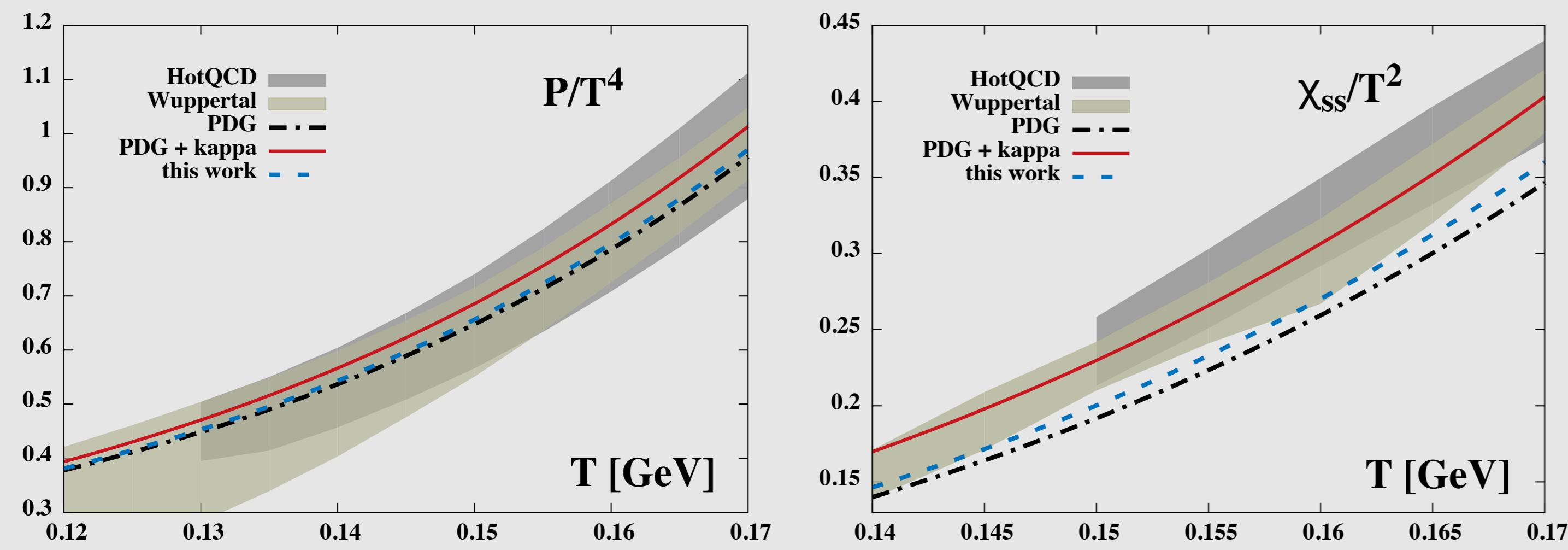


Missing Strange Resonances



- Possible resolution: $K_0^*(800)$ a.k.a. κ

- Caution! κ has a broad width.

Effects of Width on Thermodynamic Observables

S-matrix approach and Thermodynamics

1.) Empirical $K\pi$ phase shifts as input.

2.) Effective weight function \mathcal{B} :

$$\mathcal{B}(M) = 2 \frac{d}{dM} \delta(M)$$

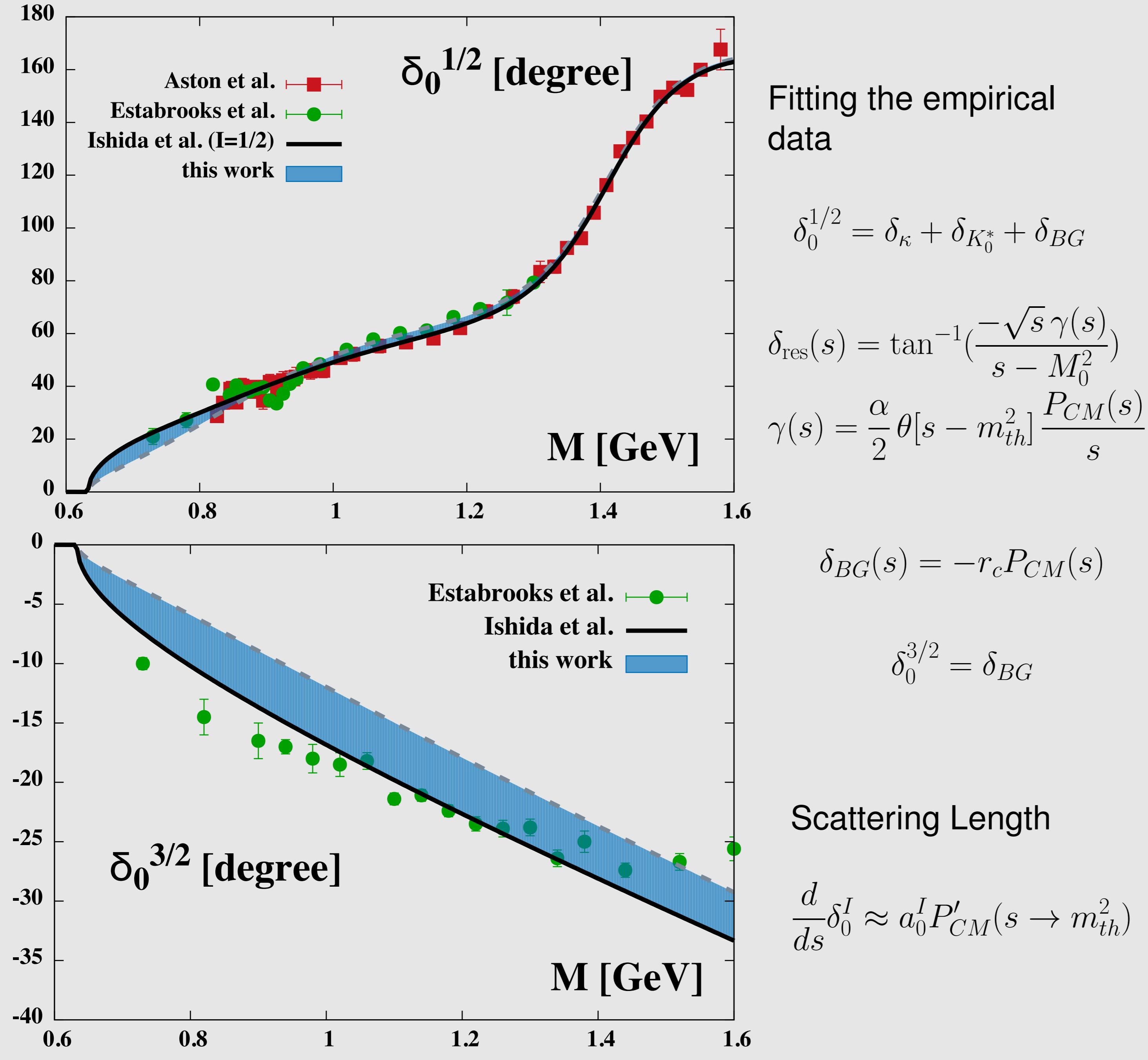
generalizes the Breit-Wigner form

$$\rightarrow 2M \frac{2M\gamma_{BW}}{(M^2 - M_0^2)^2 + M^2\gamma_{BW}^2}.$$

3.) Interaction contribution to the thermodynamic potential

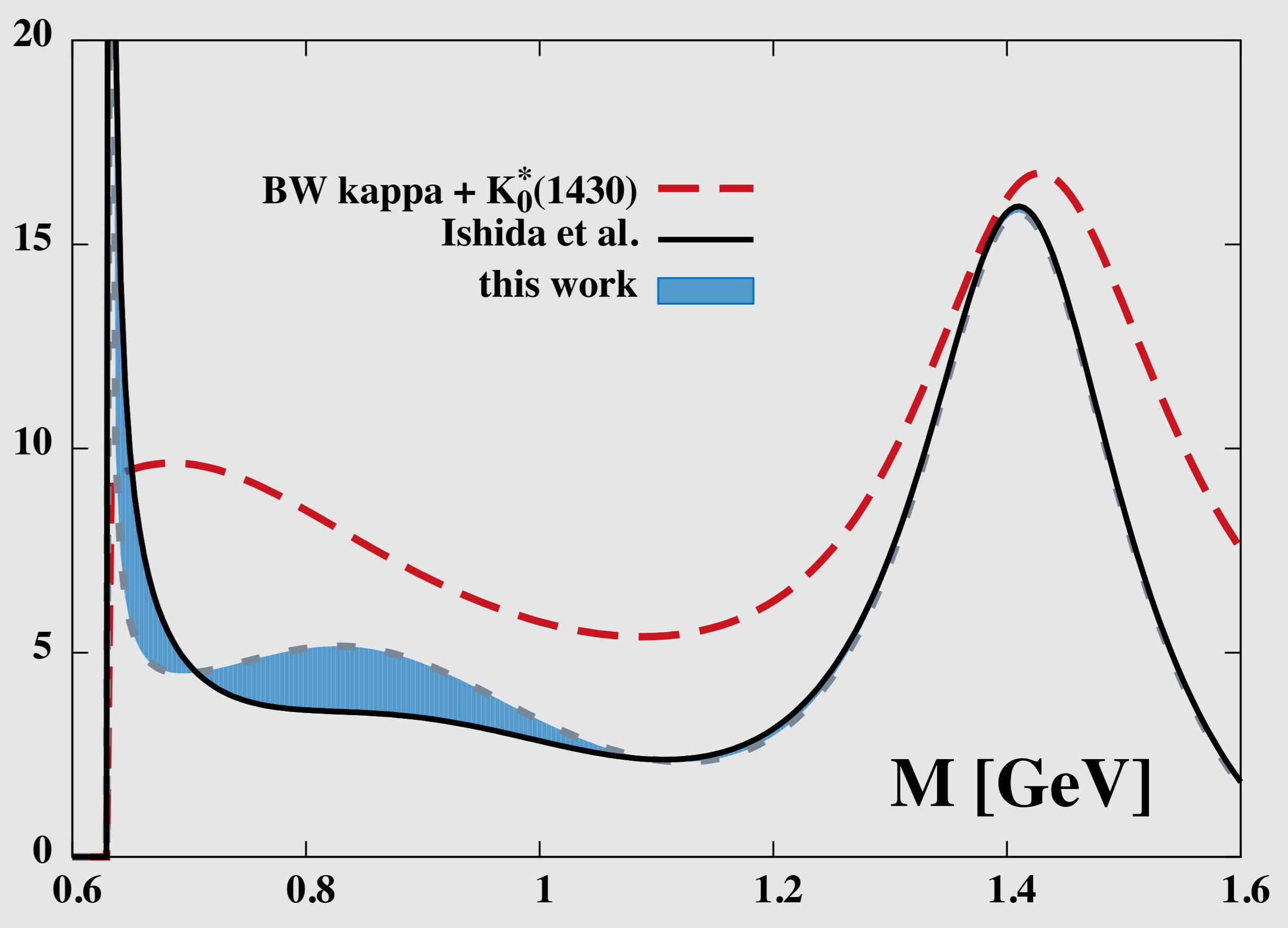
$$\Omega_{int}^B \approx 2TV \int_{m_{th}}^{\infty} \frac{dM}{2\pi} \int \frac{d^3p}{(2\pi)^3} \mathcal{B}(M) \times \left\{ \ln[1 - e^{-\beta(\sqrt{p^2 + M^2} + \mu_S)}] + \ln[1 - e^{-\beta(\sqrt{p^2 + M^2} - \mu_S)}] \right\}.$$

$K\pi$ S-wave Phase Shift

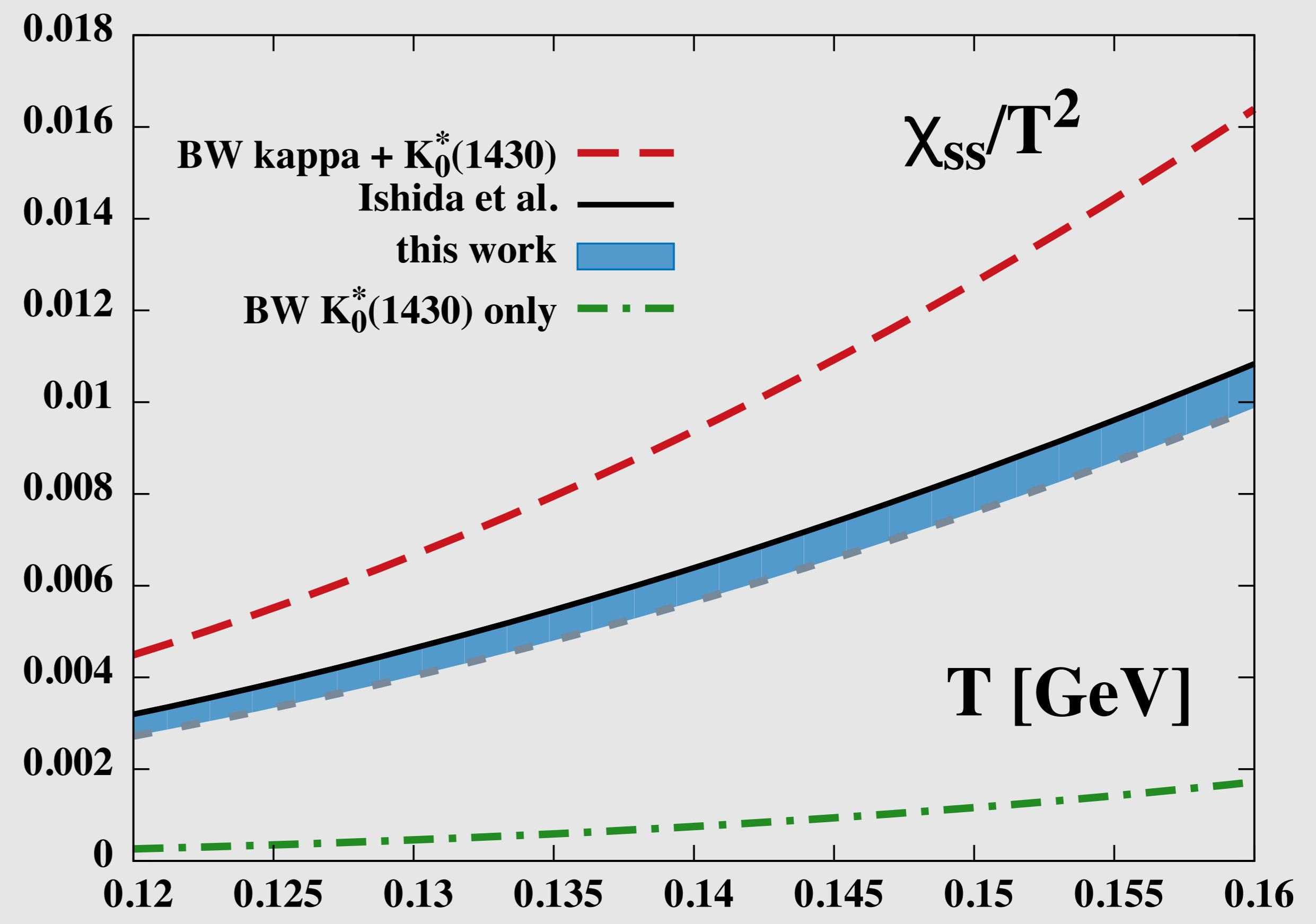


Results

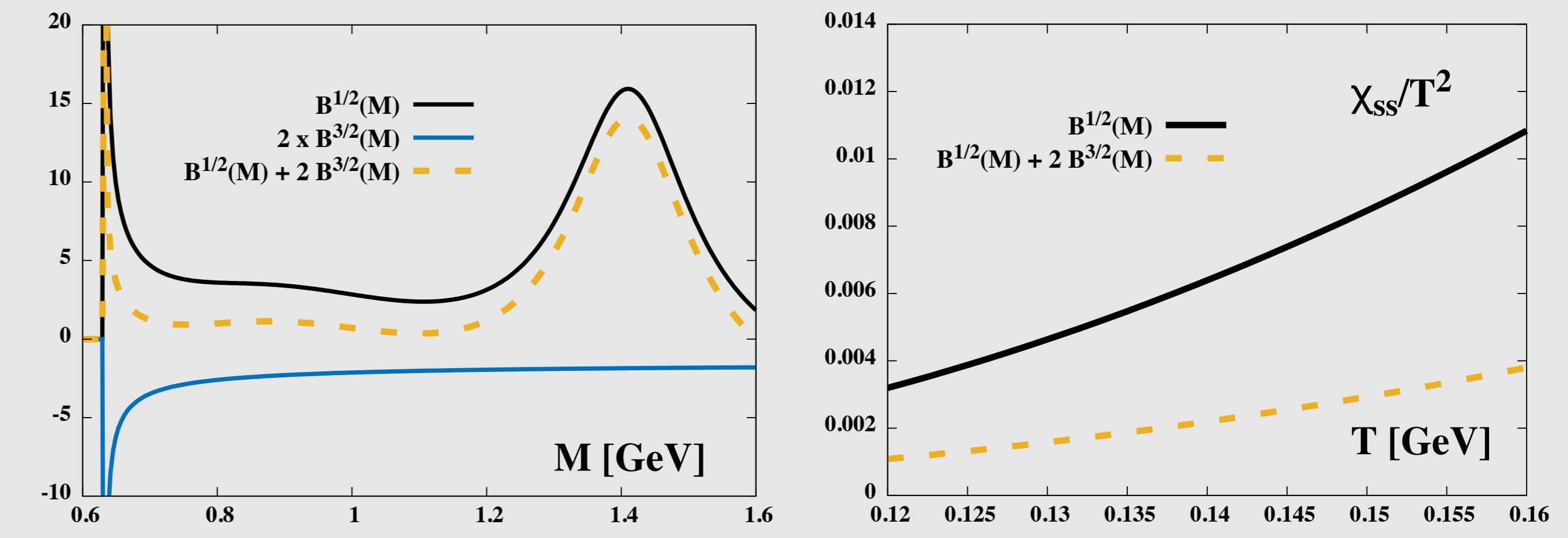
(A) Breit-Wigner VS $\mathcal{B}[M]$



(B) Influence of the κ Channel



(C) Effect of $I = 3/2$ $K\pi$ scattering



$$\mathcal{B} = \mathcal{B}^{I=1/2} + 2 \mathcal{B}^{I=3/2}$$

$$\mathcal{B}^I = 2 \frac{d}{dM} \delta^I(M),$$

Summary and Conclusions

HRG systematically **overestimates** the interaction contribution to strangeness fluctuation.

A consistent treatment for low-mass broad resonances is required:
 S-matrix approach: resonant + non-resonant contributions

References

- [1] W. Weinhold, B. Friman and W. Nörenberg, Phys. Lett. B **433**, 236 (1998).
- [2] A. Bazavov, H.-T. Ding, P. Hegde, O. Kaczmarek, F. Karsch, E. Laermann, Y. Maezawa and S. Mukherjee *et al.*, Phys. Rev. Lett. **113**, no. 7, 072001 (2014).
- [3] B. Friman, P. M. Lo, M. Marczenko, K. Redlich and C. Sasaki, arXiv:1507.04183 [hep-ph].