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Thin liquid film coating on a sphere.

We study the time evolution of a thin liquid film coating the outer surface of a sphere in the presence of gravity, rotation, surface tension and thermal effects. We derive the fourth-order nonlinear partial differential equation that models the thin film dynamics, including Marangoni terms arising from the dependence of surface tension on an externally imposed temperature field. For constant surface tension, we show that the steady states are of three different types: uniformly positive film thickness, or states with one or two dry zones on the sphere, depending on the strength of the centrifugal force relative to gravity. We also give a constructive proof for the existence of non-negative weak solutions in a suitable weighted Sobolev space. In the absence of rotation, but with an externally imposed temperature field, we consider two different heating regimes with axial or radial thermal gradients and discuss the resulting dynamics of the film in both cases. We also analyze the stability of an initially uniform coating under small perturbations and carry out numerical simulations in COMSOL for a range of parameter values.