Does the van der Waals force play a part in evaporation?

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I argue that the van der Waals force exerted by the liquid and vapor/air on the molecules escaping from one phase into the other strongly affects the characteristics of evaporation. This is shown using two distinct descriptions of the van der Waals force: the Vlasov and diffuse-interface models, each of which is applied to two distinct settings: a liquid evaporating into its vapor and a liquid evaporating into air (in all cases, the vapor-to-liquid density ratio is small). For the former setting, the results are consistent with the Hertz–Knudsen law (HKL), but the evaporation/condensation probability is very small (in the classical HKL, it is order one). For the latter setting, the dependence of the evaporation rate on the difference between the saturated vapor pressure and its actual value is shown to be nonlinear (whereas the classical HKL predicts a linear dependence). The difference between the two settings indicates that the van der Waals force exerted by the air strongly affects evaporation (contrary to the general assumption that the ambient gas is unimportant). Finally, the diffuse-interface model is shown to be inapplicable in a narrow region at the outskirts of the interface – as a result, it noticeably underestimates the evaporative flux by comparison with the (more accurate) Vlasov model.

May 8th, 12:00 p.m.

Aula videoconferenze.
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