Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

A confinement phase in carbon nanotubes as captured by the extended massive Schwinger model TAKASHI OKA, HIDEO AOKI, The University of Tokyo — We propose that the strong-coupling excitons in carbon nanotubes with electric fluxes confined in one dimension can be a condensed-matter candidate for a confinement phenomenon. Namely, we show that the system, with the Coulomb interaction proportional to $|x|$, is in a confinement phase with many properties similar to QCD in 4D. Low-energy physics is described by the massive Schwinger model with multi-species fermions labelled by the band and valley indices. We propose two means to detect this. One is an optical measurement of the exciton spectrum, where the confinement phase should be hallmarked by an absence of continuous component in the exciton spectrum. The spectrum is actually calculated with the 't Hooft-Berknoff equation utilizing the light-front field theory, where the Gell-Mann-Oakes-Renner relation is shown to be satisfied by dark excitons. The second way is through the nonlinear transport, which is shown to be related to Coleman's "half-asymptotic" state. (arXiv:1007.5393)

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Date submitted: 19 Nov 2010 Electronic form version 1.4