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Chain formation in a magnetic fluid under the influence magnetic fields. MATT BARRETT, ANDREAS DESCHNER, McMaster University, JAN EMBS, ETH Zurich & Paul Scherrer Institut, AN-CHANG SHI, MAIKEL RHEINSTADTER, McMaster University — We studied the aggregation of magnetic particles into simple chainlike structures in a Cobalt-based magnetic fluid, exposed to external magnetic fields [1]. The length of chain segments in very strong magnetic fields of up to 2 T was measured using small angle neutron scattering in-situ. Although it was predicted that the chain length can be described by a Langevin function, leading to chains several hundred particles in length, we observe a maximum correlation length of $\sim$ 650 Å, or 4-5 particles. To gain insight into the molecular mechanisms involved, our experiments were complemented by Monte Carlo simulations. We observed that the chains which formed increased in length as the magnetic field increased until reaching equilibrium at 4 particles, in excellent agreement with our experimental findings. We speculate that the interplay between the entropy and energy of the system combined with the particular properties of the magnetic dipole-dipole interaction ultimately decide the length of the particle chains. We observed attractive or repulsive interaction between chain segments depending on their relative position. [1] *"Chain formation in a magnetic fluid under the influence of magnetic fields",* M. Barrett, A. Deschner, J.P. Embs, A.-C. Shi, M.C. Rheinstädter, submitted to Physical Review Letters.

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