Plasmoid instabiltiy during CHI startup

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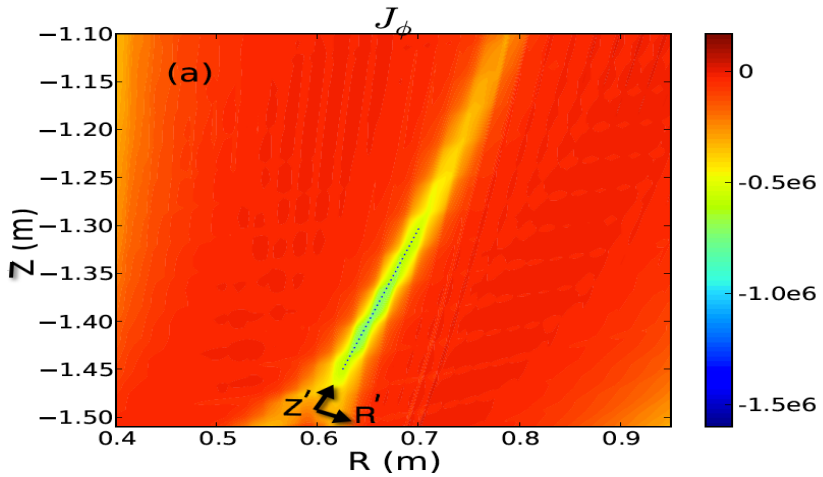
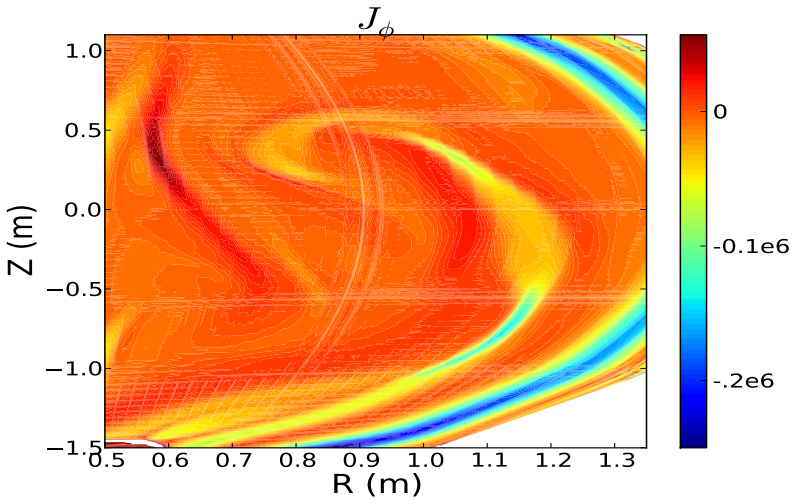
Background: Fast flux closure is affected by the local and global magnetic reconnection process.

- Simulations reveal that a local 2-D Sweet-Parker type forced reconnection is triggered in the injection region and closed flux surfaces are formed in the global domain.
- At high S, the elongated S-P current sheet can become unstable, a transition to a plasmoid instability is demonstrated in the simulations.
- As the transition to plasmoid instability occurs, the reconnection rate becomes nearly independent of S = LVA/η

S-P reconnection



Plasmoid instability



Systematic study of reconnection physics during CHI

- Understanding the reconnection process during CHI and finding the conditions for possible instabilities during the reconnection would help to optimize the maximum good flux closure (and CHI-generated plasma current).

- How transient CHI scales as it is extrapolated to future (larger) devices, such as the ST-FNSF? What are the physics process for an effective fast flux closure? Plasmoid instability? two-fluid effects?

Proposed research

Physics objective: is to explore and better understand conditions under which small and large plasmoids are generated.

Plans

- Control and vary key parameters governing S
  - plasma temperature, poloidal injector flux, injector, flux footprint
  - in addition to using ECH, plasma temperature could be increased by increasing the voltage at reduced density.
- detect plasmoids, measure the reconnection flows and current sheets around the injector region via
  - high resolution fast framing camera with optical filters.
  - ion Doppler spectrometer

Run plans

- Measure plasma parameters or relative changes to plasma parameters (density, temperature, magnetic field) as the following parameters are changed.
  1. Magnitude of injector flux
  2. Variations in gas injection amount
  3. Variations in injector voltage
  4. Variations to the injector flux foot print width
- Need high resolution camera images with optical filters
  1. Fish eye images
  2. Divertor views with optical filters
  3. Other diagnostics
- Run time
  1. Most of the data will be collected in a piggyback manner during the main CHI XP
  2. Some dedicated run time may be needed to fill in missing data (0.5 to 1 days)