# Simulation of nucleon motion (updated)

*V. Grichine* (*LPI*)

## Abstract

Proposal for GEANT4 simulation of nucleon motion is discussed. The dependence of the Fermi momentum (relativistic Fermi gas (RFG) model) versus the atomic weight (and number) is parametrized. The nucleon momentum sampling according to proposed two Γ generator is compared with experimental data and predictions of G4Fancy3DNucleus class.

# Outline

1. Nucleon momentum sampling two $\Gamma$ generator vs. G4Fancy3DNucleus.
2. Summary (proposal).

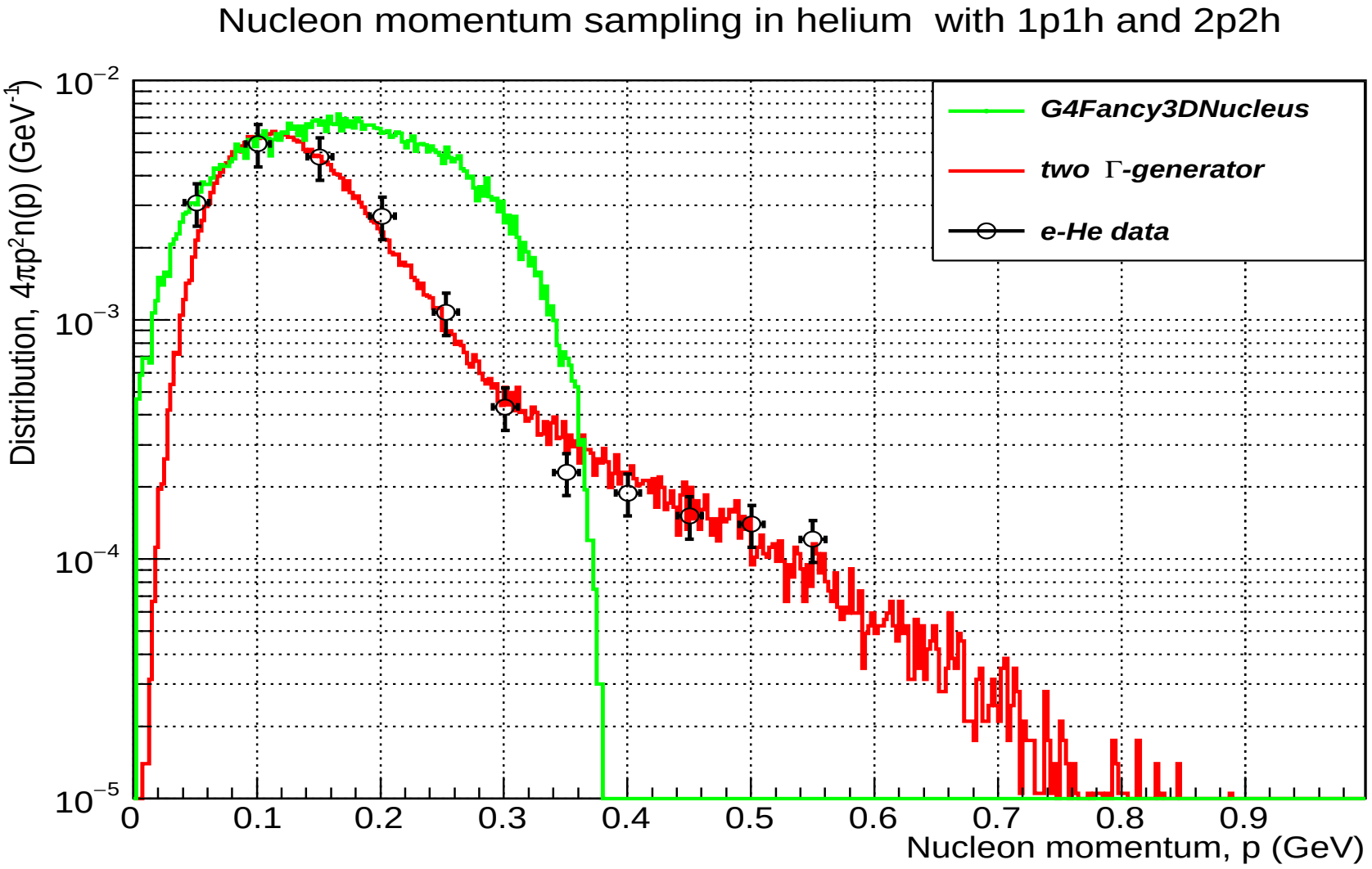
# G4Fancy3DNucleus and two Γ generators

G4Fancy3DNucleus utilizes the following momentum, $p$, distribution for a nucleon with position $r$ from the nucleus center:

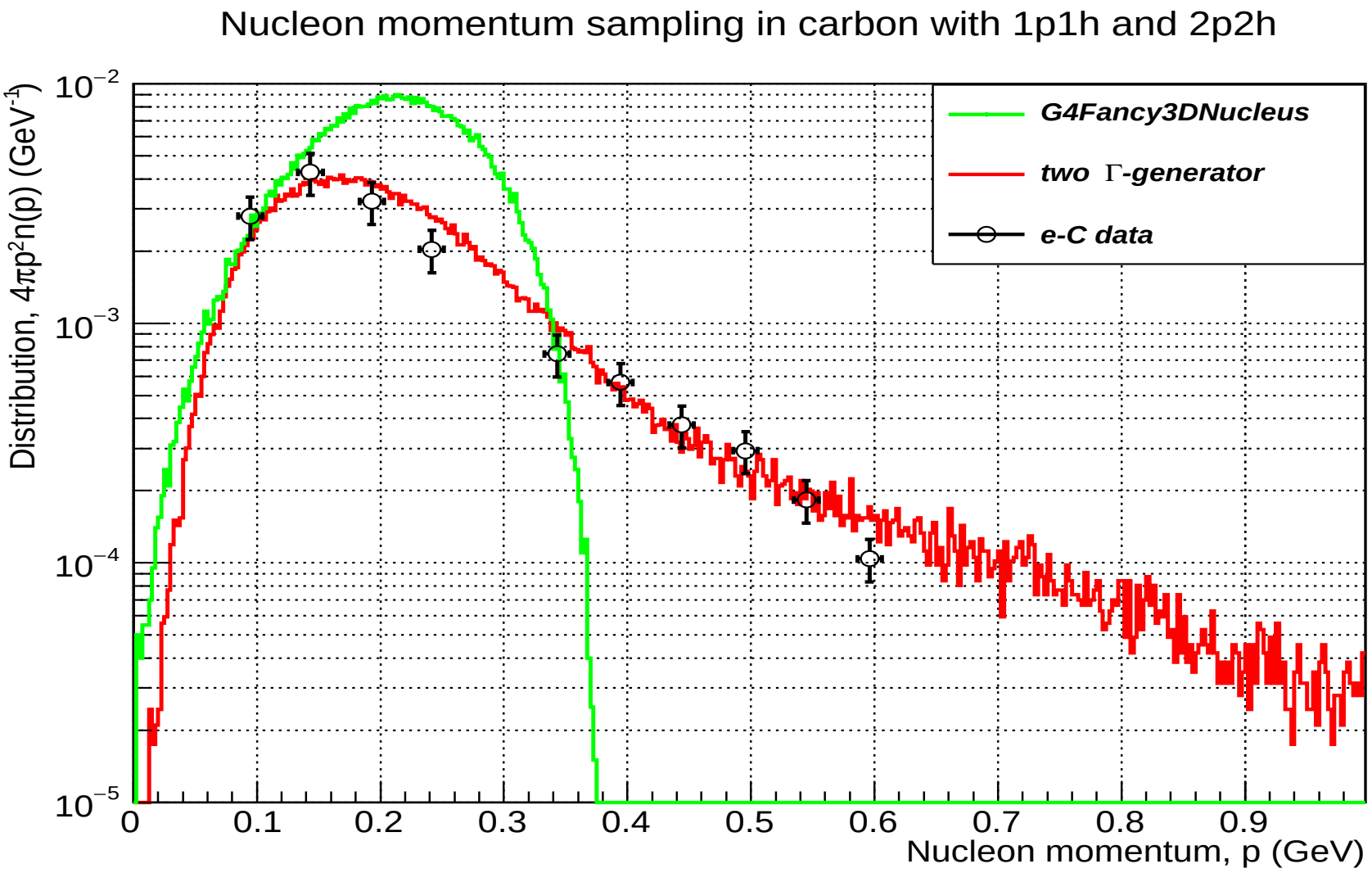
$$W(p)dp \simeq p^2 dp, \quad 0 \leq p \leq P_F(r) = \hbar c \left[3\pi^2 \rho(r)\right]^{1/3} \quad (MeV)$$

where $\rho(r)$ is the nucleus density.

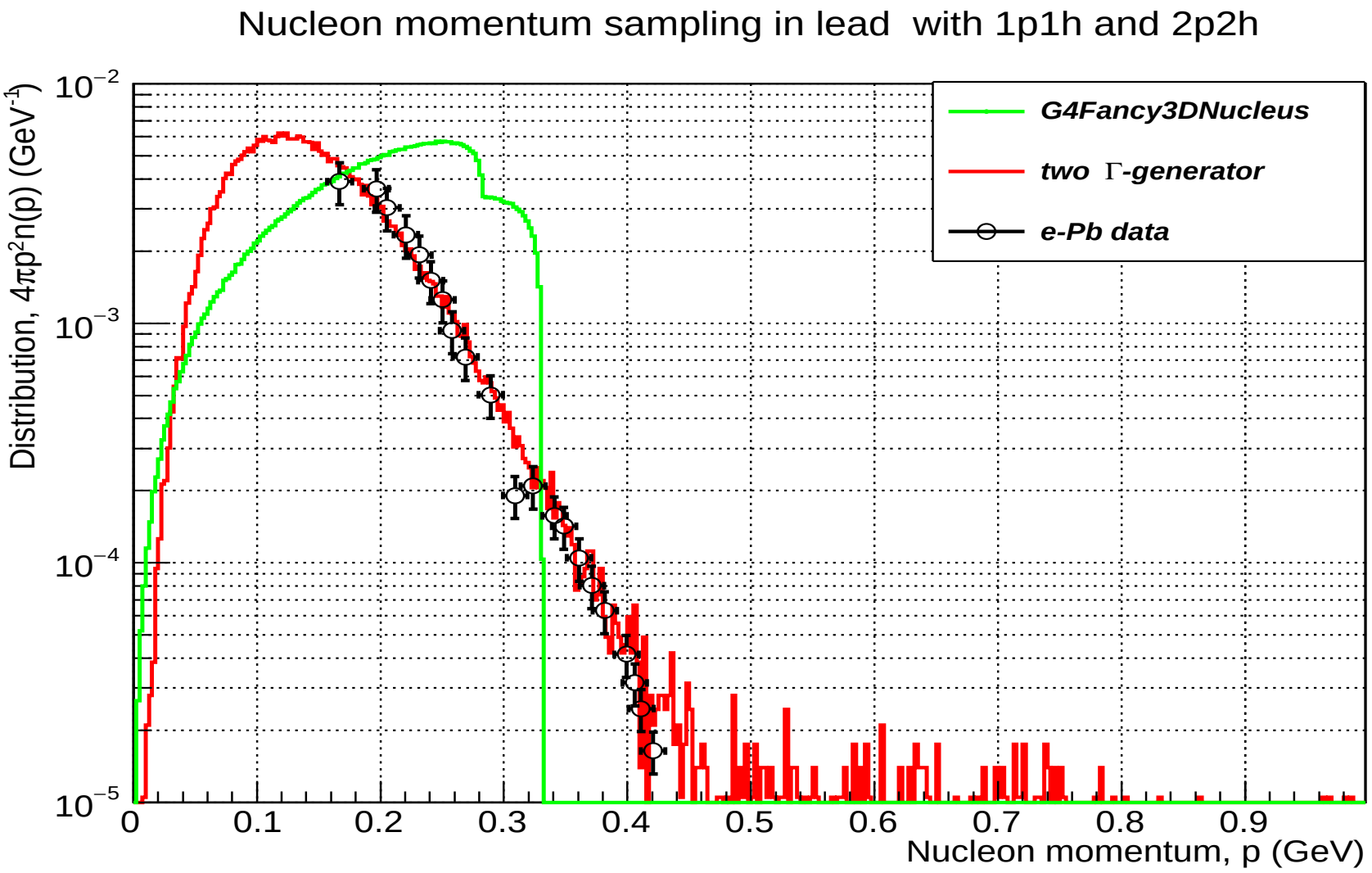
Two Γ-generator uses two Γ-functions (central part and tail) in terms of dimensionless variable $p/p_F$, where $p_F(Z, A)$. The latter is considered to be independent on the nucleon position inside nucleus (averaged over all nucleons). Some of the Γ-function parameters depend on A (reducing of tail and changing in the central part slope).




GEANT4 sampling (two Γ-functions and G4Fancy3DNucleus) of the nucleon momentum spectra for helium.




GEANT4 sampling (two Γ-functions and G4Fancy3DNucleus) of the nucleon momentum spectra for carbon.

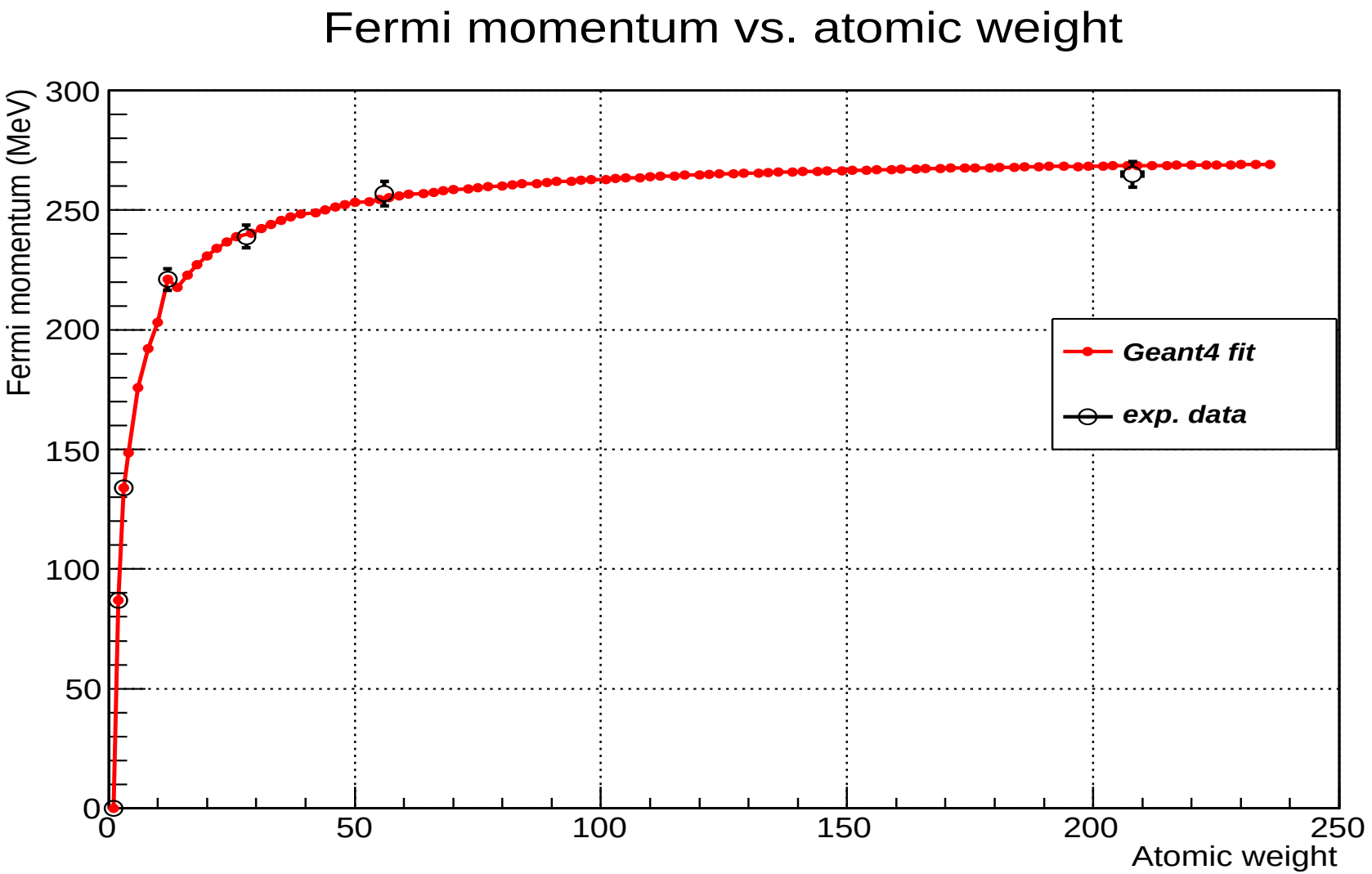



GEANT4 sampling (two Γ-functions and G4Fancy3DNucleus) of the nucleon momentum spectra for lead.

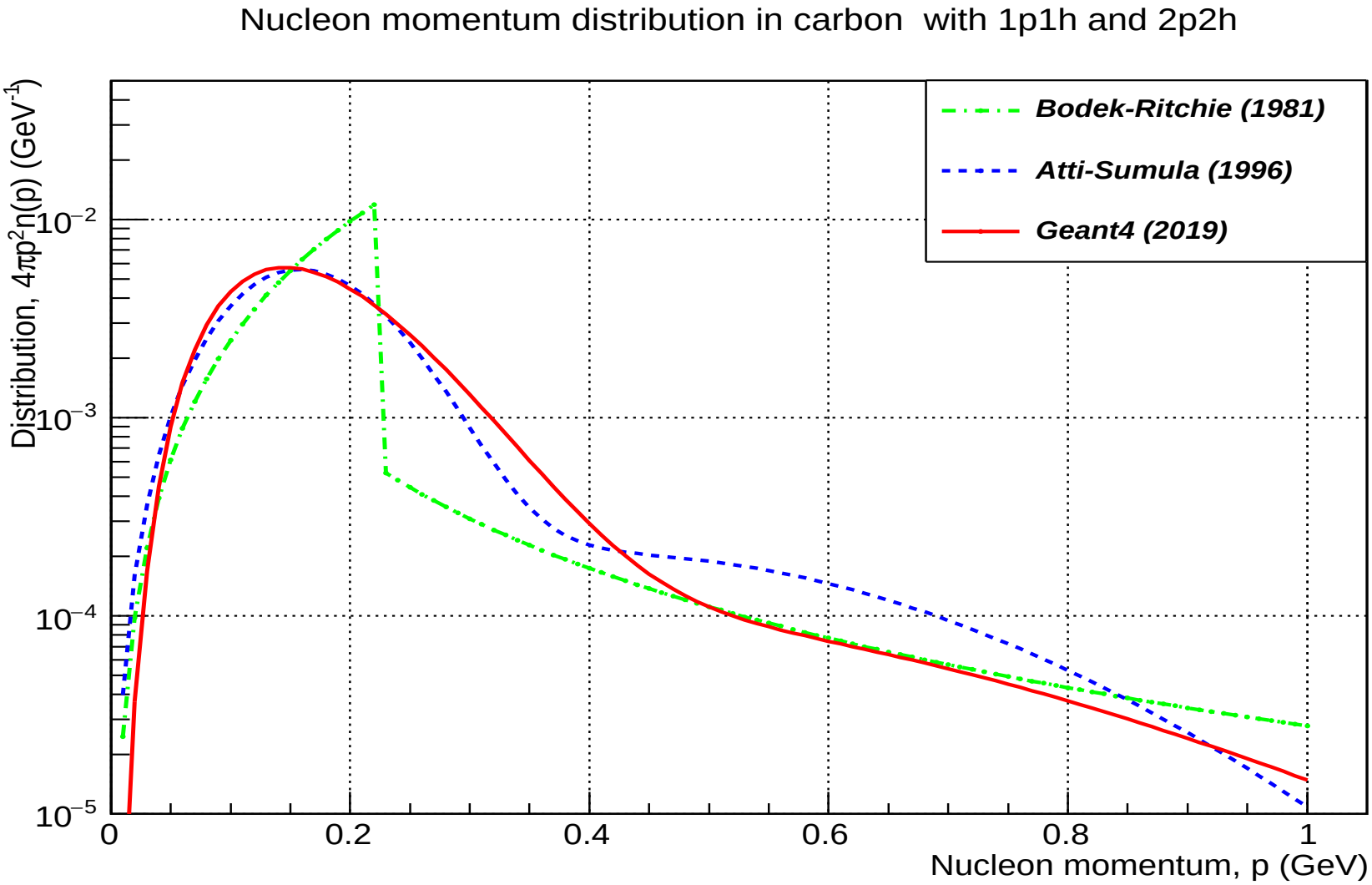
# Summary

1. The RFG Fermi momentum is paramerized for different nuclei.
2. The nucleon motion is sampled according to a simplified model (two $\Gamma$-functions) and G4Fancy3DNucleus class
3. Two new static methods, $GetFermiMomentum(Z, A)$ and $SampleNucleonMomentum(Z, A)$ can be proposed for new $G4NucleonMotion$ class (or for existing $G4FermiMomentum$).

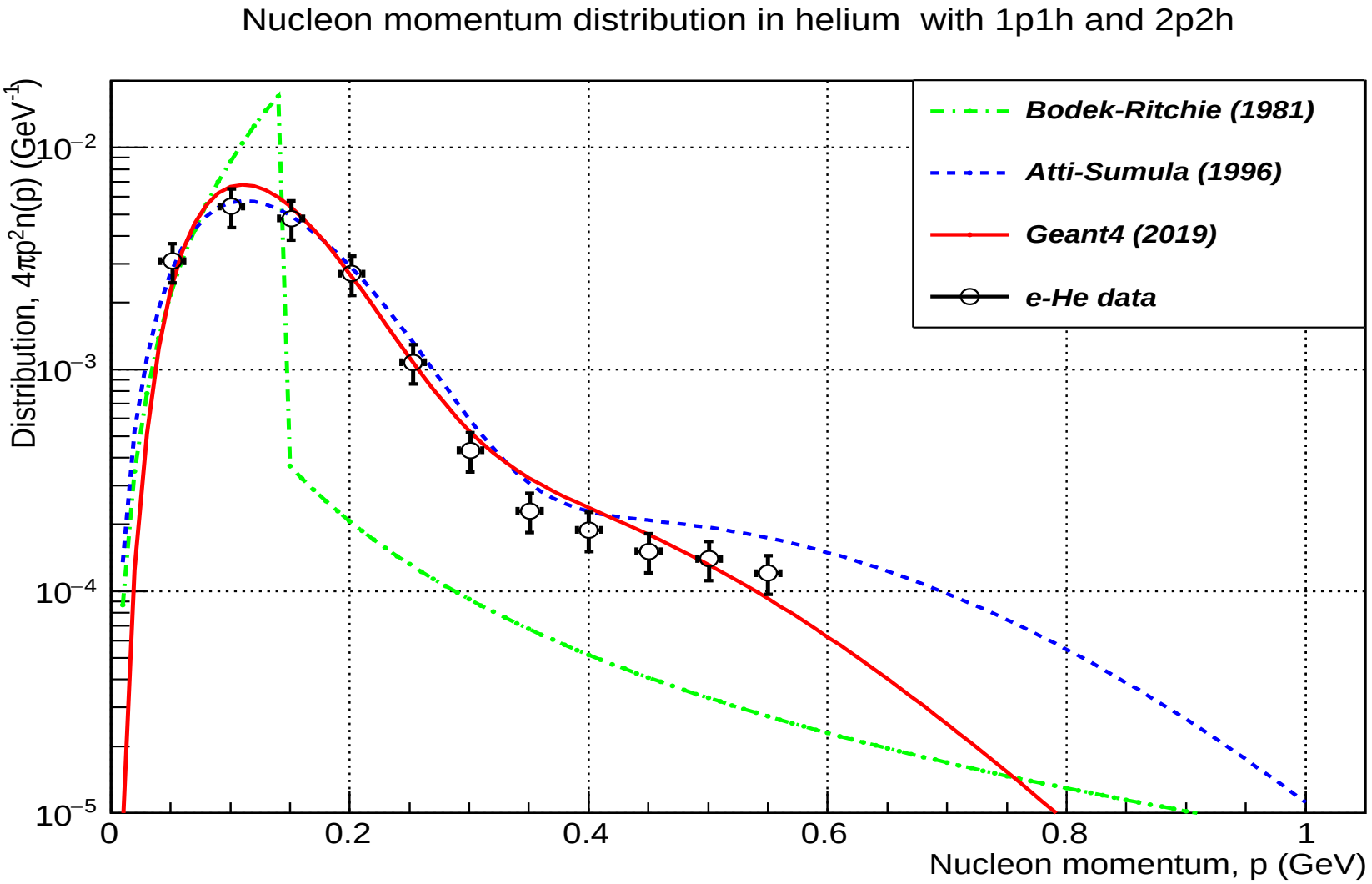
# Back up




RFG Fermi momentum vs. atomic weight for $\beta$-stable nucleii. The mean value is 251 MeV (is close to the GEANT4 value of 250 MeV)




The nucleon momentum spectra for carbon.




Nucleon momentum spectra for helium.