

# Convection (L16)

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Convection is the name given to the means used by fluids to transfer heat when fluid flow is more effective than conduction. In a fluid layer, for example, between horizontal boundaries held at fixed temperatures, convection occurs when the temperature difference is sufficiently large. The onset of convection can be thought of as an instability of pattern forming type, and there are many interesting questions that can be asked: What are the pattern and horizontal scale of convection near onset? How does the heat transfer depend on the temperature difference? How do the simple patterns seen at onset break down? What is the effect on convection of other physical effects such as rotation, and what happens when there are two sources of buoyancy, such as thermohaline convection?

The course will address many of these issues. Though convection requires that fluid density depend on temperature and so be non-uniform, most of the course will use the Boussinesq approximation, in which the fluid may be treated as incompressible except for the buoyancy term. This approximation is a good one for laboratory liquids and gives a good guide to many aspect of convection for which the approximation is not accurate.

There will be three problem sheets and associated examples classes.

## Desirable Previous Knowledge

Knowledge of fluid dynamics and dynamical systems would be an advantage.

## Introductory Reading

- (a) Chandrasekhar, S. Hydrodynamic and Hydromagnetic Stability. Dover
- (b) Drazin, P and Read, W. Hydromagnetic stability (chapter 2). CUP

## Reading to complement course material

- (a) Getling, A.V. Rayleigh-Benard convection: structures and dynamics. World Scientific
- (b) Hoyle, R. Pattern Formation. CUP