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**Manipulation of long-term dynamics in a colloidal active matter system using speckle light fields** ERCAG PINCE, SABAREESH K.P. VELU, AGNESE CALLEGARI, PARVIZ ELAHI, Bilkent University, SYLVAIN GIGAN, Universit Pierre et Marie Curie, GIOVANNI VOLPE, Bilkent University, GIORGIO VOLPE, University College London — Particles undergoing a stochastic motion within a disordered medium is a ubiquitous physical and biological phenomena. Examples can be given from organelles performing tasks in the cytoplasm to large animals moving in patchy environment. Here, we use speckle light fields to study the anomalous diffusion in an active matter system consisting of micron-sized silica particles (diameter  $5\mu\text{m}$ ) and motile bacterial cells (*E. coli*). The speckle light fields are generated by mode mixing inside a multimode optical fiber where a small amount of incident laser power is needed to obtain an effective disordered optical landscape for the purpose of optical manipulation. We experimentally show how complex potentials contribute to the long-term dynamics of the active matter system and observed an enhanced diffusion of particles interacting with the active bacterial bath in the speckle light fields. We showed that this effect can be tuned and controlled by varying the intensity and the statistical properties of the speckle pattern. Potentially, these results could be of interest for many technological applications, such as the manipulation of microparticles inside optically disordered media of biological interest.

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