Thermal Properties of Glueballs in SU(3) Lattice QCD

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One of the most interesting subjects in the finite temperature QCD is the deconfinement phase transition and the resulting quark gluon plasma (QGP) phase. From the theoretical side, SU(3) lattice QCD predicts the critical temperature as $T_c = 150 \sim 170$ MeV in the chiral limit. From the experimental side, the RHIC project is currently going on to create the QGP phase experimentally at Brookhaven National Lab (BNL). Hence, the considerable progress is desired in the theoretical understanding of the finite temperature QCD. At finite temperature, even in the confinement phase, a lot of effective models predict sizable changes in various hadron masses[1,2], which is considered as one of the most important precritical phenomena of the deconfinement transition. Inspired by them, lattice calculations of the thermal hadron masses have been desired. However, the accurate measurement had been rather difficult until quite recent due to the lack of temporal informations on the lattice. To overcome this, the anisotropic lattice has been used for the accurate measurement, and thermal masses of various mesons have been measured[3]. We measure the thermal masses of the glueballs at finite temperature using SU(3) anisotropic lattice QCD at quenched level[4,5]. We observe a significant reduction of the thermal mass of the 0^{++} glueball by about a few hundred MeV near T_c in the confinement phase as shown in Fig. 1. This is actually the largest mass reduction, which has been ever observed on the lattice at finite temperature in the confinement phase. Our result suggests that the glueball may be one of the most interesting particles in the RHIC project.

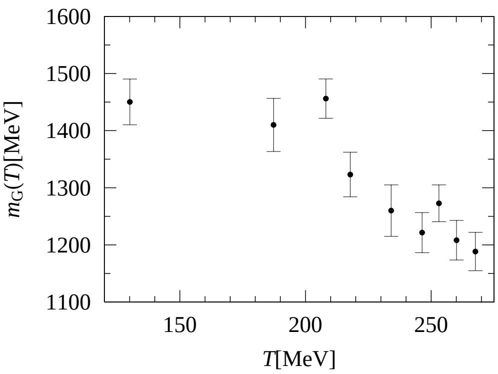

Figure 1: The thermal 0^{++} glueball mass $m_{\mathrm{G}}(T)$ is plotted against the temperature T. The vertical dotted line indicates the critical temperature of the deconfinement transition in quenched SU(3) QCD. The significant reduction of thermal glueball mass is observed by about a few hundred MeV.

References

[1] T.Hashimoto, K.Hirose, T.Kanki and O.Miyamura, Phys.Rev.Lett.**57**,2123(1986).
[2] T. Hatsuda and T. Kunihiro, Phys. Rev Lett. **55**, 158 (1985).
[3] QCD TARO Collaboration, Phys. Rev. **D63**, 054501 (2001).
[4] N. Ishii et al., Nucl. Phys. **B** (Proc. Supple.) **106**&**107**, 516 (2002).
[5] N. Ishii, H. Suganuma and H. Matsufuru, hep-lat/0109011.