Collaboration on NSTX-U Milestone R18-4:
Optimize energetic particle distribution function for improved plasma performance
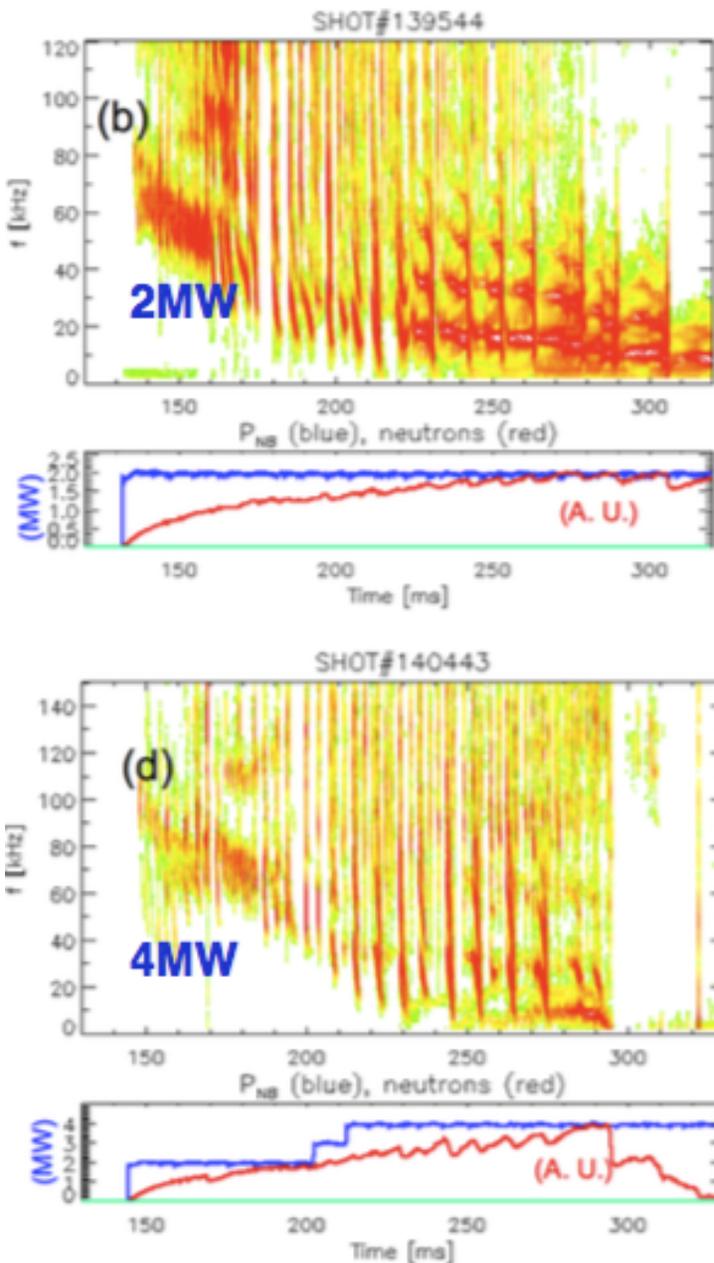
M. Podestà and EP-TSG
PPPL

November 22th, 2017

Goal: develop/test model for EP transport by fishbones and kinks for TRANSP

- *R18-4: "Validation of the 'kick model' for scenarios with unstable fishbones will be conducted in collaboration with MAST-U"*

  – Start from 'kick model' infrastructure

  – MHD modeling to get mode structure for kink/fishbones

  – Use particle following code (ORBIT) to get transport probability

  – Test in TRANSP, validate against data from neutrons, neutron camera, Charged Fusion Product array, perhaps FIDA

- MP will do initial implementation/tests, then export to Culham

- After initial tests, MAST-U can expand analysis & validation work

- Status: have contacts at MAST-U, discussing target scenario for tests, data format for inputs

Fishbones, LLM/kinks can strongly affect ramp-up & early flat-top phases

SHOT#139544
(b)
2MW
P_{NB} (blue), neutrons (red)
(A. U.)
Time [ms]

SHOT#140443
(d)
4MW
P_{NB} (blue), neutrons (red)
(A. U.)
Time [ms]

[G. Dong, APS 2014]

- Large β_{fast}/β_{th}, $q_{min} \rightarrow 1$
  – Strong drive for instabilities
- Clear effect on neutron rate, stored energy -> decrease in performance

- Developing time-dependent simulation capabilities is first step in discharge optimization
  > Model validation is key aspect
  > Data already available from NSTX/NSTX-U, MAST