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Universality of transition temperatures in families of copper oxide superconductors[1] ANGELA KOPP, University of California Los Angeles, SUDIP CHAKRAVARTY, University of California Los Angeles — The transition temperature (T_c) of multi-layer cuprate superconductors has an unusual dependence on the number of layers (n) per unit cell: it forms a bell-shaped curve peaked at $n = 3$. An explanation of this behavior is due to the combined effects of interlayer tunneling and a competing order, the latter effect being enhanced for $n \geq 3$ by a charge imbalance between the layers. We explore this proposal further by examining the mean-field theory of a superconducting order parameter and a competing d-density wave (DDW) order parameter. We focus on three effects: interlayer DDW coupling, increased charge imbalance in the five-layer system, and fluctuations of the superconducting order parameter. We find that (1) the DDW order parameters in neighboring layers prefer to couple "anti-ferromagnetically"—and, surprisingly, the coupling vanishes identically for two layers with order parameters that are "ferromagnetically" aligned; (2) both the interlayer DDW coupling and the increased charge imbalance bring the calculation into better agreement with the experimental results; and (3) fluctuations can have a more pronounced effect when they occur in the presence of a competing order parameter.

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