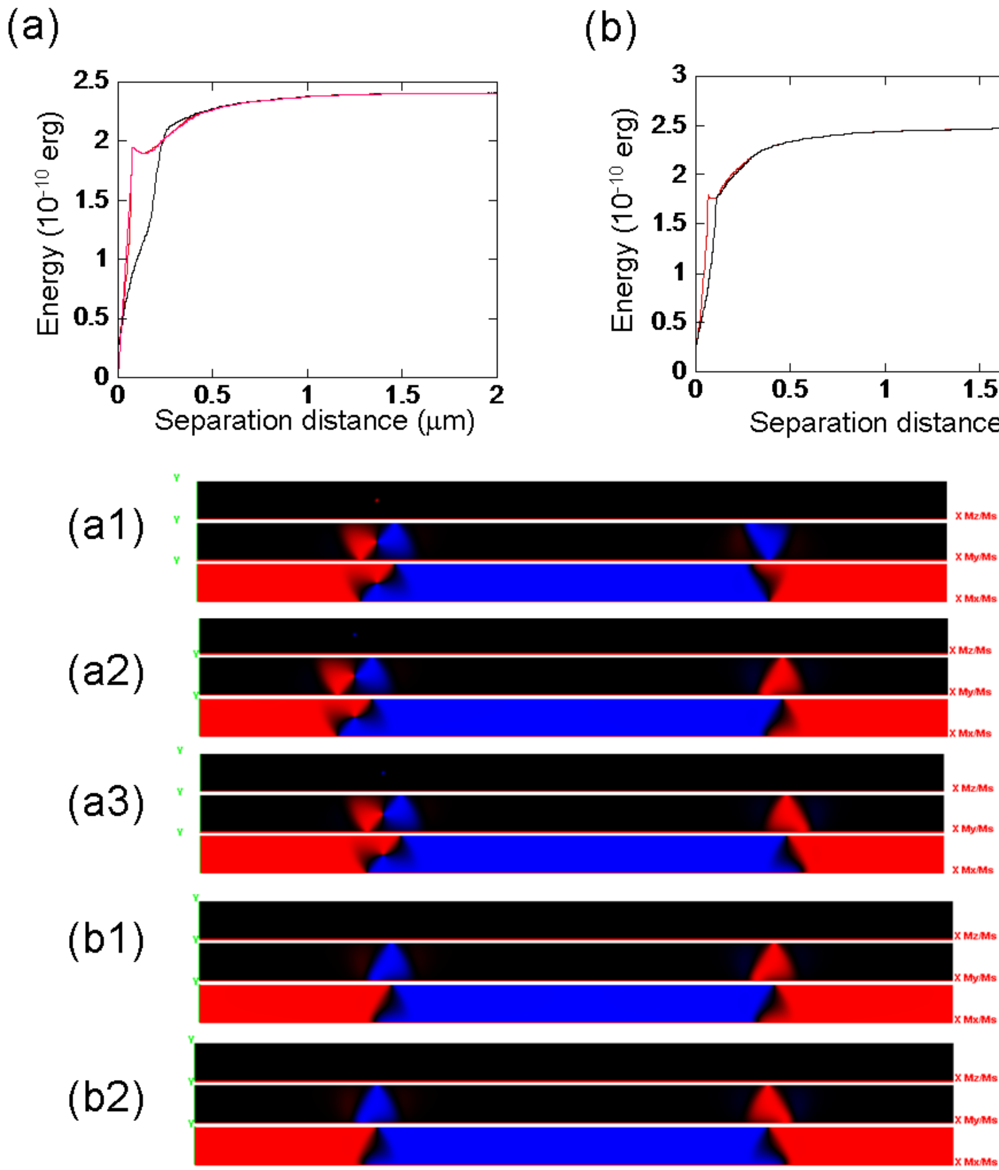
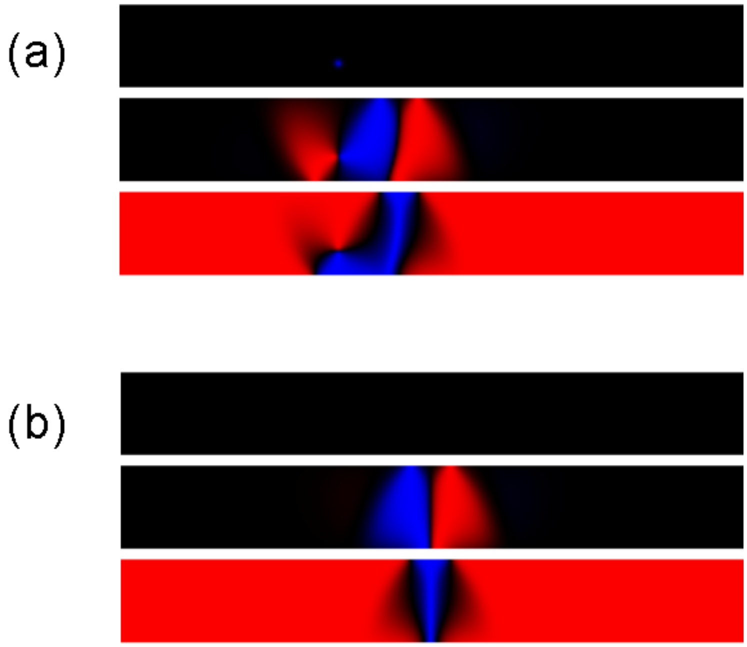
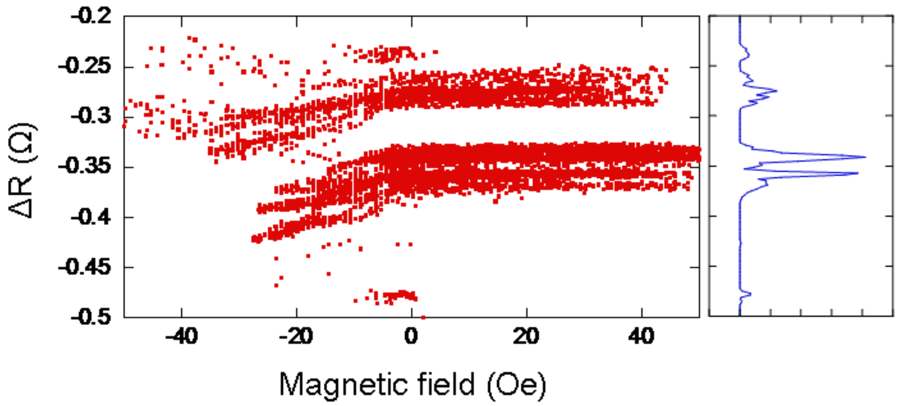


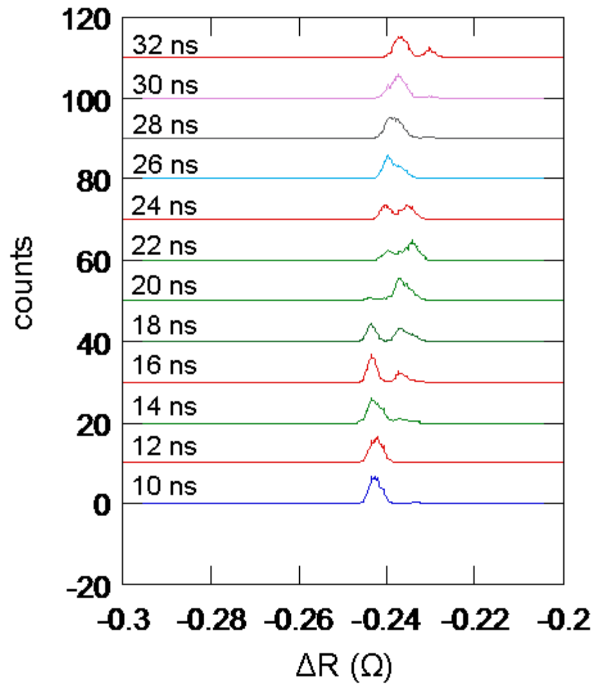
Supplementary Figure S1 | Micromagnetic simulations of interacting domain walls. Panels (a) and (b) show the energy of a permalloy nanowire containing 2 domain walls as a function of the separation distance between one V wall and one T wall and between two T walls, respectively. The energy is calculated for the different configurations shown by the color maps. The black solid line in panel (a) corresponds to the configuration (a1), the red and pink lines to (a2) and (a3). The black and red solid lines in panel (b) correspond to configurations (b1) and (b2), respectively. The color maps show the 3 components of the magnetization i.e., out-of-plane (Mz), in-plane perpendicular to the long axis of the nanowire (My) and in-plane along the nanowire (Mx). The direction of the magnetization is shown in a two-color scheme (red for magnetization along the respective positive x, y, or z axis, and blue for the corresponding negative axis).



Supplementary Figure S2 | Magnetization maps of metastable bound states. Color maps of the equilibrium magnetization configuration of the bound states formed by one V wall and one T wall (a) and by two T walls (b). The 3 panels show the three components of the magnetization as shown in Supplementary Figure S1. The separation distances at equilibrium are ~135 nm for one V and one T wall, and ~90 nm for two T walls. These are both much shorter than the separation distance of ~220 nm found for two V walls.



Supplementary Figure S3 | Deformation of the bound states. . Resistance levels are measured after injection of 2 DWs. Measurements are carried out in zero magnetic field after application of a field between +/- 50 Oe along the nanowire. This field is smaller than the value needed to either annihilate the bound state or pull the two DWs away from each other. The right panel shows the histogram of ΔR measured before application of the field. Let us consider, for example, the two largest peaks on the histogram which correspond to bound V walls. When a negative field is applied, the walls are pulled away from one another and when the field is removed, the magnitude of ΔR is increased by up to 50 mΩ. This shows that a slightly wider bound state has been created. Note, however, that the maximum value of |ΔR| remains smaller than that for two independent V walls, as expected, since the two walls exit the nanowire as soon as the field is large enough to pull them apart. When a positive field is applied, the resistance of the bound states is almost unchanged, showing that the two V walls cannot be compressed further without annihilation. However, when the DWs are injected from opposite ends of the nanowires, wide bound states can be formed, with resistance levels up to -0.39 Ω. These states can then be compressed by field until they reach a resistance level of ΔR ~-0.3 Ω.



Supplementary Figure S4 | Fluctuations of the AMR signal of a single V wall. Histograms of the resistance of a single V wall are measured as a function of the length of the injection pulse. While the resistance level of the injected V wall remains close to ΔR= -0.24 Ω irrespective of the pulse length, more careful inspection reveals that ΔR exhibits small systematic variations as a function of the pulse length. These variations are of the order of 0.02 Ω, which are much smaller than the difference between V and T walls (~0.06 Ω). We attribute these variations to slight modifications of the DW width due to variations of the local pinning. We have observed a similar, albeit much larger effect, when DWs are trapped at artificial pinning sites such as notches.