Superconductivity and planar hole densities in the cuprates from NMR

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DAMIAN RYBICKI, AGH University of Science and Technology — We show how nuclear magnetic resonance (NMR) of $^{63}$Cu and $^{17}$O provides a quantitative measure of the charge distribution in the ubiquitous CuO$_2$ plane, the common structural feature of cuprate physics. The various materials are found to differ significantly in the local charge distribution, while the total charge per CuO$_2$ matches expectation from stoichiometry. Using the local charges on Cu and O measured by NMR, a new three-dimensional cuprate phase diagram is drawn that consistently encompasses all cuprate materials. These appear ordered according to their maximum $T_c$. It is the sharing of the inherent Cu hole with O that sets an upper limit for $T_c$, and it correlates with the superfluid density measured by $\mu$SR, over all cuprate families.