Point-Source Helicity Injection Startup

- Capabilities are being explored for NSTX-U…
  - ~1 MA startup plasma, appropriate for OH, NBI, and/or RF sustainment
  - Well-defined startup procedures and plasma development scenarios
  - Unobtrusive and retractable injection hardware
- Pegasus results are evolving the conceptual design:
  - Arc gun needed to generate the "seed" plasma
  - Formation of the poloidal field null is sensitive the geometry
  - Outer-PF induction provides finite Volt-seconds
  - Passive electrodes may be the optimum tool for providing maximum effective Volt-seconds with high Taylor limit for I_p
  - Electrodes and guns require different fuelling → active gas control
  - Local limiters mitigate impurities (Pegasus $Z_{eff} \leq 2$ during HI; ~1 in OH)

Conceptual design for the NSTX-U startup system

- Gun/electrode injector:
  - Single 8+ inch port off midplane
  - Retractable behind gate valve
  - Combines gun with large electrode
  - Piezoelectric gas control
  - Local limiter structure
- Power supplies:
  - Bias comparable to Pegasus (1-2 kV; 15 kA; $\Delta t \sim 1$ ms)
  - Arc plasma uses simple PFN supply
- Robust operating scenarios
  - Especially null formation and I_p buildup
  - Pegasus experiments informing and validating scenario development