# Control issues for LPO

- The algorithms:
  - burn control: keep plasma away from uncomfortable limits while maximizing burn [*Schuster*]
    - must also keep machine safe
    - advocated approach is lightweight 0D with 1D model only for performance assessment
    - actuator/diagnostic-agnostic controller with much of the nonlinearity absorbed by actuator allocator
  - shape control with model-driven "real-time feedforward" minimizing strain on fast feedback loops [*Eidietis*]
  - proximity (to disruptive limits) control [*Eidietis*]
  - current **and** loop voltage control (LHCD + CS, WEST) [*Nouailletas*]
  - detachment [*Xu*]
    - impressive new high-performance ELM-free N2-seeded H-mode in EAST
  - MHD control

Any particular challenges arising from LPO?

Realization that true steady-state is elusive (wall equilibration, erosion, boronization peeling): "dirty" environment, what measures to take?

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- Control requires actuators:
  - magnetic actuators; NBI; wave heating; gas injection (standard, seeding, massive) and pellets, powder dropper, etc.
  - e.g. analysis of additional ECRH needs on DIII-D to achieve or approach different requirements of FPP [*Holcomb*]; need for more current drive on EAST [*Xu*]
- Control requires adaptive conditions
  - e.g. hot-wall operation to alleviate impurity retention [*Xu*]
- Control requires diagnostics: diagnostic development satisfying specific requirements of LPO
  - e.g. high-resolution X-ray spectroscopy on WEST [*Delgado-Aparicio*]
  - PFC temperature monitoring [*Nouailletas*]
- Control requires modeling:
  - **Integrated** modeling is crucial now [*Holcomb, Fonghetti, Xu*] – must include all relevant physics (including MHD!)