Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Tunable current-phase relation in double-dot Josephson junctions
JENS KOCH, KARYN LE HUR, Departments of Physics and Applied Physics, Yale University — The current-phase relation $I(\varphi)$ for a Josephson junction contains information about the microscopic nature of the Cooper pair transfer. In particular, junctions more complicated than the single tunnel junction exhibit characteristic non-sinusoidal forms. Here, we investigate the Josephson effect in a superconducting double dot device, similar to the devices studied experimentally by Y. A. Pashkin et al. [1] and E. Bibow et al. [2]. In the vicinity of a charge degeneracy line, the system reduces to a two-level system equivalent to a charge qubit. In this regime, we find that the interplay between sequential tunneling and cotunneling of Cooper pairs leads to a strongly non-sinusoidal current- phase relation, tunable via gate electrodes. We propose the measurement of $I(\varphi)$ in a SQUID configuration, analyze the implications of flux noise, and compare our results to different types of Josephson junctions such as single-dot systems and microbridges. [1] Y. A. Pashkin et al., Nature (London) **421** (2003), 823 [2] E. Bibow, P. Lafarge, L. Lévy, Phys. Rev. Lett. **88** (2002), 017003

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Date submitted: 23 Nov 2007 Electronic form version 1.4