Progress on Evaporation test

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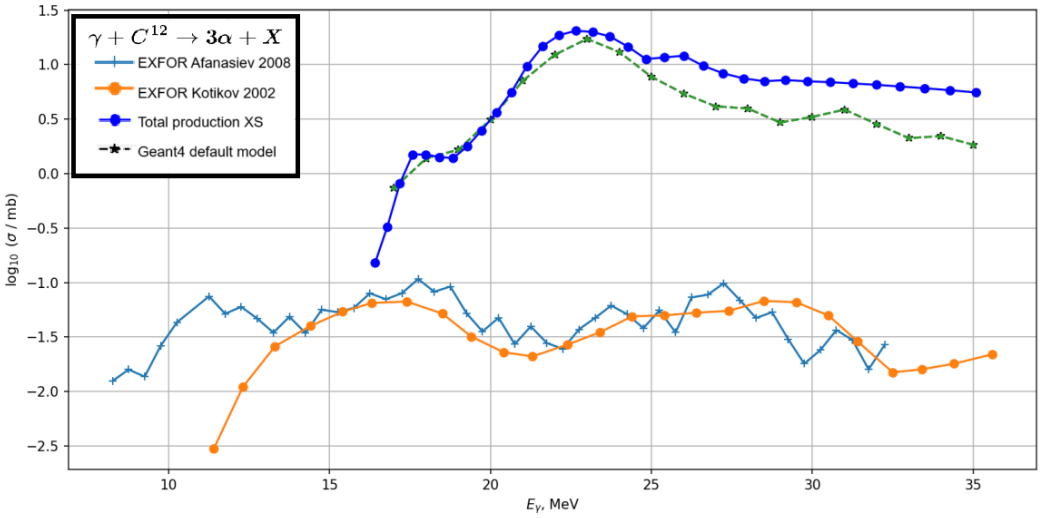
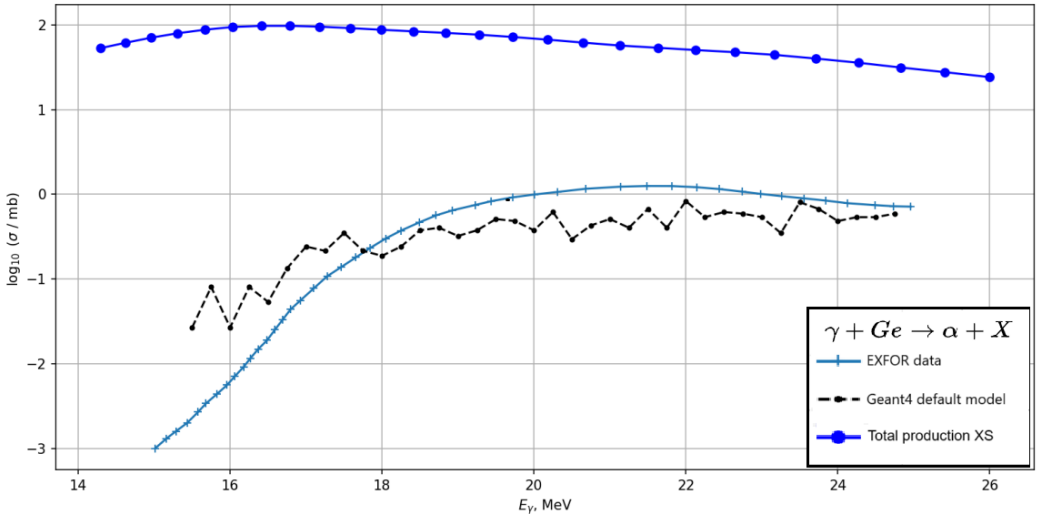
Problem

- We considered (g,α) reactions on C12, Ge, etc.
- Default Geant4 model works fine on high Z (Ge), but overestimate alpha production off C12
- To understand the problem we develop Evaporation test





Evaporation test

- We consider $\sigma_{\text{inv}}(\varepsilon)$ in evaporation model probability of emission of final particle with energy ε from excited fragment with E_{x} excitation energy:

$$P_j(E_{\text{x}},\varepsilon)d\varepsilon = g_i\sigma_{\text{inv}}(\varepsilon)\frac{\rho_d(E_{\text{x}}-\varepsilon)}{\rho_i(\varepsilon)}\varepsilon d\varepsilon$$

- Evaporation test was made for comparison of $\sigma_{\text{inv}}(\varepsilon)$ from different models. G4 x-sections and Evaporation model x-sections
  - Evaporation x-section calculate using Kalbach parameterization
  - Geant4 x-section taken from G4PARTICLEXS4.1
- Previous talk: https://indico.cern.ch/event/1428256/#1-study-of-low-energy-evaporat
- Version of Geant4: 11.3-beta

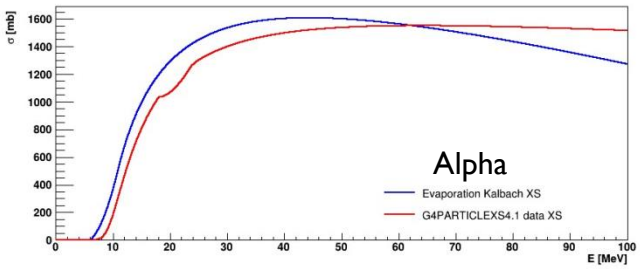
Changes

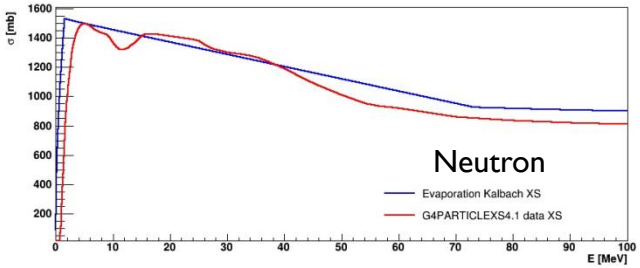
- Kalbach parameterization is done on base of limited number of targets (Fe group)
- We found that inelastic neutron x-sections data for some isotopes in G4PARTICLEXS4.1 are not continuous around 20 MeV
- For some isotopes low energy x-section is not known
- To make x-sections more uniform we access x-section via ComputeCrossSectionPerElement() for all elements
- Here we present results of alpha, proton and neutron XS comparison for C12, Cu, Fe, W, Ge and Pb

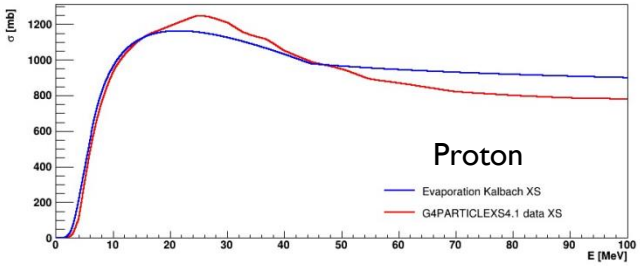
Plots for Cu and Fe

- Evaporation model works best for Fe group of elements

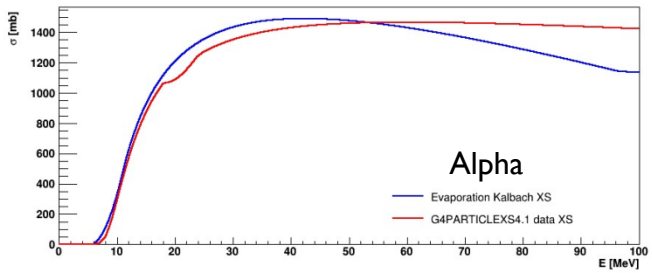
Cu

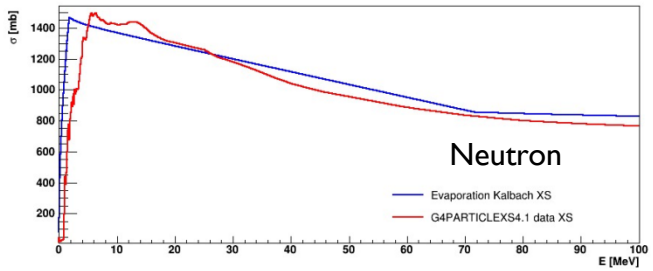


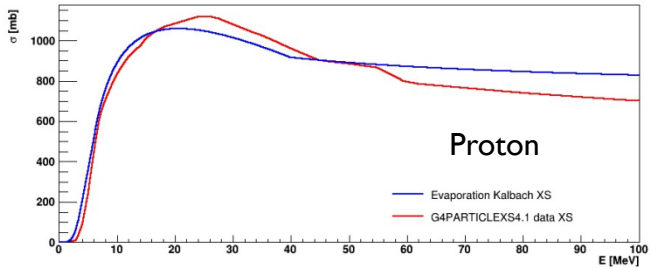




Fe



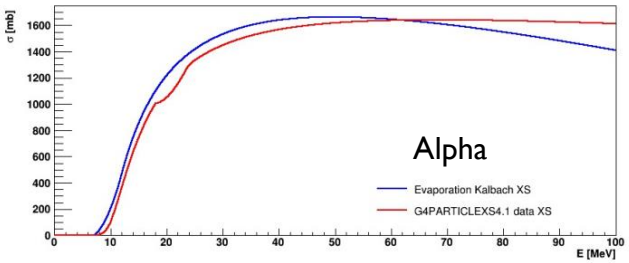


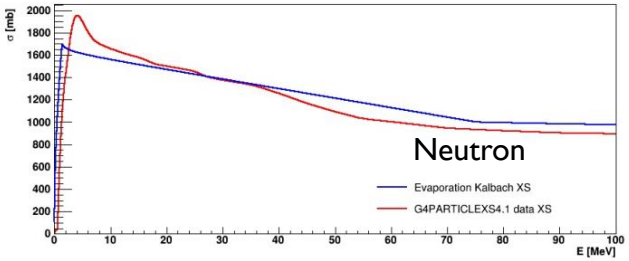


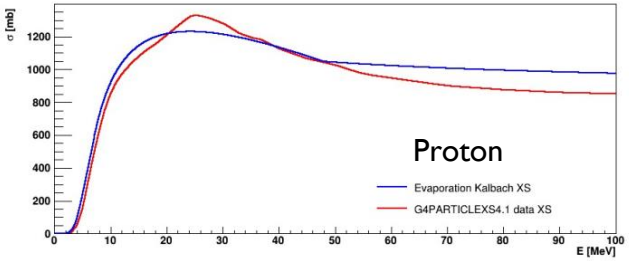
Plots for Ge and W

- For high Z Kalbach shows anomaly peak at low E for neutrons

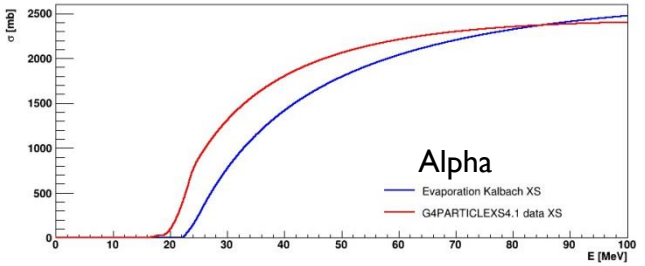
Ge



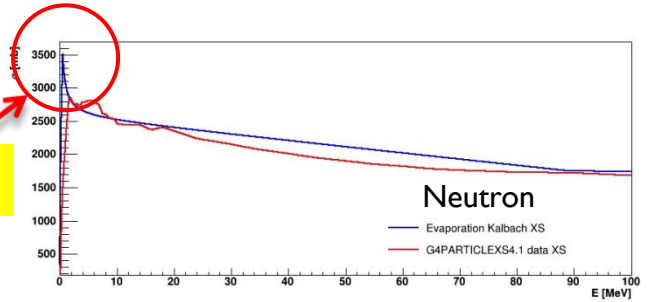


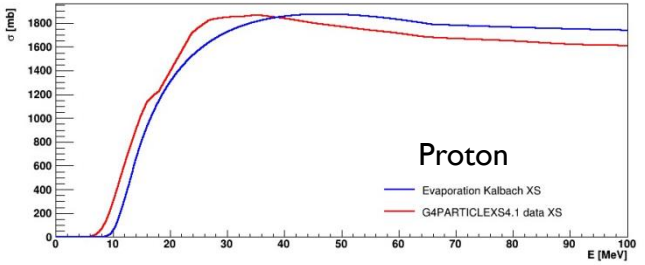


W



Anomaly

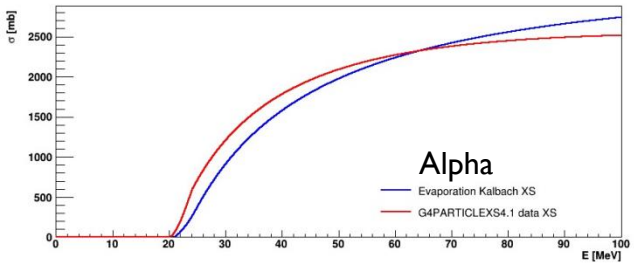


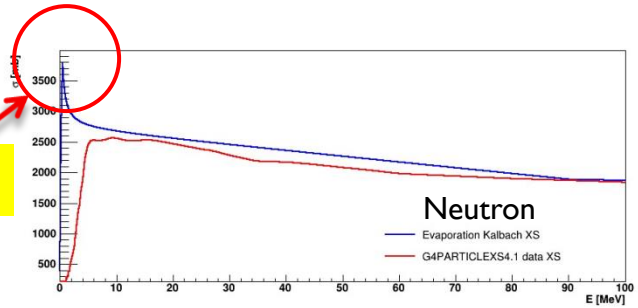


Plots for Pb and C12

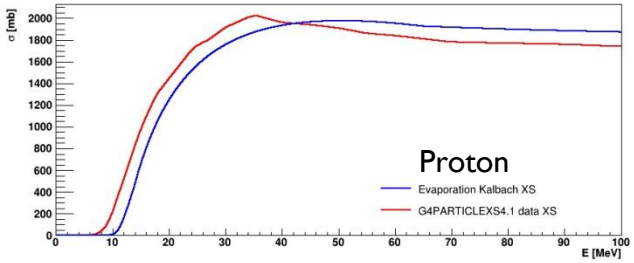
- Pb same problem as W. C12 and other low Z vary a lot

Pb

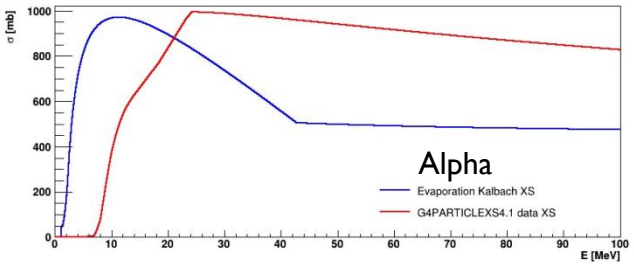


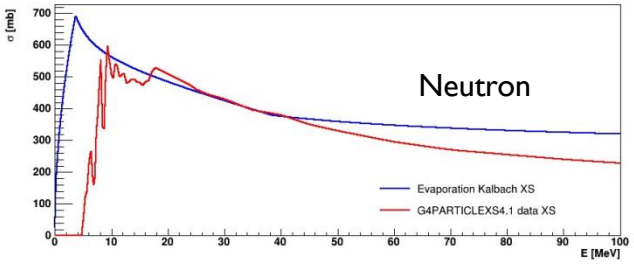


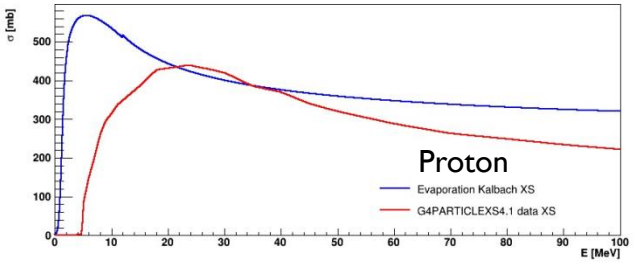
Anomaly



C12







Conclusion

- Kalbach parameterization of Fe group of elements works decent, but not so well for lower and higher Z
- Use of G4PARTICLEXS4.1 element x-sections for Evaporation probability doesn't have much of an impact on alpha production by gamma projectile just yet, might need some work of FermiBreakUp model
- Although, using G4PARTICLEXS4.1 x-sections instead of Kalbach x-sections might be considered now in various other tests for lower energies
- This option also does not make any impact on CPU

Thank you for your attention!