Electronic supplementary information: How to distinguish between interacting and noninteracting molecules in tunnel junctions

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ADDITIONAL MEASUREMENTS

The experiments were done for a fixed bias near zero and by sweeping the gate voltage continuously in order to increase the definition of the peaks associated to crossing the charge degeneracy points. This is standard procedure when checking if there are molecules present in the nano-transistors, and we used it here to minimize the time between measurements with and without magnetic field. Molecules in electromigrated three-terminal junctions are very unstable, and frequently move, changing their coupling to the transistor leads. This was actually the case of the molecule measured here.

We have measurements of the diamond for one of the charge degeneracy points of this molecule (see Fig. 1), where one can see how all excitations are equally affected by a magnetic field. Although not with the same precision than in the measurements for a single bias potential, the shift can be clearly resolved in these results, which show that the shift affects equally all excitations and that there is no Zeeman splitting (at least not comparable to the observed shift). Note that for these measurements, the molecule has already moved with respect to the measurements presented in the main text, and the first charge degeneracy point appears now at around $V_g = -1.5$ V for both fields (-0.95 V in the measurements included in the main text).

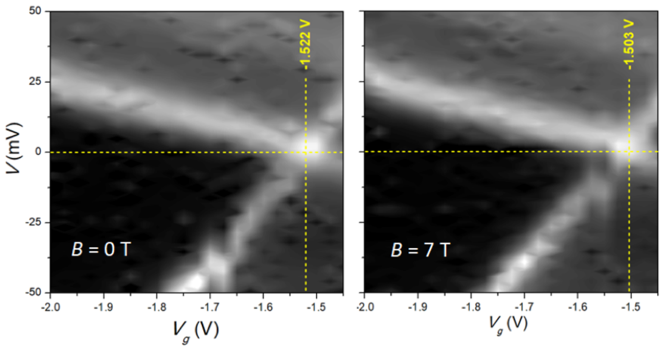

FIG. 1: Excitations in the presence of a magnetic field.

ADDITIONAL CALCULATIONS

The detailed amplitude ratio depends on the molecules coupling to the metallic reservoirs. For $\Gamma \ll k_B T$ the peak height is proportional to $\Gamma_1 \Gamma_2$ and inversely proportional to temperature [1]. In general, the couplings are Porter-Thomas distributed and therefore the peak amplitudes fluctuate. Below, we present in Fig. 2 theoretical conductance curves where we used different values of γ. Our results show that the lower resonance has a smaller amplitude compared to the Coulomb-shifted one.

[1] C. W. J. Beenakker, Phys. Rev. B 44, 1646 (1991).

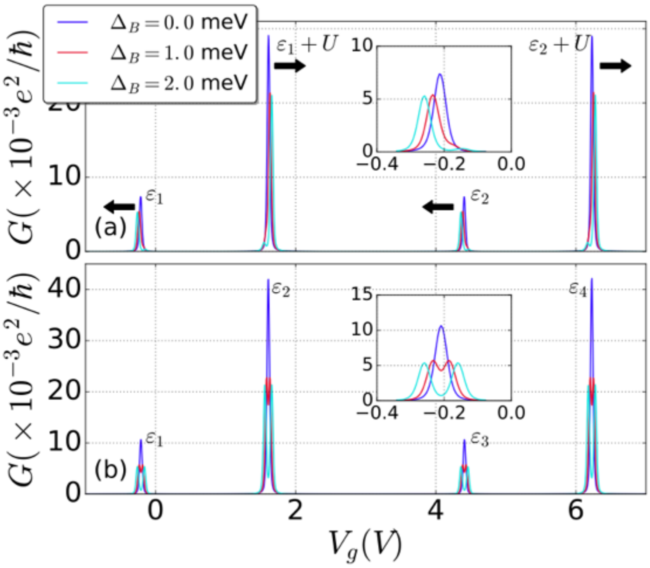

FIG. 2: Conductance curves for different values of the tunnel couplings: $\gamma_{L1} = 0.01$ meV, $\gamma_{R1} = 0.4$ meV, $\gamma_{L2} = 0.05$ meV and $\gamma_{R2} = 0.4$ meV. We use the couplings for ε_2 in (a) the same as for ε_1 while in (b) the couplings for the third (fourth) level ε_3 (ε_4) are taken the same as for ε_1 (ε_2).