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Light induced kickoff of magnetic domain walls in Ising chains[1]

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Controlling the speed at which systems evolve is a challenge shared by all disciplines, and otherwise unrelated areas use common theoretical frameworks towards this goal. A particularly widespread model is Glauber dynamics, which describes the time evolution of the Ising model and can be applied to any binary system. Here we show, using molecular nanowires under irradiation, that Glauber dynamics can be controlled by a novel domain-wall kickoff mechanism. Contrary to known processes, the kickoff has unambiguous fingerprints, slowing down the spin-flip attempt rate by several orders of magnitude, and following a scaling law. The required irradiation power is very low, a substantial improvement over present methods of magnetooptical switching: in our experimental demonstration we switched molecular nanowires with light, using powers thousands of times lower than in previous optical switching methods. This manipulation of stochastic dynamic processes is extremely clean, leading to fingerprint signatures and scaling laws. These observations can be used, in material science, to better study domain-wall displacements and solitons in discrete lattices. These results provide a new way to control and study stochastic dynamic processes. Being general for Glauber dynamics, they can be extended to different kinds of magnetic nanowires and to a myriad of fields, ranging from social evolution to neural networks and chemical reactivity. For nanoelectronics and molecular spintronics the kickoff affords external control of molecular spin-valves and a magnetic fingerprint in single molecule measurements. It can also be applied to the dynamics of mechanical switches and the related study of phasons and order-disorder transitions.

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