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Magnetic domains in ferromagnetic particles with perpendicular anisotropy STAVROS KOMINEAS, CHRISTOFOROS MOUTAFIS, TONY BLAND, University of Cambridge — We derive a Derrick-like virial theorem for static states in a disc-shaped ferromagnetic particle with an axially symmetric magnetic configuration. This is applied to elementary magnetic states such as a single domain and a vortex. We calculate the vortex state in a disc-shaped particle with no anisotropy and study the very thin and very thick limits. In the very thin limit the virial relation effectively gives the vortex core radius. We also consider a particle with significant perpendicular anisotropy and show that a vortex is a static state for sufficiently thin particles. For thicker particles the vortex core expands to become comparable to the particle lateral size while the magnetization at the periphery of the particle tilts out of plane opposite to the vortex core region. In sufficiently thick particles, the magnetic state takes the form of a magnetic "bubble" (well-known in films) viewed here as a bidomain state. The signature of a bubble is its magnetostatic field which consists of two concentric regions of opposite sign above the particle top surface. Higher order states of multiple concentric domains of opposite magnetization are found in larger particles. We finally study the effect of an external field on magnetic bubble states.

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