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Colossal spin fluctuations in a molecular quantum dot magnet

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We report our recent study [1] on the enhanced spin fluctuations in a molecular quantum dot with an intrinsic spin degree of freedom s coupled to two magnetic electrodes. To investigate whether we can control the molecular spin by sending current from these polarized electrodes, we calculated the average, noise and higher moments of jz (z-component of the sum of molecular and conduction electron spins (the latter denoted by s; j=s+s, averaged during a measurement time). We focused so far on the incoherent tunneling regime, in which the average and noise can be calculated by considering a Markov chain; random sequential jumps between neighboring spin (and charge) states. [2] We found that the sum over all such possible (infinite number of) sequences combines to give an analytic expression of the jz-noise for an arbitrary polarization P of the electrodes (actually a rational fraction of P). The jz-noise is inversely proportional to the tunneling rate, and its amplitude is characterized by some magic numbers, which we we found to be 22/5 for s=1/2, j=1, 138/7 for s=1, j=3/2, 520/9 for s=3/2, j=2 in the case of j=s+1/2 spin sector in the bias window, in contrast to a considerably smaller value 1/3 for a usual quantum dot (s=0, j=1/2). We also reproduced all these results by an alternative method, employing a generating function obtained by solving an eigenvalue problem of the Master equation with a counting field for jz. [3] We also calculated the third and fourth order cumulants for s=0, 1/2, 1, 3/2 ...

[1] T. Jonckheere, K.-I. Imura and T. Martin, arXiv:0803.3058, Phys. Rev. B in press.
[2] A. N. Korotkov, Phys. Rev. B 49, 10381 (1994).
[3] K.-I. Imura, Y. Utsumi and T. Martin, Phys. Rev. B 75, 205341 (2007).