SHANNON ENTROPY FOR PP COLLISIONS AT RHIC AND LHC ENERGIES

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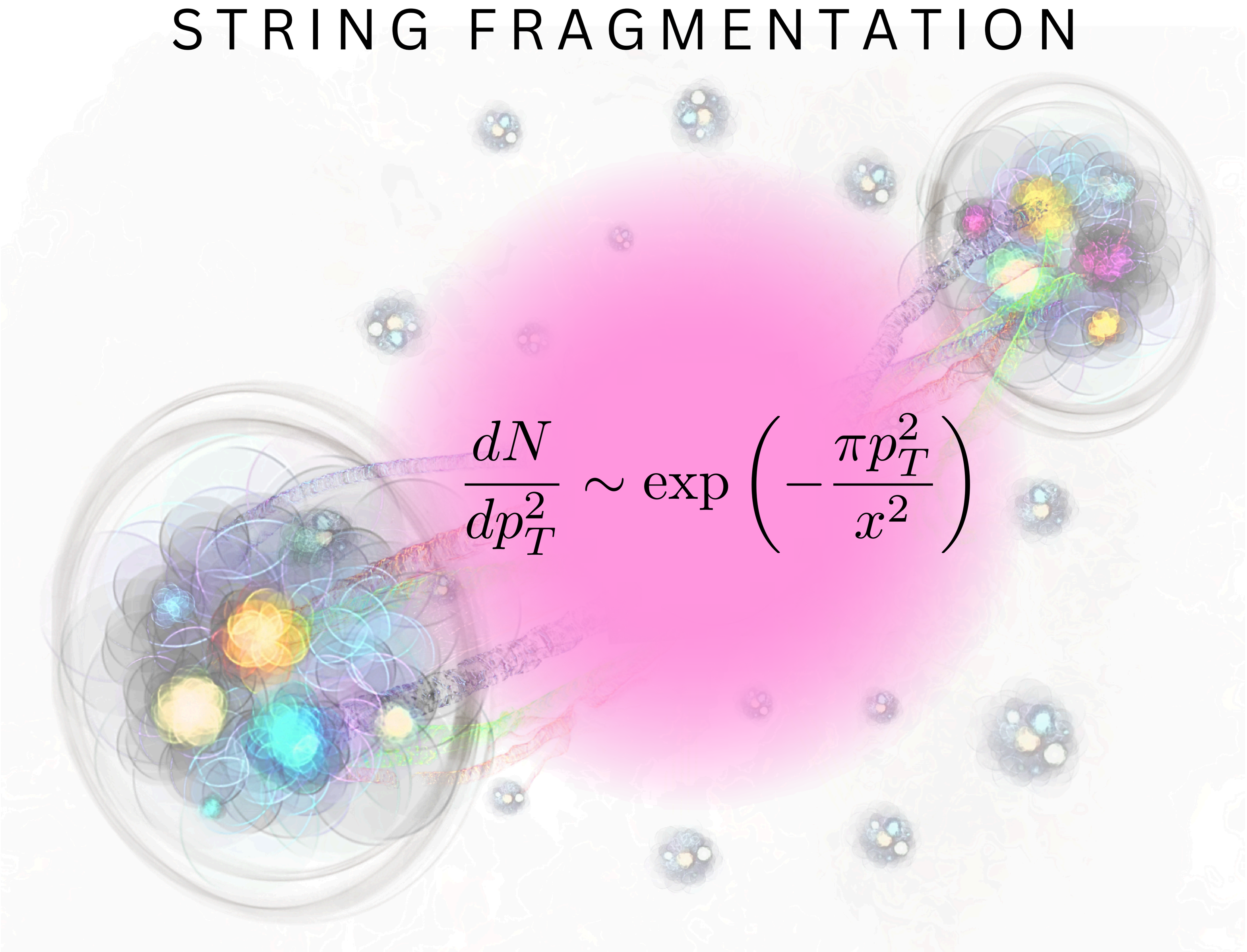
We present a transverse momentum spectra analysis using the thermal distribution and Tricomi functions, which can be derived from the Schwinger mechanism convoluted with Gaussian and q-Gaussian string tension fluctuations, respectively. We determine the statistics of the charged particles' invariant yield by analyzing the experimental data of charged particle production in minimum bias pp collisions reported by RHIC and LHC experiments. We compute the Shannon entropy, finding that the heavy tail of the spectrum leads to a rise in the monotonically increasing behavior of the entropy as a function of the center of mass energy.

STRING FRAGMENTATION



STRING TENSION FLUCTUATIONS

Thermal description (Gaussian)

$$\mathcal{N}_G \exp\left(-\frac{x^2}{2\varsigma^2}\right)$$

Nonthermal description (q-Gaussian)

$$\mathcal{N}_{qG}\left(1+\frac{(q-1)x^2}{2\sigma^2}\right)^{\frac{1}{1-q}}$$

Transverse momentum distribution

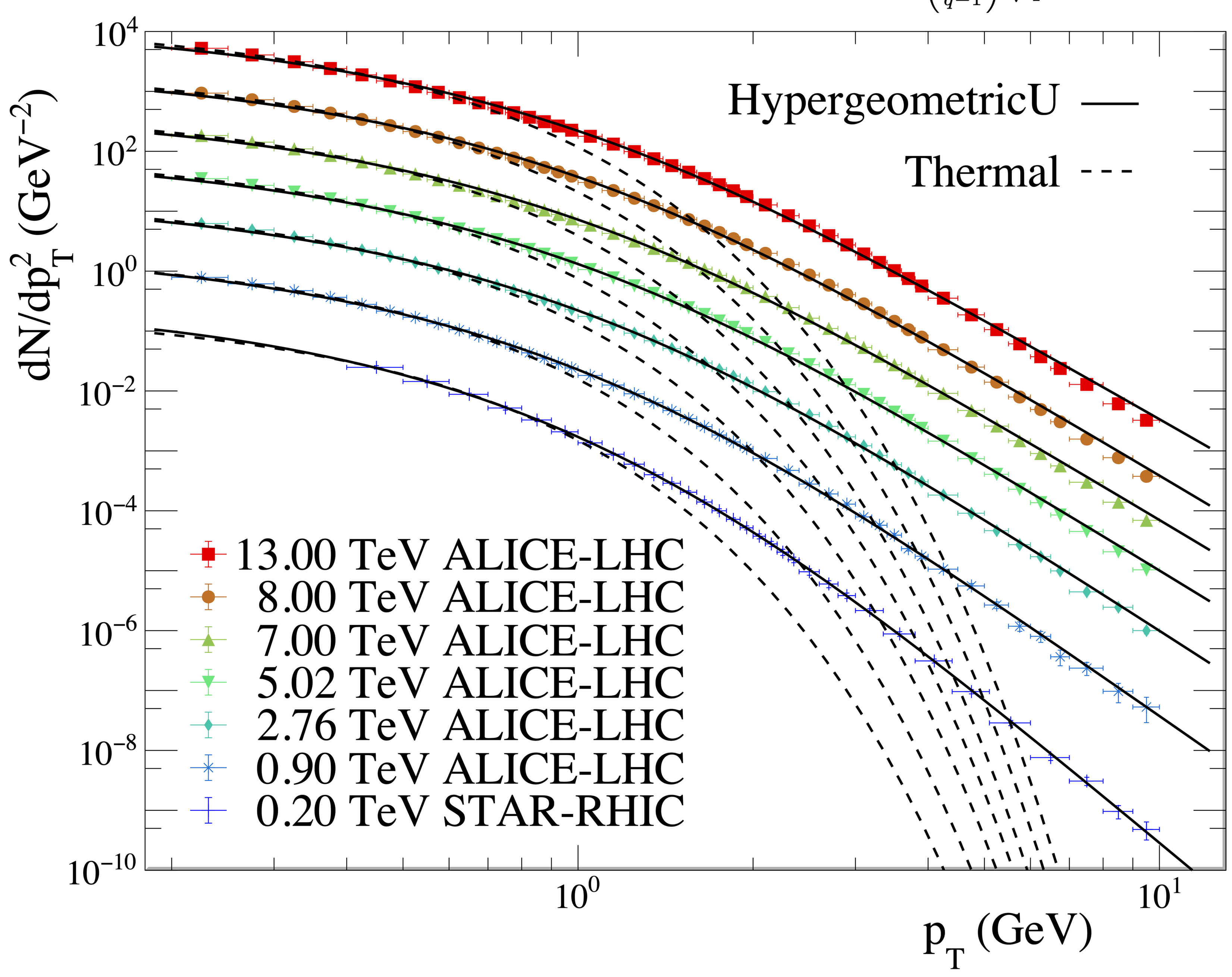
$$\frac{dN}{dp_T^2} \sim \int_0^\infty P(x)\exp\left(-\frac{\pi p_T^2}{x^2}\right)dx$$

$$\sim \exp\left(-\frac{p_T}{T_{\rm th}}\right)$$

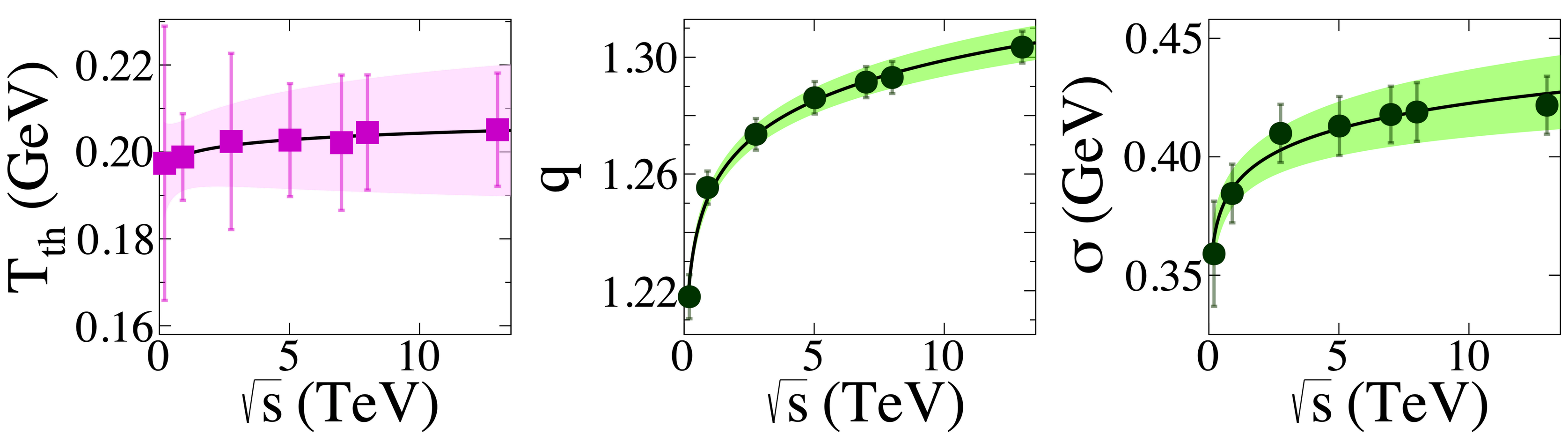
Soft scale $T_{\rm th} = \varsigma/\sqrt{2\pi}$

$$\sim U\left(\frac{1}{q-1}-\frac{1}{2},\frac{1}{2},\pi p_T^2\frac{q-1}{2\sigma^2}\right)$$

Soft scale $T_U = \frac{\sigma}{\sqrt{2\pi}}\frac{\Gamma\left(\frac{1}{q-1}-\frac{1}{2}\right)}{\Gamma\left(\frac{1}{q-1}\right)\sqrt{q-1}}$



Parameter's energy dependence (power law)

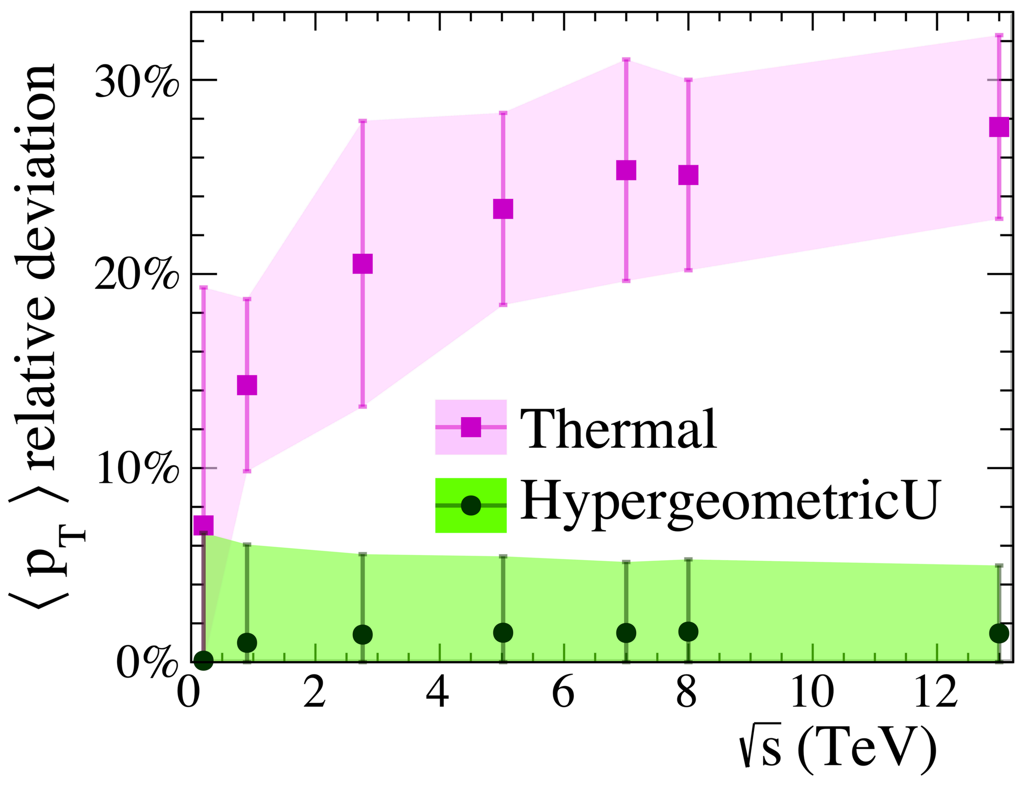


MOMENTS OF DISTRIBUTION

$$I_n = \int p_T^n \frac{dN}{dp_T^2}dp_T$$

Mean transverse momentum

$$\langle p_T\rangle = I_2/I_1$$

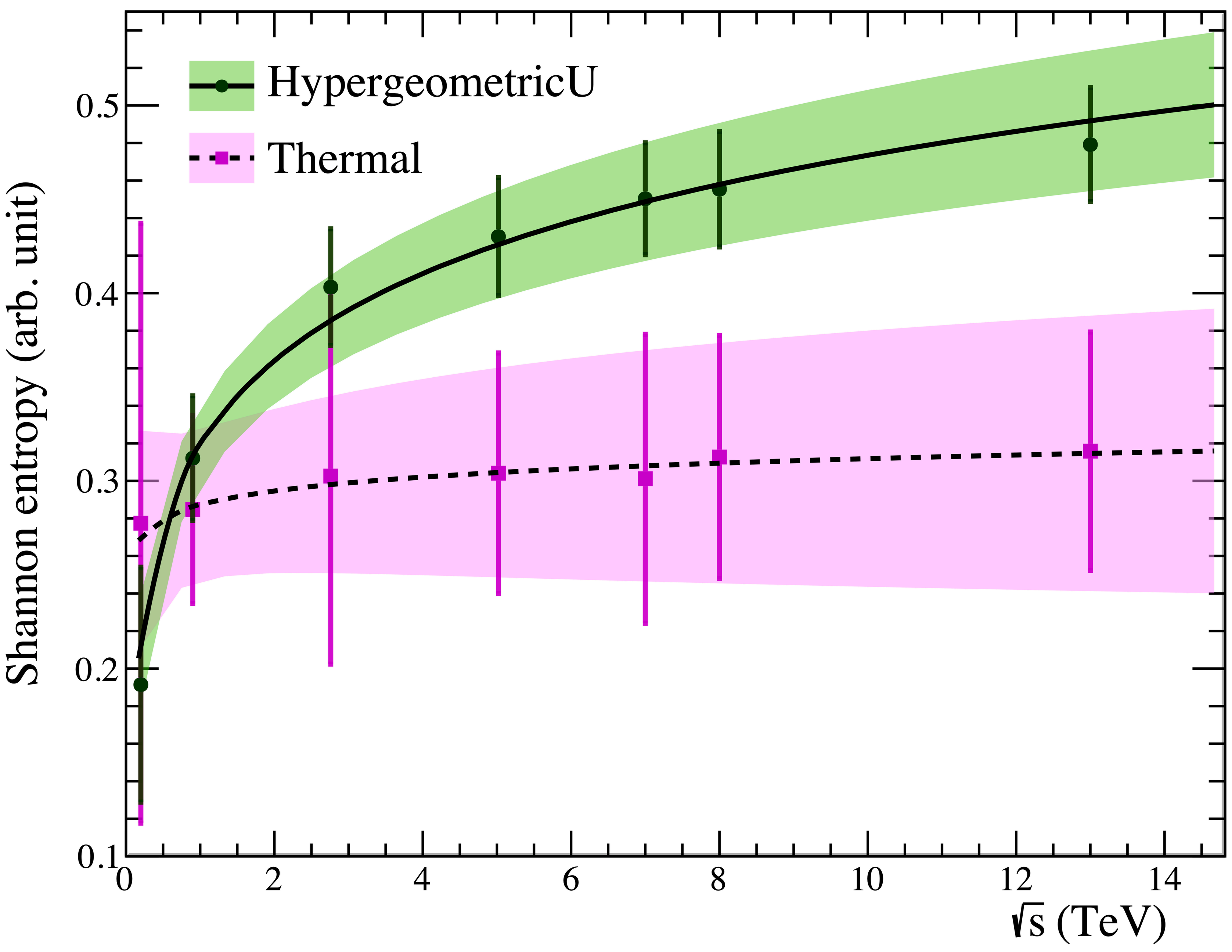


The nonequilibrium approximation improves the system description

SHANNON ENTROPY

$$\mathcal{H} = -\int_0^\infty \mathrm{nTMD}\ln(\mathrm{nTMD})dp_T$$

$$\mathrm{nTMD} = \frac{1}{I_0}\frac{dN}{dp_T^2}$$



CONCLUSIONS

The nonequilibrium approximation leads to a better description of the system.

The Shannon entropy grows with the center of mass energy of the collisions, implying that more energetic collisions produce more information.

The heavy tail of the spectrum leads to a more pronounced monotonically increase in the entropy.

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