Stellarator/Heliotron Contributions
to
the ITPA Groups

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Background:

- each ITPA group has a stellarator representative
  - ITPA T&C group: Carlos Hidalgo, Kenji Tanaka, Andreas Dinklage

- Discussions along the Stellarator/Heliotron Workshop (2009) on
  inclusion of 3d expertise in joint experiments and joint actions.

- First step: papers in the ITPA meetings in Seoul (2010)
  (Estrada: H-mode in 3d devices, Ida: Impurity transport in 3d devices)

- ITPA meeting San Diego (Apr. 4-5,11):
  Discussion of 3d contributions in JEX, joint actions

- Idea: collect proposals and requests
  (premise: rationale based on mutual benefits and individual scopes)

Purpose of this discussion:

- communication of ideas,
- discussion of prioritzation,
- identification of resources

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TC TG Meetings
- 7th Meeting (2011)
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ITPA Transport & Confinement Topical Group

Scope

The overall scope of the Transport and Confinement Topical Group is to explore and to develop a fundamental understanding of transport and confinement physics governing plasma performance, including that of ITER and burning plasmas in general. This scope includes: maintaining the confinement and L-H threshold databases, and augmenting them as necessary; developing an understanding of the basic processes controlling plasma particle, energy and momentum transport; supporting the identification of experiments, inter-machine comparisons and analysis to address critical transport issues; and facilitating the validation of physics based ion and electron thermal transport models in support of developing a fully predictive transport capability that could be used for integrated scenario modelling. The group will interface as necessary with other Topical Groups on cross-cutting topics.

Tasks

The tasks of the Transport and Confinement Topical Group are broad-based, covering experiment, theory and modelling. The group will work not only on characterizing transport and confinement properties, but also towards developing physics-based models with the aim of using these models to predict performance in future devices. Topics in which the group will be active will depend on both the immediate needs of ITER and the interests of the group. The high priority topical areas of interest, and possible specific topics for focused research, are:

- Maintain confinement databases and augment these as necessary:
  - L-mode, H-mode, L-H and profile databases
- Develop an improved characterization of the L-H transition threshold:
  - Species, toroidal field, density (including low density limits)
  - Effect of rotation on threshold power
  - Confinement enhancement just above threshold
- Determine global confinement characteristics:
  - Effect of shape and edge stability on beta scaling of confinement
  - Confinement dependences in hybrid discharges
  - Effects of metal walls on confinement and transport
  - Impact of ELM control on core plasma performance, including plasma and impurity transport, rotation, etc.
  - Impact of Resonant Magnetic Perturbations (RMPs) – as a proxy for global magnetic field ripple – on confinement, local transport and rotation
- Develop an improved characterization of particle and impurity transport:
  - Parametric dependences of density peaking over a wide range of conditions, including pellet injection
  - Local particle transport and pinch processes
  - Correlations between impurity and main ion density profiles
  - Impurity transport to address burn control issues
- Determine electron thermal transport properties over a range of conditions:
  - Resolve role and importance of Electron Temperature Gradient (ETG) vs. coupled Ion Temperature Gradient (ITG)/Trapped Electron Mode (TEM)/ETG induced transport
  - Assess role of electromagnetic fluctuations in driving electron transport (low- and high-frequency)
  - Demonstrate and understand, through modelling and theory, the reduced electron transport regimes with dominant electron heating
- Determine ion thermal transport properties over a range of conditions:
  - Understand the source of ion transport under various conditions, including regimes in which neoclassical transport dominates
  - Assess the role of rotation in suppression of low-k turbulence
  - Increase test/model validity to plasmas with ITBs and other enhanced confinement regimes
- Improve characterization and understanding of momentum transport and plasma rotation:
  - Evaluate effects of rotation sources, especially with regard to intrinsic rotation
  - Determine momentum pinch velocity and its theoretical basis
  - Assess and understand effects of rotation on transport barrier formation
- Improve characterization and understanding of barrier formation:
  - Assess rates of internal and edge barrier formation in support of ITER control system development (e.g. time scales)
  - Develop understanding of triggering mechanisms (e.g. rotation vs. q-shear)
- Validate models:
  - Assess validity of physics-based transport models for basic understanding and in support of ITER scenarios
  - Incorporate turbulence measurements for comparison with synthetic diagnostics

Announcements

There are currently no active announcements.

Current Events

Title	Location	Start Date	End Date
6th Transport & Confinement TG Meeting	San Diego, US	04/04/2011	06/04/201
7th Transport & Confinement TG Meeting	Cadarache, France	05/10/2011	08/10/201

Links

There are currently no favorite links to display.

What is in `our´ interest and what can we offer?

Tentative list of subjects of interest for ITPA (groups)

bb	ITER relevance	Physics topics	3d expertise	Activity proposals*
LH transition	ITER scenario development ramp-up/down scenarios	role of magnetic topology (shear)	configuration dependence	
3d transport	effect of stochasticity on t&c ELM mitigation RMP operation	transport in ELM mitigation scenarios assessment of tokamak/stellartor edge transport influence of magnetic topology on depostion patterns	3d edge transport modeling 3d configuration exp. (LHD)	Comparative experiments
magnetic topology of ergodic layers	scenario development RMP operation	turbulence spreading transport in ergodic layers	3d magnetic equilibria	
impurity transport	phys. understanding operation scenarios (density peaking)	conditions for temperature screening 3d effects on impurity transport	3d effects on impurity transport	
zonal flows	phys. understanding	long-range correlations	experimental investigations	
plasma rotation	ITER scenario development	rotation and quasi-symmetry impact of islands viscosity	interaction with islands 3d edge structure symmetries in 3d magnetic fields	
energetic particles	physics of burning plasmas	AE excitation	3d effects	
turbulent transport	phys. understanding	electron heat transport	role of 3d magnetic configuration	
confinement scaling	reactor extrapolation	3d effects on dimensionless parameter scaling	beta scaling in 3d technical	assess comparability of scalings create joint/linked database
neoclassical viscosity calculations	rotation			relation to 8?
isotpe effect				joint experiments
profile stiffness				joint experiments

Preliminary

Feed-back highly appreciated

3-D effects on zonal flows:

Influence of 3-D magnetic topology effects (stochasticity, rationals) in the interplay between equilibrium radial electric fields and zonal flows.

Profile stiffness in stellarators:

Role of electron versus ion dominated transport

Investigation of joint probability distributions of fluctuations in gradients and radial transport (tokamaks vs stellarators):

Role of edge magnetic shear and plasma parameters

Zonal flows in D vs H (tokamaks vs stellarators):

Characterization of mean and fluctuating radial electric fields (zonal flows) in tokamaks and stellarators (D vs H plasmas)

Profile dynamics, flows and confinement in tokamaks and stellarators

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Euratom-Ciemat, Madrid, Spain

Recent experiments in tokamaks and stellarators have shown that the paradigm of turbulence con
Furthermore, comparative studies in tokamaks, stellarators and reversed field pinches have revea
These observations provide a guideline for further comparative studies between tokamaks and ste
a) <u>3-D effects on zonal flows.</u> Influence of 3-D magnetic topology effects in the interplay between e
b) <u>Isotope scaling physics and zonal flows in tokamaks and stellarators.</u> There is clear experiment
An open question is clarifying the scales involved in the isotope physics. If the ion Larmor radius h
c) <u>Profile dynamics and zonal flows in tokamaks and stellarators.</u> Profile stiffness is well establishe
The influence of low magnetic shear and flows on profile stiffness has been investigated in JET [],
Then, the influence of magnetic configuration (i.e. magnetic shear)
on zonal flows and profile dynamics should compared in tokamaks and stellarators []

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Turbulence and transport in ELMy and ELM free H mode in LHD and comparison with tokamak

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In LHD, a clear suppression of ELM activities are observed in the outwardly shifted configuration, where natural ergodic layer is thick and its width is around 30% of minor radius. Under constant fueling and heating, ELM activities are suddenly suppressed and density starts to increases.
At this transition from ELMy to ELM free transition, turbulence reduced and the shear of fluctuation velocity increased. This transition occurs naturally without any external magnetic perturbation. It is clear contrast that in tokamak external applied RMP suppress ELM.
The difference between LHD and DIII-D about edge plasma parameter (edge pressure, density temperature gradients) and magnetic parameter (profile of q, connection length, Chrikov parameter, Kolmogronogh length) will be discussed in order to investigate the similarities and dissimilarities between two device.