

How Suspensions Remember

A new experiment elucidates the ability of some particle–fluid mixtures to behave in ways that depend on their previous flow.

By Charles Day

Chocolate syrup and fresh concrete are examples of non-Brownian suspensions. Their particles are large enough and their fluids viscous enough that the thermal jiggling known as Brownian motion plays little role in their mechanical behavior. Instead, particle interactions predominate. Surprisingly, non-Brownian suspensions seem to have memory in that their response to a new stress can depend on how they flowed in the past. Now Surendra Padamata and Nathan Keim have studied this puzzling property in their lab at Pennsylvania State University [1]. They found that a non-Brownian suspension’s previously studied memories of the direction and amplitude of past flows are not distinct. Rather, the two recollections are aspects of the same nonequilibrium physics.

Padamata and Keim stirred 100- μm -diameter plastic spheres into a thick organic detergent and poured the mixture into the gap between the two concentric cylinders of a rheometer. They applied a single continuous shear to imprint a memory of direction and then ten or so oscillations whose magnitudes varied between experiments to imprint a memory of amplitude. Finally, they measured the mixture’s viscosity using a readout

shear whose direction was either the same as or opposite to the initial shear.

The researchers found that the memory formed by the initial shear caused the viscosity measured during the readout shear to be lower when the two were in opposite directions. This original memory of direction coexisted with the new memory of amplitude, but they competed: Direction memory diminished as the amplitude of the oscillating shear increased. At a threshold amplitude, the direction-dependent difference was erased completely by the amplitude memory. Padamata speculates that this nontrivial interplay is due to many-body interactions among the particles.

Charles Day is a Senior Editor for *Physics Magazine*.

REFERENCES

1. S. Padamata and N. C. Keim, “Memories of amplitude and direction coexist and compete in non-Brownian suspensions,” *Phys. Rev. Lett.* **136**, 258201 (2026).



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