Resolving the liquid-to-glass transition(s) of water under soft nanoconfinement

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Water has challenged scientists with numerous anomalies and confounding problems since the very early times. The kinetic glass transition of bulk water is a pristine example, as its location remains mostly inaccessible to experimentalists in an area below about −41 °C, where bulk water spontaneously crystallises. Confining water within nanometre-sized domains is an intriguing approach inspired by the cellular environment in nature to completely prevent crystallisation. In this talk I will present our recent efforts directed to probing the liquid-to-glass transition(s) of water nanoconfined between non-freezing lipidic bilayers and will showcase a peculiar and counterintuitive regime over an extended temperature range, for which a sub-nanometre layer of water remains glassy in between fluid (mobile) walls of lipidic molecules. I will provide comprehensive evidence for a slowing down of water dynamics under soft nanoconfinement occurring in the −63 to −20 °C range across six orders of magnitude in time scales from 10^{-6} to 10^{-12} s, and a static glass transition ranging between −74 and −64 °C. These findings offer previously uncharted insights into the elusive glass transition of water under nanoconfinement, with broader implications for all those areas where water is confined at the nanometre scale below its freezing point.

Keywords:
No-man land, supercooling, glass transition, dynamic arrest