

Validation Plans for NIMROD Modeling of Localized Helicity Injection in Pegasus

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with input from

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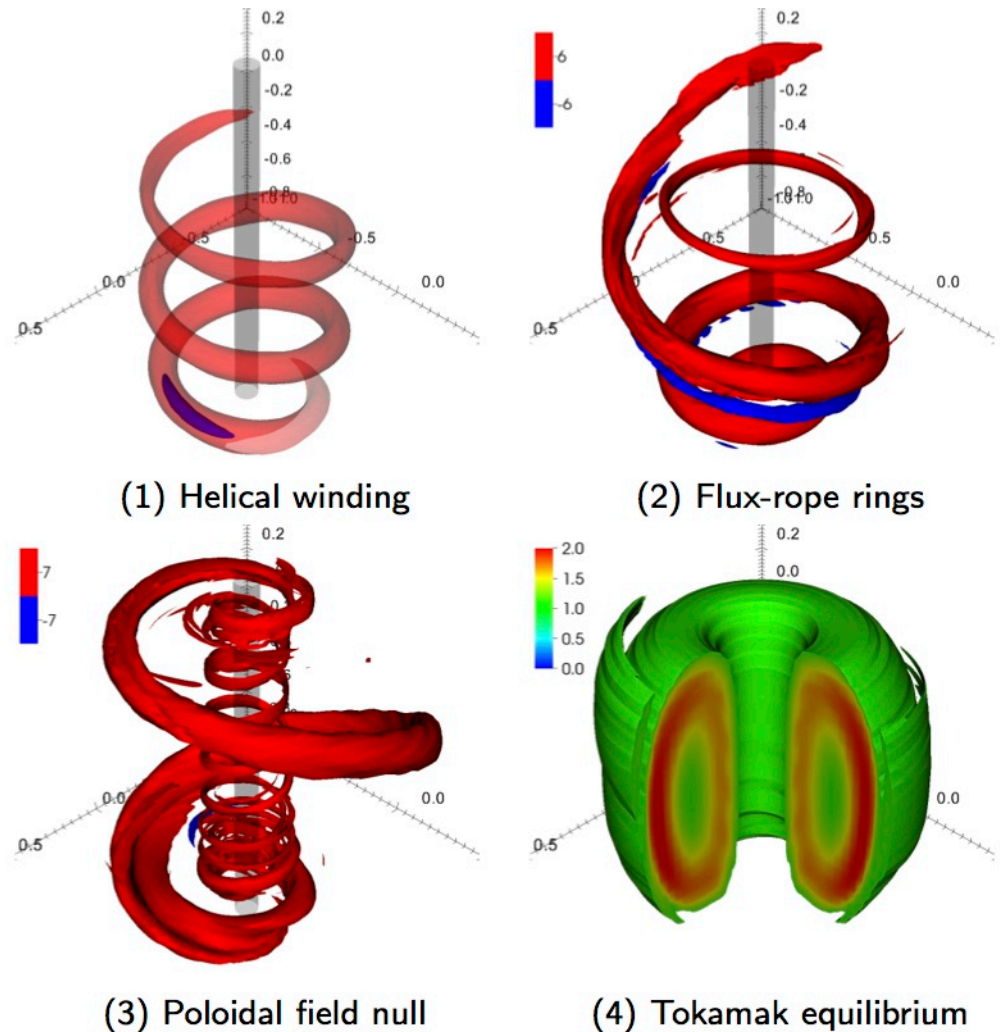


Outline

- Brief review of previous results
- Directions of Pegasus LHI experimentation
- Opportunities for simulation and validation

Brief review of previous results: John O'Bryan modeled the original divertor-gun configuration.

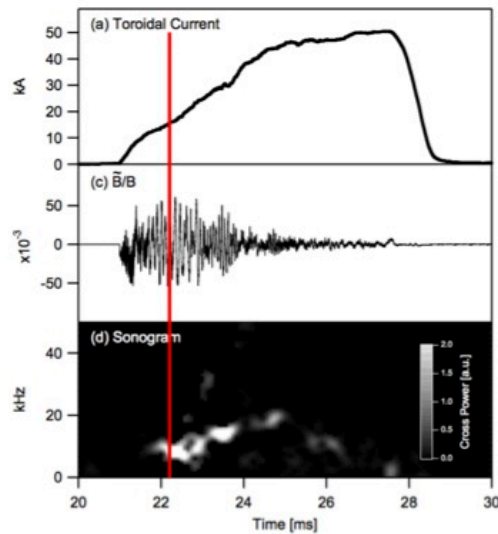
- The gun injector is represented by spatially localized sources of heat and (effectively) parallel current.
- MHD and two-fluid computations used Braginskii heat flux density with magnetization effects.
- Poloidal flux develops over multiple filament-merger/relaxation events.



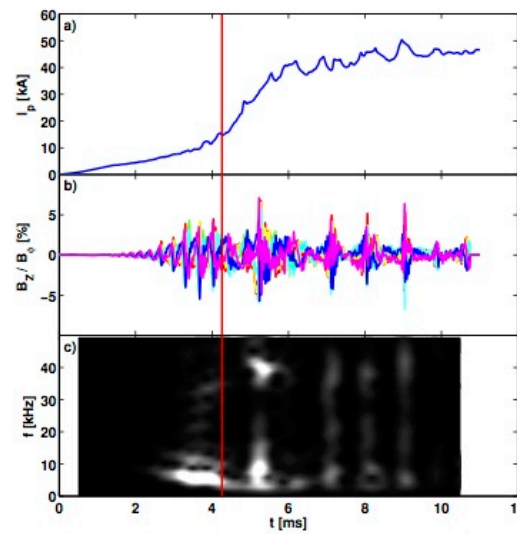
Computed evolution of $J_{||}/B$ [O'Bryan & Sovinec, PPCF 56, 064005].

O'Bryan used magnetic signals to compare with Eidietis's Pegasus results on divertor-gun injection.

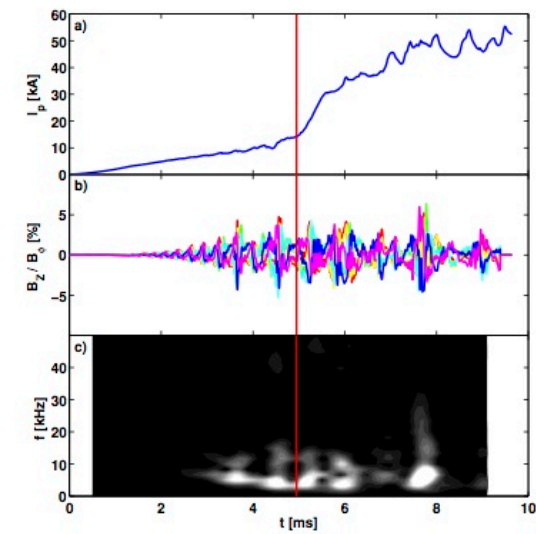
- Simulated signals are recorded for probe locations in Pegasus.
- Fluctuation amplitudes during flux build-up are approximately 5% in simulation and experiment.
- Cross-power spectra are primarily in the 10 kHz range.



(a)



(b)



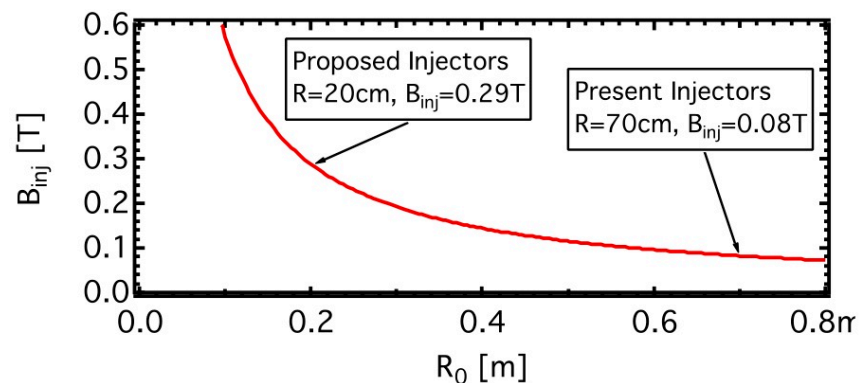
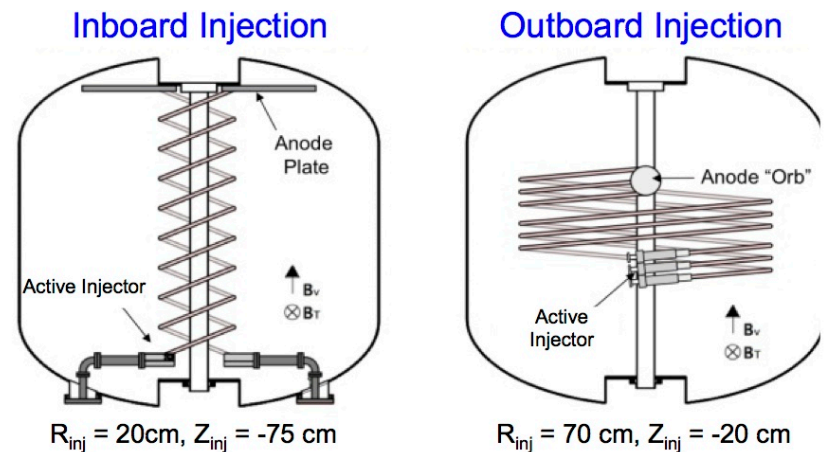
(c)

Experimental fluctuations from Eidietis PhD thesis (a) and MHD (b) and two-fluid (c) simulation results. [Comparison from J. B. O'Bryan, PhD thesis, UW-Madison, 2014.]

- Preliminary Thomson results indicate large T_e (100+ eV) with PF induction. Simulations show $T_e \sim 20$ eV.

Directions of Pegasus LHI Experimentation

- A divertor-gun injector has been reinstalled without removing the outboard injectors.
- Divertor-gun startup necessarily uses less vertical-field swing (PF induction).
 - Experiments without PF induction will again be possible.
- Operational goal is higher current.



Schematic from J. M. Perry's 2014 APS presentation.

Opportunities for Validation and Simulation

- Compare magnetic probe signals without and with PF induction in divertor-gun geometry.
 - PF induction has been simulated; modeling outboard-gun anode had been problematic.
 - Pegasus can add additional coils to better measure current-stream dynamics, including kink distortions.
- New diagnostics are available.
 - Thomson scattering array is now online.
 - X-ray imaging from K_α radiation excited by diagnostic beam is being developed.