Brief EPS 2010 Trip Report

Monday, June 21, 2010:

The Alfvén Prize was awarded jointly to A. Boozer from Columbia University who presented "Mathematics and Maxwell's Equations" and J. Nuehrenberg, who presented "Development of quasi-isodynamic stellarators". Allen gave a nice talk largely free of complicated equations, and explained the utility of simplified models to explain plasma physics phenomena relevant to 3D magnetic field effects in tokamaks and magnetic reconnection, rather than relying solely on complicated non-linear simulations. Nuehrenberg described the progress in theoretical understanding and simulation that has led to the latest generation of stellarators.

Hartmut Zohm from ASDEX-U presented a very good invited talk entitled "A closer look at the ELM cycle" which highlighted the high spatial and time resolution profile diagnosis of the pedestal evolution during the ELM cycle. The time evolution of the electron temperature gradient apparently shows an initial phase of saturation before later rising back to levels near those needed to trigger ELMs consistent with peeling-ballooning theory. Based on consistency of the density and temperature gradients with marginal stability to ETG modes, it was hypothesized the early post-ELM Te gradients is limited by ETG modes.

Modelling of the electric field evolution was also carried out, and it was argued the equilibrium current density profile (assuming neoclassical conductivity and bootstrap current) saturates too quickly to explain the observed time-scale for the ELM crash cycle.

Tuesday, June 22, 2010:

Presented my poster entitled "Physics design of the NSTX Upgrade" representing the NSTX and NSTX Upgrade teams. Also put up the poster "Snowflake Divertor Configuration in NSTX" by V. A. Soukhanovskii (LLNL) since he could not attend. I was so busy representing the NSTX-U poster I did not have much time to represent Vlad's poster, but R. Maingi also helped out with this.

There was also interesting contributed oral presentation (O2.107) by M. De Bock entitled "Edge current measurements using MSE during MAST H-modes" which described the usage of 30+ channels of MSE to measure the evolution of the toroidal current density during the ELM cycle. In these measurements it was found that the pitch angle change during an ELM crash is well outside the measurement uncertainty and cannot be accounted for by changes in the radial electric field profile. It was also stated that the inferred total ohmic + bootstrap current in the edge region under-predicted the reconstructed total, and overall is providing a good test of neoclassical theory.

Wednesday, June 23, 2010:

Bill Heidbrink gave an interesting invited talk entitled "Evidence for fast-ion transport by microturbulence" which described the discrepancies observed between fast ion profile measurements using the Fast Ion D-alpha diagnostic (FIDA) and the classical slowing down predictions using the TRANSP code. The discrepancy is observed even with plasmas measurably free of Alfvenic instabilities above a certain auxiliary power level,

and apparently is a function of T/E, i.e. ratio of ion temperature to fast ion energy, such that when T/E exceeds 0.1-0.2 the effects become more prominent.

The fast ions are largely redistributed rather than lost. Also, for ITER, for 1MeV NNBI, the effects on the fast ion population may be modest/acceptable, and could also be a means of naturally diffusing He ash from the plasma core.

J. Kesner also described the recent physics results and potential for reactors for the levitated dipole in the talk: "The Levitated Dipole Experiment: Towards Fusion Without Tritium Fuel". The thermal and particle transport is apparently driven as expected by low-frequency turbulence which leads to adiabatic flux tube mixing which results in profiles near to the theoretically predicted stationary density and pressure profiles. Clear distinctions between levitated and attached (due to losses to attachment points)

These profiles are largely MHD stable at beta values up to 20% beta, providing a very interesting plasma physics regime relevant to magnetic fusion understanding and for simulating aspects of dipolar astrophysical/planetary systems such as Jupiter.

Went on EPS afternoon excursion this day (Newgrange – 5000 year old burial chamber (pre-dates pyramids!), designed to have sun illuminate up internal chamber during 4 days near winter solstice, got to tour inside, simulate solstice w/ light bulbs)

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Thursday, June 24, 2010:

Presented poster "Multi-energy SXR measurements of Resistive Wall Mode behavior in NSTX" for L. Delgado-Aparicio who could not attend the EPS meeting.

Also had good discussions with A. Redd from UW-Madison whose poster ("Non-solenoidal startup and peeling-ballooning studies in the Pegasus Toroidal Experiment") described recent progress with plasma gun injection start-up on Pegasus. Recent progress has been made in coupling gun plasmas to induction by reducing the plasma current ramp-rate and increasing the internal inductance to above 0.3-0.4 to avoid large-scale MHD instabilities in the plasma core. Similar operational techniques are needed for the conventional OH ramp-up of NSTX high-performance plasmas, implying the gun plasma temperature and confinement are sufficiently good to create very broad current profiles if the current ramp-rate is too high.

Also had good discussions with Dylan Brennan who was analyzing the linear resistive and energetic particle stability of tearing modes in DIII-D plasmas for hybrid scenarios. The inclusion of energetic ions was found to reduce stability at low qmin, contrary to some theoretical expectations (since core fast ions are generally thought to be stabilizing). I mentioned that these instabilities might be redistributing fast-ions, leading to elevation of q-min, which could lead to a non-linearly saturated state similar to that observed previously on NSTX.

Friday, June 25, 2010:

Took vacation day this day to see more of Dublin = Malahide castle, etc – sorry Stefan