Research & Coordination Activity

N. Vianello

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Personal research interest

- Actively involved in fusion plasma science since the M.Sci. thesis in 1999
- Personal research interests can be summarized in four main macro-areas
  - (A) Flows & Turbulence induced transport in magnetized plasmas
  - (B) Emerging of electromagnetic structures
  - (C) 3D physics and helical plasmas
  - (D) Statistical characterization of electromagnetic fluctuations

Flows & Turbulence induced transport

A

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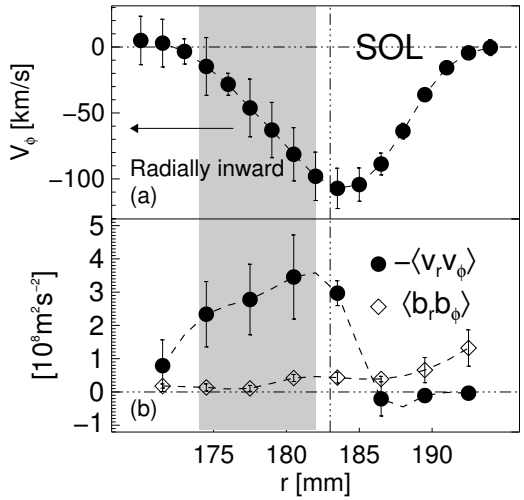
(i) Role of electrostatic Reynolds stress in momentum generation in RFPs, including first measurements of non-linear momentum flux $\langle \tilde{v}_\perp \tilde{v}_r \tilde{n} \rangle$



PRL 94 p. 135001, NF 45 p. 761, PPCF 48 p. S193

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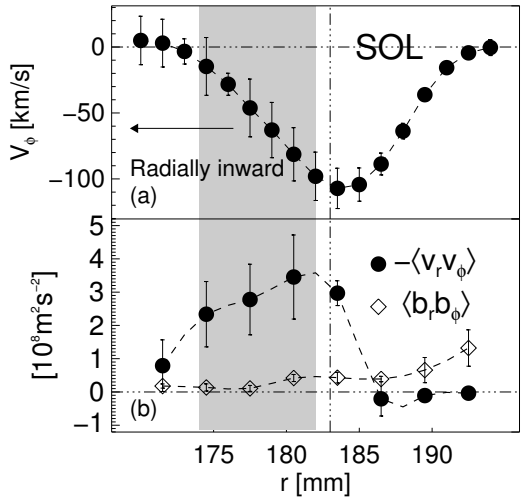

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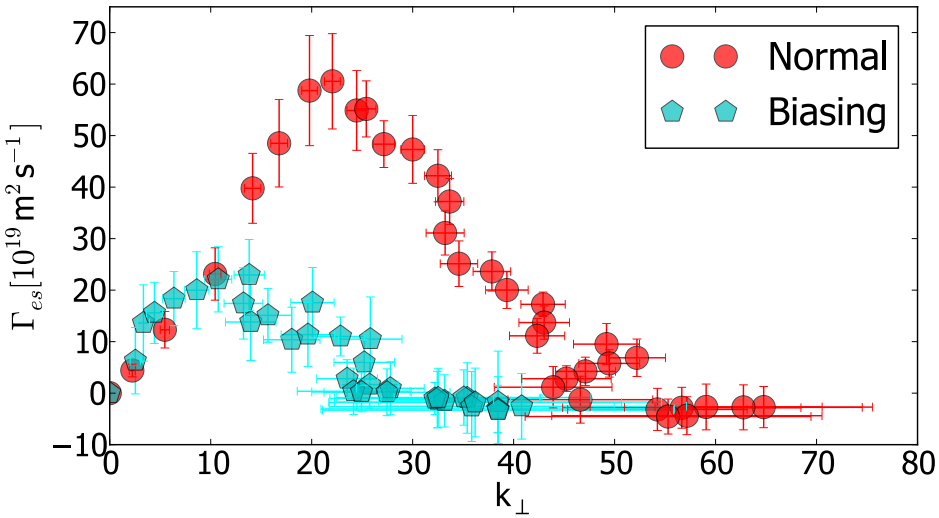
(ii) Transport reduction induced by active modification of sheared flow

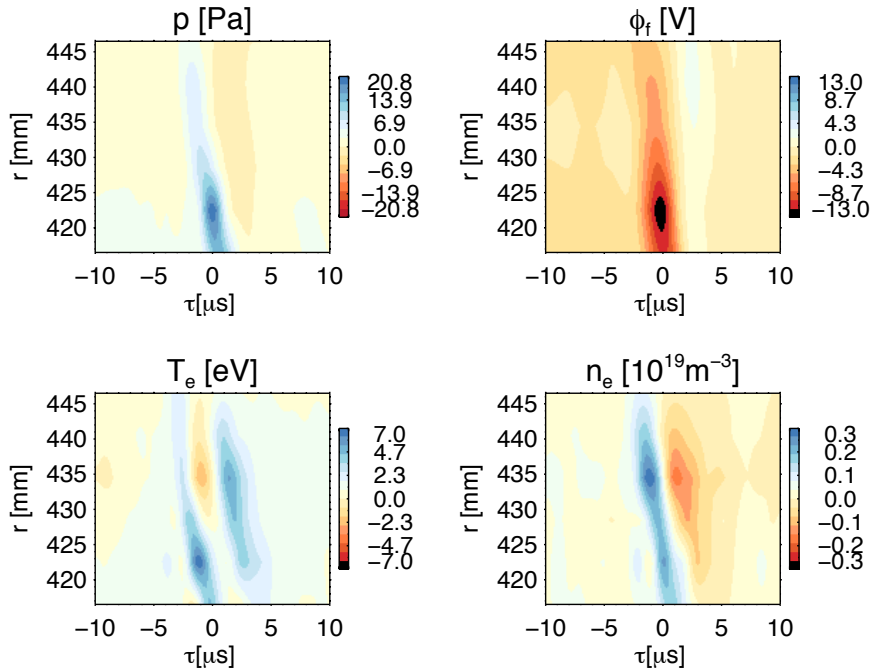


PPCF 42, p. 83

Coherent structures characterization

B

- Complete characterization of coherent structures responsible for intermittency



Coherent structures characterization

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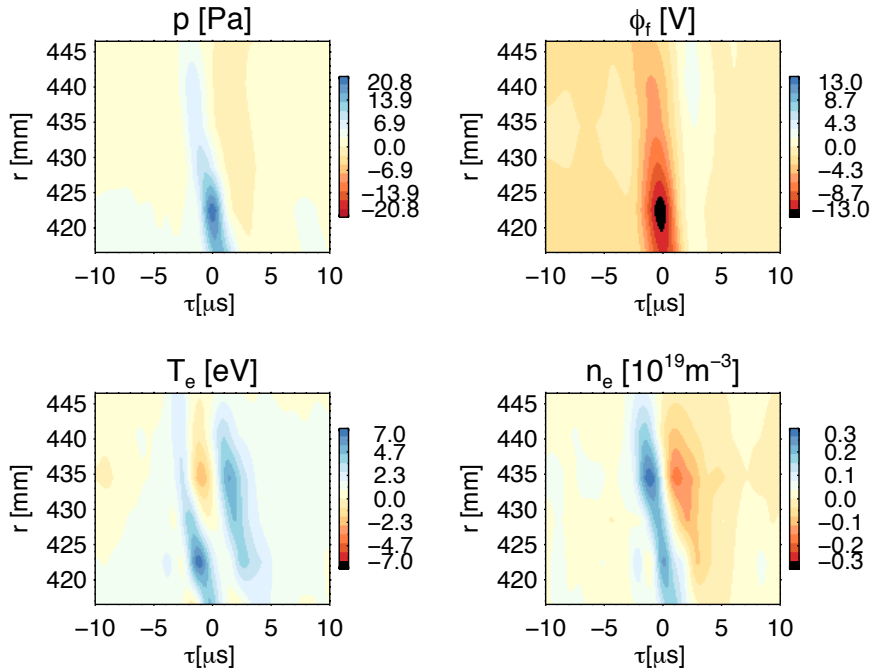
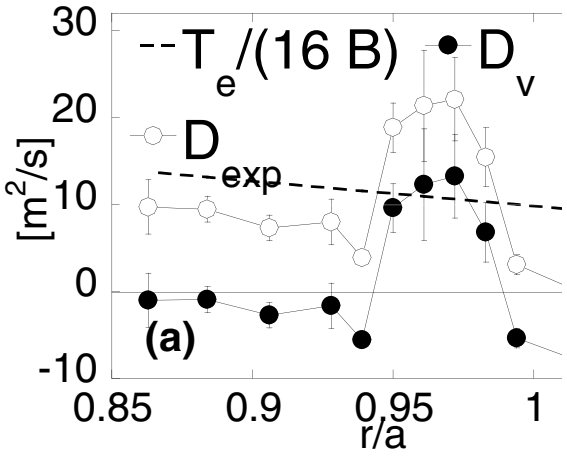
- Complete characterization of coherent structures responsible for intermittency
- Evaluation of transport contribution due to coherent structures

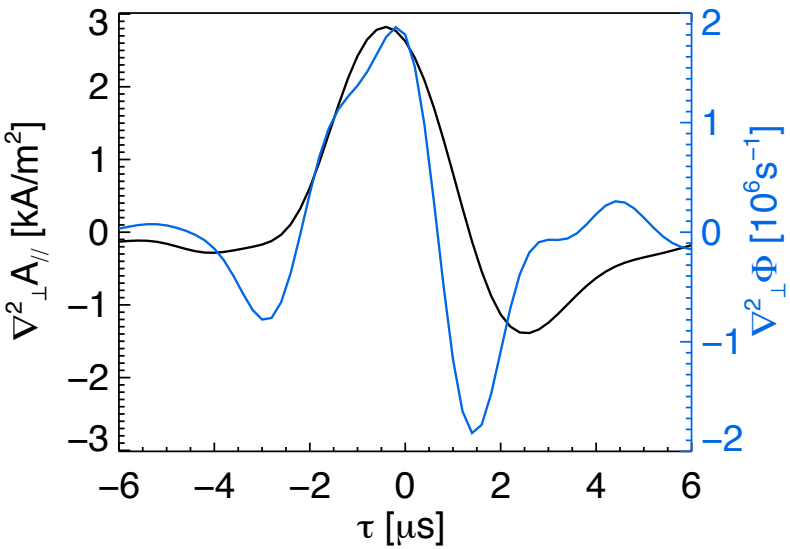


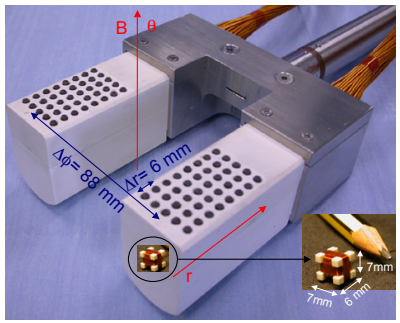


PRL 93 p.215003, PoP 9 p.4110

Current filaments

- Measurements of parallel plasma current associated to *blobs* & *filaments* in different experiments with different magnetic configuration





RFX-mod Reversed Field Pinch

- First direct measurements of current filaments associated to plasma blob identified as DKA vortex PRL 102 2009, NF 50 2010

Current filaments

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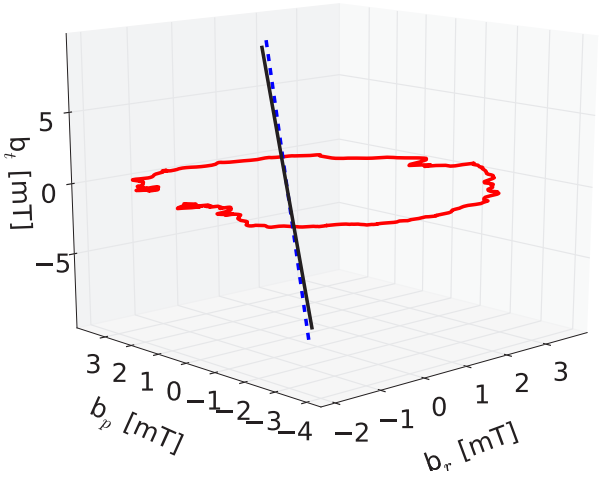
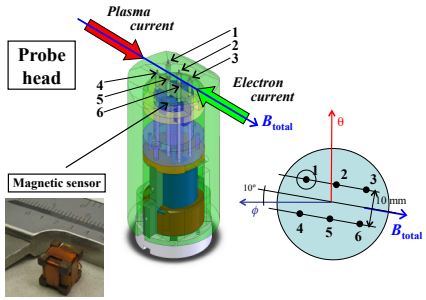




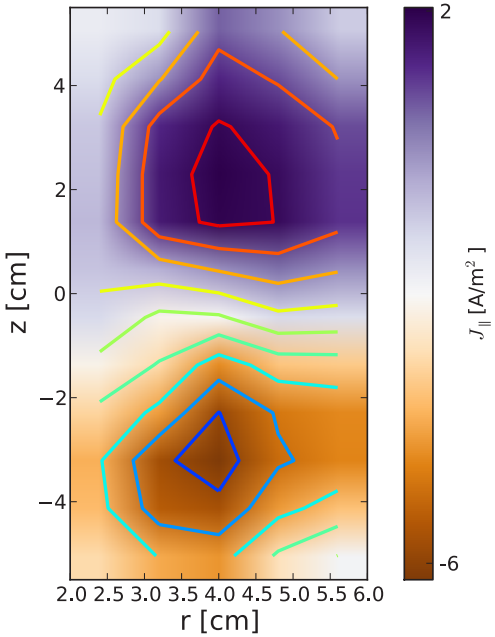
ASDEX-Upgrade Tokamak

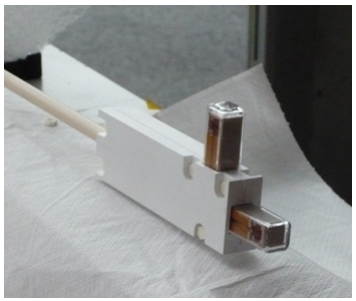
- First direct measurements of current asociated to type-I filaments (PRL 106, 2011)

Current filaments

B

- Measurements of parallel plasma current associated to *blobs* & *filaments* in different experiments with different magnetic configuration





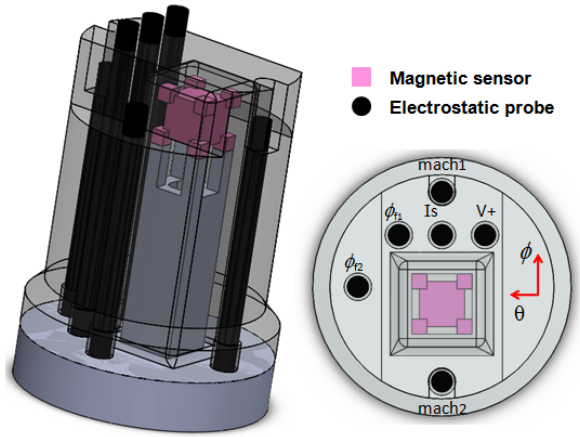
- First direct 2D map of parallel current associated to an interchange-induced plasma blob (PRL 106, 2011)

Current filaments

B

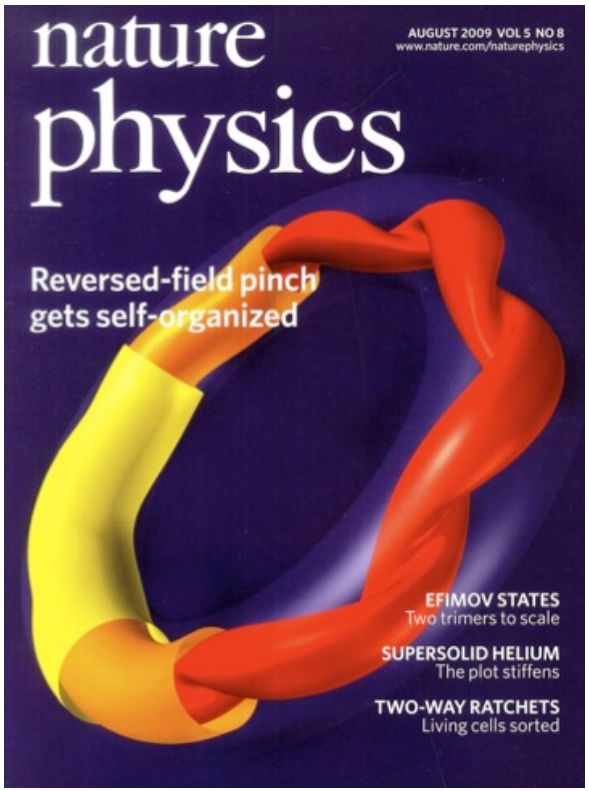
- Collaboration established to extend studies of current filaments to other devices, namely TJ-II stellarator, with a probe which combines vorticity and current measurements and EAST tokamak for the studies of ELMs

TJ-II Stellarator



EAST-Tokamak

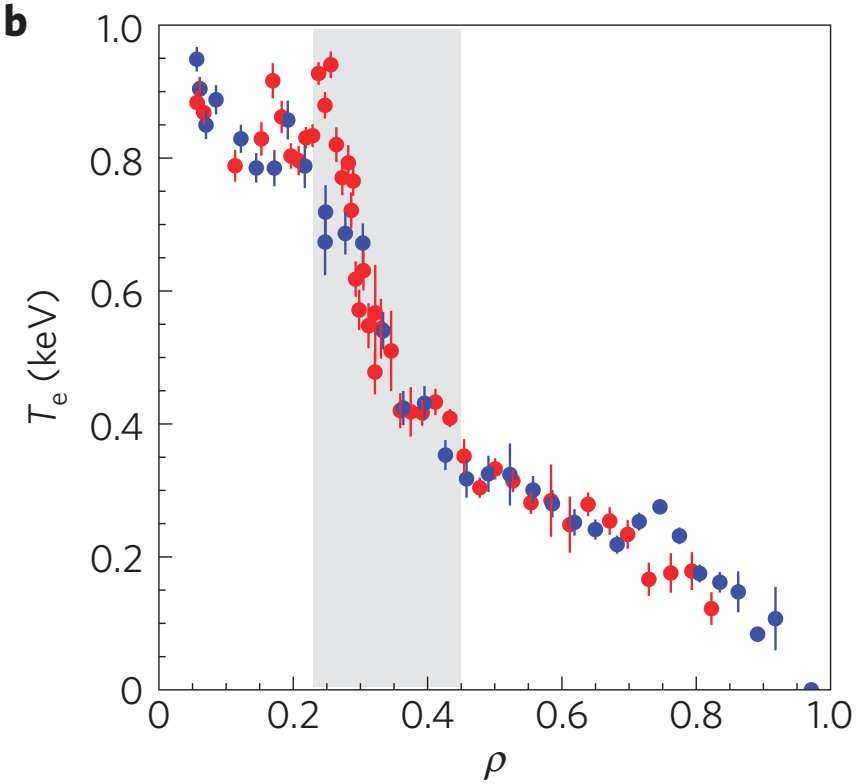
Helical plasmas



- Observation and characterization of spontaneous helical plasmas developing in high current Reversed Field Pinch operation

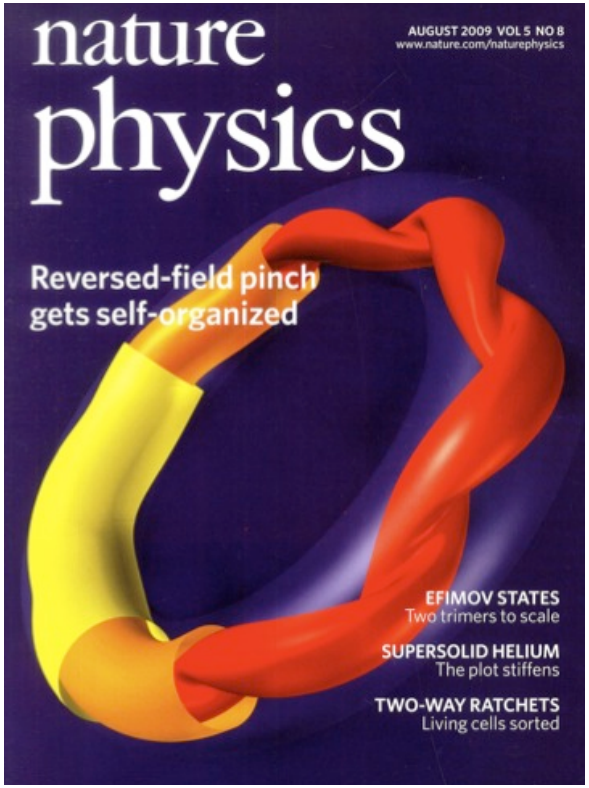
  Nat. Phys. 5 pp. 570

Helical plasmas



- With the appearence of a transport barrier located in the region of a local maxima of q value

Helical plasmas



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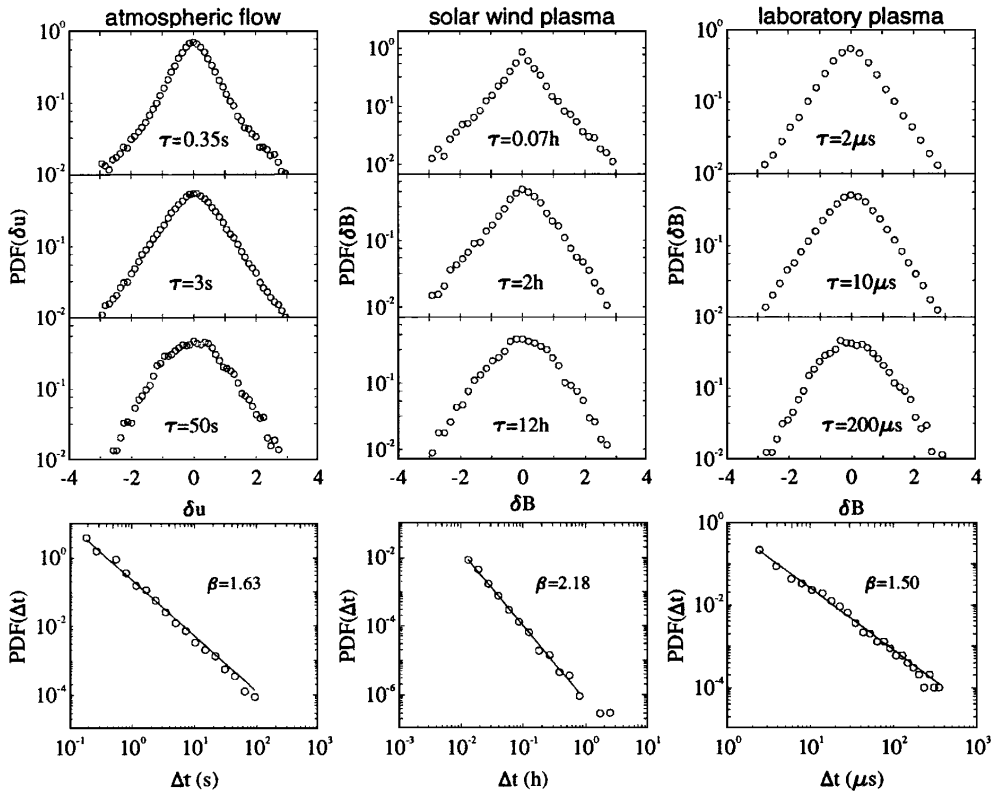
Intermittency & SOC

- The presence of Intermittency, as lack of self-similarity, revealed in laboratory plasmas, in analogy to solar wind turbulence and ordinary flow



EPL 54 p.51, PRL 87 p.045001, PPCF 2002 pp 2513, EPL 58, pp 349

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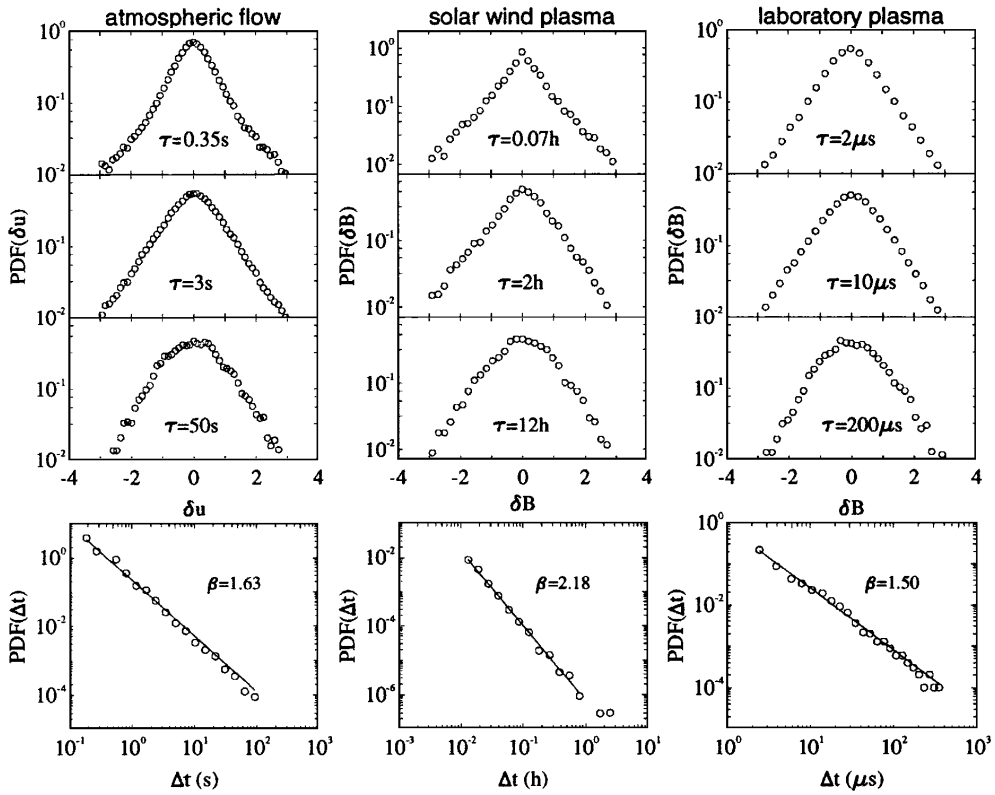

EPL 54 p.51, PRL 87 p.045001, PPCF 2002 pp 2513, EPL 58, pp 349

- Inconsistency with SOC model revealed PRL 86 pp 3032, EPL 58 pp 349, PRL 87 045001

Pedagogical experience

- Assistant for the course `Fluid and Plasma physics` with lessons on `Tangential stress in a newtonian fluid` and exercise on fluid dynamics
- Supervising of 2 Bachelor and 1 Ms.Sci. Thesis on Plasma physics. Addressed the following thematic:
  (a) BA.: Modification of spectral properties of fluctuations as a function of plasma equilibria in a Reversed Field Pinch. Role on the emphasis of $m = 0$ islands
  (b) BA: The role of toroidal flow in the high density regimes of an RFP plasma. Relation between flow and topology
  (c) M.Sci: Comparison between filamentary structures in a Reversed Field Pinch and a Tokamak

Planned research activity

3D effects on flow and transport: 3D effects are present in almost all the present experiment and foreseen for future one. The role of 3D magnetic field on flow, both in the external region where stochastic layer can be created, and in the core are fundamental topic to be addressed and considered

Fast ions: MHD and turbulence modification of fast ion population is a subject to be investigated for future machines. Experimentally, small devices may be thought as test bed if equipped with tools for fast ion injections (Beam or ion sources), or if available spontaneous population (reconnecting processes)

Spontaneous magnetic reconnection: Interdisciplinary subject where collaboration with space and astrophysical plasma may be considered

Planned pedagogical activity

Multidisciplinary approach to data analysis: A lot of techniques, used in different research area (e.g. space plasma, signal and image processing, speech recognition etc.), may be applied to fusion plasma data

Small fusion device as learning tools: The use of smaller device, eventually with cold plasmas may offer the opportunity for students for a comprehensive approach to the data, from the diagnostic through the acquisition up to the analysis