Non-equilibrium Glass Transitions and the Non-monotonic Behavior in Crowded Active Colloids

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Active matter, where an energy injection occurs at an elementary level and is converted to self-propulsion, opens new questions for out-of-equilibrium physics. Here, we study experimentally active matter in a crowded condition, where glass transition meets collective motion. Our system is a monolayer of micron-size gold-platinum Janus particles in water. Upon addition of hydrogen peroxide, the colloids become self-propelled due to the different chemical gradient on both sides. Besides, the amount of activity can be controlled by the concentration of hydrogen peroxide. From this setup, we are able to investigate its behavior at various density regimes and levels of activity. In the dense regime, we notice a non-monotonic behavior as the activity level rises up. Starting from a passive glassy system, introducing a very low activity drastically decreases the mobility. As the activity is further increased, we observe the opposite trend: the system becomes more fluid as expected in the first place. We correlate this non-monotonic trend with the density-dependence of effective diffusion in order to find out how the glass transition is affected by non-equilibrium active forces.

[1] F. Ginot, I. Theurkauff, D. Levis, C. Ybert, L. Bocquet, L. Berthier and C. Cottin-Bizonne, Nonequilibrium Equation of State in Suspensions of Active Colloids, Phys. Rev. X **5**, 011004 (2015)

[2] L. Berthier, E. Flenner and G. Szamel, How active forces influence nonequilibrium glass transitions, New Journal of Physics **19**, 125006 (2017)

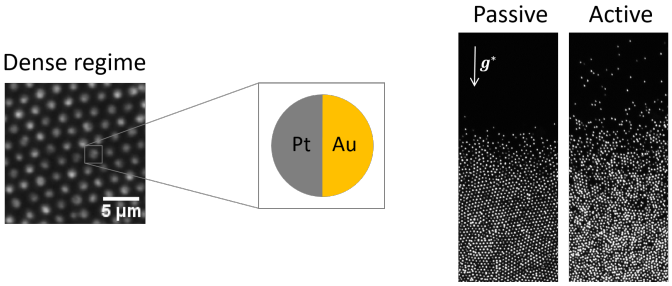

Figure 1: (left) A monolayer dense regime of the colloids. (right) Profile of the sedimentation comparing between the passive and the active cases. The colloids are confined by the effective gravity $g^* \ll g$.