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Mushy Zone Evolution: Experimental and Theoretical Approach

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Melting and freezing phenomena play key roles in materials and biological sciences, and might also influence geophysical and nebular processes. To interpret microgravity melting experiments two of the authors (MEG/AL) recently developed a quasi-static model for the conduction-limited melting of prolate spheroids by solving the quasi-static moving boundary problem in the absence of capillarity, assuming that the ratio of major to minor axes, C/A, is constant. Capillarity, as observed in experiments, plays an increasingly important role in the late stages of melting as the curvatures diverge when a melting crystal nears extinction. The other authors (VC/JL) recently developed adaptive 3D boundary integral methods for quasi-steady solid/solid and solid/liquid phase transitions. Their numerical approach tests the assumption of shape-constraint (prolate spheroids) and quantifies the effect of capillarity not yet included in the model. Using 3D adaptive boundary-integral methods, the authors are also simulating fragmentation dynamics during melting.

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