Atelier
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Workshop
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Thermal QCD at finite gauge coupling from string/M theory involving six-/seven-folds of SU(3)-/G2-structure

Aalok Misra*

aalokfph@iitr.ac.in;aalokfph@gmail.com

We will discuss the delocalized Strominger-Yau-Zaslow mirror of the McGill type IIB dual of large-N thermal QCD involving N black $D3$-branes, M $D5$ (and anti-$D5$) branes wrapping a two-cycle and N_f $D7$ (and anti-$D7$) branes embedded via the Ouyang embedding in a non Kaehler resolved warped deformed conifold (NKRWDC), and its M-theoretic uplift to black $M3$-branes which could be thought of as black $M5$-branes wrapping a two-cycle in an asymptotic $AdS_5 \times M_6$. We will do so in a large-N limit referred to as the MQGP limit involving $g_s <\sim 1$ [given that sQGP is expected to involve a finite gauge coupling (thereby necessitating addressing the gravity dual from an M-theory perspective)], finite M, large N and small gs M^2/N. In this process, building up on the fact that deviation of three-form fluxes from being ISD is UV and (small) resolution-parameter-suppressed, the following will also be discussed:

(i) We will see that in the MQGP limit, locally, the $SU(3)$ structure torsion classes follow : $\tau(IIB)_{\mathrm{SU(3)}} = W4 + W_5$ (such that $2/3W_5^{3\mathrm{bar}} = W_4^{3\mathrm{bar}}$ implying KS-like supersymmetry) — Delocalized SYZ mirror $\rightarrow \tau(\mathrm{IIA})_{\mathrm{SU(3)}} = W_2 + W_4 + W_5$, i.e., the large-$N$-suppression of the NKRWDC's deviation from being complex, is lost in taking the mirror. With a further fine tuning, however, the same can approximately be recovered $W_2 \approx 0$;

1. (ii)] We will work out a local G_2 structure of the M-theory uplift after a fine tuning of the mirror type IIA metric, and find the G_2 structure torsion classes: $\tau_{G_2} = W_{14} + W_{27_-}$ in the large-N limit G_2 structure approaches G_2 holonomy;

*Department of Physics, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand 247667, INDIA.

(iii) the local T^3 used for implementing SYZ mirror symmetry as a triple T dual, in the UV, will be shown to satisfy the same conditions as the maximal T^2-invariant special Lagrangian three-cycles of deformed conifold (if deformation > resolution in the RWDC) and resolved conifold (if resolution > deformation in the RWDC);

(iv) We will show that with the mass of the lightest vector meson as an input it is possible to obtain the QCD deconfinement temperature Tc consistent with the lattice results with (the number of colors) $N \sim 10$ as well as the correct mass scale of the light (first generation) quarks, at the same time ensuring the thermodynamical stability of the type IIB background;

(v) Using the $D = 11EH + GHY + Flux + O(R^4)$ action, we will demonstrate the thermodynamical stability of the local M-theoretic uplift by demonstrating positivity of the specific heat;

(vi) We will discuss evaluation of a host of two-point functions involving gauge field fluctuations about a baryon chemical potential background (leading to the evaluation of DC electrical conductivity and charge susceptibility) and metric fluctuations (leading to the evaluation of shear viscosity and thus shear viscosity ? entropy density ratio, and speed of sound).