Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Interplay between electronic transport and mechanical degrees of freedom in metallic atomic-size contacts ALEXEI MARCHENKOV, ZHENTING DAI, BRANDON DONEHOO, CHUN ZHANG, ROBERT BARNETT, UZI LANDMAN, Georgia Institute of Technology — Comprehensive measurements of transport properties of the smallest metallic contacts, both in normal and superconducting states, may provide sufficient information to identify their atomic structure. We demonstrated completely reversible mechanical manipulation of the electronic state of niobium atomic-size contacts. This regime includes switching between two distinct configurations manifested as two-level conductance fluctuations. Synergetic first-principles numerical modeling of the structure and transport properties, based on the combination of the Density Functional Theory and Non-Equilibrium Green's Functions formalism, revealed that these contacts consist of niobium dimers trapped between apexes of bulk leads. The observed bistability was associated with the dimer shuttling between a symmetric and an asymmetric configurations in the gap. Point contact spectroscopy of these configurations reveals, on top of the expected signatures due to phonon modes, features, which we associate with the excitation of the vibrational modes of the trapped dimer. Finally, we discuss the evidence that these vibrations can be caused by the intrinsic Josephson radiation.

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Date submitted: 29 Nov 2006 Electronic form version 1.4