Electron screening in the liquid-gas mixed phases of nuclear matter
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abstract
Screening effects of electrons on inhomogeneous nuclear matter, which includes spherical, slablike, and rodlike nuclei as well as spherical and rodlike nuclear bubbles, are investigated in view of possible application to cold neutron star matter and supernova matter at subnuclear densities. Using a compressible liquid-drop model incorporating uncertainties in the surface tension, we find that the energy change due to the screening effects broadens the density region in which bubbles and nonspherical nuclei appear in the phase diagram delineating the energetically favorable shape of inhomogeneous nuclear matter. This conclusion is considered to be general since it stems from a model-independent feature that the electron screening acts to decrease the density at which spherical nuclei become unstable against fission and to increase the density at which uniform matter becomes unstable against proton clustering.