The LOCUST v3.0 NBI Modelling Platform

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LOCUST v3.0 is a complete re-write of the NBI Monte Carlo full gyro-tracking (non-adiabatic orbits) code developed for START (~30K lines of code). Significant modifications include:

Code written in F90 + MPI (parallelised, modularised, no COMMON blocks, strong typed, explicit interfacing, operator and function overloading, rigorous error checking, warning notification etc.)

Particle inventory, equilibria, experimental data etc. are all held in dynamically linked structures (derived types) - ptcle inventory is loaded dynamically in parallel mode

Equilibria, thermal plasma and output are all a function of time (non steady state calculations)

Cross section data lifted from ADAS database **[NOT AVAILABLE AT PPPL - NEEDS AN ALTERNATIVE]**

More sophisticated fitting to TS, CX spectroscopy, Langmuir probe data etc.

Static (eg HHFW antenna) and dynamic (eg. MAST R-probe) limiter structures.

Code is implemented on:
a) fusl# (Culham) PLANET CLUSTER (PPPL) **[single processor]**
b) Aethelwulf (34 proc - Culham), PARED (PPPL), PUFFIN (PPPL) **[Parallel]**

This work was jointly funded by the DTI and EURATOM. The NBI equipment is on loan from ORNL, the NPA is on loan from PPPL and EFIT has been provided by General Atomics.

Code can calculate/includes:

- Fast Ion distribution function (for input to Anysotropic Equilibrium solvers (Colin Roach, Culham), ASTRA, transport code solutions, fast ptcle MHD codes such as HAGIS and NOVA-K, equilibrium stability codes, confinement analyses etc.)
- Fast ion evolution due to electron drag, thermal ion scattering (energy diffusion to be coded)
- Charge exchange driven direct loss and cross field transport
- e- and H/D heating profiles (+direct SOL heating - direct impurity heating not coded)
- Fast ion pressure, V-space and poloidal flux surface isotropy
- Momentum transfer (not yet coded)
- NBCD profiles (back e- current and back emf not yet coded)
- Power flux to in vessel components (such as the HHFW antenna, vessel and MAST Reciprocating Probe)
- NPA signals (arbitrary chord), bolometer signals etc.

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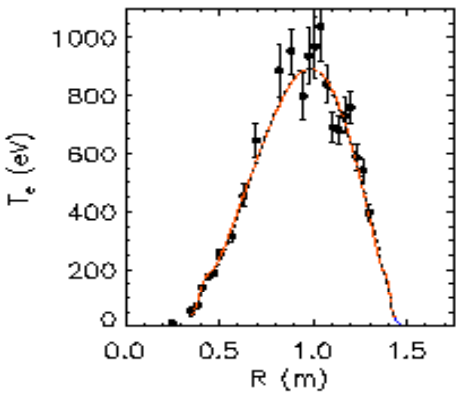
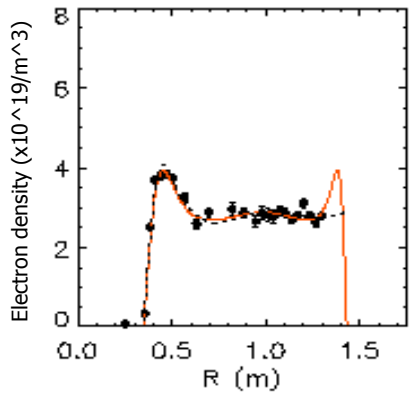
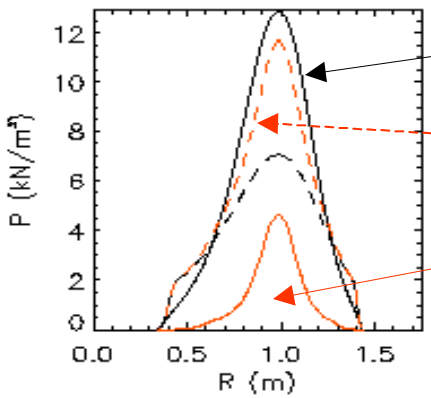
LOCUST v3.0 + TS, NPA and EFIT data indicate low NBI ion losses for 30keV H in 0.5MA plasmas

Excellent EFIT agreement with TS (few % inward shift of Rmag required to make fit perfect)





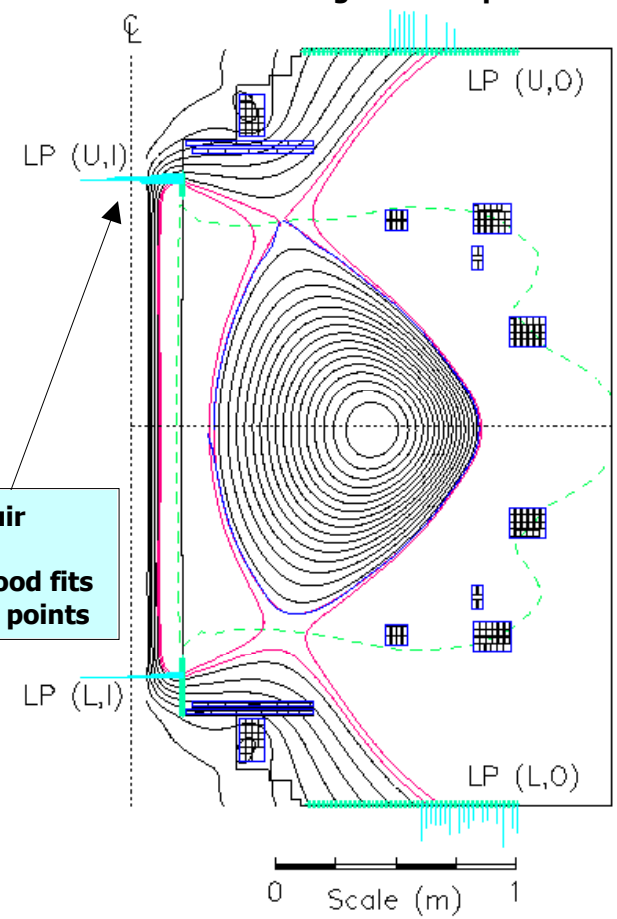


EFIT

Total Kinetic

Fast Ion pressure (assuming zero losses)

LOCUST v3 diagnostic output



Fixed Lanmuir probe data indicating good fits to the strike points

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