Thermal Transitions in Dense Two-Colour QCD

Dale Lawlor[1], Simon Hands[2], Seyong Kim[3], Jon-Ivar Skullerud[1]

[1]Department of Theoretical Physics; National University of Ireland, Maynooth
[2]Department of Mathematical Sciences; University of Liverpool
[3]Department of Physics; Sejong University

XQCD 2022, 27th July 2022

**Ollscoil
Mhá Nuad**
Ollscoil na hÉireann
Má Nuad

Why QC$_2$D?

- Would like to probe dense QCD on the lattice
- Sign problem means probability density is complex for real QCD at $\mu_B \neq 0$, but is non-negative in $SU(2)$ QCD
- Baryons are now quark-quark pairs, so follow Bose-Einstein Statistics
- Enables us to apply lattice techniques to areas like Neutron Star physics.
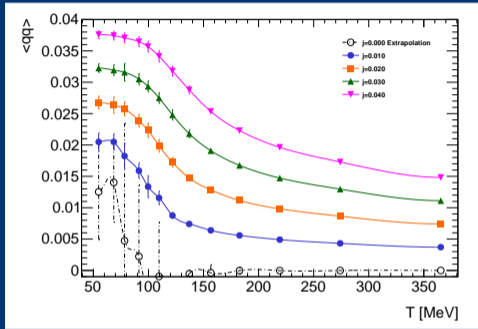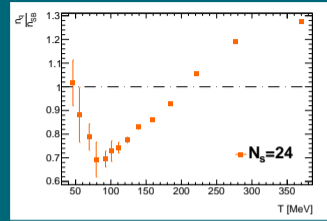- This particular study is on runs at a larger volume and range of diquark sources

Lattice Setup
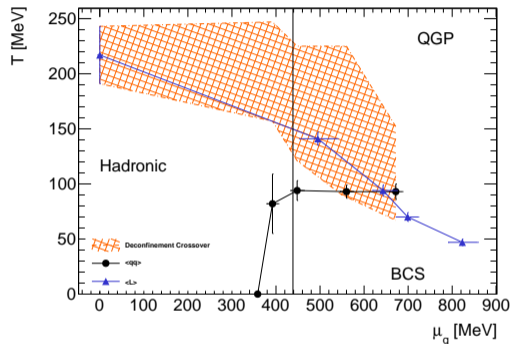
Phase diagram of QC$_2$D for $\frac{m_\pi}{m_\rho} = 0.80(1)$.

- Using a spatial extent $N_s = 24$
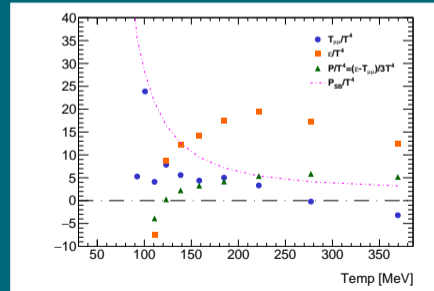- Conducted a temperature scan using fixed $\beta = 1.9$ at $a\mu_b = 0.400$

Superfluid Phase Transition

Quark Number Density

Thermodynamic Observables

► The superfluid phase transition occurs around $T \sim 100\,\text{MeV}$.

► This indicates that the superfluid phase transition is indeed distinct from the deconfinement crossover.