Contributions from paper "Feedback control design for non-inductively sustained scenarios on NSTX-U using TRANSP", M. D. Boyer, et al. (EX/P4-43)

- The first planned studies of **non-inductive scenarios on NSTX-U** will clamp the solenoid current after inductively forming and ramping the plasma current

- **Predictive TRANSP** simulations have been used to **study the time-dependent behavior of such a scenario**
  - Plasma **slowly relaxes** to steady-state with a **time scale comparable to maximum allowable discharge lengths**
  - Scenario is **sensitive to disturbances** in profile shapes, confinement, and density

- A **linear dynamic model** of the response of **current, on-axis safety factor, and stored energy** to changes in **NBI source powers and plasma shape** was generated
  - Fit to predictive TRANSP simulations with modulated actuators

- Using the identified model, a **model-based feedback controller** was designed
  - Accounts for **dynamic coupling of actuators and plasma parameters**
  - Since actuators are constrained, a scheme for **mitigating the effect of saturation** was developed

- A newly developed **framework for conducting closed-loop simulations in TRANSP** was used to test the controller
  - Controller can **track targets, reject disturbances, and speed up system response**
  - Actuator **constraints limit controllable range** of outputs
  - **Pulse-width-modulation of the beam sources** leads to **oscillations in stored energy** – strategies for reducing modulation frequency or severity will be studied in future work