Supplementary information: Capillary assemblies in a rotating magnetic field

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The accompanying video `SupMat_traj.mp4` shows four successive clips corresponding to the four experimental trajectories from fig. 4 in the article. The corresponding numerical simulations from fig. 9 are shown simultaneously. Each of the four clips corresponds to one set of parameters and is shown for 5 s in real time. The first three clips show three increasing values of the amplitude of the rotating horizontal field $B_h = 0.25\,\mathrm{mT}$, $0.5\,\mathrm{mT}$ and $2\,\mathrm{mT}$ while the frequency f is kept constant at 1 Hz. The last clip corresponds to $B_h = 2.5\,\mathrm{mT}$ and $f = 2\,\mathrm{Hz}$.

These clips cover the various regimes discussed in the paper. First, at low amplitude, the dynamics is driven by the magnetic anisotropy of the particles. The rotation speed is low and the shape of the assembly is unaffected by the field. Thanks to dirt trapped on one of the particles, one can see its individual rotational motion, which at first is only partial. In the second clip, this individual rotation makes a full turn and the rotation speed is increased. In the third clip, the dipole-dipole interaction becomes more important, as the assembly begins to deform. Finally, the fourth clip shows the peculiar "juggling" regime, where the combined high amplitude and high frequency causes high deformations. The effect of the magnetic isotropy of the particles becomes negligible as the dynamics is mainly driven by the non-reciprocal deformation of the structure. The numerical simulations recover the same general behavior. However, the simulated assembly rotates more slowly at low amplitude, where a more complete description of the magnetic properties might be required. By comparison, the high-deformation regime is more accurately predicted.

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