

Holographic thermal propagator from modularity

We revisit the low-temperature thermal propagator of a holographic conformal field theory in four spacetime dimensions by exploiting its connection to the Nekrasov–Shatashvili (NS) limit of the Ω -deformed $\mathcal{N} = 2$ supersymmetric $SU(2)$ Yang–Mills theory with $N_f = 4$ hypermultiplets. In the regime of vanishing energy, the low-temperature expansion corresponds to a large adjoint vacuum expectation value expansion. In this limit, we show that a second expansion in instanton numbers organizes into quasi-modular forms, which can be resummed into closed-form expressions in terms of Eisenstein series. The resulting thermal propagator series in positive powers of small temperatures exhibits clear signs of being asymptotic. Our method—combining modular properties, q -recursion techniques, and the NS prepotential—provides a systematic and computationally efficient framework for analyzing retarded Green’s functions of holographic black branes in the low-temperature limit.

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