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Dynamics of interfacial breach by colloidal spheres DAVID M. KAZ, RYAN MCGORTY, Harvard University, MADHAV MANI, University of California at Santa Barbara, VINOTHAN N. MANOHARAN, Harvard University — We present observations of individual colloidal spheres as they approach and penetrate a flat aqueous interface. Polystyrene spheres with various surface chemistries (sulfate, carboxyl, etc) are brought to the boundary between an oil phase (decane) and an aqueous phase (water+glycerol+NaCl) using radiation pressure from a tightly focused laser. Holographic images are recorded at up to 24,000 frames per second and subsequently compared with Mie-scattering calculations to obtain positional data at a resolution of 5nm in x,y, and z. Typical trajectories consist of an approach to the interface that is dominated by hydrodynamics; a discontinuous jump at the point of penetration (POP); and a very long timescale relaxation that is logarithmic in time. We find that the concentration of salt in the aqueous phase must be above a certain threshold (depending on species) for breach to occur. Well above this threshold, trajectories just prior to the POP are characterized by short-timescale features that are non-monotonic in salt concentration. DLVO type calculations reproduce some aspects of these features, but the non-monotonicity remains mysterious.

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