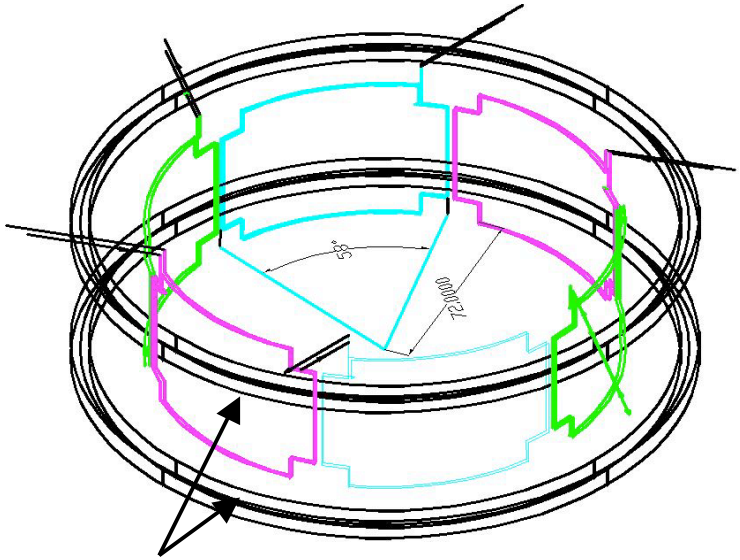
Comparison of pedestal responses to non-axisymmetric perturbations in NSTX and DIII-D

- Does the new NSTX external coil produce pedestal and divertor responses similar to those seen in DIII-D?
  - In DIII-D:
    - Type-I ELMs are suppressed with n=3 perturbations
    - The edge toroidal rotation is strongly damped
    - Divertor heat flux peaks are split and reduced
    - ≈ τ_E, $\beta_N H_{L89}$, $P_e(\psi)$ - unaffected: $j_{||}(\psi)$ edge - increases
  - In NSTX:
    - Complex edge dynamics are observed during ELMs
    - Turbulent structures seen with GPI can be used as markers for stochastic transport studies



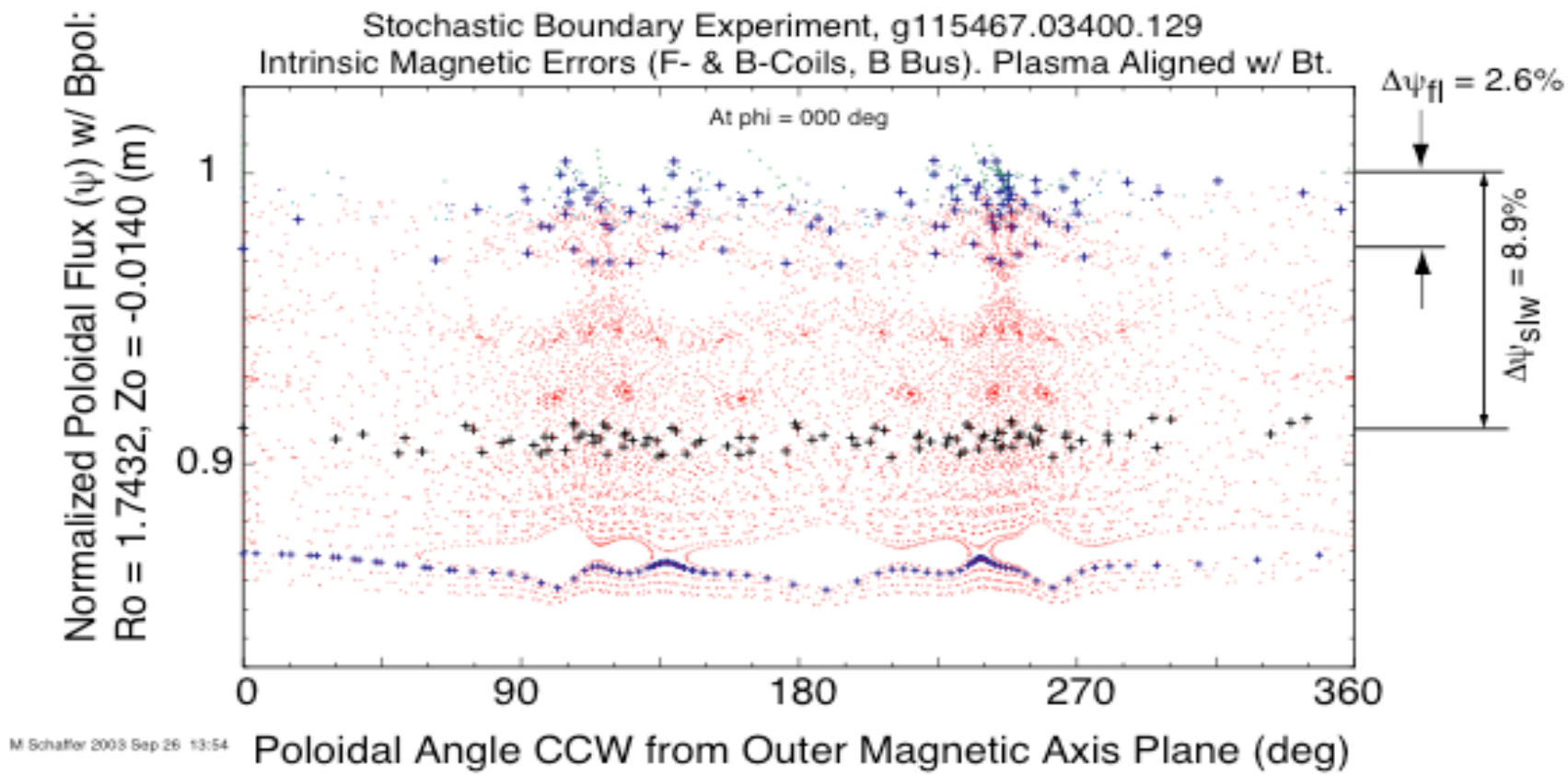
PF5 coils (main vertical field)

Approach:
-Model the NSTX perturbation coil with GA field line integration code
-Select experimental parameters best matched for pedestal physics studies:
-Toroidal mode number, shape, density, P_{inj}, etc.

NSTX ROF, 22-24 September 2004,
PPPL, Princeton, NJ

T. E. Evans, et al., *General Atomics*
R. Maingi, et al., *ORNL (@ PPPL*

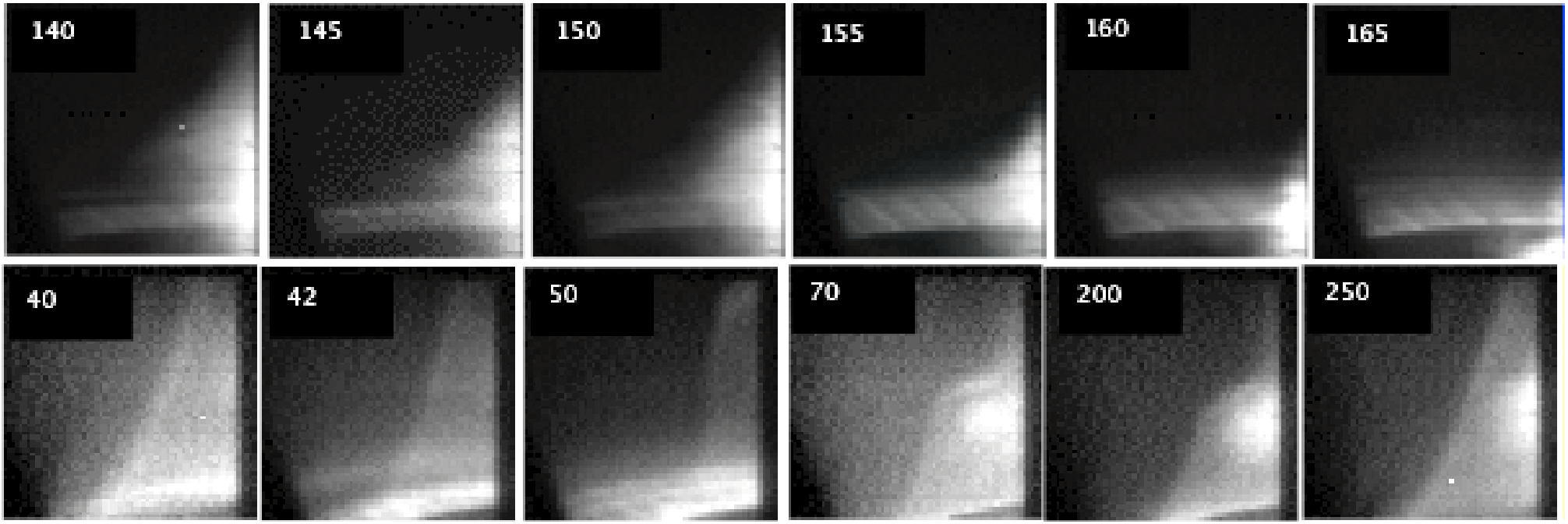
In DIII-D the stochastic layer width $\Delta\psi_{slw}$, the poloidal magnetic flux loss $\Delta\psi_{fl}$ and the location of remnant islands have a significant impact on the edge plasma



- Poincaré plot showing a field line integration calculation of the magnetic structure due to field errors in DIII-D *(no plasma response included)*.

tee-04nstxrof-2

Complex dynamics are observed in the NSTX divertor during ELMs



- Highly radiating, MARFE-like, structures are seen in the NSTX divertor near the centerpost (upper frames 140-155).
- Large Type-I ELMs intensify patterns in the outer target plate recycling light and push these high-field side radiating structures down to the divertor floor (upper frames 155-165).
- These MARFE-like structures return between ELMs and display various complex, rapidly evolving, patterns before the onset of another ELM (lower frames).

Proposed approach for NSTX/DIII-D stochastic boundary comparisons

- Used GA's field line integration code (TRIP3D) with NSTX equilibria to model perturbations from the new NSTX coil.
- Identify coil configurations (n=1 versus n=3) and discharge parameters (q95, outer gap, shape, etc.) that are best suited for the NSTX/DIII-D comparison experiments.
- Complete experiments on NSTX and DIII-D (prior to the 4/05-06 DIII-D NBI re-orientation) to obtain:
  - Pedestal physics data such as:
    - Fast imaging (40k fps NSTX and DIII-D)
    - GPI (NSTX); CER, BES, Langmuir probes (DIII-D)
- Compare the pedestal response to resonant magnetic perturbations in NSTX with those found in DIII-D to:
  - Better understand transport and stability in edge stochastic layers
  - Develop stochastic boundary layer control scenarios for ELMs, MARFEs, impurities, and exhaust.