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Giant loops in hot SYM and holography¹

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The AdS/CFT correspondence is a powerful tool which can be used, among other things, to explore the strong coupling behaviour of $\mathcal{N} = 4$ super Yang-Mills theory with large number of colors. In this work, we look for phase transitions in hot SYM on a spacial three-sphere. In particular, we study the expectation value of the Polyakov loop operator in large completely symmetric and completely antisymmetric representations. A non-zero expectation value for the loop signals that the corresponding representation is confined. We find, for example, that in the deconfined phase of SYM, large enough symmetric representations are confined, while smaller representations are not. This represents a phase transition. On the gravity side of the AdS-CFT duality, the related Maldacena-Wilson loop corresponds to a fundamental string worldsheet suspended into the bulk of AdS from the loop contour at the boundary. When the representation is large, the fundamental string wraps the contour many times, and undergoes a ‘blow up’ to a higher dimensional object, a D-brane. Finite temperature requires a black hole horizon at the center of AdS, and the question of confinement at non-zero temperature translates to asking whether or not the D-brane touches the horizon.

¹Joint work with Gordon Semenoff (UBC) and Gianluca Grignani (Universita di Perugia).