Abstract Submitted
for the DAMOP11 Meeting of
The American Physical Society

**Majorana Fermions in Cold Atom Quantum Wires** LIANG JIANG, IQI, Caltech, TAKUYA KITAGAWA, Harvard University, JASON ALICEA, University of California, Irvine, ANTON AKHMEROV, Universiteit Leiden, Netherlands, DAVID PEKKER, GIL REFAEL, Caltech, IGNACIO CIRAC, Max-Planck-Institute, Garching, EUGENE DEMLER, MIKHAIL LUKIN, Harvard, PETER ZOLLER, University of Innsbruck — Majorana fermions, which unlike ordinary fermions are their own antiparticles, are widely sought for their exotic exchange statistics and potential for topological quantum information processing. We propose to create and detect Majorana fermions using optically trapped 1D fermionic atoms. The background molecular BEC cloud induces an s-wave pairing for the atoms. Two internal states of the atoms are coupled via an optical Raman transition, which simultaneously induces an effective spin-orbit interaction as well as an effective external magnetic field. We find that the cold atom quantum wire can support Majorana fermions at phase boundaries. When we periodically drive the quantum wire, it can also support Floquet Majorana fermions. We analyze experimental parameters, detection schemes, and various imperfections.

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Date submitted: 04 Feb 2011 Electronic form version 1.4