Curriculum Vitae

Name : POUQUET Annick

Affiliation and official address : NCAR, BP 3000, Boulder, CO 80307–3000
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Education : 1966, Sophomore year, San Diego ; 1976, Thèse d'Etat, University of Nice

Career/Employment :

- October 2000 - , senior scientist at NCAR
- 1974 - 2000, CNRS (from Attaché to Directeur de Recherche de Première Classe)
- 1973 - 1974, Post–Doctoral position, NCAR

Specialization :

1. *main fields :* Turbulence (neutral and MHD): theoretical approaches, phenomenology and modeling, numerical methods; solar applications; statistical physics
2. *current research interests :* Intermittency, adaptive mesh refinement, heating of the solar corona, models of geo-dynamo, multi-scale physics, helical flows, large eddy simulations and parametrization

Research/Managerial Responsibilities :

- 2004 – : Acting then *Deputy Director, Earth and Sun Systems Laboratory, NCAR*
- 2004 : *Fellow, American Physical Society, Division of Fluid Mechanics*
- 2003 : Deputy Director, ASP
- 2000 – Present: Director of the Geophysical Turbulence Program at NCAR
- 1998 – October 2000: Director, Cassini Laboratory (CNRS & OCA)
- 1990 – Present: Associate Editor for the *Journal of Computational Physics*
- PI for several contracts (NSF, ONR, EEC, CNRS, DRET)
- Supervisor, Thesis and Habilitations (in full or collaboration): R. Grappin (1985), T. Passot (1987 & 1992); B. Galanti (1991); H. Politano (1994); Y. Ponty (1996); S. Galtier (1998); T. Gomez (1999); L. Sorriso–Valvo (2002); Jonathan Graham (ongoing).
- Lecturer at the doctoral level: Courses on Turbulence, INLN (Nice), 15 hours (see also list of publications for international summer schools)
- Referee in 23 International Journals (Astrophysics, Geophysics, Numerics, Physics)

𝒮YNOPSIS

𝒰nderstanding turbulence remains a major stumbling block of classical physics: a large number of spatial and temporal modes are coupled leading to power–law spectra, exponential wings of *pdf*, long–lived coherent structures and intermittency, all of which are observed in geophysical and astrophysical fluids and plasmas. The solar and planetary environments (photosphere, corona and the Solar Wind, the magnetosphere of Jupiter or the liquid core of the Earth as the locus of the dynamo phenomenon) are specific applications of my research. The challenge is to put together a team that develops powerful new tools – harnessing the increase in power of both computer technology and algorithms –, in parallel contribute to the theoretical research in turbulence and build phenomenological and numerical models, and follow this path all the way to its consequences for geophysical and astrophysical flows.

A selection of recent publications on turbulence (see also publication list) :

Total number of papers : 240, including 4 in preparation, 2 submitted and 6 published sets of Lectures; *Number of papers in refereed journals :* 103 ; *Editing of Books :* 2

* Alex Alexakis, Pablo Mininni and Annick POUQUET, "Large scale flow effects, energy transfer, and self-similarity in turbulence," arXiv:physics/0602148, to appear, *Phys. Rev. E* (2006).

* Jonathan Graham, Darryl Holm , Pablo Mininni and Annick POUQUET, "Inertial Range Scaling, Kármán-Howarth Theorem and Intermittency for Forced and Decaying Lagrangian Averaged MHD in 2D," *Phys. Fluids* **18** 045106 (2006).

* Duane Rosenberg, Aimé Fournier, Paul Fischer and Annick POUQUET, "Geophysical-astrophysical spectral element adaptive refinement (GASpAR): Object-oriented h-adaptive code for geophysical fluid dynamics simulations," *J. Comp. Phys.* **215** 59 (2006).

* P. Mininni, D. Montgomery & POUQUET, A., "A numerical study of the alpha model for two-dimensional magnetohydrodynamic turbulent flows," *Phys. Fluids*, **17**, 035112 (2005).

* J. Saur, POUQUET, A. & W. Matthaeus, "An acceleration mechanism for the generation of the main auroral oval on Jupiter", *Geophys. Res. Lett.* **30(5)**, 1260 (2003).

* Liu, H.-L., P. Charbonneau, A. POUQUET, T.J.Bogdan & S.W. McIntosh, "Continuum Analysis of an Avalanche Model for Solar Flares", *Phys. Rev. E* **66**, 056111 (2002).

* S. Galtier, S. Nazarenko, A. Newell & A. POUQUET, "A weak turbulence theory for incompressible MHD", *J. Plasma Phys.* **63**, 447 (2000).

* H. Politano & A. POUQUET, "A von Kármán–Howarth equation for magnetohydrodynamic fluids and its consequences on third–order longitudinal structure and correlation functions", *Phys. Rev. E Rapid Comm.* **57**, R21 (1998).

* D. Porter, P. Woodward & POUQUET, A. " Inertial range structures in compressible turbulent flows", *Phys. Fluids* **10** 237 (1998).

* Einaudi, G., Velli, M., Politano, H. & A. POUQUET, "Energy release in a turbulent corona", *Astrophys. J. Lett.* **455**, L113 (1996).

Collaborations since 1997 :

D. Balsara (NCSA), F. Bacciotti (Firenze), A. Bhattacharjee (U. New Hamshire), T. Bogdan (NCAR), M.E. Brachet (Paris), V. Carbone (Cosenza), P. Charbonneau (Montréal), C. Chiuderi (Firenze), S. Galtier (Orsay), T. Gomez (Paris), D. Holm (LANL & Imperial College), HanLi Liu (NCAR), W. Matthaeus (Bartol), D. Montgomery (Dartmouth), S. Nazarenko (Warwick), A. Newell (Arizona), Chung-Sang Ng (U. New Hamshire), C. Nore (Orsay), A. Noullez (Nice), T. Passot (Nice), H. Politano (Nice), D. Porter (Minnesota), J. Saur (Cologne), Amik St Cyr (NCAR), L. Sorriso–Valvo (Cosenza), P. Sullivan (NCAR), I. Sytine (Minnesota), E. Vàzquez (Mexico), P.L. Veltri (Cosenza), P. Woodward (Minnesota), E. Zienicke (Ilmenau).

Brief description of scientific work since my arriving at NCAR in October 2000:

My work has presently three main focii:

1) **Development of an adaptive mesh refinement (AMR) code using spectral elements** (GASpAR or Geophysical Astrophysical Spectral elements Adaptive Refinement), thus preserving accuracy which is essential for turbulent flows; this development is carried out by Duane Rosenberg (Software Engineer hired two years ago) and Aimé Fournier (Project Scientist, hired last year). The code is object oriented and flexible; it combines finite-element efficiency with spectral accuracy and it accomodates non-conforming elements. It is well along and tested in two space dimensions on the heat and Burgers equations; several problems will be examined in the near future, *e.g.* convecting plumes, tracer advection and extreme events, rotating flows, magnetohydrodynamic (MHD) turbulence in the presence of a strong magnetic field. Extension to three dimensions is planned, but preference is presently given to exploiting the code in 2D. Several proposals are submitted.

2) **Development, testing and use of a model for turbulent flows** first derived by Holm, Titi and collaborators for fluids and now extended to MHD; this work is done within the framework of a CMG/NSF proposal which funds Jonathan Graham (graduate student in Applied Mathematics at CU) and Pablo Mininni (post-doctoral fellow). The small magnetic Prandtl number dynamo (as is the case for the Earth, the convective zone of the Sun and in laboratory experiments using liquid metals) has been shown to exist down to $P_M \sim 0.01$ on the Taylor-Green flow, the configuration used in the Lyon and Maryland experiments, whereas most previous studies used purely random flows and still do not see any dynamo effect below $P_M \sim 0.25$. Follow-up on this research concerns the locality of non-linear interactions in MHD, and the fact that small scales play an essential role in the instability even though for late times, the magnetic field is dominant at large scales. This has interesting consequences in other non-linear geophysical problems, such as in climate studies.

3) **Exploring the properties of turbulent MHD flows** as they occur in the solar wind, the solar corona, the solar convection zone or in the liquid core of the Earth as for example the possibility to predict large solar flares using the abrupt change in the cancellation exponent of the current helicity, or the possibility of developing power-law tails in probability distribution functions of velocity gradients and magnetic currents, a signature of extreme events in turbulent flows, or finally the possibility of developing singular structures in MHD flows. These phenomena are best studied in two space dimensions for which higher Reynolds numbers can be reached, and in preparation of using the AMR code as described in point (1) above.