Only if the spin-triplet state is transformed into a spin-singlet state by some kind of interaction is current able to 'leak' out of the spin-blockaded system.

Two kinds of interaction can give rise to such a leakage current: spin–orbit and hyperfine coupling. To evaluate the importance of these two mechanisms in the two types of CNT, Marcus and co-workers analysed the dependence of the leakage current in the spin-blockade regime on a magnetic field applied along the CNT axis[5]. The measured current characteristics showed a striking difference between the ^{12}C-enriched and the ^{13}C-enriched devices in the experiment. Whereas in the ^{12}C-enriched double dots the leakage current in the spin-blockade regime was found always to be a minimum at zero magnetic field, some of the ^{13}C-enriched devices by contrast displayed corresponding maxima. The former behaviour is similar to that previously observed in indium arsenide nanowire-defined quantum dots[10] and can be attributed to spin–orbit effects. The latter observation, however, results from singlet–triplet mixing caused by strong hyperfine coupling.

The Harvard group provide further evidence of the strong hyperfine interaction in ^{13}C double dots through observations of the hysteretic behaviour of the spin-blockade leakage current from magnetic field sweeps near zero detuning. Such hysteresis is in agreement with the existence of an Overhauser field originating in nuclear spins that become dynamically polarized by the leakage current. Marcus and co-workers suggest electron–electron interactions as one of the possible origins for the observed strong hyperfine coupling in their ^{13}C devices. Such interactions have recently been shown to strongly enhance nuclear spin effects in ^{13}C nanotubes[11].

A quantitative comparison of CNT data with theories developed for other host materials, such as gallium arsenide heterostructures, must be treated with some caution owing to the additional orbital degeneracy present in CNT quantum dots. Therefore, further theoretical as well as experimental work on the subject seems desirable. The interplay of the two most important decoherence channels, spin–orbit interaction[12] and hyperfine coupling to nuclear spins, provides a rich test ground for further exploration of spin phenomena in CNT quantum dots, with the goal of identifying ideal parameter regimes of minimum decoherence and maximum qubit control. In addition, as pointed out by Marcus and co-workers, ^{13}C-enhanced nanotubes are also an interesting system for memory applications based on nuclear spins, similar to those in magnetic semiconductors, where the polarization of the localized moments can be controlled electrically. ❐

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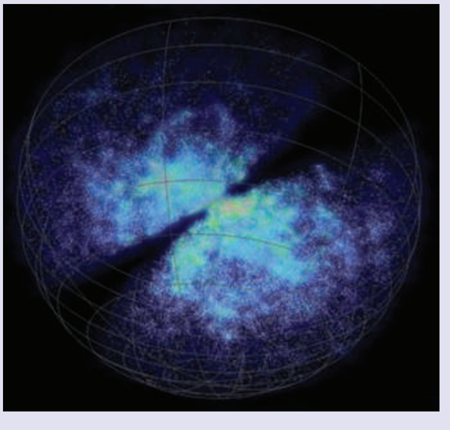
NEARBY GALAXIES

Have map will travel

Astronomers using the UK Schmidt Telescope in New South Wales, Australia, have completed a detailed map of more than 83% of the local galaxies in the southern sky (D. H. Jones *et al.* Preprint at <http://arxiv.org/abs/0903.5451>; 2009). For six years, the 6dF Galaxy Survey (6dFGS) collected 136,304 spectra, including redshift data for 125,071 galaxies up to two billion light years away. The combination of these distance measurements and the survey's peculiar velocity measurements — velocity relative to the uniform expansion of the cosmic background frame of reference described by Hubble's law — can differentiate motion due to the expansion of the universe from that due to gravitation. Hence the motion of invisible matter becomes visible.



CHRIS FLUKE, SWINBURNE UNIVERSITY OF TECHNOLOGY

To map half the sky in a reasonable time frame, the Six-degree Field (6dF) instrument uses optical fibres and robotic positioning to increase the telescope's observational power 100-fold, thus mapping 150 stars or galaxies in one go. This broad and shallow survey extends the coverage of the older 6dF Galaxy Redshift Survey by an order of magnitude and covers more than twice the area of the Sloan Digital Sky Survey. Astronomers may now concentrate on the evolution of large-scale structures, such as clusters and filaments, as well as numerous voids in the nearby Universe. About 500 empty regions have been identified or verified.

The precision mapping has also revealed new intervening structures between superclusters, such as Shapley and Hydra-Centaurus. Both of these clusters of galaxy clusters lie close to the constellation Centaurus, which our own Galaxy — as well as our neighbours — is speeding towards. This conglomeration of matter is known as the Great Attractor. Its gravitational pull is stronger than it should be based on the amount of visible matter. And as it lies behind the plane of the Milky Way, which obscures our view of the receding mass, the Great Attractor has been difficult to study; in fact, its presence was first reported only in 1973. The data from 6dFGS will help us understand the history — and, hopefully, the future — of such inhomogeneous mass distributions.

The database is available online at www-wfau.roe.ac.uk/6dFGS.

MAY CHIAO

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