From Icosahedra to the Ideal Glass: Structure in Vitrification and Crystallisation

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Host: Associate Professor Massimo Pica Ciamarra

Abstract

When a liquid is cooled below its melting point, two routes to solidification are presented: vitrification and crystallisation. Our understanding of the mechanism by which the viscosity of supercooled liquids increases by many orders of magnitude is a major challenge in condensed matter physics [1,2]. To resolve this, it is necessary to discriminate between incompatible theoretical approaches which provide equally good descriptions of experimental data. These approaches boil down to whether the glass transition is driven by an underlying thermodynamic transition, or whether it is predominantly dynamical [1]. Here we report new developments with experiments and simulations on soft matter, which provide significant insight into the nature of the glass transition. With our new methodologies, we are able to access a new dynamical regime in the supercooled liquid, and our results provide strong evidence in support of a thermodynamic phase transition underlying the dynamical arrest that is the glass transition [3] and reconcile the competing theoretical descriptions of the glass transition [4,5].


Short Biography

C. Patrick (Paddy) Royall began his independent research career at the University of Bristol in 2007 upon the award of a Royal Society University Research Fellowship, receiving a proleptic appointment to lecturer in 2009, promotion to reader (associate professor) in 2015 and professor in 2018. He has published over 100 papers, over 20 in high-impact factor journals. He is distinguished for the breadth and depth of his expertise, which ranges from cutting-edge theory to novel imaging experiments. At one end of this spectrum, his work has delivered an analytical theory of many-body interactions in liquids. At the other end, developing from his background with colloidal particles, his lab is the first to examine collective behavior in 3D tracking of zebrafish. In between his lab carries out real space analysis of colloids, synthesises state-of-the-art active colloids, builds novel bionano materials, develops novel computer simulation techniques for rare-event sampling and applies statistical mechanical methods to brain-imaging data.

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