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Probing no man's land: ice nucleation at the nanoscale

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Nucleation is a stochastic process. At a given thermodynamic condition, nucleation events occur at a frequency that scales with the volume of the system. Therefore at the nanoscale, *e.g.*, in nano droplets, one may expect to obtain supercooled liquids below the bulk homogeneous nucleation temperature. However it is not clear to what extent would nucleation in nano droplet be connected with bulk water. In this talk, I will discuss the insight gained from our recent molecular simulations on ice nucleation at nanoscale. In particular, the study provides direct computational evidence for size-dependent ice nucleation rate within supercooled water nano droplets. Using a thermodynamic model based on classical nucleation theory, I will show that it is the Laplace pressure induced by the curved liquid vapor interface present in droplets that is responsible for the suppression of ice crystallization. Consistent with this model, our simulations show that the nucleation rates found for droplets are similar to those of liquid water subject to a pressure of the order of the Laplace pressure within droplets. The findings thus provide a link between supercooled bulk water and nano droplet through ice nucleation rate. In addition, the findings also support the hypothesis of surface crystallization of ice in microscopic water droplets in clouds.