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Scanning SQUID microscopy studies of the penetration depth and pairing symmetry in Fe-pnictide superconductors[1]

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We present scanning SQUID magnetometry and susceptometry data on dense polycrystalline samples of the iron oxypnictide superconductors $NdFeAsO_{0.94}F_{0.06}$ and $SmFeAsO_{0.85}$, and on a single crystal of LaFePO. On LaFePO, we demonstrate, in a local measurement requiring no correction for sample geometry,that the magnetic penetration depth is linear in T, indicating line nodes in the superconducting order parameter. On polycrystalline $NdFeAsO_{0.94}F_{0.06}$ and $SmFeAsO_{0.85}$, we show that the order parameter is s-wave: if the order parameter were non-s-wave there would be direction-dependent phase shifts in the intergrain tunnelling, which in a dense polycrystalline sample would result in spontaneous orbital currents below T_c. Orbital currents would give a complex magnetization, and moments polarizable by a weak field during cooling. Paramagnetism against weak cooling fields is a well-established phenomenon in polycrystalline cuprate samples, consistent with d-wave superconductivity. In $NdFeAsO_{0.94}F_{0.06}$ and $SmFeAsO_{0.85}$, we observe neither the complex magnetization nor weak-field paramagnetism, ruling out non-s-wave order parameters.

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