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Deterministic propagation of nanomagnetic logic observed by time-resolved XMCD-PEEM[1] MARK NOWAKOWSKI, ZHANG GU, BRIAN LAMBSON, JEONGMIN HONG, RALPH STORZ, PATRICK BENNETT, UC-Berkeley, DAVID CARLTON, WEILUN CHAO, LBNL-CXRO, SCOTT DHUEY, LBNL-Molecular Foundary, ANTHONY YOUNG, ANDREW DORAN, MATTHEW MARCUS, ANDREAS SCHOLL, LBNL-ALS, JEFFREY BOKOR, UC-Berkeley — Nanomagnetic logic (NML) is a low-power logic architecture that relies on the dipolar coupling of closely spaced (30 nm) magnets (450x150 nm) to flow binary information down lithographically defined chains. A majority logic gate selects an output based on the magnetic orientation of three intersecting NML chains, permitting logic functions without requiring electrical currents like those used in Si-based transistors. The repeatable and reliable flow of magnetic signal propagation down a chain, a critical feature of this technology, has not been experimentally demonstrated, however computational models have predicted NML signal flow and have postulated a better performance from lithographically engineered magnets with configurational anisotropy. Using the PEEM-3 microscope at the Advanced Light Source, we perform an XMCD pump-probe measurement and observe signal propagation along a chain of 13 magnets with configurational anisotropy. We resolve successive individual magnets flipping on 100 ps time scales and complete signal propagation down the chain after 1-2 ns. This behavior is consistent with previous computational models.

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