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A coherent electronic spin cluster in diamond HELENA KNOWLES, DHIREN KARA, METE ATATURE, University of Cambridge — An optically active spin in solid state coherently coupled to a dark spin cluster has been at the heart of many exciting proposals in recent years, from implementations of spin chains to environment-assisted schemes that enhance the performance of a single-spin magnetic field sensor. Dark electron spins, with magnetic moments compared with nuclear spins, are particularly interesting as they enable fast dipolar coupling and exhibit strong interactions with target fields. Realised in a nanodiamond such a cluster could transform the performance of a unique sensing device that enables temperature and magnetic field measurements inside living cells. Experimental progress on this front has been promising, albeit hindered by the limited ability to polarise, control and readout dark spins. We use a nitrogen-vacancy centre (NV) in a nanodiamond to polarize and readout a cluster formed of three dark nitrogen (N) spins. We also demonstrate an interferometric method to probe each N spin individually and extract their coupling strengths and degrees of polarisation. This enables us to locate the spins to within a few lattice sites. Moreover, we report the first observation of coherent spin exchange between NV and N electron spins, essential for any exploitation of such multi-spin systems.

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