Equations of state with conserved charge conditions for heavy-ion collisions

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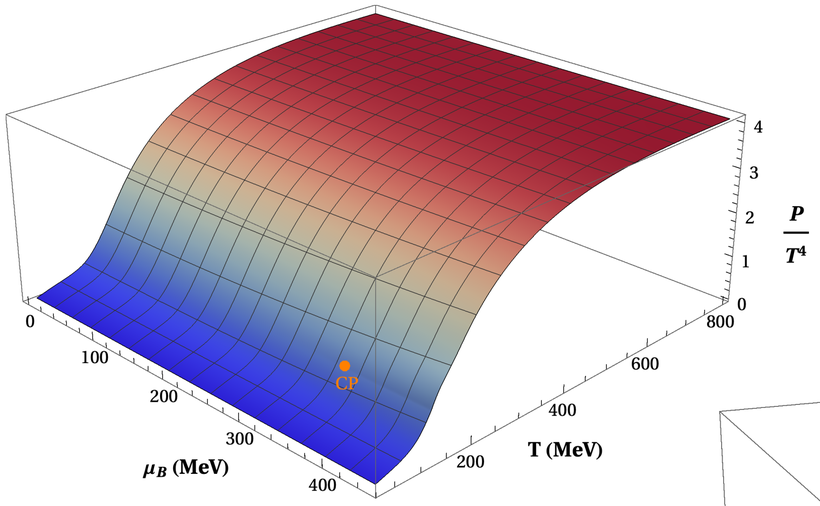
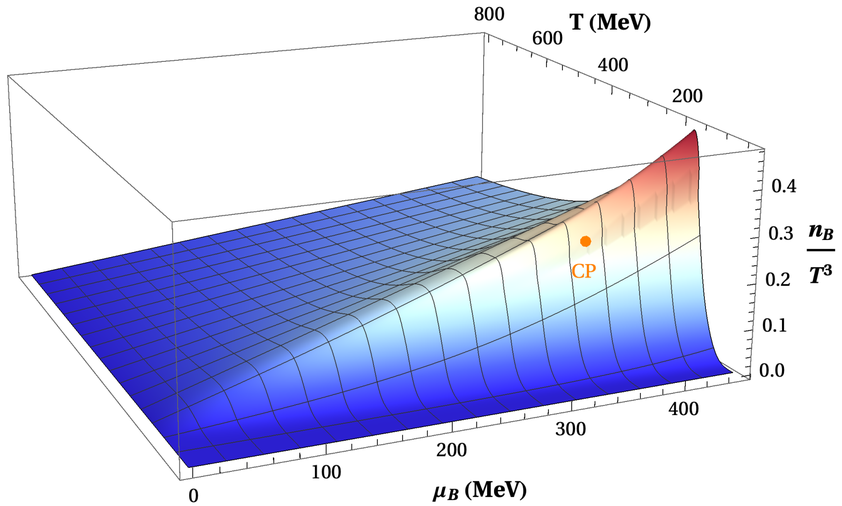
EoS Thermodynamic Outputs

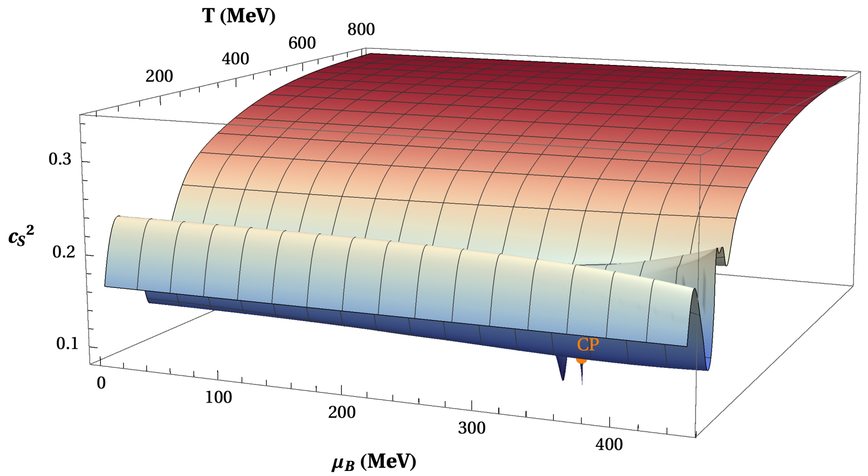
- Pressure and its derivatives show effects of a critical point in the QCD phase diagram



Pressure



Baryon density



Speed of sound

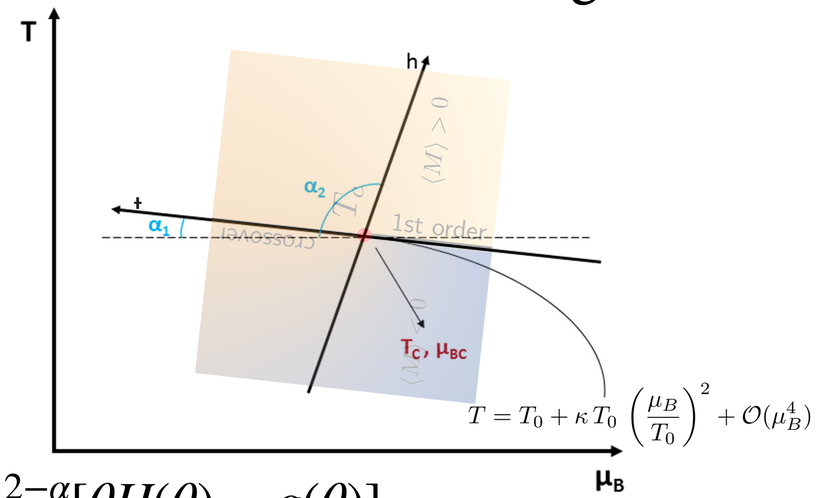
J.M. Karthein, D. Mroczek et al, EPJ Plus (2021)

The Scaling Equation of State

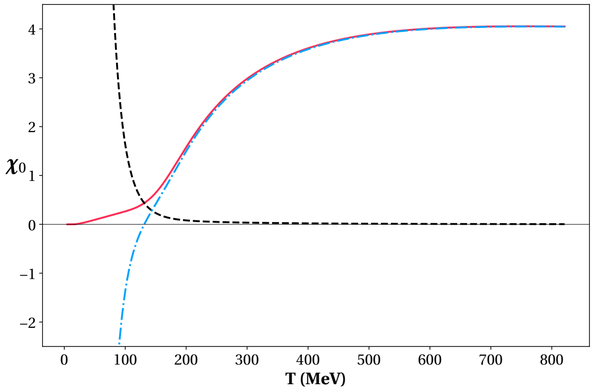
- Criticality is implemented by mapping the critical point from the 3D Ising model onto the QCD phase diagram

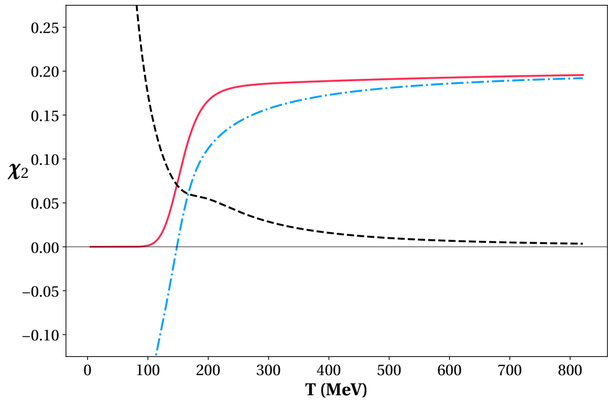
$$\frac{T - T_C}{T_C} = w\ (t\ \rho\ sin\alpha_1 + h\ sin\alpha_2)$$

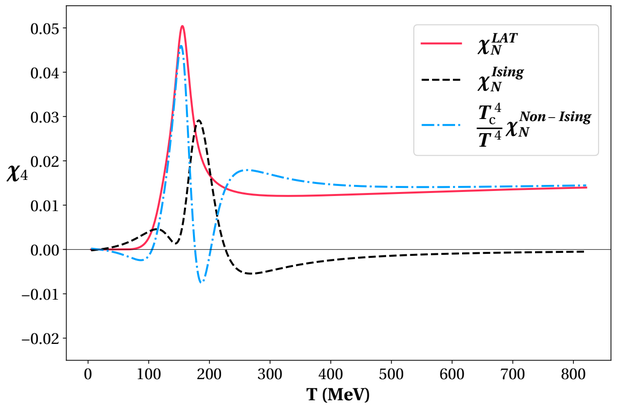
$$\frac{\mu_B - \mu_{B,C}}{T_C} = -\ w\ (t\ \rho\ cos\alpha_1 + h\ cos\alpha_2)$$



- Pressure from scaling equation of state: $P = -G = h_0 M_0 R^{2-\alpha}[\theta H(\theta) - g(\theta)]$
- Singular and non-singular contributions to the pressure: $\chi_N^{Lat}(T) = \chi_N^{Ising}(T) + \chi_N^{Non-Ising}(T)$



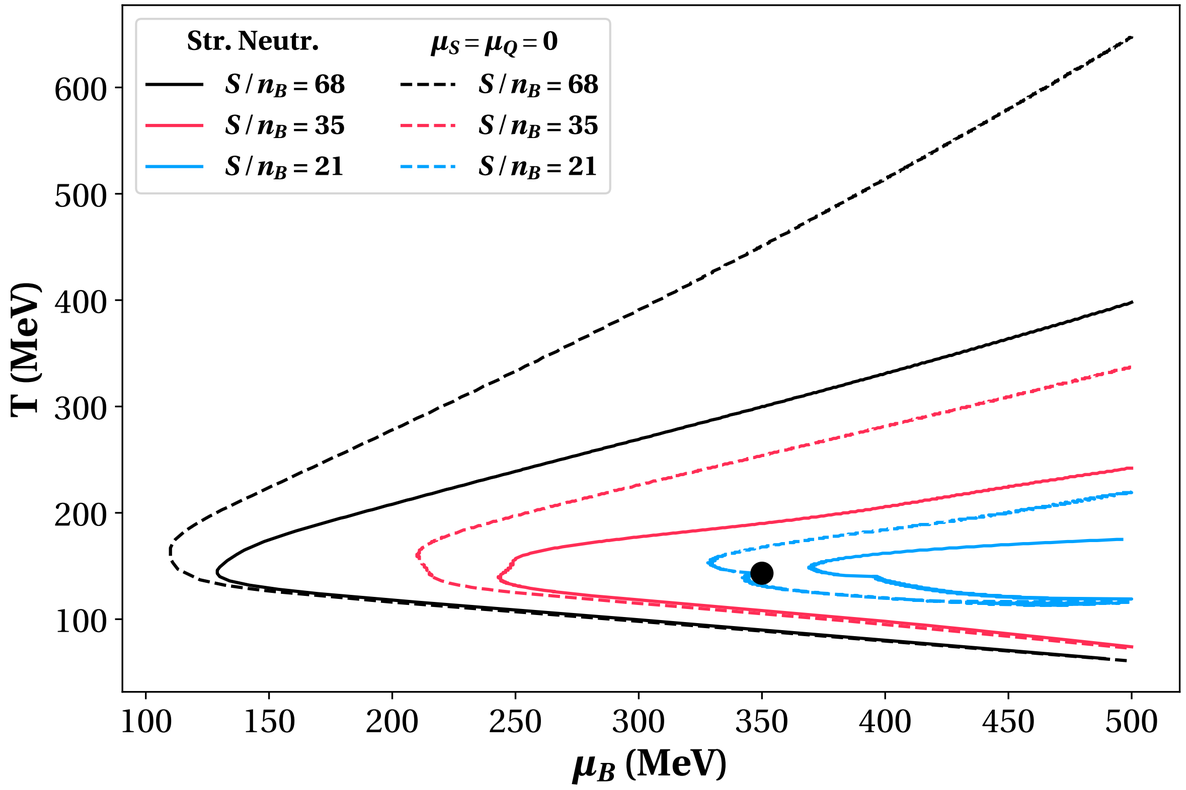




P. Parotto et al, PRC (2020)
A. Bzdak et al, Phys. Rep. (2020)
C. Nonaka, M. Asakawa, PRC (2005)
J. Zinn-Justin Quantum Field theory and Critical Phenomena

Isentropic Trajectories and Conserved Charge Constraints

- Isentropes show the path of the HIC system through the phase diagram in the absence of dissipation
  - Different path when conserved charge conditions applied: $\langle n_S \rangle = 0 \quad \langle n_Q \rangle = 0.4 \langle n_B \rangle$



J.M. Karthein, D. Mroczek et al, EPJ Plus (2021)