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Universality of Tip Singularity Formation in Freezing Water Drops OSCAR ENRIQUEZ, University of Twente, ALVARO MARIN, Bundeswehr University Munich, PHILIPPE BRUNET, CNRS/Université Paris 7, PIERRE COLINET, Université Libre de Bruxelles, JACCO SNOEIJER, University of Twente — A drop of water on a cold plate freezes from the bottom up and forms a pointy tip in the last moments of the process. Although this phenomenon is known to be caused by the expansion of water upon freezing, a quantitative description of the tip singularity has remained elusive. Our systematic measurements of the angles of the conical tip, for a wide range of temperatures and wetting angles, suggest a universal, self-similar mechanism that does not depend on the rate of solidification. Furthermore, using a Hele-Shaw geometry, we have observed the dynamics of the solidification front. Here we demonstrate how the geometry of the freezing front, determined by heat transfer considerations, is crucial for the tip formation. We propose a geometrical model for the tip formation and derive resulting tip angles analytically, in good agreement with the experiments.

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