Nanoscale electronic order in iron pnictides

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In the iron pnictide superconductors, a controversial issue is the boundary between the static magnetism and superconductivity regions of the phase diagram of the main families, with reports so far of microscopic or mesoscopic ground-state coexistence, a second-order boundary, or a first-order boundary. Beyond the possible ground states, it remains unclear whether intrinsic electronic inhomogeneities and an associated order, short-range or more, can show up as in related transition metal oxides. Using a pnictide family (RFeAsO$_{1-x}$F$_x$, R = La or Sm) where dopant-disorder effects are minimized, we investigated the charge distribution using As nuclear quadrupole resonance [1]. Whereas undoped and optimally doped or overdoped compounds feature a single charge environment, two charge environments are detected in the underdoped region, irrespective of the ground state. Spin-lattice relaxation measurements show their coexistence at the nanoscale. Together with the quantitative variations of the spectra with doping, they point to a local electronic order in the iron layers, where low- and high-doping-like regions would coexist. Implications for the interplay of static magnetism and superconductivity are discussed.

[1] G. Lang *et al.*, Phys. Rev. Lett. **104** (2010) 097001