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## Torque Magnetometry of an Individual Aggregate of ~350 Nanoparticles

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Magnetic properties for isolated and small-scale assemblies of nanoparticles are generally derived from measurements of bulk nanoparticle systems. To complement this, we aim to investigate these properties for individual assemblies of single-domain magnetite nanoparticles.

Nanoparticles, ~ 50 nm in size and harvested from magnetotactic bacteria, were deposited by Nano eNabler (BioForce Nanosciences TM) on a 100 nm thick, high stress Si<sub>3</sub>N<sub>4</sub> membrane 40 × 200 μm in size. The nanoparticles form diverse patterns on the membrane, including aggregates influenced by dipolar coupling. To capture select structures for measurement, nanomechanical torsional resonators are fabricated in the membrane by direct writing with a focused ion beam. Magnetic measurements are obtained by nanomechanical torque magnetometry, a sensitive method to probe the quasi-static magnetization response.

The observations are compared to micromagnetic modeling of the hysteresis of a specific measured cluster of ~ 350 nanoparticles, and to numerical simulations of the mechanical modes.

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