CONDENSED MATTER PHYSICS SEMINAR SERIES

Jamming and clogging of passive and active particles in disordered media

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There has been tremendous growth in studying nonequilibrium systems of particle assemblies which can exhibit jamming effects in the absence of quenched disorder. Here we examine the dynamics of active and passive particles interacting with random or periodic substrates and obstacle arrays, and show that it is possible to make a clear distinction between jammed systems and clogged systems. Non-active particles flowing through random obstacle arrays reach a clogged state when the particle density is still well below that at which an obstacle free system would jam. The clogged states are spatially heterogeneous, fragile, and have a pronounced memory effect, whereas jammed states are homogeneous, robust, and have much weaker memory effects. We outline a possible scenario in which jamming is dominated by a diverging length scale associated with a critical density at point J, while clogging is associated with a diverging time scale similar to that found at absorbing phase transitions. We have also investigated clogging and jamming in active matter or self-motile particle systems, which include biological systems such as run-and-tumble bacteria or crawling cells as well as non-biological systems such as self-driven colloids or artificial swimmers. For active particles driven over random disorder we find that for intermediate amounts of self-motility the system does not clog; however, as the self-propulsion of the particles increases, there is a strong reduction of the mobility due to a self-clogging or self-clustering in the system that resembles the "faster is slower" effect found in certain pedestrian panic models.

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