

Phase transitions: a mesoscale bridge between the nano and the macroscale

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Among the key challenges in the world of nanoscience and nanotechnology is the transfer of knowledge and engineering of microscopic processes to the macroscopic world, paving the way for more thorough scientific discoveries and large-scale industrial adoption. As an alumnus of Nanotechnology Engineering and a PhD student here in Sapienza, I am working on exactly this: building a mesoscopic framework to bridge nanoscale phenomena (in particular, thermal fluctuations) and collective behaviour that takes place on larger scales (phase transitions), within the realm of fluid dynamics. A combination of theoretical tools, such as the Landau-Lifshitz-Navier-Stokes theory of fluctuating hydrodynamics (FHD), and rare-event techniques taken from large deviation theory (LDT), coupled with numerical methods, allows us to have unprecedented insight into the liquid to vapour phase change process, highlighting both its non-equilibrium nature and its intrinsically multi-scale features.