

Contribution submission to the conference Quanten 2025

Computational fluid dynamics simulation of dipolar gases in the hydrodynamic regime — •MICHAEL MAYLE¹, REUBEN R. W. WANG^{2,3}, and JOHN L. BOHN⁴ — ¹Fakultät Angewandte Mathematik, Physik und Allgemeinwissenschaften, Technische Hochschule Nürnberg Georg Simon Ohm, Nürnberg, Germany — ²ITAMP, Center for Astrophysics | Harvard & Smithsonian, Cambridge, Massachusetts 02138, USA — ³Department of Physics, Harvard University, Cambridge, Massachusetts 02138, USA — ⁴JILA, NIST, and Department of Physics, University of Colorado, Boulder, Colorado 80309, USA

In a recent theoretical effort, a hydrodynamic model of ultracold, but not yet quantum condensed, dipolar gases has been derived. Within this model, the dipolar scattering results in an anisotropic viscosity tensor. Effects of the anisotropy have been predicted to be observable in the weltering motion, i.e., the collective oscillations of a dipolar Fermi gas, as well as in its acoustic behavior.

In this contribution, we approach dipolar fluids from a computational fluid dynamics (CFD) perspective. To this end, previously derived analytic expressions of the anisotropic viscosity tensor are implemented in the finite-element software COMSOL Multiphysics. This allows us to investigate a whole spectrum of fluid flow situations but now including the inherent anisotropy of dipolar scattering. We present first results of such CFD simulations with an emphasis on effects attributable to the special characteristics of the anisotropic viscosity tensor.

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