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Why positive hole carriers and negatively charged planes are conducive to high temperature superconductivity

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The vast majority of superconducting materials have positive Hall coefficient in the normal state, indicating that hole carriers dominate the normal state transport. This was noticed even before BCS theory, and has been amply confirmed by materials found since then: the sign of the Hall coefficient is the strongest normal state predictor of superconductivity. In the superconducting state instead, superfluid carriers are always electron-like, i.e. negative, as indicated by the fact that the magnetic field generated by rotating superconductors is always parallel, never antiparallel, to the body's angular momentum ("London moment"). BCS theory ignores these facts. In contrast, the theory of hole superconductivity, developed over the past 20 years (papers listed in http://physics.ucsd.edu/~jorge/hole.html) makes charge asymmetry the centerpiece of the action. The Coulomb repulsion between holes is shown to be smaller than that between electrons, thus favoring pairing of holes, and this fundamental electron-hole asymmetry is largest in materials where the conducting structures have *excess negative charge*, as is the case in the cuprates, arsenides and MgB_2. Charge asymmetry implies that superconductivity is driven by lowering of kinetic energy, associated with expansion of the carrier wavefunction and with *expulsion of negative charge* from the interior to the surface of the material, where it carries the Meissner current. This results in a macroscopic electric field (pointing outward) in the interior of superconductors, and a macroscopic spin current flowing near the surface in the absence of external fields, a kind of macroscopic zero point motion of the superfluid (spin Meissner effect). London's electrodynamic equations are modified in a natural way to describe this physics. It is pointed out that a dynamical explanation of the Meissner effect *requires* radial outflow of charge in the transition to superconductivity, as predicted by this theory and not predicted by BCS. The theory provides clear guidelines regarding where new higher T_c superconductors will and will not be found.