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Liquid "Coffee Rings" and the Spreading of Volatile Liquid Mixtures[1] CLAY WOOD, JUSTIN PYE, JUSTIN BURTON, Department of Physics, Emory University — When a volatile liquid drop is placed on a wetting surface, it rapidly spreads and evaporates. The spreading dynamics and drop geometry are determined by a balance between thermal and interfacial forces, including Marangoni effects. However, this spreading behavior is drastically altered when drops contain a miniscule amount of a less-volatile miscible liquid (solute) in the bulk (solvent); contact line instabilities in the form of "fingers" develop. Characteristic finger size increases with increasing solute concentration and is apparent for concentrations as small as 0.1% by volume. Also, the spreading rate depends sensitively on the solute concentration, especially if the solute preferentially wets the substrate. At higher solute concentrations, the spreading droplet will form "beads" at the contact line, rather than fingers, and are deposited as the solvent recedes and evaporates, leaving behind a complex pattern of solute micro-droplets. Liquid "coffee rings" are often left behind after evaporation because there is a high evaporation rate of the solvent at the contact line, which increases the concentration of the solute, and the longevity of the rings depends on the solute vapor pressure. These results highlight the unusual sensitivity to contamination of volatile spreading, and the complex patterns of liquid contamination deposited following evaporation from a wetted surface.

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