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ON NONRELATIVISTIC $Q\bar{Q}$ POTENTIAL VIA THE WILSON LOOP IN GALILEAN SPACETIME

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We calculate the static Wilson loop from string/gauge correspondence to obtain the $Q\bar{Q}$ potential in nonrelativistic quantum field theory, i.e. CFT with Galilean symmetry. We analyze the convexity conditions[13] for $Q\bar{Q}$ potential in this theory, and obtain restrictions for the acceptable dynamical exponent z.

Keywords: Wilson loop; Galilean symmetry; $Q\bar{Q}$ pair; potential; holography.

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1. Introduction

It has been shown by Maldacena that large-N superconformal gauge theories have a dual description in terms of string theory in AdS space.[1] This proposal was realized by Maldacena to compute the energy between quark (Q) and anti-quark ($\bar{Q}$) pairs.[2] His method was to calculate expectation values of an operator similar to the Wilson loop in the large-N limit of field theories. Maldacena's idea was improved later by Rey, Theisen, and Yee.[3] It turns Wilson loop into a physical gauge-invariant property that can be read from the string picture. The $Q\bar{Q}$ energy in the large-N superconformal $\mathcal{N} = 4$ Yang–Mills theory can be obtained from the Wilson loop of the corresponding string in AdS space. It is proposed that quark and anti-quark pairs live on the boundary, connected by a U-shaped string in the bulk. In the discussion on this spacetime, the energy has a non-confining Coulomb-like behavior, as expected for a conformal field theory. Later this approach was applied to many other spaces and models, as summarized in Ref. 4.

Recently, gravity duals for a certain Galilean-invariant conformal field theory has attracted some attention in theoretical high energy physics community.[5–9] A special case when we take the dynamical exponent $z = 2$ of this theory (whose isometry is the Schrödinger group $Sch(d-1)$) is considered to be the basis in constructing duality between gravity and unitary Fermi gas. However, our interest