

Recent physics investigations at ASDEX Upgrade using TRANSP

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TRANSP User Group Meeting, Princeton, May 5th 2017

Power balance analysis

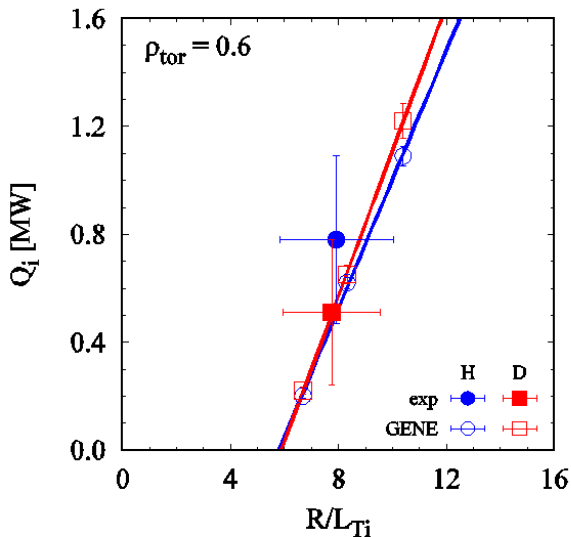
- Comparison with GK

Fast ions physics

- NBCD studies
- Phase space tomography (FIDA+CTS)
- Impact of P_{fast} on equilibrium reconstuction
- Redistribution of fast ions in presence of Alfvén eigenmodes
- RSAEs and fast ion profiles
- Impact of fast D poloidal asymmetry on W transport

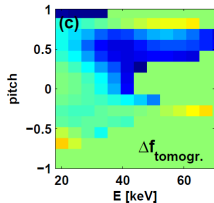
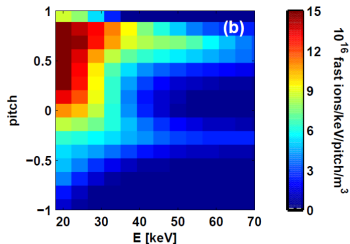
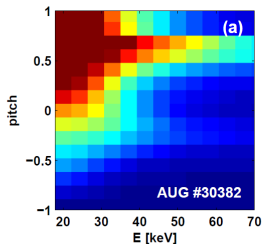
Development

- TORBEAM in TRANSP
- NTM modelling

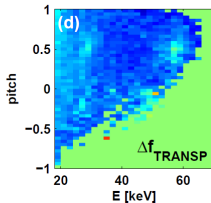


Before sawtooth crash

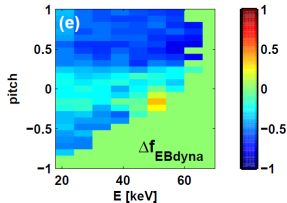
After



FIDA+CTS

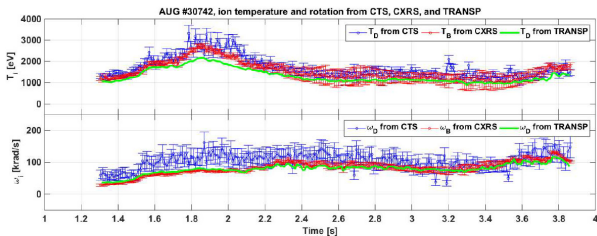
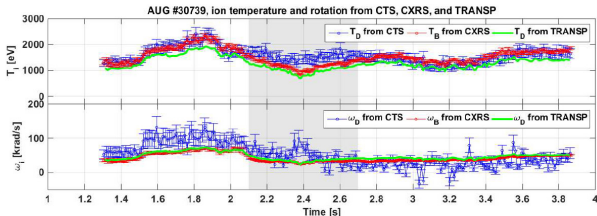


TRANSP

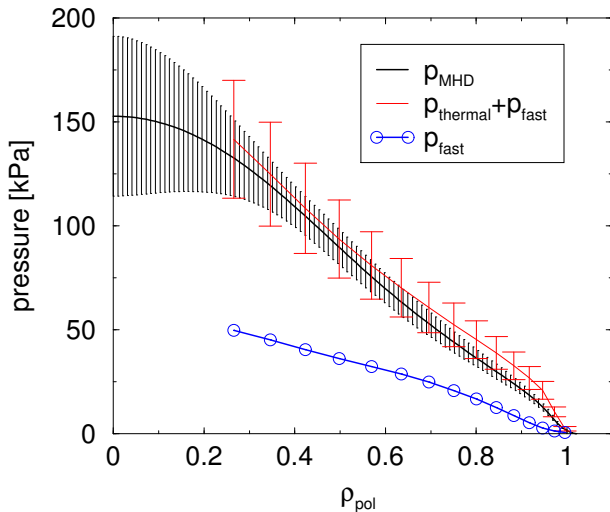


EBdyna

J. Rasmussen, NF 2016

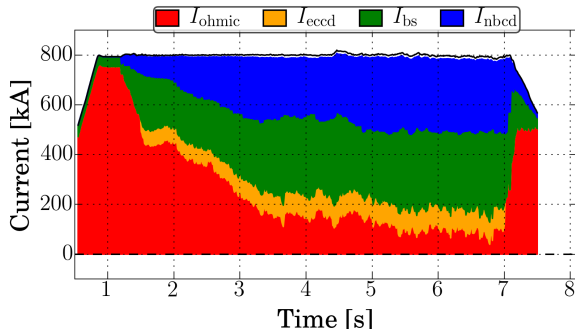


M. Steijner, NF 2017



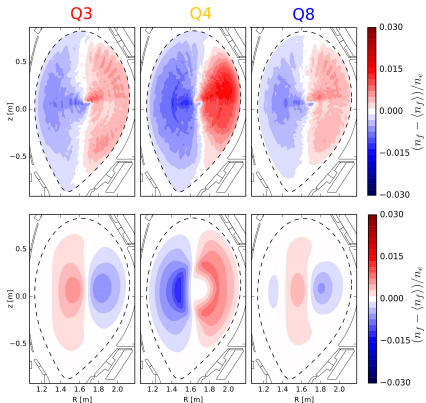
$P_{fast} \approx 0.5 * P_{MHD}$ significant in equilibrium reconstruction.

R. Fischer, Fusion Sci. Techn. 2016



Almost non-inductive discharges, NBCD calculated with TRANSP

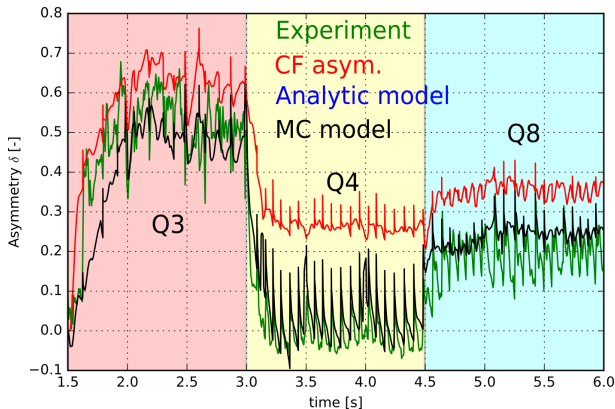
A. Bock, D. Rittich



Study of n_W poloidal asymmetries. Contributions:

- T anisotropy of fast minority ions (ICRF)
- **Poloidal asymmetry of fast D ions (mainly NBI) (TRANSP)**

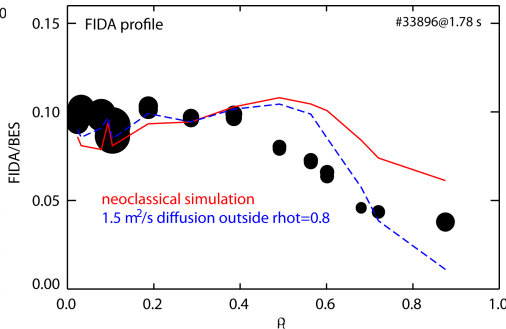
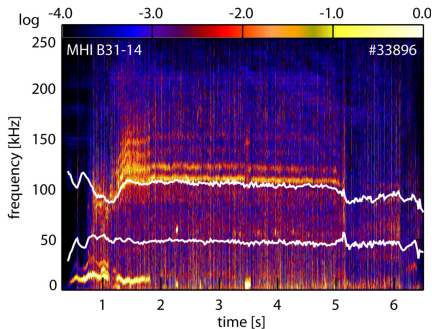
T. Odstrcil



Synthetic SXR diagnostics

- Excellent match of TRANSP/NUBEAM prediction
- Follows even sawtooth dynamics

T. Odstrcil

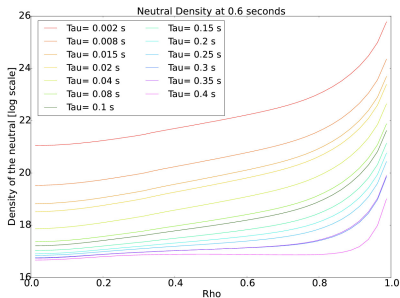
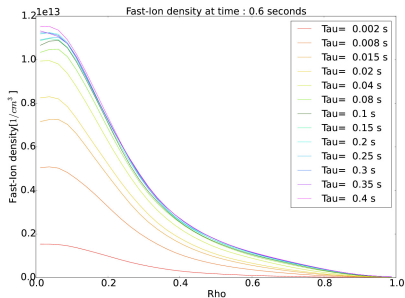


- Bad FIDA match for neoclassical simulation
- Slight improvement with $D_{fi} = 1.8 \text{ m}^2/\text{s}$ for $\rho_t > 0.8$.

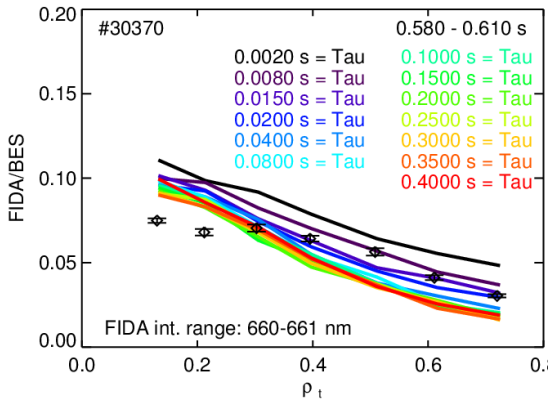
B. Geiger

Mismatch FIDA vs. TRANSP/FIDASIM

- RSAE observed
- **Neutral density (τ_D scan with TRANSP-FRANTIC)**
- Sensitivity on initial q-profile
- Non-maxwellian background plasma

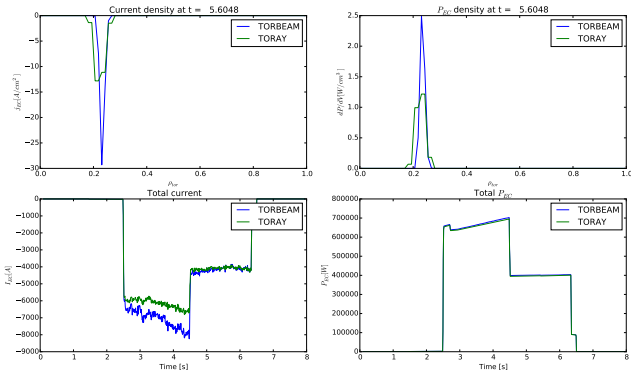


Soutter, master thesis, TUM 2017



- Best match for $\tau_D=0.02$, inconsistent with β_N and neutron rate
- Different neutral profile shape would possibly do?
- Need a more refined neutral penetration model?

E. Soutter, master thesis, TUM 2017



- TORBEAM: thinner P_{ECCD} , j_{ECCD} profiles
- TORBEAM: more CD with gy3-4 (3-4.5 s), identical with gy1 (j 4.5 s)

G. Tardini, F. Poli

- TRANSP used predictively, default code for PB analysis in NBI shots
- NBCD studies for non-inductive operation
- Phase space tomography of fast ions (FIDA+CTS): combined information, applied to sawtooth crashes
- P_{fast} can be very significant for equilibrium reconstruction
- Redistribution of fast ions by Alfvén eigenmodes: losses, no satisfactory prediction yet with a simple D_{fi}
- RSAEs study: neutral density affects strongly the fast ion density profile. Scan in τ_D for FRANTIC: better match to FIDA values, not to gradient, and not consistent with β_N and neutron rate.
- D poloidal asymmetry contributes to W asymmetry and hence to W transport

- More refined neutral model than FRANTIC for different neutral profile shape?
- TORBEAM in TRANSP (underway)
- Validation of NTM (underway)
- Heat, torque and particle fluxes in standard NetCDF output

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