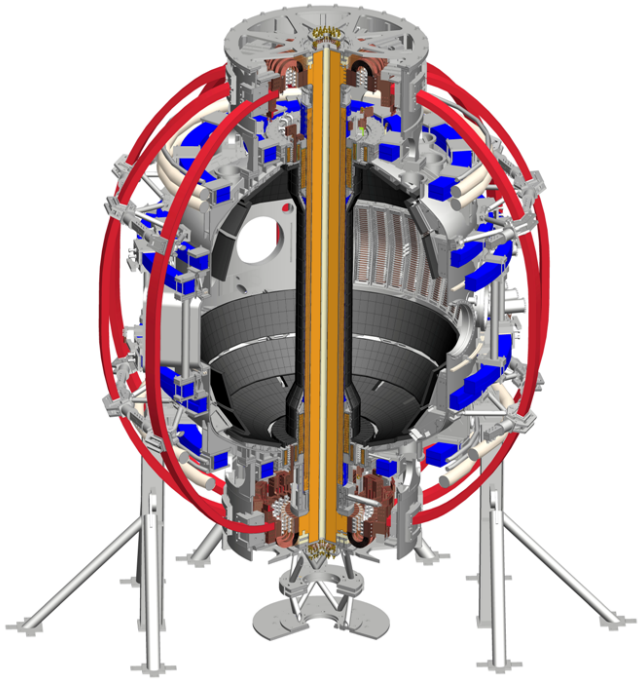
Multi-machine investigations of nonlinear ELM dynamics



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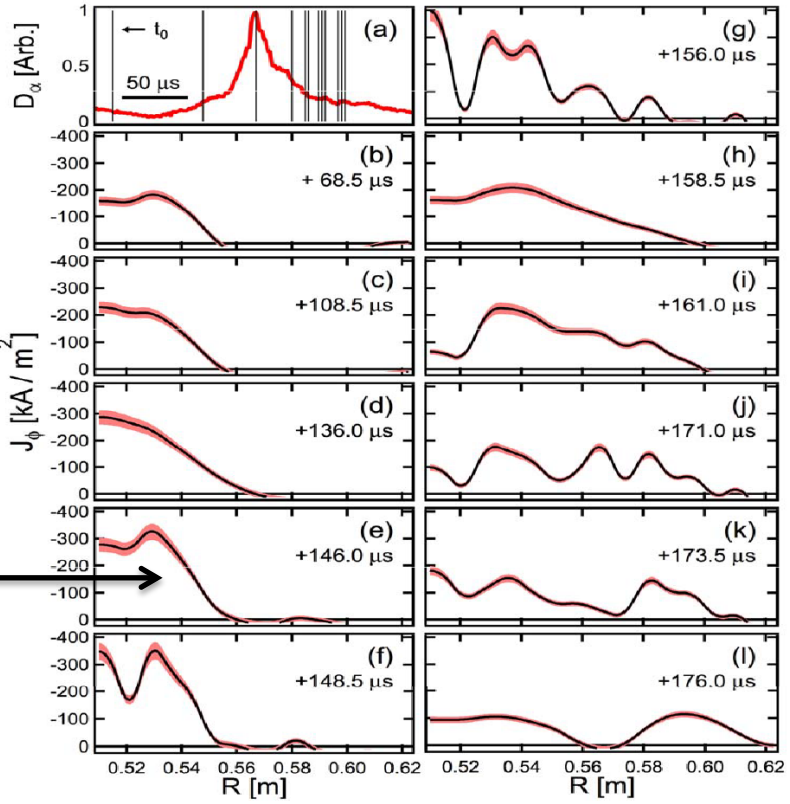
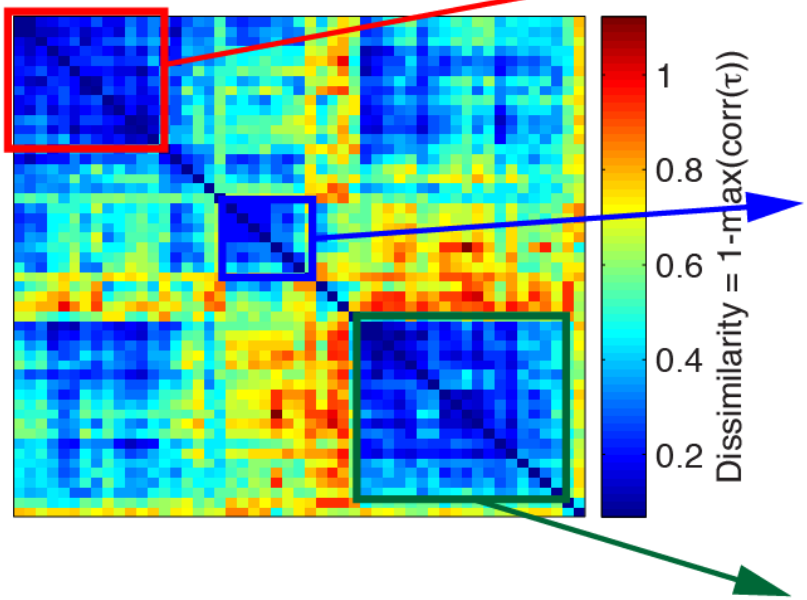
The UW group is positioned for a multi-machine investigation of nonlinear ELM dynamics

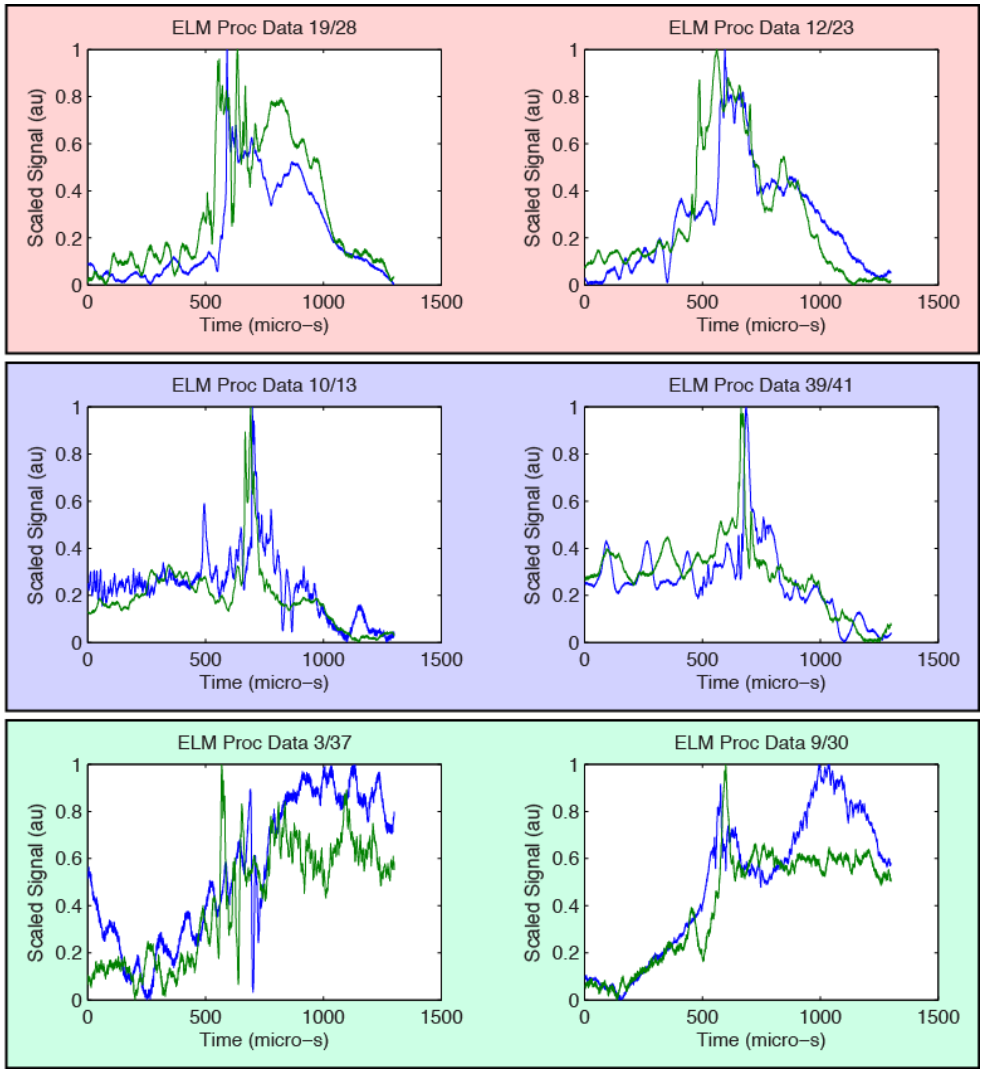
- Linear ELM models and taxonomy schemes fail to capture the physics of ELM event intensity, saturation mechanisms, and filament dynamics
  - Note that nonlinear MHD codes (e.g. NIMROD, BOUT++) can simulate the evolution of ELM events
- Assets within the UW group can capture nonlinear ELM evolution on Alfven/µs-scales
  - NSTX-U (low A): 2D BES for Ne(R,Z,t)
  - DIII-D (high A): 2D BES for Ne(R,Z,t)
  - Pegasus (ultra-low A): in situ meas-urements of Ne(R,Z,t), J(R,t), and Phi(R,Z,t) fields during ELMy H-modes



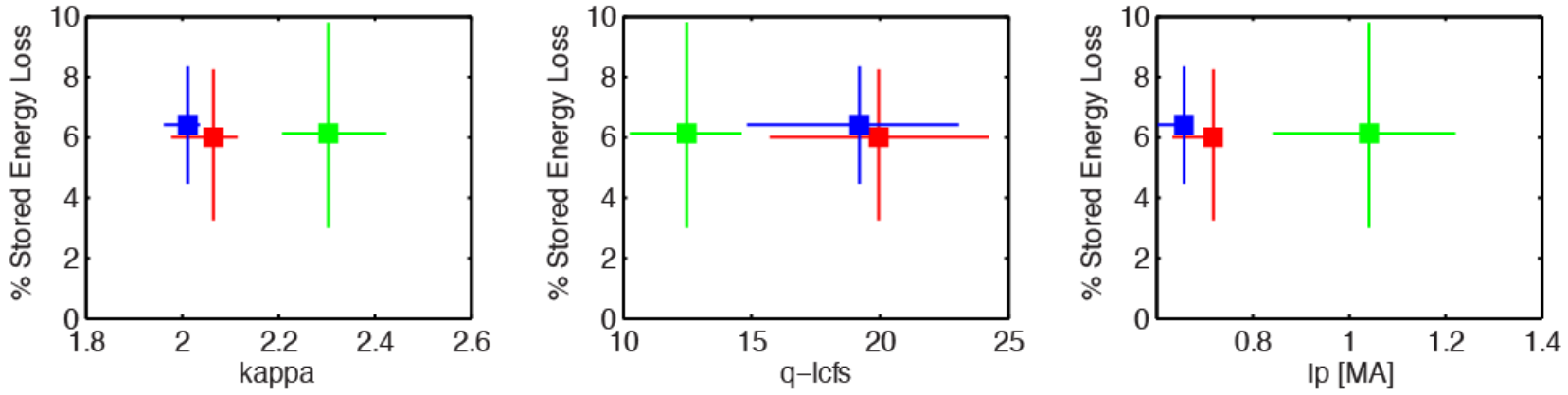
Previous BES measurements on NSTX point to 2 or 3 ELM groups with distinct NL evolution patterns

Unsupervised machine learning analysis of ELM events with time-series similarity metrics





Also, the NSTX ELM groups occur in distinct regions of parameter space



- Experimental plan
  - Reproduce/document ELMy H-modes with Ip, q, and κ scans
    - Target 1) low Ip, low kappa and 2) high Ip, high kappa
  - Investigate ELM factors identified by NL simulations
    - Edge current density (NIMROD)
    - Equilibrium flow shear (BOUT++)
    - Density gradient (BOUT++)
  - Coordinate NL ELM investigations on DIII-D and Pegasus