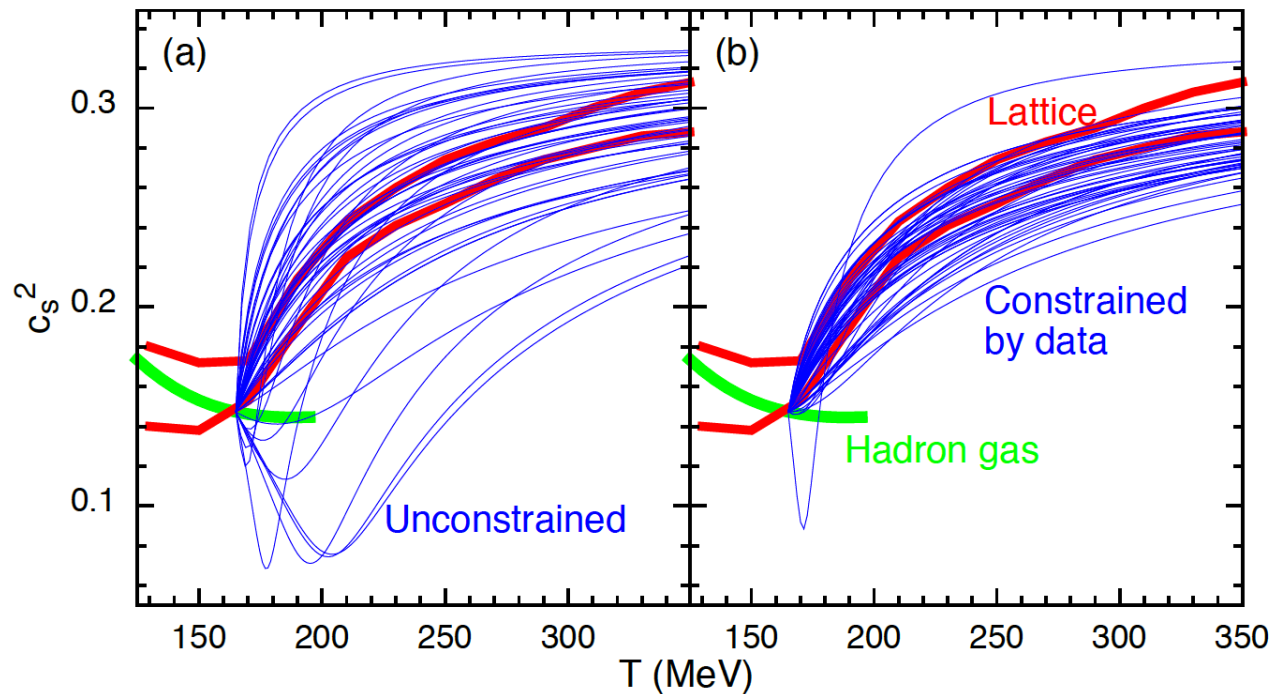


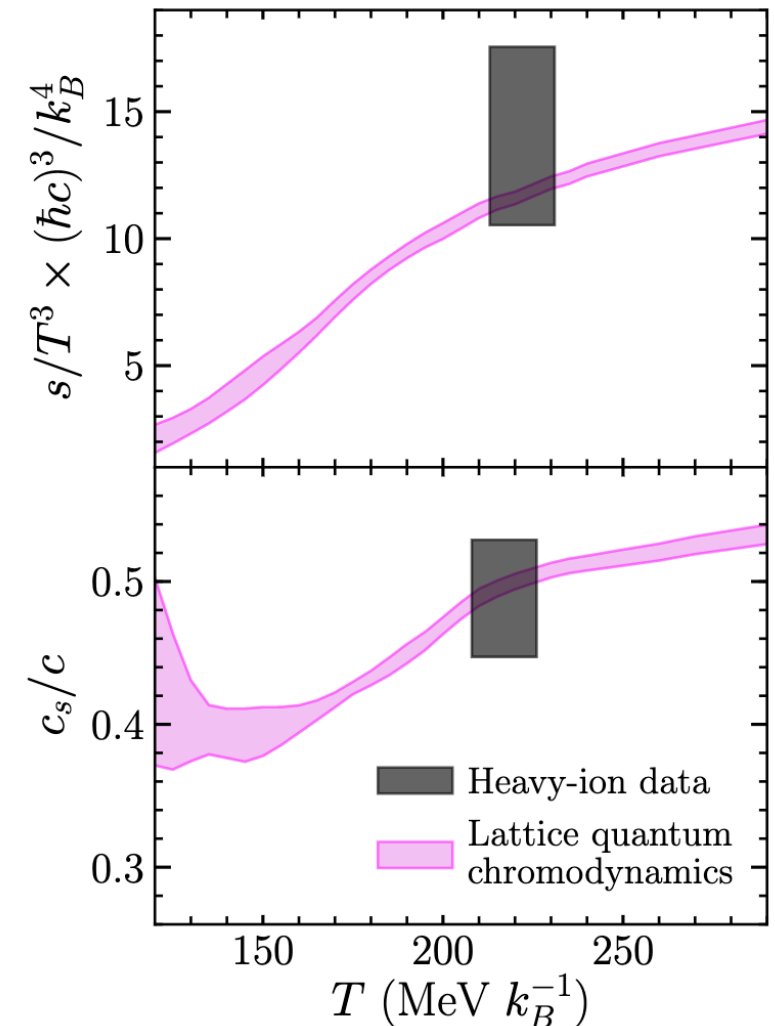
Particle Production and freeze-out

Is lattice QCD suitable to describe the HI system?

- Equation of state



S. Pratt et al., PRL (2015)



F. Gardim et al., Nature Physics (2020)

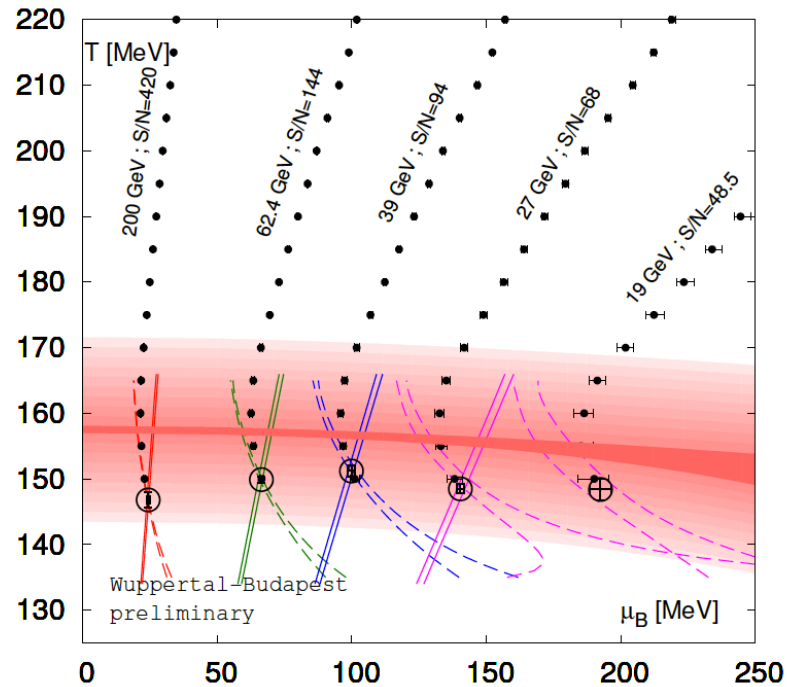
Particle Production and freeze-out

Comparison with lattice QCD

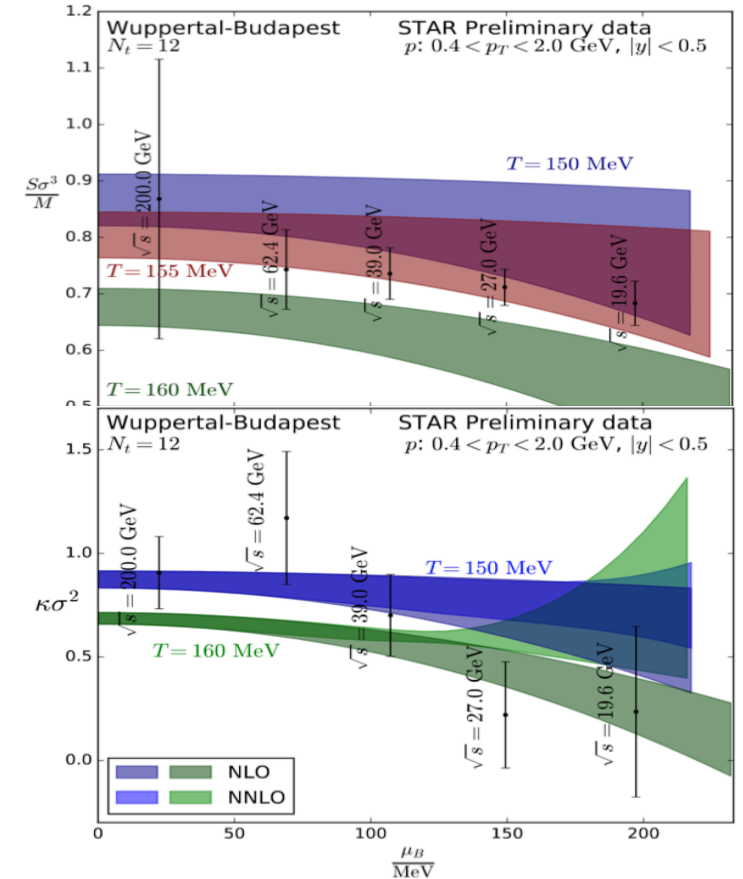
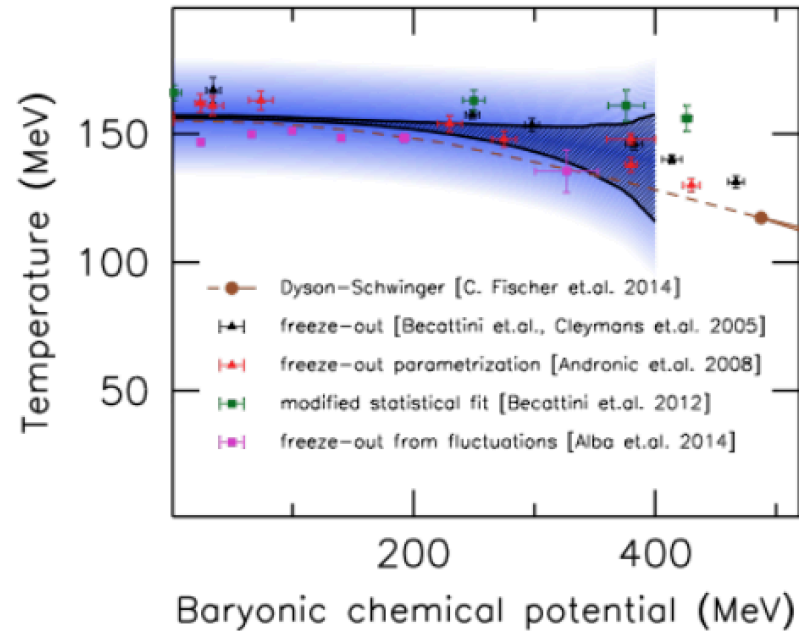
WB, JHEP (2018)

- Fluctuations of conserved charges

WB collaboration, 2013



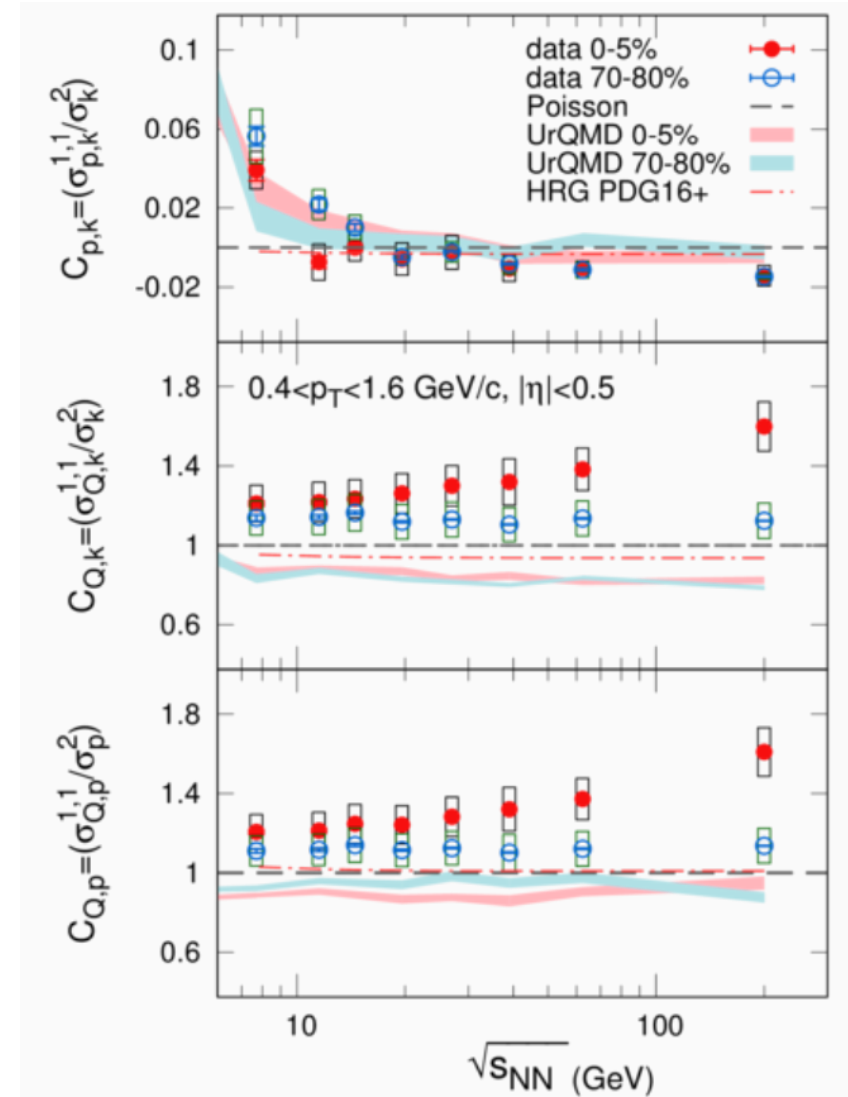
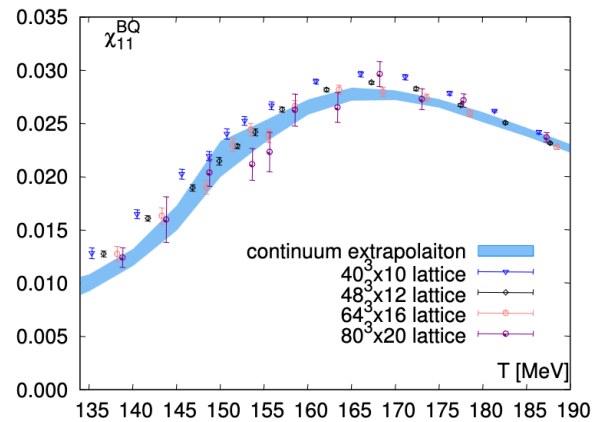
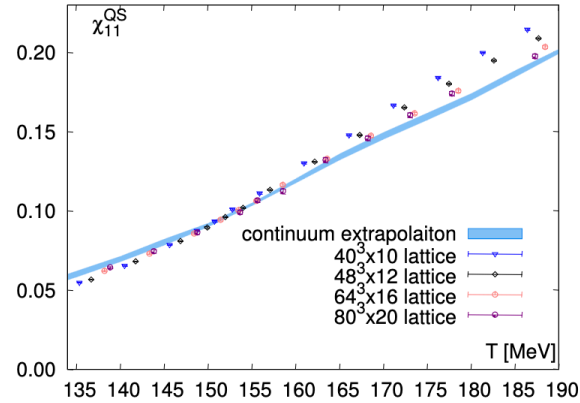
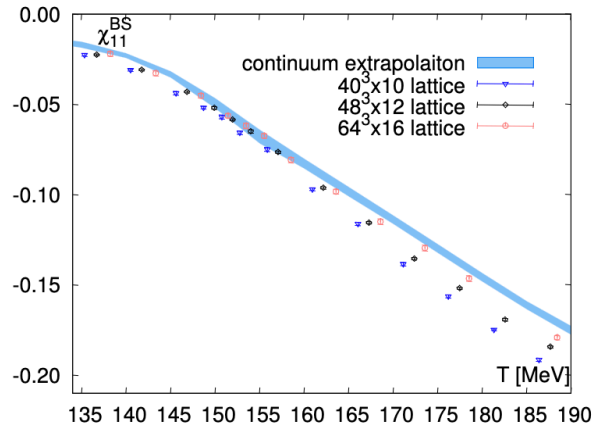
WB collaboration, PLB (2015)



Particle Production and freeze-out

Conserved charge correlators

Experimental Proxies

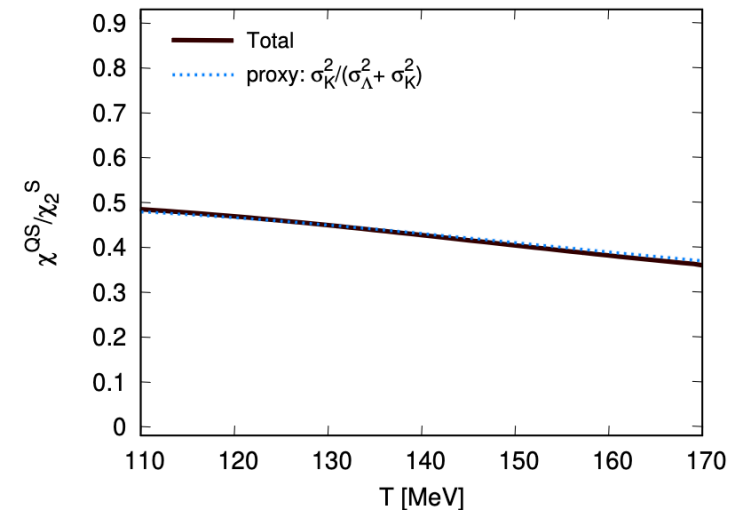
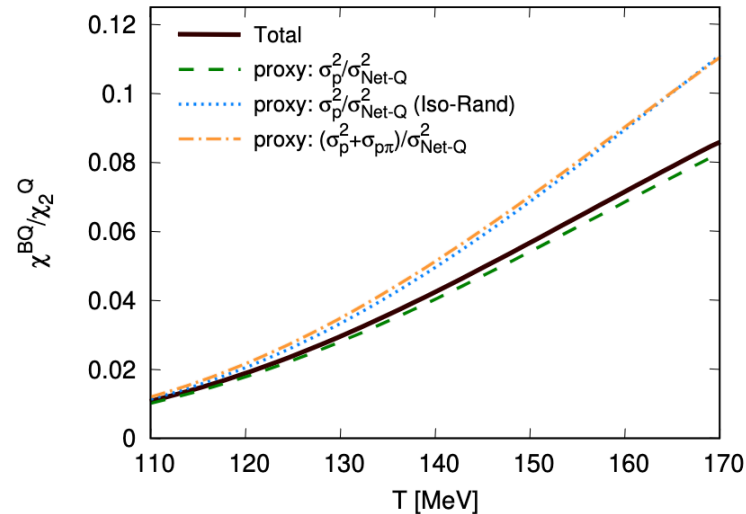
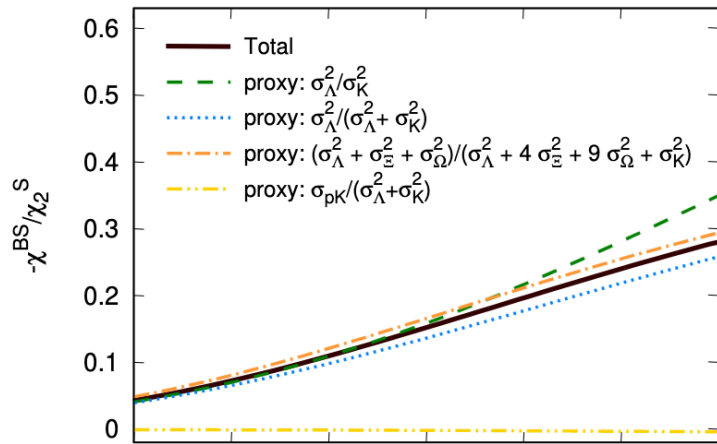
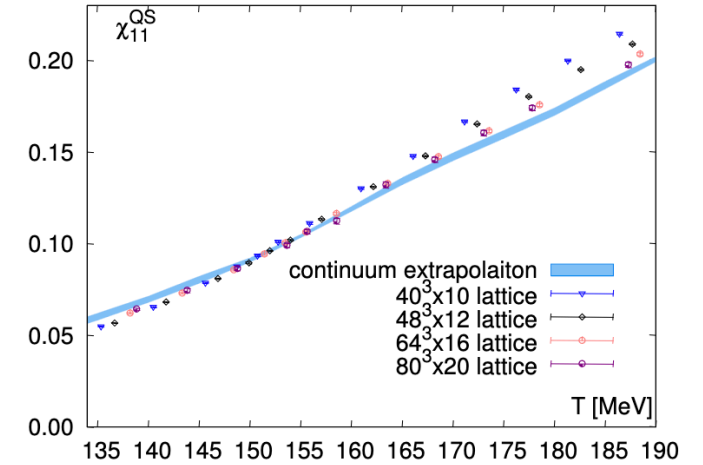
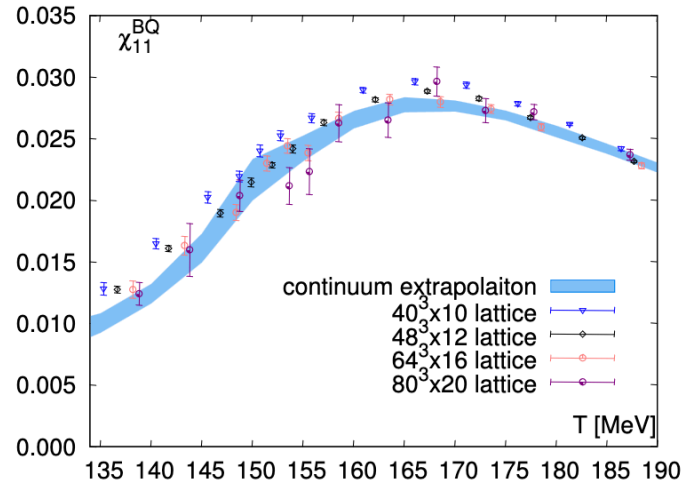
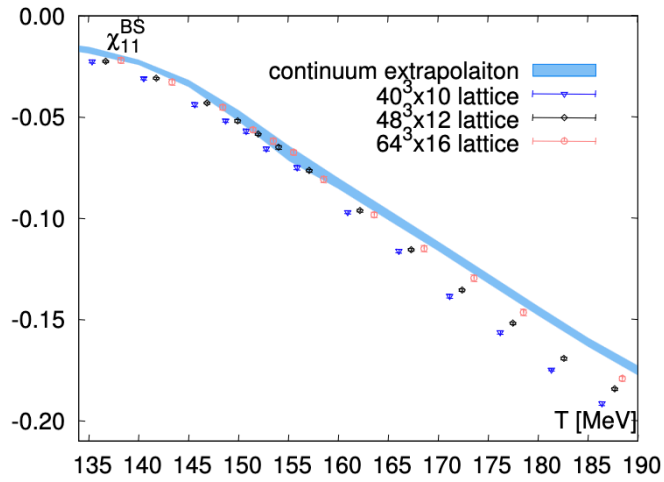


STAR: Phys.Rev.C 100 014902
(2019)

Particle Production and freeze-out

Conserved charge correlators

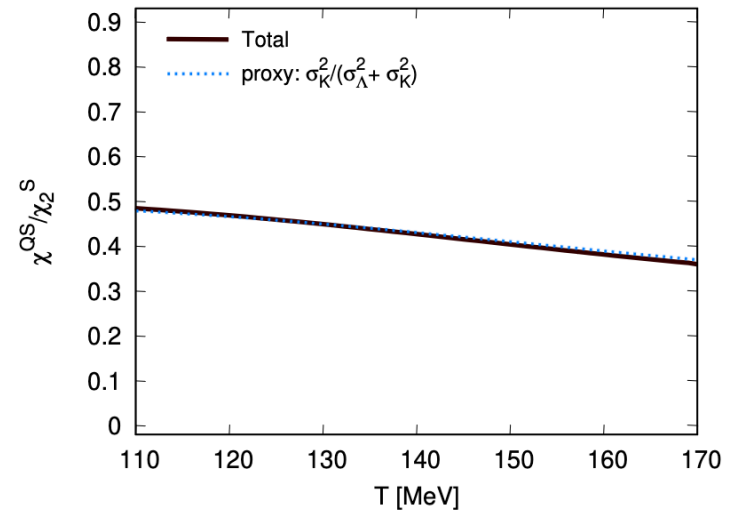
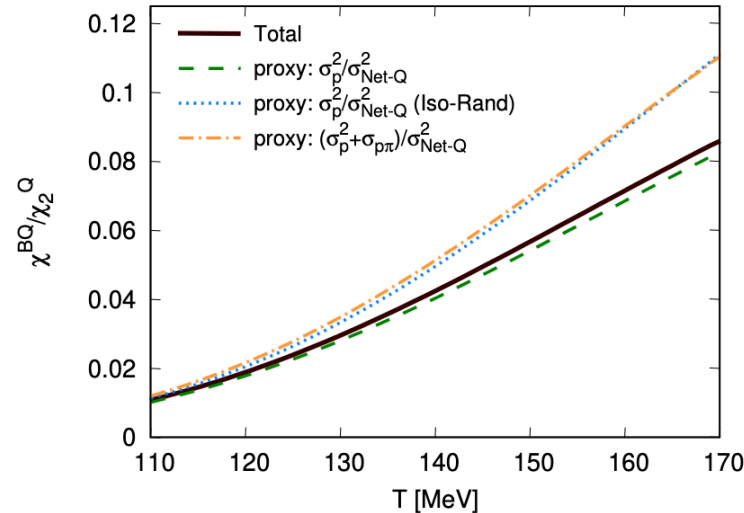
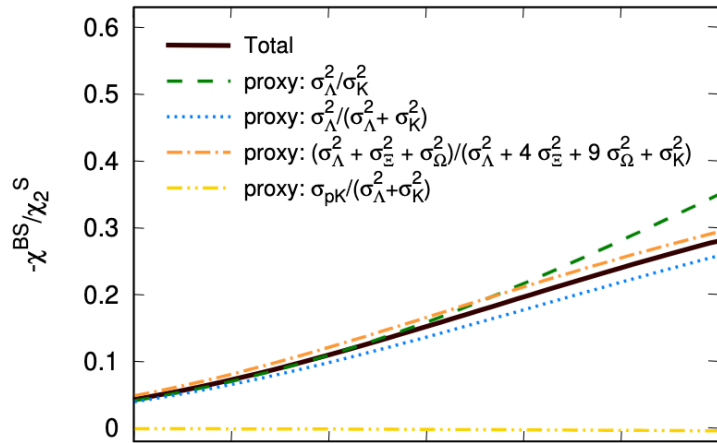
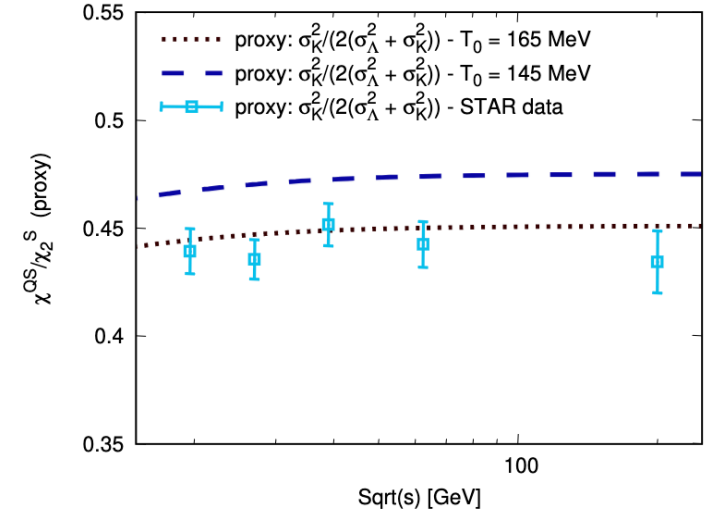
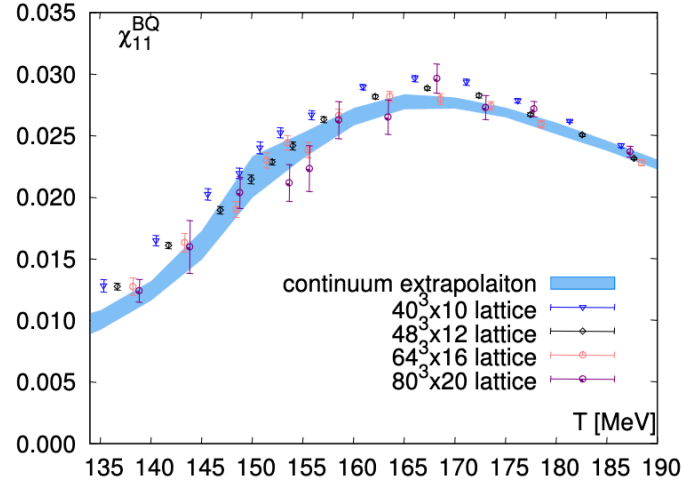
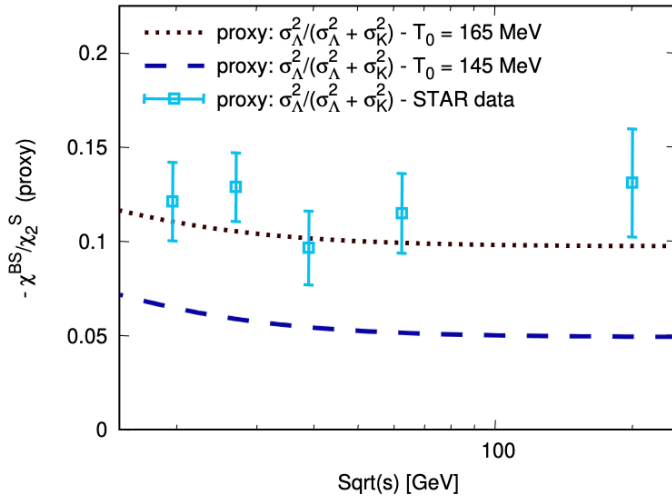
Experimental Proxies



Particle Production and freeze-out

Conserved charge correlators

Experimental Proxies

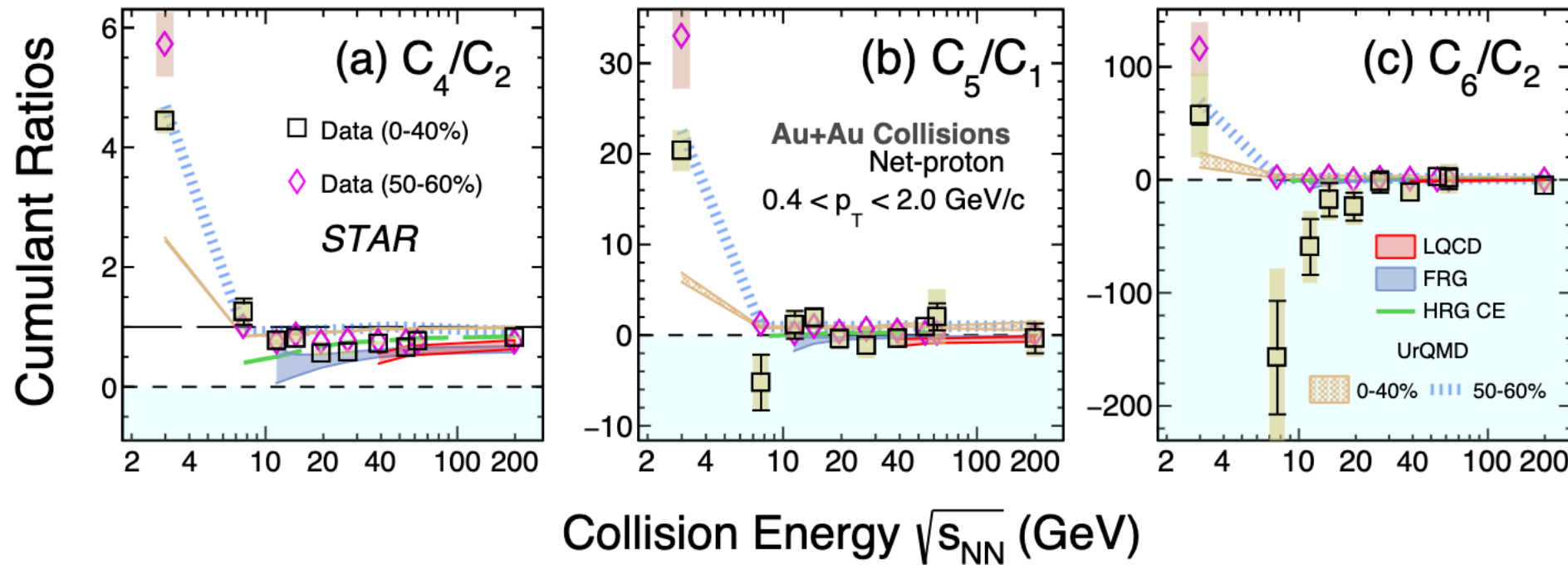


Particle Production and freeze-out

Search for the QCD critical point

- Critical point signatures

STAR, PRL (2022)



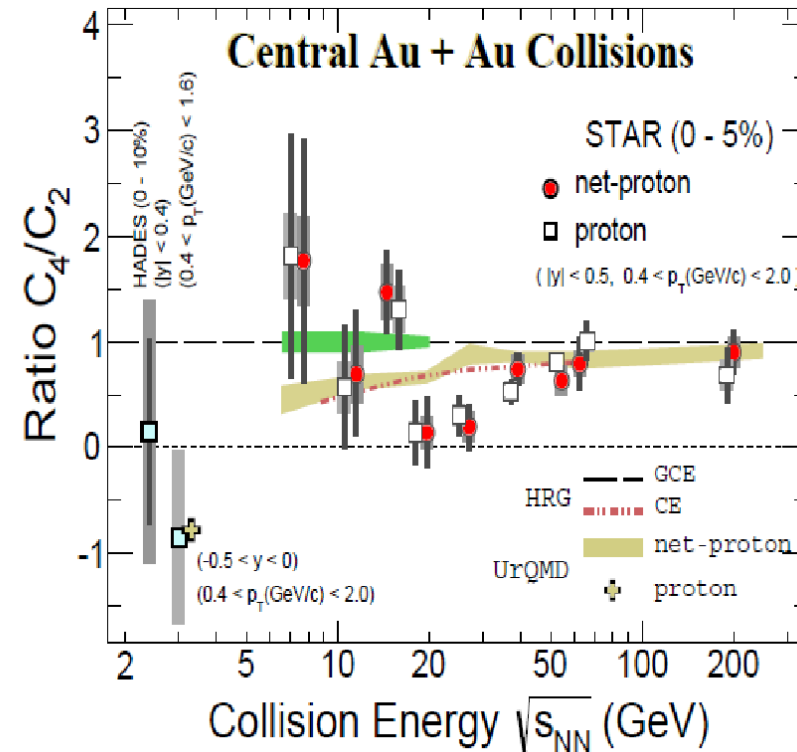
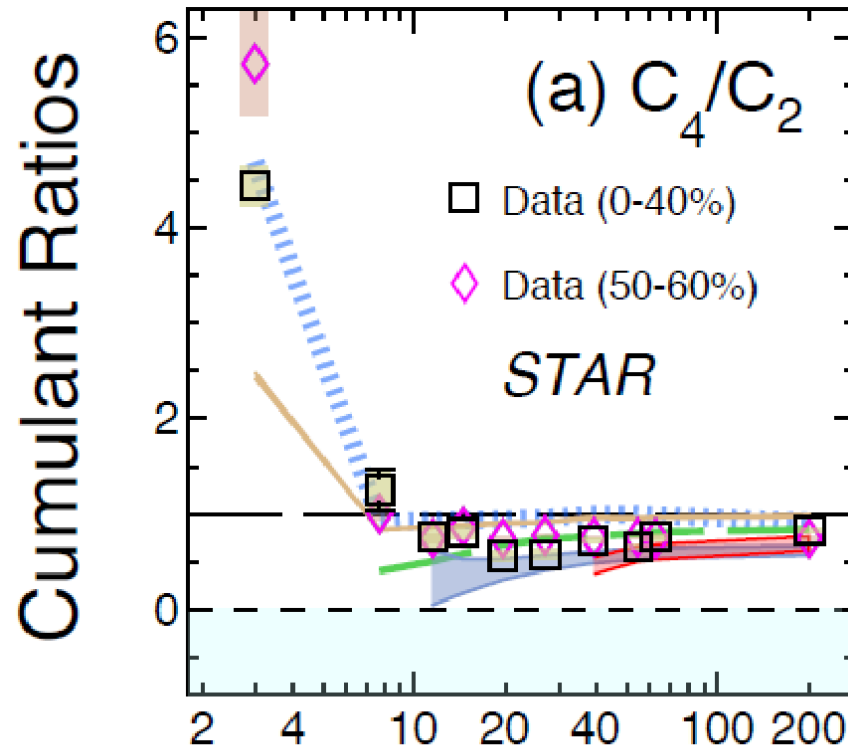
- What is the 3 GeV point telling us?

Particle Production and freeze-out

Search for the QCD critical point

Phys.Rev.Lett. 130 (2023) 8, 082301

Phys.Rev.Lett. 128 (2022) 20, 202303



Particle Production and freeze-out

Issues with fluctuations of conserved charges

- For a theory-experiment comparison, we need to remove all spurious sources of fluctuations
- Baryon number conservation
- Initial volume fluctuations
- Acceptance cuts
- Probabilistic nature of resonance decays
- Conserved charges versus particles

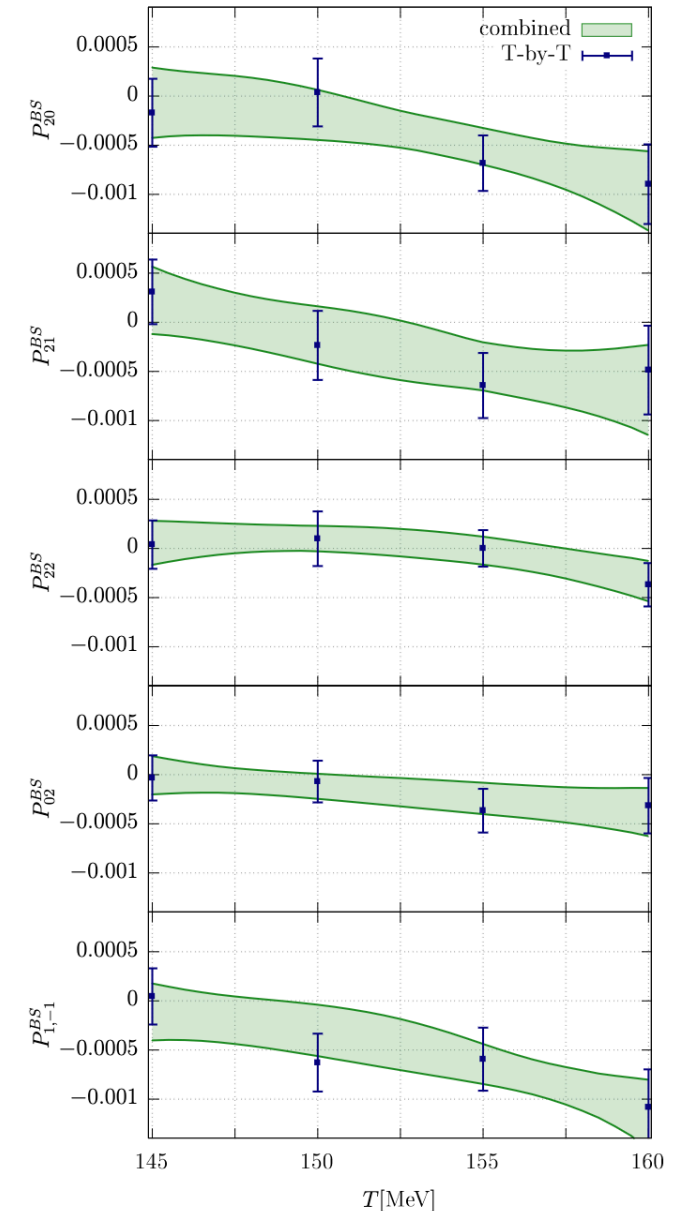
Particle Production and freeze-out

R. Bellwied et al., PRD (2022)

Fugacity expansion

- We expand the QCD pressure as a Laurent expansion in e^{μ_B} and e^{μ_S}
- Due to charge conjugation symmetry, it becomes an expansion in hyperbolic cosines:

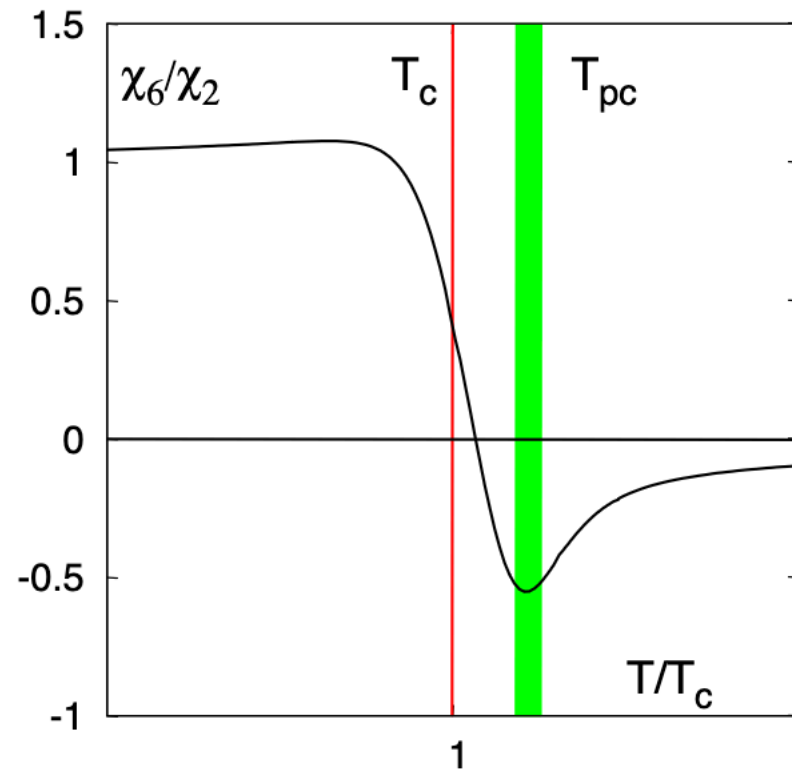
$$P(T, \hat{\mu}_B, \hat{\mu}_S) = \sum_{j,k} P_{jk}^{BS}(T) \cosh(j\hat{\mu}_B - k\hat{\mu}_S)$$



Particle Production and freeze-out

Chiral criticality

B. Friman et al., EPJC (2011)



- Chiral models predict that χ_6/χ_2 is negative at the peak of the chiral susceptibility
- Preliminary lattice QCD results confirm this behavior
- Do we have the resolution to observe this in experiment?

Particle Production and freeze-out

Thermal fits

- Is ideal HRG model good enough?
- Scattering phase shifts
- Van der Waals corrections at high density
- Baryon-antibaryon annihilation

A. Andronic et al., PLB (2019)

