MUST

Mathematical Underpinning of Stratified Turbulence

UK Engineering and Physical Sciences Research Council

IAB meeting

19 April 2017

UNIVERSITY OF CAMBRIDGE

Agenda

- 1000 Arrival and introductions
- 1030 Update (PFL)
- 1045 PDRA presentations
  - Jamie Partridge
  - Qi Zhou
  - Dan Lucas
  - Jacob Page
- 1300 Lunch
- 1345-1400 Future plans (PFL)
- 1400-1500 IAB closed session
- 1500 Feedback and discussion

Vision

- Structures
  - Extracting structures responsible for mixing
  - Exploring their life cycles
- Mixing
  - Determining the efficiency as functions of Re, Ri and Pr
- Fluid properties
  - Examining how mixing changes qualitatively and quantitatively as Pr changes
- Forcing
  - Examining the roles of boundary and body forcing

Appointments

Started June 2013, PDRAs in post beginning of 2014. End date extended to end November 2018

Initial appointments

Cambridge

Pierre Augier – LEGI, Grenoble (October 2014)

Enrico Deusebio – data analysis in Milan (May 2015)

Bristol

Colin Leclercq – Onera (July 2016)

Appointments

Current appointments

Cambridge

Jamie Partridge – to end of grant

Qi Zhou – tenure track at U. Calgary (31/08/17)

Dan Lucas – lectureship at Keele (31/08/17)

Bristol

Jacob Page – to end of grant

Expenditure

Cambridge

Staff costs

We (just about) have sufficient funds to hire a further PDRA for the duration of the grant

Equipment

£18K remaining (includes 50% university contribution)

Travel

£50K remaining

Bristol

Funds to support Jacob until the end of the grant

Outputs

- Publications
  - 17 papers (14 in JFM)
- Conferences presentations
  - Approximately 50
- Meetings
  - Euromech 567 2015
  - RS meeting 2016
- Hardware
  - New system for measuring 3 components of velocity and a scalar field in 3D over a volume at a resolution suitable to initialise a DNS

Associated funding

- Related grants
  - NERC grant: Characterising the Ice Shelf/Ocean Boundary Layer 2017-202
  - ERC Advanced Grant 2017-2022: Stratified turbulence and mixing processes (STAMP)
- Studentships: includes 4 completed PhDs
  - NERC (2)
  - EPSRC (5)
  - Indian Government (1)
  - CONACYT Mexico (1)

Collaborations

- US
  - De Bruyn Kops (U. Mass)
  - Diamessis (Cornell)
  - Manucharyan (WHOI)
  - Mezic (UCSB)
  - Monismith (Stanford)
- Australia
  - Ivey (UWA)
- Canada
  - Peltier & Salehipour (Toronto)
- China
  - Ling (SCSIO)
- UK
  - Woods (BPI)
  - Burridge, Hughes (Imperial)

Questions

- What areas/topics should we emphasise in this final 18 months?
- What areas/topics should we de-emphasise
- What aspects are likely to have the most impact, both within the community and more broadly?

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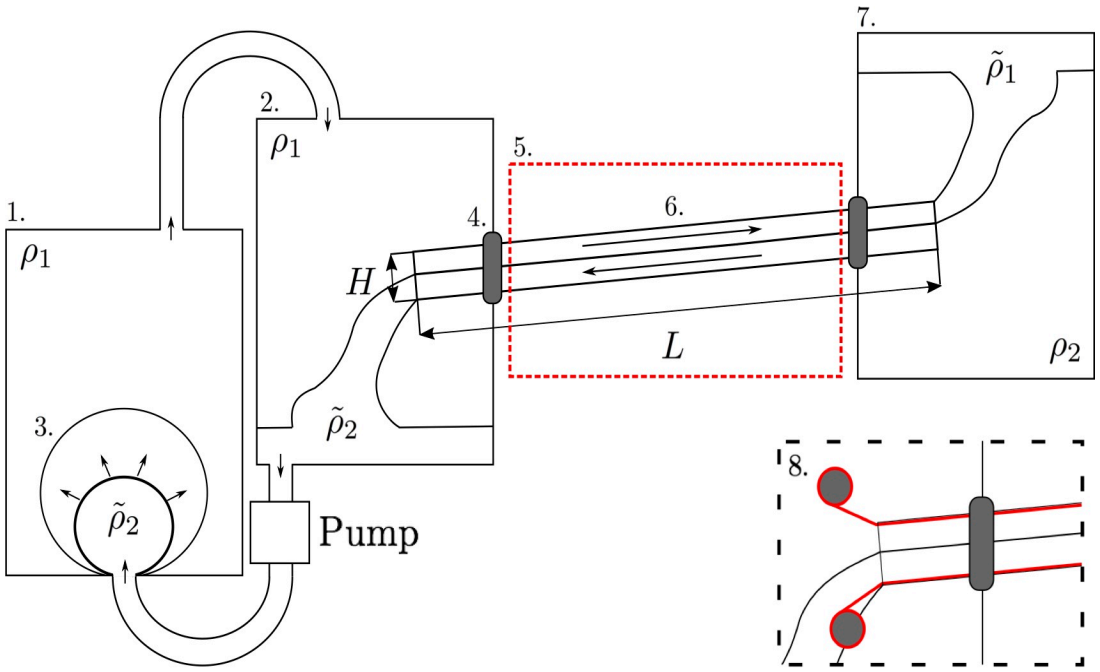
Future plans

- Hire a new PDRA to continue DNS at Cambridge
- Build a new apparatus to extend SID, supported by ERC grant 2017-2022
- Continue a combined experimental-computational study based around SID until (at least) 2022
- Hold an Isaac Newton Institute programme in 2020 or 2021.

New version of SID



Allows moving boundaries, and ensures zero net flow

Specific objectives

A. 3D measurements of the scalar field and the 3 components of velocity in the new SID in order to characterise the flow structures and lifetimes in the four previously identified regimes.

B. Examine the effects of moving boundaries.

C. Examine the effects of fluid properties. We will study the effects of Prandtl number using heat and salt and (possibly) by changing the viscosity using water-glycerol mixtures. We also plan to look at more general molecular effects using flows with both heat and salt contributing to the density field, one in the doubly-stable configuration (cold, salty beneath warm fresh) and the double-diffusive case.

D. Examine the effects of initial conditions. We will study the implications of different starting conditions e.g. the duct initially containing a two-layer stratification, or changing the inclination as a function of time.

E. Examine the influences of constrictions on the flow to alter the hydraulic properties. We will also force small perturbations at the sidewall boundaries to see if they influence transition and the intermittency of the flow.