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Surface boundary condition and Fermi surface effects in Josephson (001) tilt grain boundary junctions of high temperature superconductors GERALD ARNOLD, University of Notre Dame, RICHARD KLEMM, Kansas State University — We calculate the supercurrent across symmetric and asymmetric (001) tilt grain boundary junctions of high temperature superconductors for both specular and random weak tunneling processes. We construct the superconducting half spaces on the left (L) and right (R) sides of the junction, assuming the angle between the (100) axis and the junction normal is θ_R and θ_L, resp. The Fermi surface is taken to have either the two-dimensional tight-binding hole-doped shape consistent with angle-resolved photoemission experiments, or a nearly circular electron-doped shape, and take the physical surface on each half space to be perfectly flat. Both asymmetric and symmetric junctions with θ_R=0, $\theta_L = \theta$, $\theta_R = \theta_L = \theta$ are constructed, and the superconducting order parameter is take to have $d_{x^2-y^2}$, s-, or extended-s-wave symmetry. For d-wave superconductors the surface boundary conditions with specular tunneling cause the supercurrent $I(\theta)$ to change sign at $\theta = \theta_0 < 45°$, inconsistent with the tricrystal experiments of Tsuei and Kirtley. For random tunneling, a d-wave interpretation of the tricrystal experiments is possible, but the magnitude of $I(\theta)$, while non zero because of the surface boundary conditions, is greatly reduced from the Ambegaokar-Baratoff value for s-wave superconductors.

Gerald Arnold
University of Notre Dame

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