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Encoding mechano-memories in filamentous-actin networks[1]
SAYANTAN MAJUMDAR, University of Chicago, LOUIS FOUCARD, ALEX LEVINE, University of California, Los Angeles, MARGARET L. GARDEL, University of Chicago — History-dependent adaptation is a central feature of learning and memory. Incorporating such features into 'adaptable materials' that can modify their mechanical properties in response to external cues, remains an outstanding challenge in materials science. Here, we study a novel mechanism of mechano-memory in cross-linked F-actin networks, the essential determinants of the mechanical behavior of eukaryotic cells. We find that the non-linear mechanical response of such networks can be reversibly programmed through induction of mechano-memories. In particular, the direction, magnitude, and duration of previously applied shear stresses can be encoded into the network architecture. The 'memory' of the forcing history is long-lived, but it can be erased by force applied in the opposite direction. These results demonstrate that F-actin networks can encode analog read-write mechano-memories which can be used for adaptation to mechanical stimuli. We further show that the mechano-memory arises from changes in the nematic order of the constituent filaments. Our results suggest a new mechanism of mechanical sensing in eukaryotic cells and provide a strategy for designing a novel class of materials.

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