Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

The acoustic radiation force on a small thermoviscous or thermoelastic particle suspended in a viscous and heat-conducting fluid JONAS KARLSEN, HENRIK BRUUS, Tech Univ of Denmark — We present a theoretical analysis (arxiv.org/abs/1507.01043) of the acoustic radiation force on a single small particle, either a thermoviscous fluid droplet or a thermoelastic solid particle, suspended in a viscous and heat-conducting fluid. Our analysis places no restrictions on the viscous and thermal boundary layer thicknesses relative to the particle radius, but it assumes the particle to be small in comparison to the acoustic wavelength. This is the limit relevant to scattering of ultrasound waves from sub-micrometer particles. For particle sizes smaller than the boundary layer widths, our theory leads to profound consequences for the acoustic radiation force. For example, for liquid droplets and solid particles suspended in gasses we predict forces orders of magnitude larger than expected from ideal-fluid theory. Moreover, for certain relevant choices of materials, we find a sign change in the acoustic radiation force on different-sized but otherwise identical particles. These findings lead to the concept of a particle-size-dependent acoustophoretic contrast factor, highly relevant to applications in acoustic levitation or separation of micro-particles in gases, as well as to handling of μm- and nm-sized particles such as bacteria and vira in lab-on-a-chip systems.

Jonas Karlsen
Tech Univ of Denmark

Date submitted: 14 Jul 2015 Electronic form version 1.4