



Contribution ID: 164

Type: Talk

Determination of $U_A(1)$ restoration from meson screening masses by using the entanglement PNJL model: Toward chiral regime

Saturday, 18 July 2015 10:40 (20 minutes)

We determine temperature (T) dependence of $U_A(1)$ restoration from meson screening masses calculated with 2+1 flavor lattice QCD, using PNJL model with entanglement vertex. The entanglement PNJL (EPNJL) model exhibits the $U_A(1)$ anomaly through the Kobayashi-Maskawa-'t Hooft (KMT) interaction. T dependence of KMT interaction strength is then determined from the difference between pion and a_0 meson screening masses. The strength is strongly suppressed around the pseudocritical temperature of chiral transition. This suppression is much stronger than that predicted by instanton liquid model.

Using this T -dependent KMT interaction, we draw the Columbia plot near the physical point. In the light-quark chiral-limit with the strange quark mass (m_s) fixed at the physical value, the chiral transition becomes the second order. A tricritical point appears when m_s is slightly below the physical value. Finally, we calculate T dependence of other meson screening masses with the EPNJL model and compare the model results with lattice QCD ones to check the validity of the present model.

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Session Classification: Nonzero Temperature and Density

Track Classification: Nonzero Temperature and Density