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Tangling clustering of inertial particles in stably stratified turbulence

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(Submitted on 25 Nov 2009 (v1), last revised 17 Mar 2010 (this version, v3))

We have predicted theoretically and detected in laboratory experiments a new type of particle clustering (tangling clustering of inertial particles) in a stably stratified turbulence with imposed mean vertical temperature gradient. In this stratified turbulence a spatial distribution of the mean particle number density is nonuniform due to the phenomenon of turbulent thermal diffusion, that results in formation of a gradient of the mean particle number density, \nabla N, and generation of fluctuations of the particle number density by tangling of the gradient, \nabla N, by velocity fluctuations. The mean temperature gradient, \nabla T, produces the temperature fluctuations by tangling of the gradient, \nabla T, by velocity fluctuations. These fluctuations increase the rate of formation of the particle clusters in small scales. In the laboratory stratified turbulence this tangling clustering is much more effective than a pure inertial clustering that has been observed in isothermal turbulence. In particular, in our experiments in oscillating grid isothermal turbulence in air without imposed mean temperature gradient, the inertial clustering is very weak for solid particles with the diameter 10 microns and Reynolds numbers Re =250. Our theoretical predictions are in a good agreement with the obtained experimental results.

Comments:	16 pages, 4 figures, REVTEX4, revised version
Subjects:	**Fluid Dynamics (physics.flu-dyn)**; Earth and Planetary Astrophysics (astro-ph.EP); Chaotic Dynamics (nlin.CD); Atmospheric and Oceanic Physics (physics.ao-ph)
Cite as:	**arXiv:0911.4814v3 [physics.flu-dyn]**

Submission history

From: Igor Rogachevskii [view email]
[v1] Wed, 25 Nov 2009 11:12:21 GMT (893kb)
[v2] Mon, 30 Nov 2009 10:30:43 GMT (893kb)
[v3] Wed, 17 Mar 2010 15:38:29 GMT (778kb)

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