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## Macroscopic dynamics of ferrofluids

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Ferrofluids (magnetic fluids, magnetic nanofluids) are ultrastable colloidal suspensions of magnetic nanoparticles in non-polar and polar carrier liquids. The most striking feature of a ferrofluid is that it is a liquid with strong magnetic properties. The macroscopic dynamics of ferrofluids remains a subject of interest. Here we concentrate mainly on the two limiting cases. One corresponds to the assumption about equilibrium magnetization of ferrofluids i.e., under dynamic perturbations of the ferrofluids, the relaxation time of a magnetic field strength to its equilibrium value is infinitely small. Another limiting case corresponds to the assumption of frozen-in magnetization. The relaxation time of a magnetic field strength to its equilibrium value is infinitely large. The physical grounds for introducing this limiting case were descriptions of dynamic processes, in particular, ultrasound propagation in ferrofluids. The obtained expression for the velocity of fast magnetosonic waves describes the existing experimental data on the anisotropy of ultrasound wave propagation in ferrofluids. The previous theories could not describe the propagation of ultrasound waves in magnetic fluid under external magnetic field. The prediction concerning the existence of new waves, namely slow magnetosonic wave and Alfvén-type wave in ferrofluids seems very important and requires an experimental verification. We believe these waves would prove a most prolific area of experimental research.

### Recent Publications

1. Ovchinnikov I E and Sokolov V V (2013) Waves in magnetic fluids with equilibrium and frozen-in magnetization. *Acoustical Physics* 59:51–55.
2. Sokolov V V, Fotov K N and Eminov P A (2011) The Hamiltonian structure of equations of ideal ferrohydrodynamics with internal rotation. *Doklady Physics* 56:467–470.
3. Felderhof B U, Sokolov V V and Eminov P A (2011) Hamiltonian field theory of ferrohydrodynamics. *Journal of Chemical Physics* 135:144901.
4. Sokolov V V (2010) Wave propagation in magnetic nanofluids (a review). *Acoustical Physics* 56:972–988.
5. Felderhof B U, Sokolov V V and Eminov P A (2010) Ferrofluid dynamics, magnetic relaxation, and irreversible thermodynamics. *Journal of Chemical Physics* 132:184907.

### Biography

Victor V Sokolov is a Professor at MIREA-Russian Technological University, Russia. His activities and awards include the Russian Government Premium in Education (2013), Honoured Worker of Higher Education of the Russian Federation (2003), Certificate of Soros's Associate Professor of Physics (1998). He is a Member of the Russian National Committee on Theoretical and Applied Mechanics. His research interests lie in macroscopic theory of continuum with frozen-in magnetization and Hamiltonian dynamics of complex fluids.

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