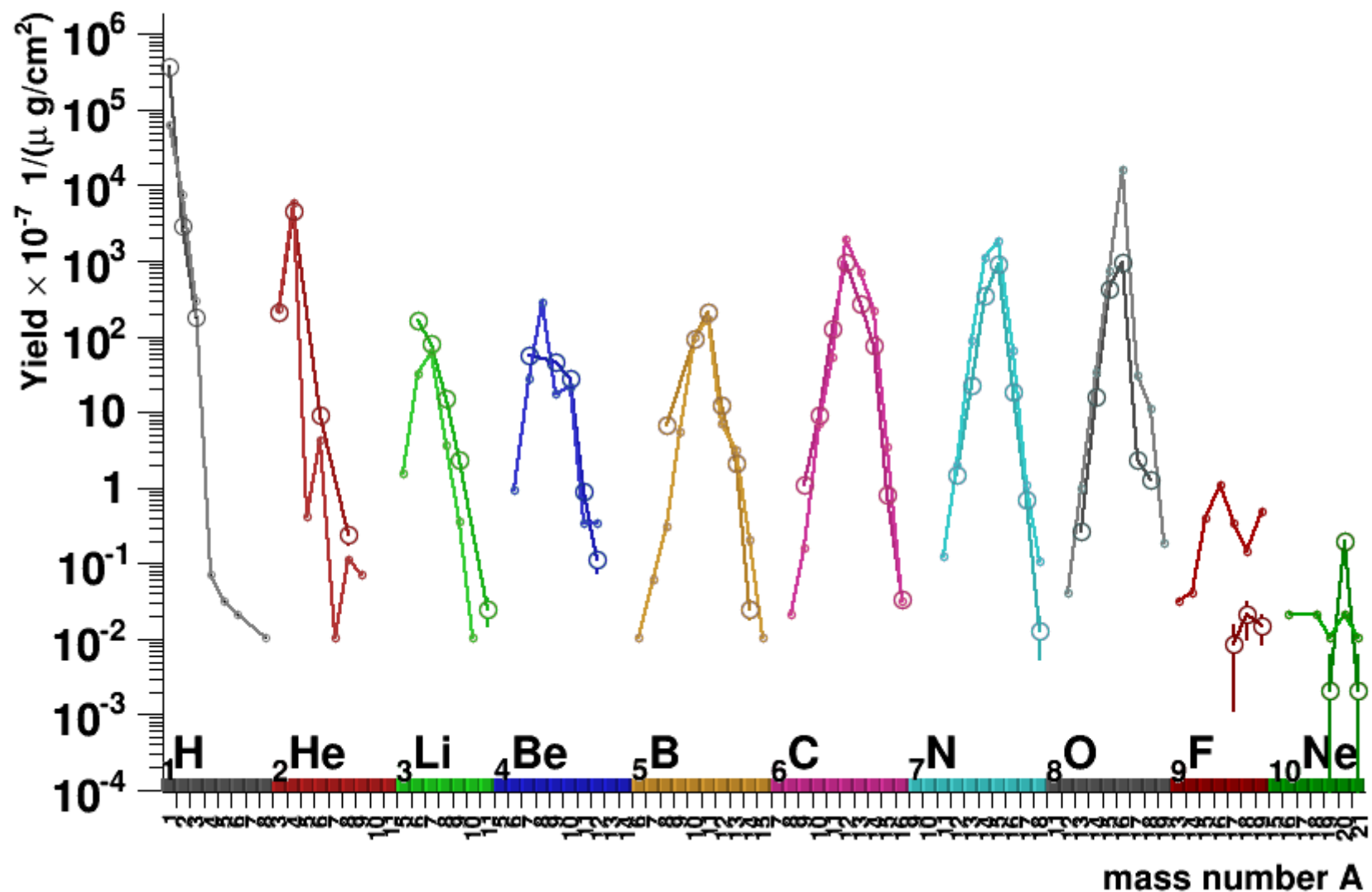
Liquid Scintillator @ All Energies for Geant4

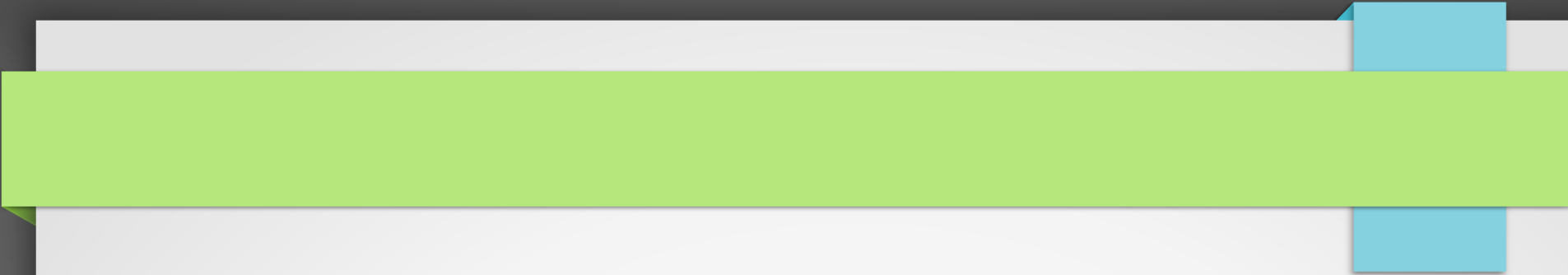


Liquid Scintillator vs. Water Fluka @ 280 GeV



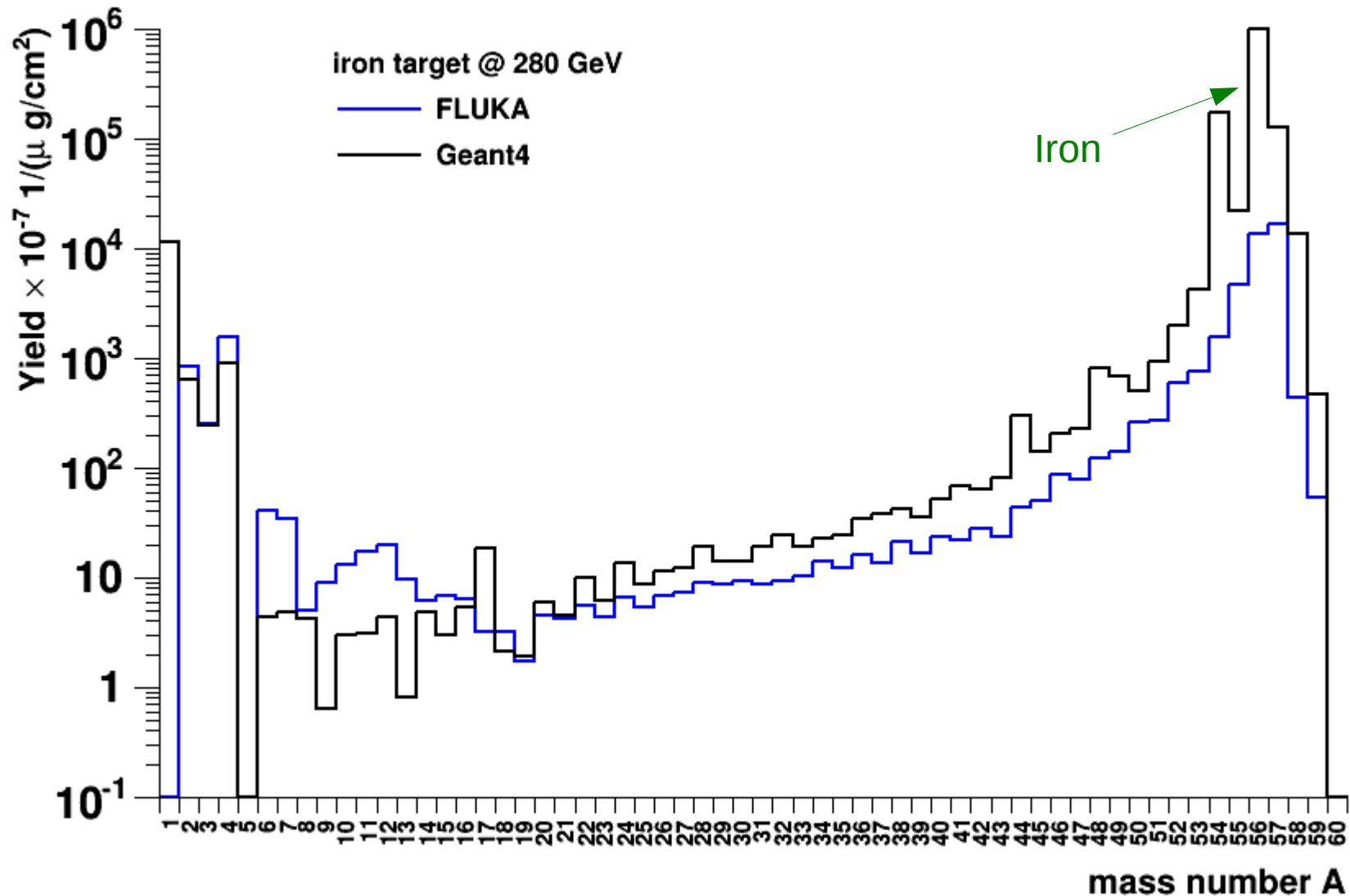
Fluka/Geant4 Water @ 280 GeV



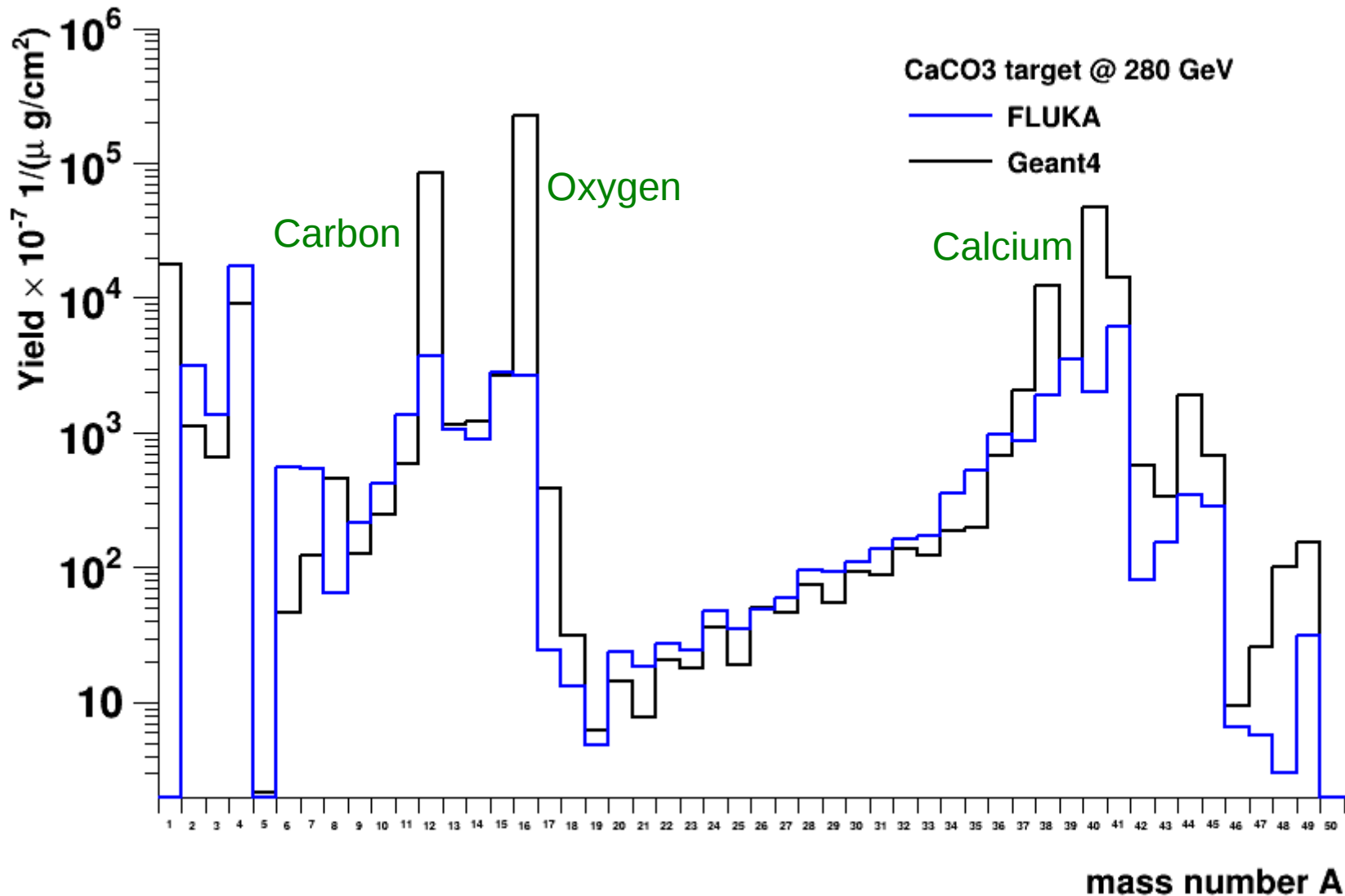
- 
- Recently we have looked at comparisons of these muon induced isotopes in our heavier targets.
 - It is not completely understood why there are such large discrepancies in some of the produced isotopes

Our first thoughts are that there is an elastic scattering threshold that is different in the two codes especially in isotopes that are present in the targets

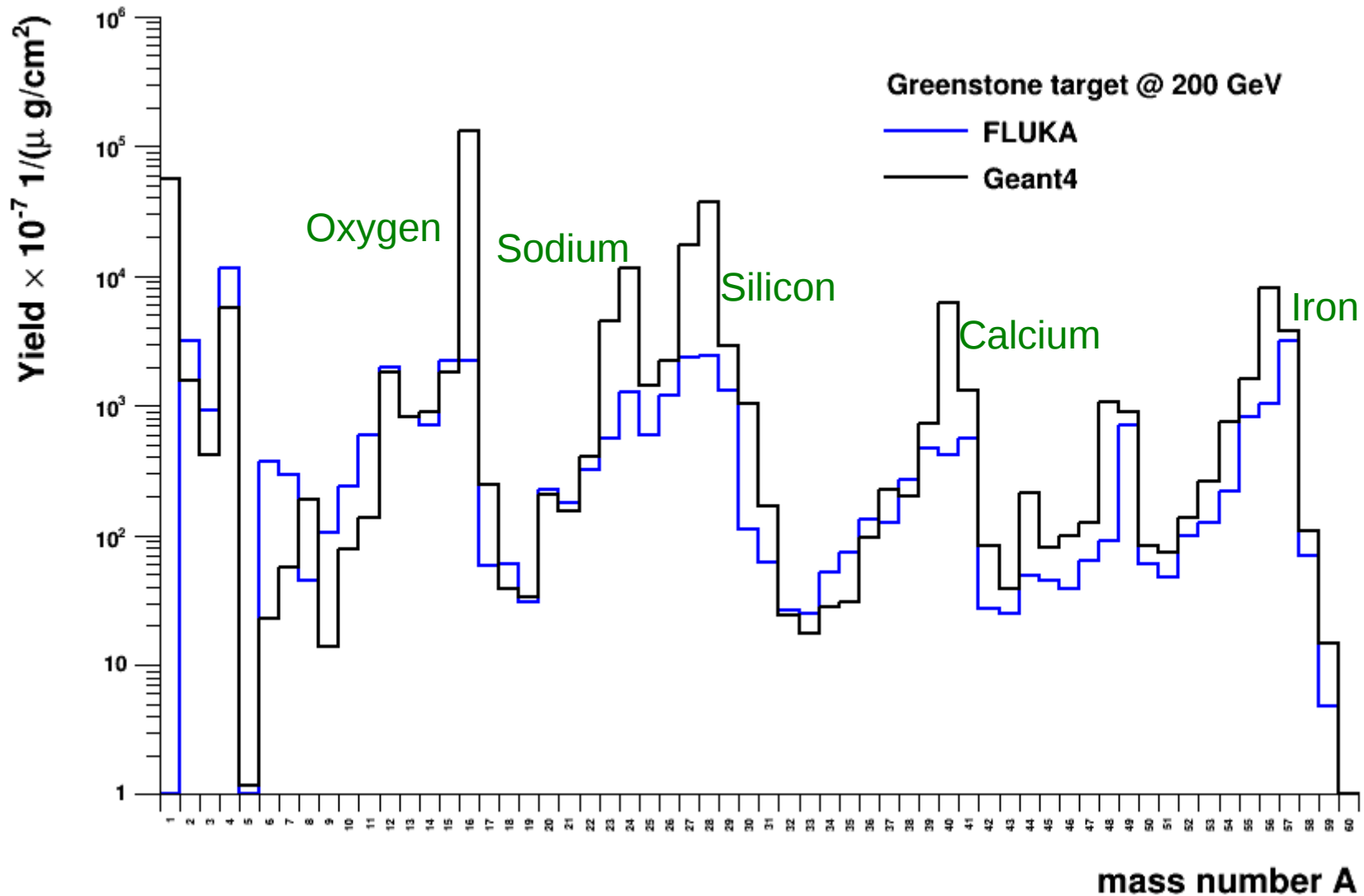
Geant4/Fluka for Iron @ 280 GeV



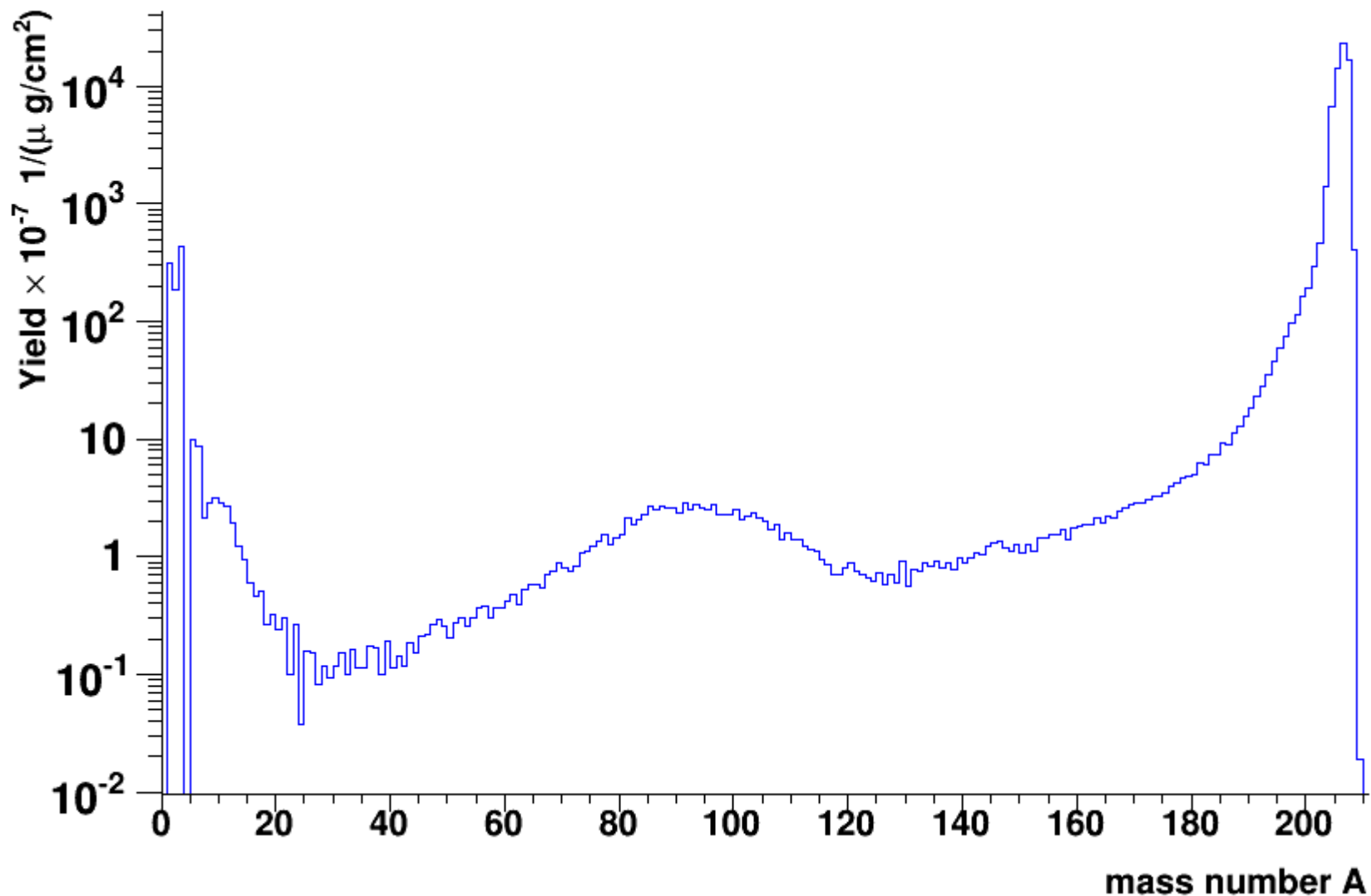
Geant4/Fluka for CaCO_3 @ 280 GeV



Geant4/Fluka for Greenstone @ 200 GeV



Fluka for Lead @ 280 GeV



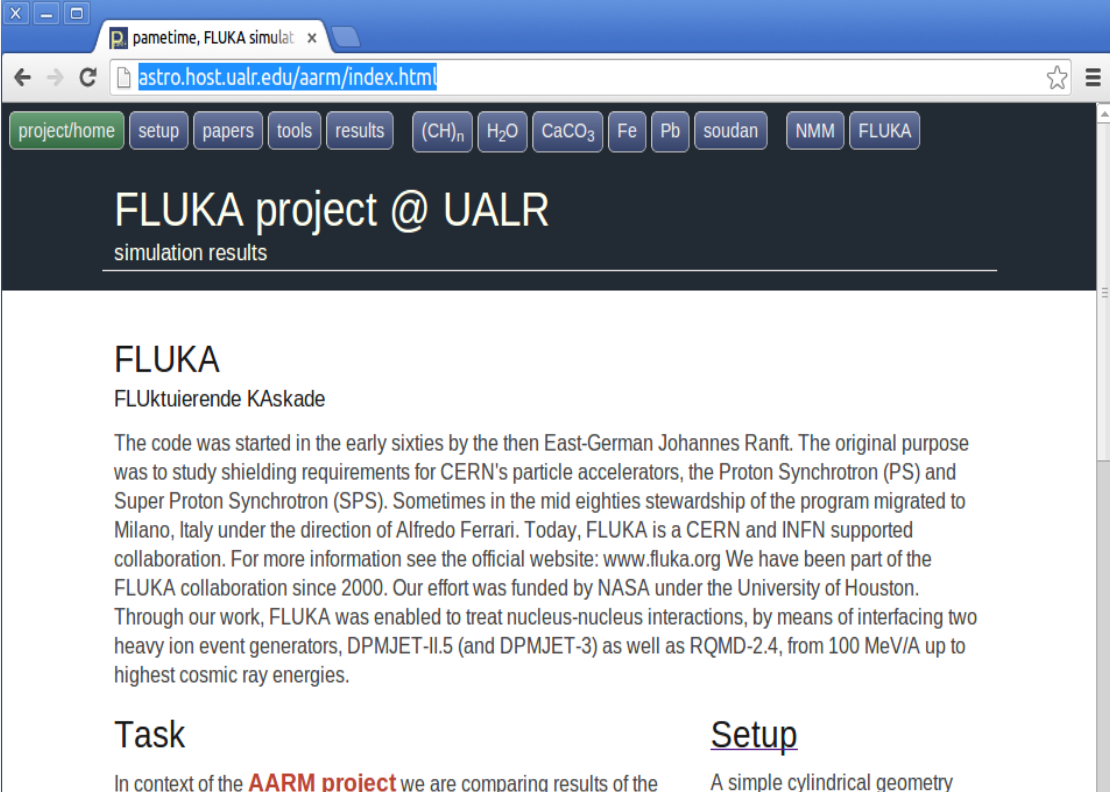
Website for FLUKA related data:

astro.host.ualr.edu/aarm

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A screenshot of a web browser displaying the 'FLUKA project @ UALR' website. The browser's address bar shows 'astro.host.ualr.edu/aarm/index.html'. The website has a dark blue header with a navigation menu containing links: 'project/home', 'setup', 'papers', 'tools', 'results', '(CH)n', 'H2O', 'CaCO3', 'Fe', 'Pb', 'soudan', 'NMM', and 'FLUKA'. Below the header, the title 'FLUKA project @ UALR' is displayed, followed by the subtitle 'simulation results'. The main content area features a section titled 'FLUKA' with the subtitle 'FLUKtuierende KAskade'. The text describes the history of the FLUKA code, starting in the early sixties by Johannes Ranft, and its evolution through CERN, INFN, and NASA. It mentions the FLUKA collaboration since 2000 and the use of heavy ion event generators like DPMJET-II.5 and RQMD-2.4. At the bottom, there are two sections: 'Task' and 'Setup'. The 'Task' section mentions the 'AARM project' and comparing results. The 'Setup' section mentions a 'simple cylindrical geometry'.

Summary and Future Work

- Carbon 11 backgrounds in detectors
- Need to look at the spikes in the isotopes that occur in the natural form of isotope in all targets
- On the Fluka side: need to update the website with a tools section

Water @ All Energies for Fluka

