Highlights

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Dynamic phase coexistence in glass forming liquids

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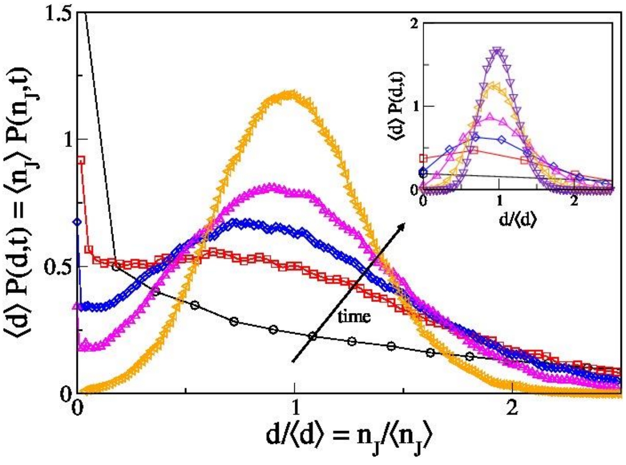
In liquids approaching the glass transition, the structure remains almost unchanged but the dynamics becomes dramatically sluggish and heterogeneous. A fascinating hypothesis for explaining this dynamics postulates the temporary coexistence of two phases of fast and slow particles [1]. However, this speculative scenario is poorly supported by quantitative results, as a dynamical order parameter that acquires a transient bimodal shape has never been found, and the two phases are commonly identified empirically [2]. Here we provide the first direct observation of the dynamical coexistence of two phases with different diffusivities, by showing that in the deeply supercooled regime the distribution of the single-particle diffusivities acquires a transient bimodal shape. Our work offers a basis for rationalizing the dynamics of supercooled liquids and for highlighting the elusive correlations between structure and dynamics [3].



Diffusivity distribution in a glass-former model. Probability distribution of the single particle diffusion coefficient at different time, rescaled by the average diffusivity, for a moderately (inset) and a deeply supercooled liquid (main panel), respectively. At deep supercooling and intermediate time, the distribution acquires a temporary bimodal shape with the maxima at d/<d>=0 and d/<d>=1 corresponding to the slow and to the fast particles, respectively.

[1] E.R. Weeks et al., Science 287, 627 (2000).
[2] L.O. Hedges et al. Science 323, 1309 (2009).
[3] R. Pastore et al., arXiv 1604.03043 (2016), accepted in JSTAT.