# TRANSP Needs for Physics Modules

R. J. Hawryluk

TRANSP Users Group Meeting

March 24, 2015

PPPL
PRINCETON
PLASMA PHYSICS
LABORATORY

# RF Physics Modules

- **Inclusion of non-Maxwellian distribution function**
  - correct treatment of minority heating
  - treatment of alpha particles
- **Replace LSC with GENRAY+CQL3D**
  - Include parallel capability
  - Can handle two frequencies with GENRAY+CQL3D
- **TORBEAM**
- **TORIC6?**
  - Has a Fokker Planck operator for minority heating and interaction with NB particles.

# Core Transport

- **Core impurity transport**
  - Impurity radiation
- **Particle transport**
  - Pellet model update (both deposition and redistribution)
  - Particle transport in the pedestal
  - Neutral penetration – not a 1D process!
    - Needed for fast ion studies as well
- **Speed up PTSOLVER for stiff transport models (TGLF)**

# Pedestal - Edge

- **Reduced pedestal model and consistent core-pedestal coupling**
  - ELMs
  - EPED lookup
- **SOL and Divertor**
  - PMI

# Reduced MHD Models

- **Sawteeth**
  - Fast Ion stabilization
  - "Flux pumping" for hybrid and "long-lived mode" simulations
- **NTMs**
  - NTCC Island model is not installed in TRANSP
- **ELMs**
- **RWMs**
  - NTV effects due to non-axisymmetric fields and MHD instabilities

# Fast Ion Physics

- **Going beyond anomalous diffusion coefficients**
  - Critical gradient models?
  - Fishbone models upgrade?
  - Coupling to Nova-K and orbit simulations (post-processing)
- **Faster NUBEAM (GPU compatible)**
  - Option for orbit following (vs guiding center)
- **SXR and gamma ray synthetic diagnostics**
- **Built-in FIDAsim**
  - Fast ion birth profile in scrapeoff
  - Beam-stopping and excitation cross-sections more easily available
  - Better 2D neutral particle modeling
- **Output distribution function in constants of motion**

# Control Simulations

- **Real time control of actuators**
  - Stored energy
  - q(0) and current profile
  - Rotation profile control
  - Shape control
- **Socket connections to Mathlab and Simulink**
- **Confinement and Greenwald density constraints**

# Between Shot Analysis

- **Effort underway to develop a "fast" version of TRANSP to do between and among shot TRANSP analysis for NSTX-U**
  - Less accurate than full TRANSP run but provide operators and diagnosticians input during the run.

# Thank You for Your Participation and Support for TRANSP



PPPL
PRINCETON
PLASMA PHYSICS
LABORATORY