Light Control of Magnetic Order

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In 1895, Pierre Curie discovered a striking thermodynamic aspect of ferromagnets: their loss of magnetic behavior above a critical temperature. More than a century later, equipped with the tools of ultrafast laser physics, researchers captured the breakdown of magnetic order on its natural timescale in a plethora of different experiments, sparkling a lively and contentious debate about the microscopic origin. However, the fact that the deposition of heat in matter - inevitably associated with the interaction with intense laser pulses - increases the spin entropy was undisputed and ruled out the control of magnetic order at ultrafast times. Using magnetic circular dichroism microscopy in a photoemission geometry and state-of-the-art theory, we demonstrate that femtosecond class linearly polarized laser pulses can indeed induce a reduction in magnetic disorder at a ferromagnet metal/oxide interface. We find a significant transient increase in the average magnetic moment with a persistent change of around 10% and, together with state-of-the-art theory, we shed light on the microscopic processes.