

The thermodynamics of heavy light hadrons at freezeout

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For Bielefeld-BNL-CCNU collaboration

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The issues addressed in this work

- Do the charm quarks deconfine at the chiral crossover transition?
- Does QCD thermodynamics gives information about abundances of open charm (and strange) hadrons in confined phase?

Consequence: Additional charm hadrons contribute to feed-down mechanism → reconsidered for the statistical hadronization at freezeout?

[Braun-Munzinger, Stachel, 00, Andronic, Braun-Munzinger, Redlich, Stachel, 06]

The melting of open charm hadrons

- The total pressure of an ensemble of non-interacting charm hadrons and resonances:

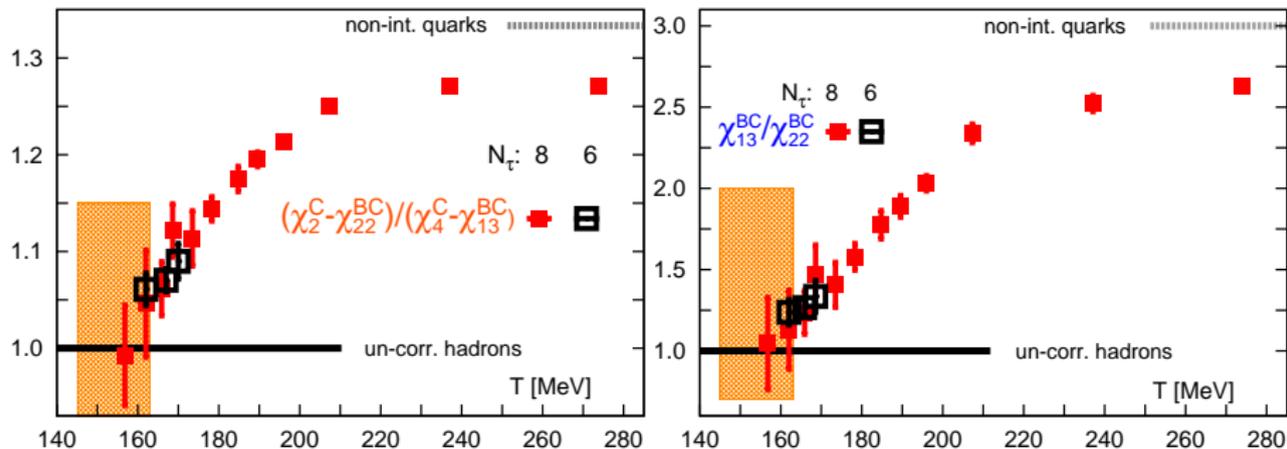
$$P(\hat{\mu}_C, \hat{\mu}_B) = P_M \cosh(\hat{\mu}_C) + P_{B,C=1} \cosh(\hat{\mu}_B + \hat{\mu}_C) \\ + \underbrace{P_{B,C=2} \cosh(\hat{\mu}_B + 2\hat{\mu}_C) + P_{B,C=3} \cosh(\hat{\mu}_B + 3\hat{\mu}_C)}_{\text{small contribution at the cross over}} .$$

- The susceptibilities in terms of these partial pressures ($n, m > 1, n + m = \text{even}$):

$$\chi_{nm}^{BC}(\hat{\mu} = 0) = 1^m P_{B,C=1} + 2^m P_{B,C=2} + 3^m P_{B,C=3} .$$

- We invert these relations with $\chi_{nm}^{BC}(0)$ computed with LQCD
→ **disentangle** partial pressures of meson and baryon sectors.

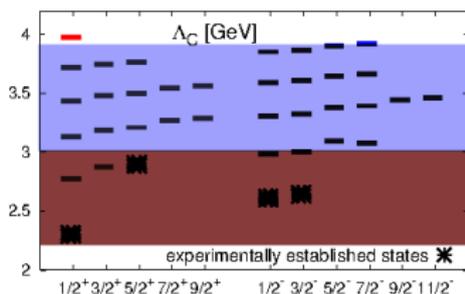
The melting of open charm hadrons



- The $P_M = \chi_2^C - \chi_{22}^{BC}$ or equivalently $\chi_4^C - \chi_{13}^{BC}$.
- $P_{B=1} \simeq \chi_{mn}^{BC}$.
- Ratio is unity in a hadron gas indep. of hadron masses and multiplicities.

Melting of open charm mesons and baryons occur at crossover

Hints of more open charm baryons from QCD thermodynamics



- The charmed baryon sector not well known experimentally
- **QM-HRG**: Hadron Resonance gas model with Quark model states + experimentally (PDG) known hadrons
- **QCD data from our lattice study provides evidence for such yet undetected states.**

