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Spins in cuprates near the edge of the superconducting phase - incoherent pairing, fluctuations on all timescales and observation of pseudogap energies.

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When doping is just enough to create the superconducting phase spins behave very differently from heavily doped cuprates. Nonetheless low doping reveals the key ingredients for the coherence of superconducting pairs. The ordered spins of the insulating antiferromagnet are replaced by a hedgehog phase with isotropically polarized spins, and a commensurate central mode with slow short-range spin correlations extending over four planar unit cells. A subcritical 3D enhancement is destroyed by temperature and energy. The spins follow not via the coherence of charge pairs but the structures caused by hole doping, so that glassy short range spin order occurs within both the superconducting and normal phase. The tumbling regions of spins exhibit a power-law spectrum similar to 1/f noise down to microeV energies. Excitations are overdamped with a millieV relaxation rate a thousand times faster, unlike the well-defined resonance familiar at large doping. Below 50 K the scale length is geometric and not linked by velocity to dynamic widths. As excited states are depopulated spin weight transfers to the central mode. At energies 300,000 times larger, decay of paramagnons into pseudogap states has been detected [1], a strong indication that it is the large density of high-energy spin states that provides the superconducting glue, rather than the resonance which is absent as a sharp spectral feature.

[1] C.Stock et al, Phys. Rev. B 75,172510 (2007).