Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Josephson (001) tilt grain boundary junctions of high temperature superconductors GERALD ARNOLD, University of Notre Dame, RICHARD KLEMM, Kansas State University — We calculate the Josephson critical current I_c across in- plane (001) tilt grain boundary junctions of high temperature superconductors. We solve for the electronic states corresponding to the electron-doped cuprates, two slightly different hole-doped cuprates, and an extremely underdoped hole- doped cuprate in each half-space, and weakly connect the two half-spaces by either specular or random Josephson tunnelling. We treat symmetric, straight, and fully asymmetric junctions with s-, extended-s, or $d_{x^2-y^2}$-wave order parameters. For symmetric junctions with random grain boundary tunnelling, our results are generally in agreement with the Sigrist-Rice form for ideal junctions that has been used to interpret "phase-sensitive" experiments consisting of such in- plane grain boundary junctions. For specular grain boundary tunnelling across symmetric junctions, our results depend upon the Fermi surface topology, but are usually rather consistent with the random facet model of Tsuei *et al.* [Phys. Rev. Lett. **73** 593(1994)]. Our results for asymmetric junctions of electron-doped cuprates are in agreement with the Sigrist- Rice form. However, our results for asymmetric junctions of hole- doped cuprates show that the details of the Fermi surface topology and of the tunnelling processes are both very important, so that the "phase-sensitive" experiments based upon in-plane Josephson junctions are less definitive than has generally been thought.

Gerald Arnold
University of Notre Dame

Date submitted: 30 Nov 2005 Electronic form version 1.4