

# Role of melting and solidification in the spreading of an impacting water drop

*mardi 18 juin 2024 14:20 (20 minutes)*

When a liquid drop impacts onto a cold enough substrate, a complex interplay occurs between phase change and the spreading dynamics of the liquid film. A better understanding of this configuration has potentially a broad scope of applications, ranging from three-dimensional printing or metallurgy to aircraft icing problems. In the present paper, we report experiments of water drop impacts on ice or cold metal surfaces, in which both the droplet and the substrate temperatures, as well as the falling height, have been varied. By doing so, ice melting or solidification of the impinging drop can be evidenced. The maximum impact diameter is affected by the presence of phase change, with fusion enhancing the liquid film spreading whereas solidification hampers it. To rationalize these observations, we extend an existing model of effective viscosity, in which the influence of the phase change dynamics on the size and form of the viscous boundary layer is taken into account. This allows us to accurately describe the impact outcome and, more importantly, to relate the present data to a universal law recently developed in the context of isothermal drop impacts.

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**Classification de Session:** Présentations