Abstract Submitted
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The bacterial cytoplasm has glass-like properties and is fluidized by metabolic activity[1] BRAD PARRY, IVAN SUROVTSEV, Yale University, MATTHEW CABEEN, Harvard University, COREY O'HERN, ERIC DUFRESNE, CHRISTINE JACOBS-WAGNER, Yale University — In eukaryotes, active transport involves motor proteins and cytoskeletal filaments. In contrast, bacteria (which lack cytoskeletal motor proteins) are thought to rely on diffusion for molecular transport, though the physical properties of the bacterial cytoplasm are poorly understood. Through single particle tracking of foreign particles of different sizes, we have found that the bacterial cytoplasm exhibits striking similarities to glass-forming liquids. Glass-forming liquids are noted for their metastability near the glass transition where their behavior changes from liquid-like to amorphous solid with even small perturbations. Particles of different sizes exhibit distinct dynamics and their mobility changes from fluid-like to glassy with increasing size. This size dependency provides an explanation for previous reports of both normal and anomalous diffusion in the bacterial cytoplasm. Moreover, we find that cellular metabolism attenuates the glassy properties of the bacterial cytoplasm. As a result, components that would otherwise be caged in narrow regions of confinement are able to explore the cytoplasmic space under metabolically active conditions. These findings have broad implications for our understanding of bacterial physiology as the glassy behavior of the cytoplasm impacts all intracellular processes involving large cellular components.

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