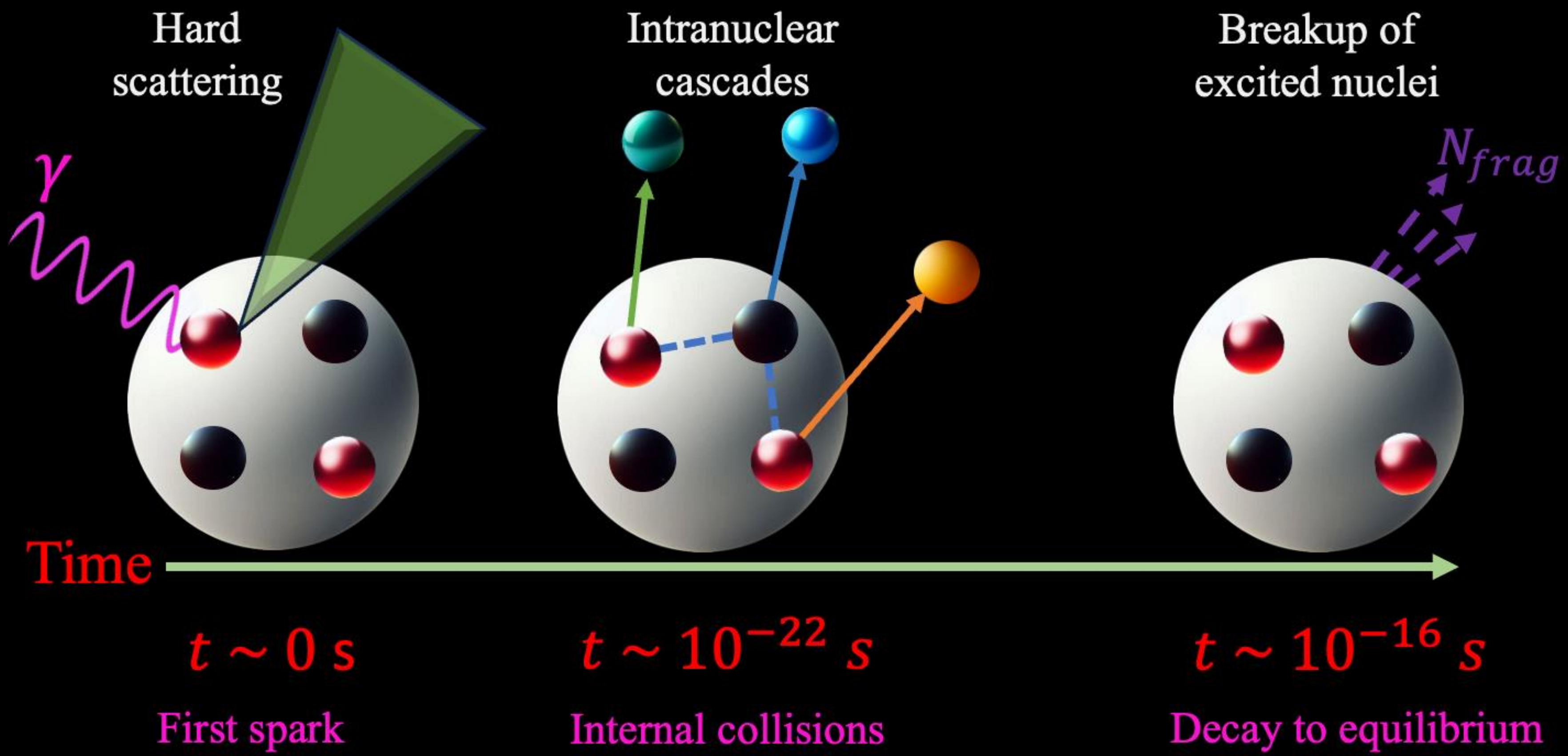
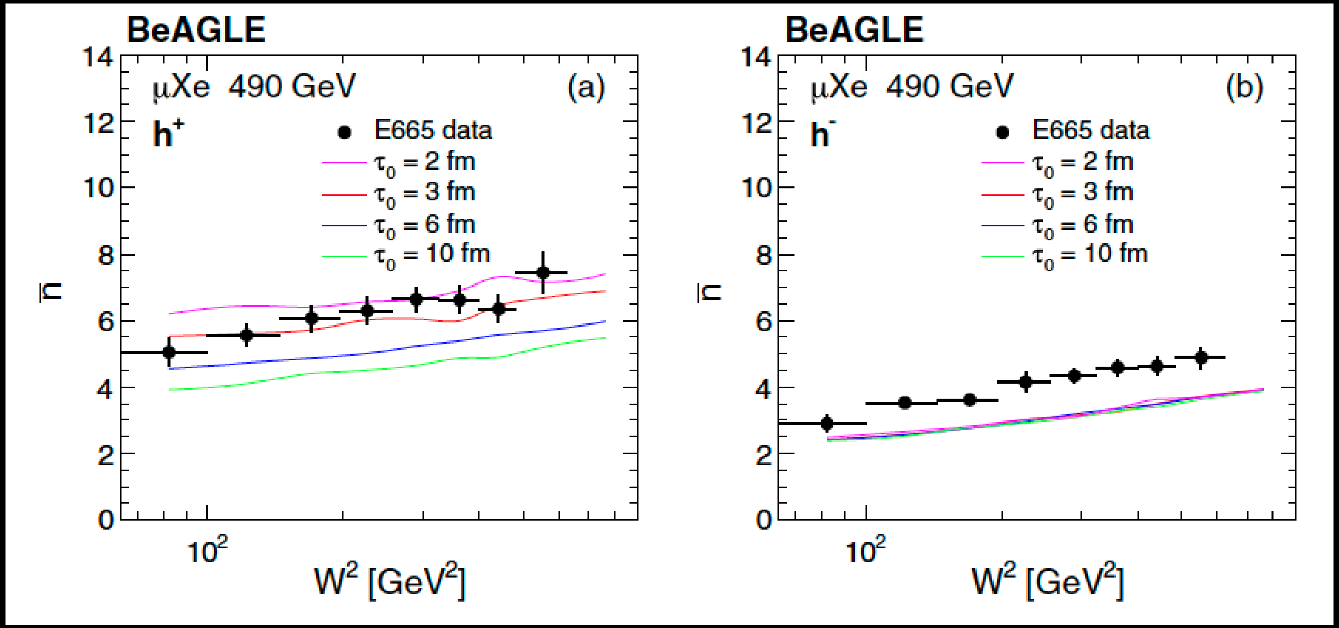
Constraining Intranuclear Cascade Formation Time and Its Impact on Compound Nuclei in e+A Collisions



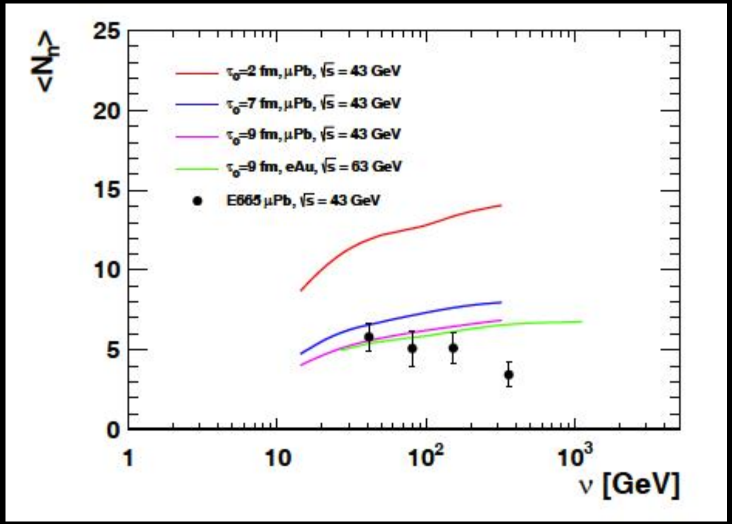
Niseem Magdy Abdelrahman
Physics Department
niseem.abdelrahman@tsu.edu

TSU
TEXAS SOUTHERN UNIVERSITY

Motivation



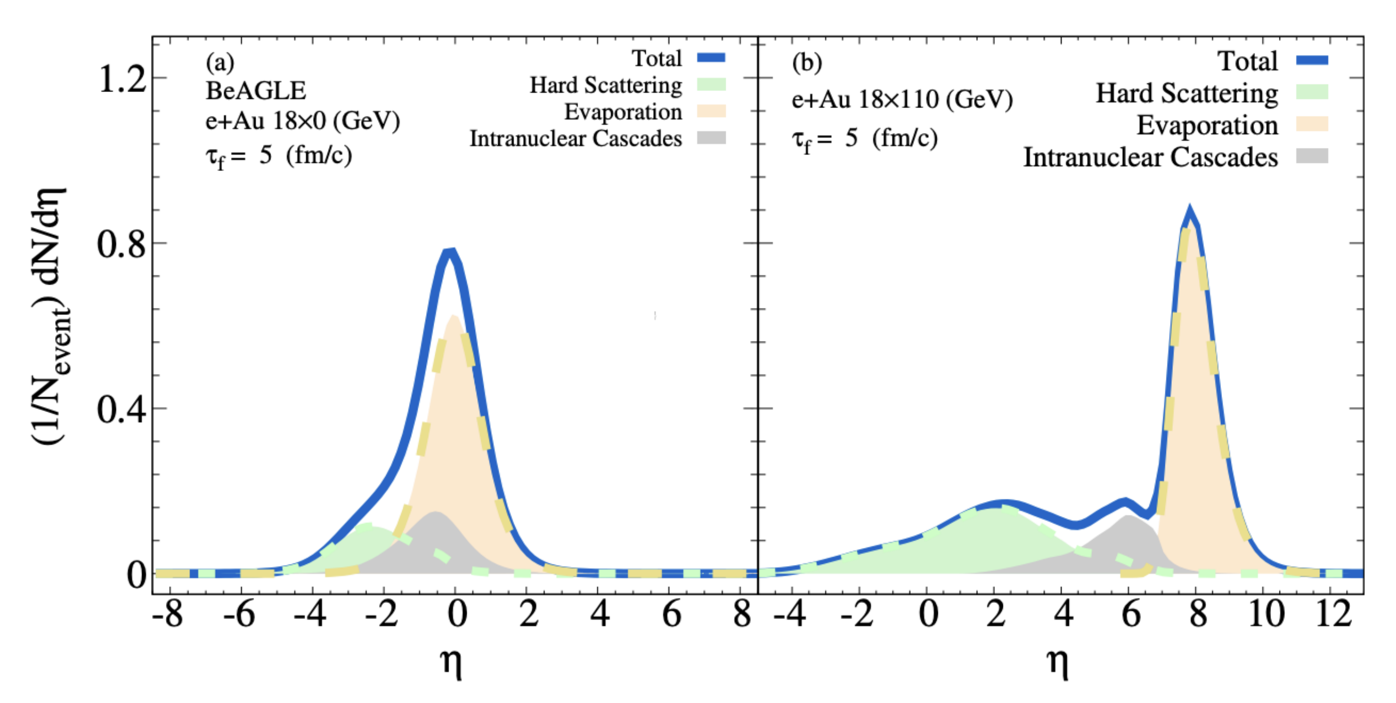
In fixed target experiment we are mixing effects from INC and evaporation



Can we separate both effects at the EIC?

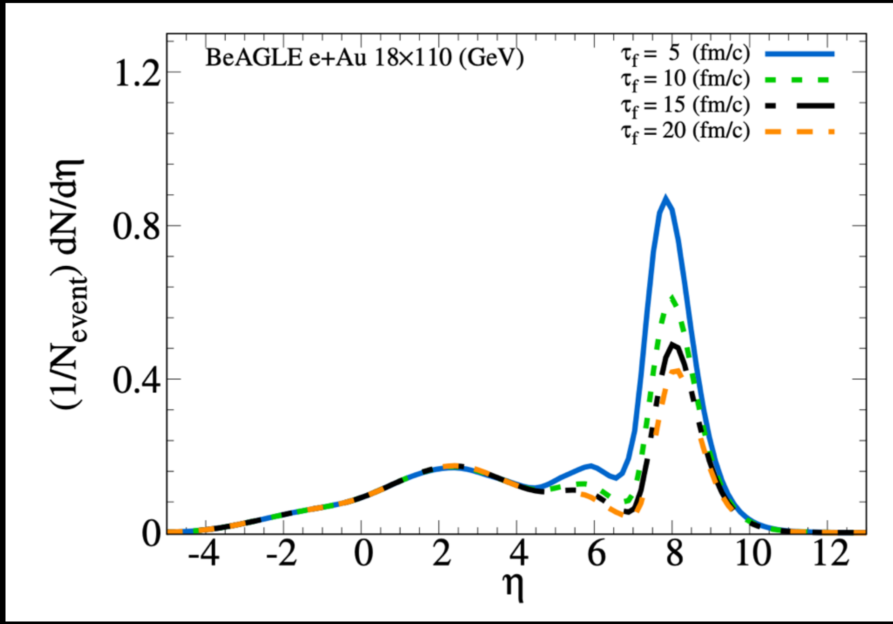
Motivation

The $dN/d\eta$ dependence on the formation time



Can we separate both effects at the EIC?

- Yes, we can via η selection.



Both effects have a similar effect on the number of particles …

Motivation

How Formation Time Impacts Evaporation/Fission

Short Formation Time	**Long Formation Time**
Secondaries escape before interacting.	Secondary hadrons interact more often inside the nucleus
More energy is deposited	Less energy is deposited
Residual nucleus is more excited	Residual nucleus is colder
Higher probability of evaporation and/or fission	Lower evaporation multiplicity, possibly no fission

- Formation time modulates the excitation energy E^* of the compound-like system.

Motivation

N-particles Momentum Correlations

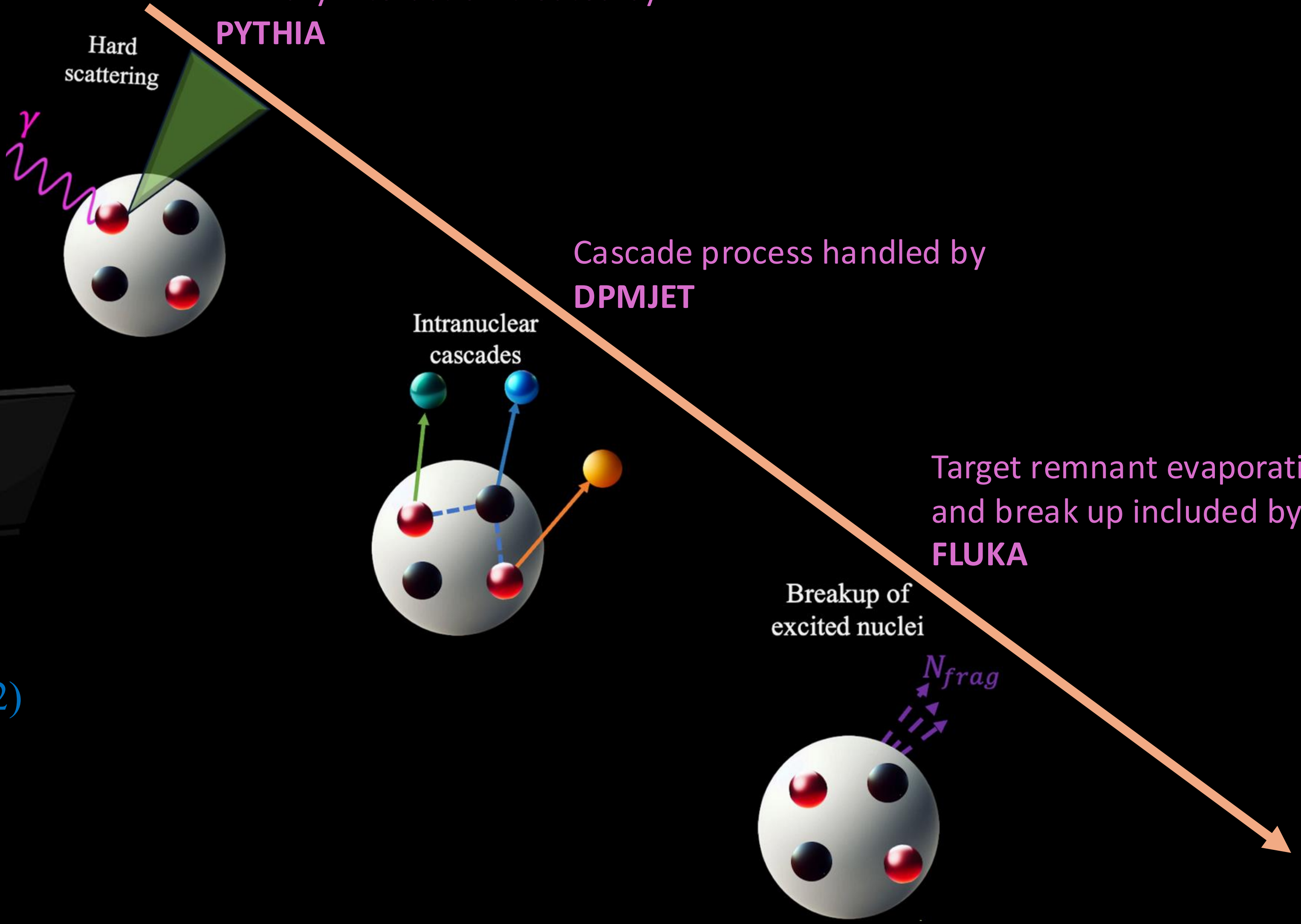
Variance	Skewness	Kurtosis
$\kappa_2 = \dfrac{c_2}{\langle\langle p_T \rangle\rangle^2}$	$\kappa_3 = \dfrac{c_3}{\langle\langle p_T \rangle\rangle^3}$	$\kappa_4 = \dfrac{c_4 - 3c_2^2}{\langle\langle p_T \rangle\rangle^4}$

$$c_n = \frac{\sum_{i_1 \neq \cdots \neq i_n} w_{i_1} \dots w_{i_n} \left(p_{T\,i_1} - \langle\langle p_T \rangle\rangle\right) \dots \left(p_{T\,i_n} - \langle\langle p_T \rangle\rangle\right)}{\sum_{i_1 \neq \cdots \neq i_n} w_{i_1} \dots w_{i_n}}$$

The relative dynamical mean-pt fluctuation, which quantifies magnitude of the dynamical fluctuations in units of the average transverse momentum.

Motivation

The BeAGLE model



Primary interaction treated by **PYTHIA**

Cascade process handled by **DPMJET**

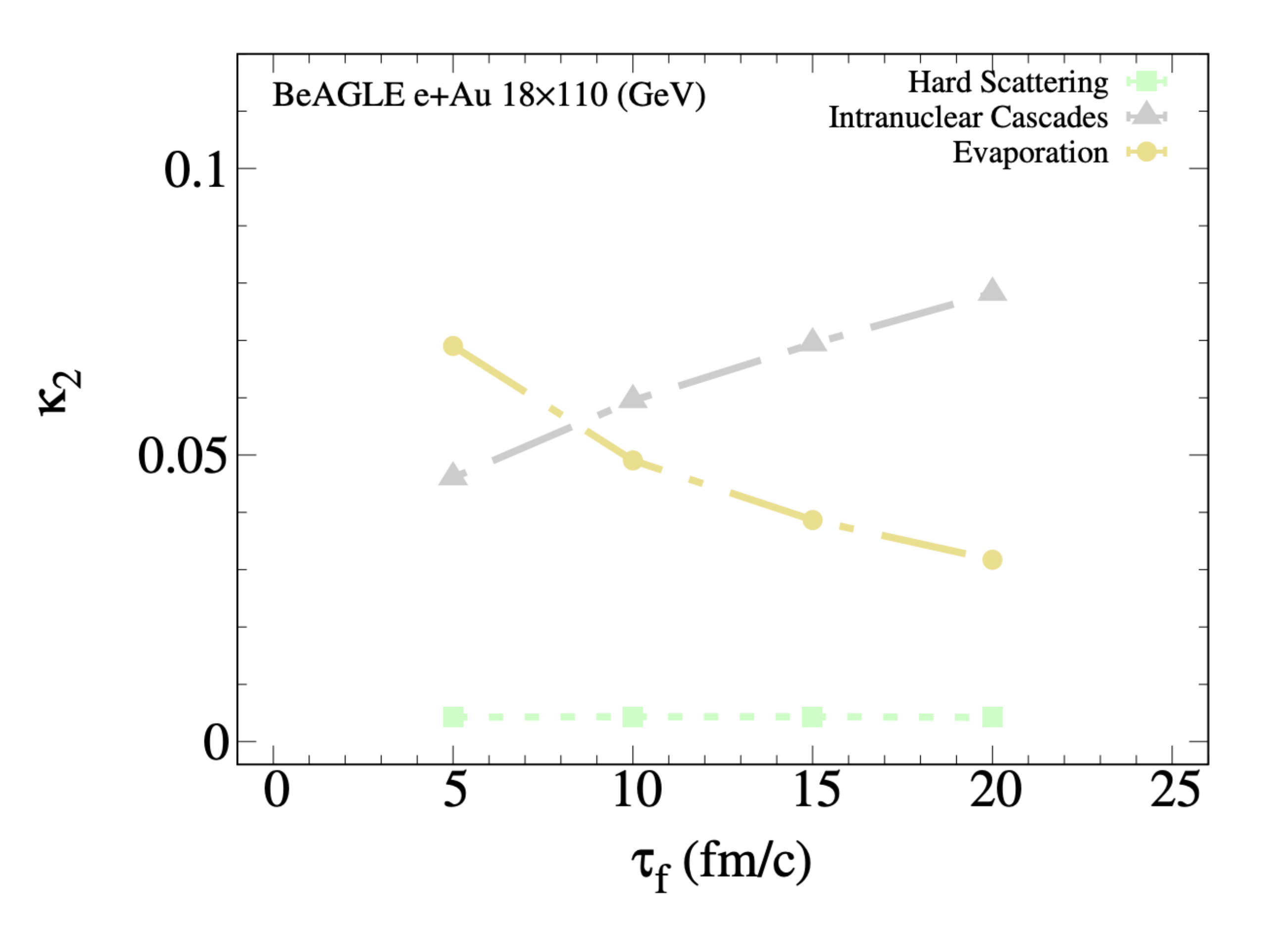
Target remnant evaporation and break up included by **FLUKA**

Wan Chang et al.,
PRD 106, 012007 (2022)

The momentum correlations in e+A collisions

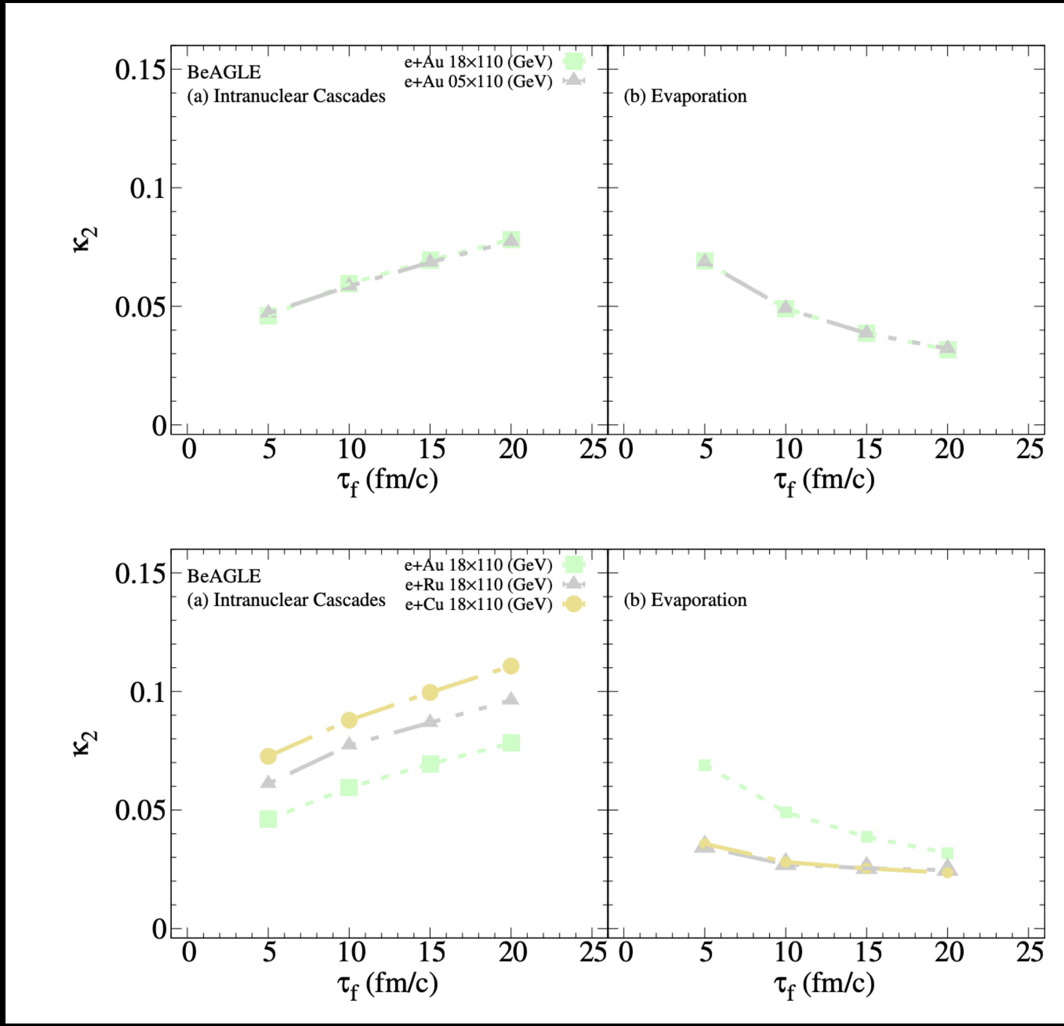
The κ_2 show:

- Independence of τ_f for H-S
- Increasing trend with τ_f for INC
- Decreasing trend with τ_f for Evaporation



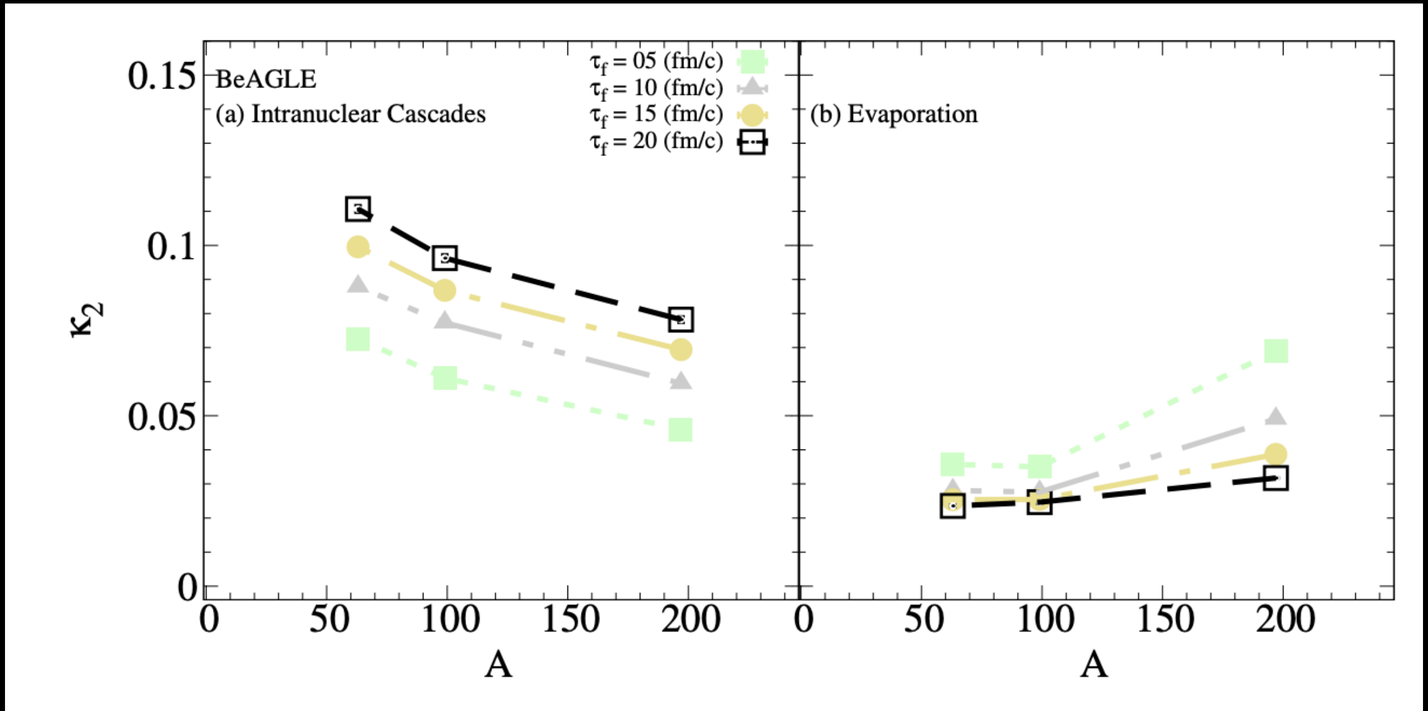
The momentum distribution variance can be used to identify τ_f as well as the relative effect on both INC and evaporation process

The momentum correlations in e+A collisions



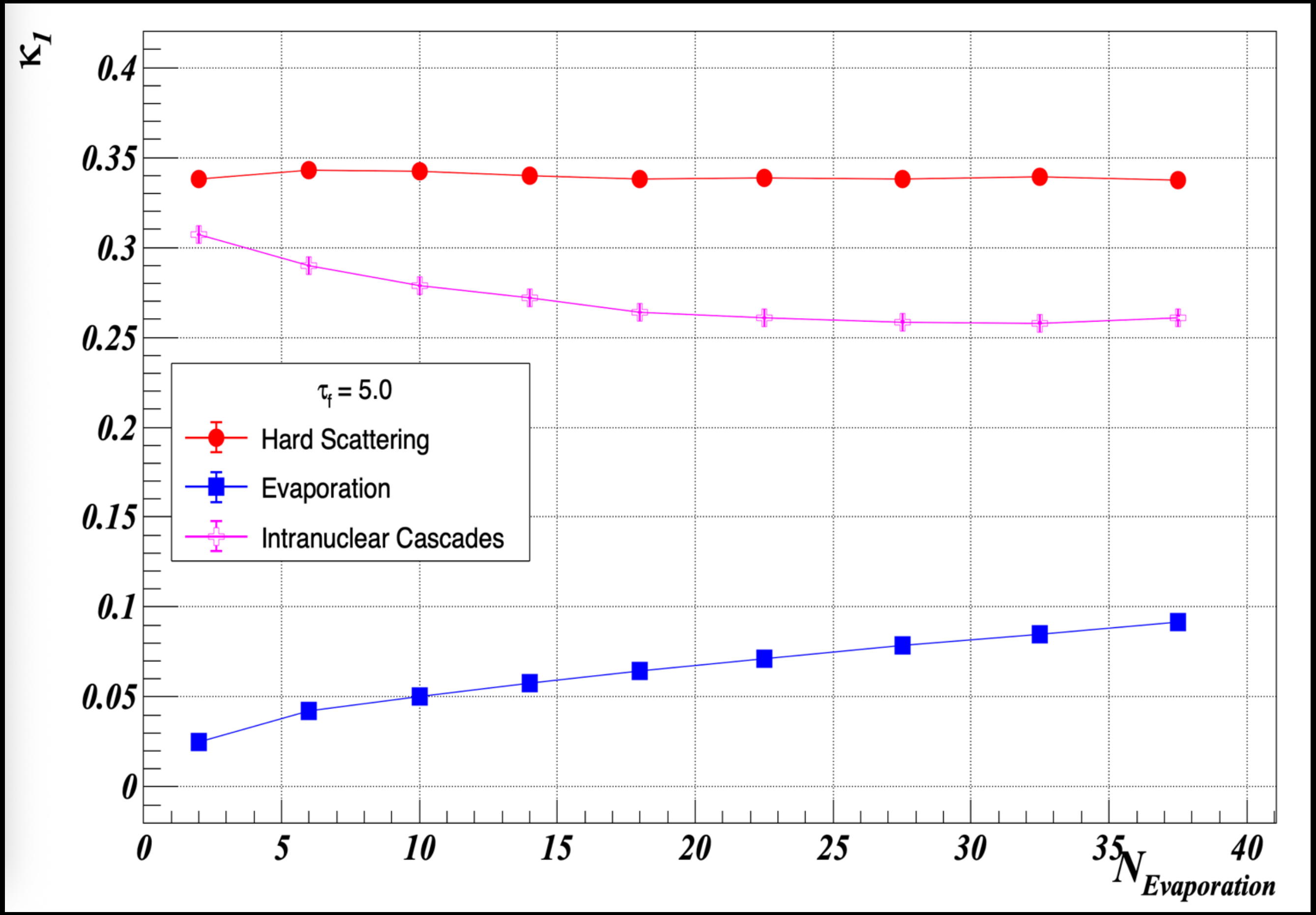
The momentum distribution variance depend on system size and not on energy

The momentum correlations in e+A collisions



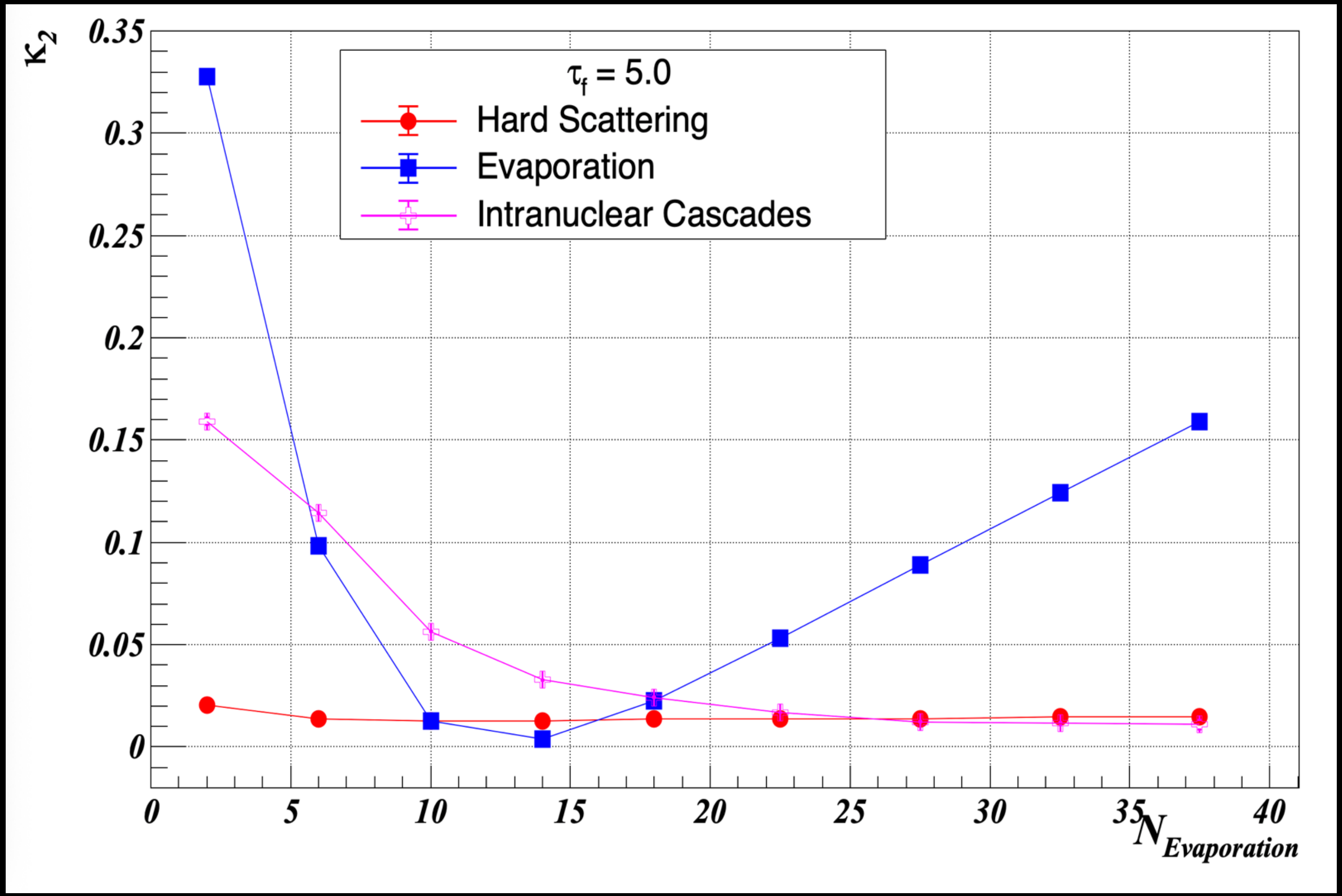
The momentum distribution variance depend on system size

The momentum correlations in e+A collisions

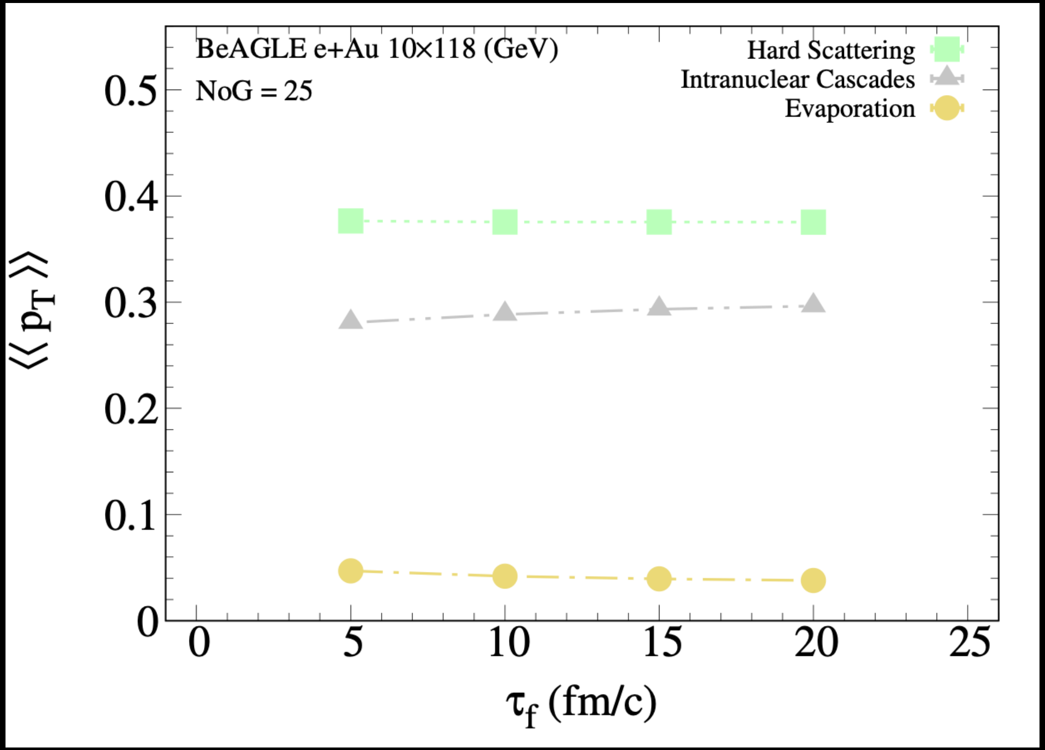


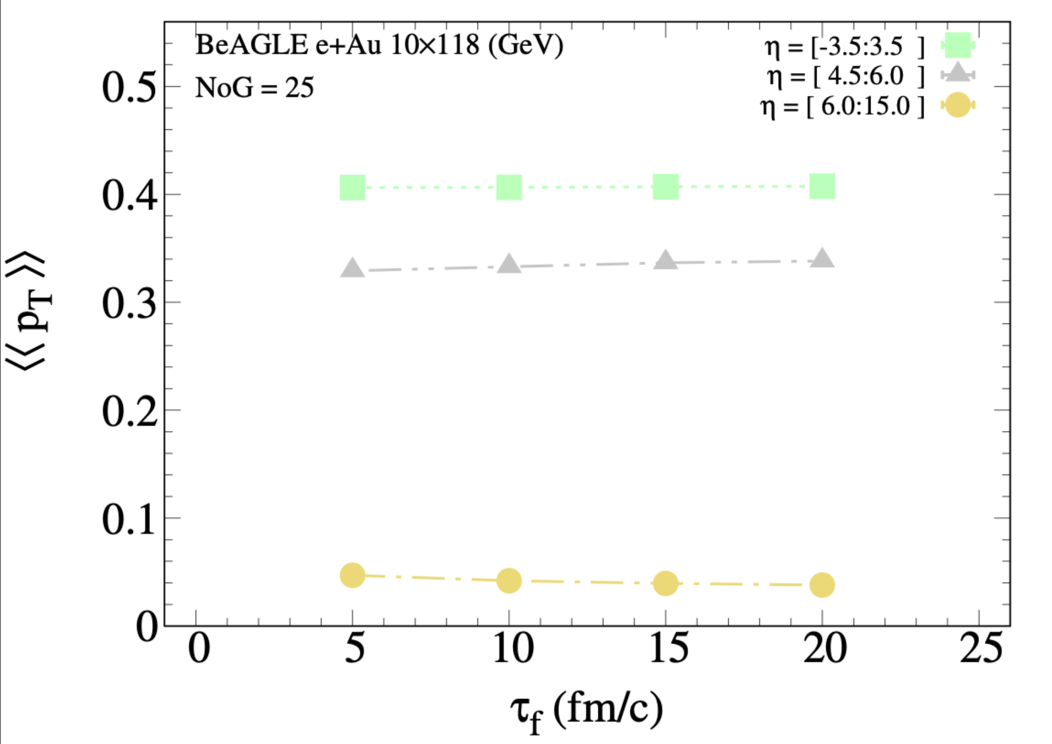
The momentum distribution variance can be used to identify τ_f as well as the relative effect on both INC and evaporation process

The momentum correlations in e+A collisions



The momentum distribution variance depend on N-Evaporation


BeAGLE e+Au 10×118 (GeV)
NoG = 25
Hard Scattering
Intranuclear Cascades
Evaporation
$\langle\langle p_T \rangle\rangle$
τ_f (fm/c)


BeAGLE e+Au 10×118 (GeV)
NoG = 25
η = [-3.5:3.5]
η = [4.5:6.0]
η = [6.0:15.0]
$\langle\langle p_T \rangle\rangle$
τ_f (fm/c)