Heavy quark potential at finite temperature

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Using the QCD sum rule with its operator product expansion reliably estimated from lattice calculations for the pressure and energy density of hot QCD matter [1], we have calculated the strength of the J/ψ wave function at origin [2] and find that it decreases with temperature when the temperature is above the transition temperature as shown in Fig.1. This result is seen to follow exactly that obtained from the solution of the Schroedingier equation for a charm and anticharm quark pair using the free energy from lattice calculations as the potential and is in sharp contrast to that using the deeper potential associated with the internal energy, which shows an enhanced strength of the J/ψ wave function at origin. Our result thus has resolved the long-standing question of whether the free energy potential or the internal energy potential should be used in analyzing the spectrum of heavy quark systems at finite temperature.
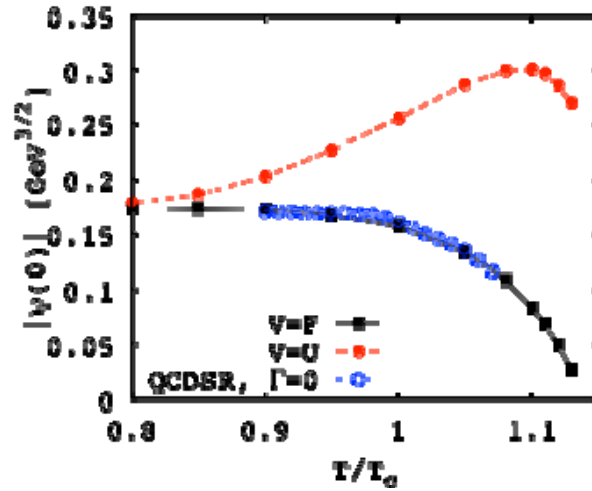

FIG. 1. Temperature dependence of |ψ(0)| obtained from the free energy (filled squares) and internal energy (filled circles) potentials together with that from the QCD sum rule (open circles).

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[2] S.H. Lee, K. Morta, T. Song, and C.M. Ko, Phys. Rev. Lett. (submitted).