MAGNETIC FITTING OF HELICITY-INJECTED PLASMAS ON NSTX

NSTX

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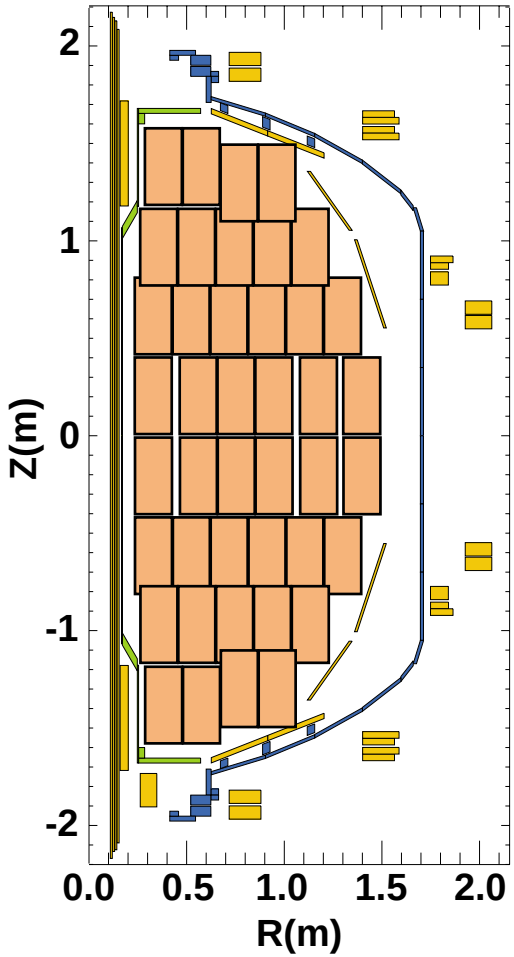
NSTX Results Revie w
PPPL
2001 Septembe r 19–20

GENERAL ATOMICS

MFIT Was Improved in FY 2001

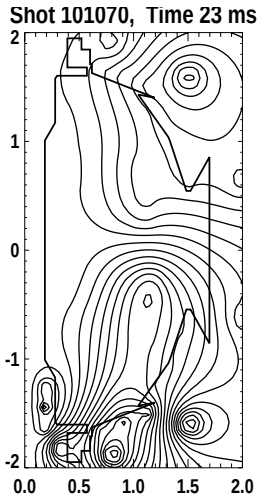


42 Ring Elements

- The NSTX MFIT fits currents in large-cross-section toroidal rings to magnetic data using singular value decomposition (SVD).
  - Previously showed tendency to spiky current distributions, including large local negative current spikes.
  - Greatly improved since Sept. 2000, by:
    - Spikiness is penalized (RMS vs average).
    - User-adjustable SVD condition number.
- Can now use more ring elements than before with little or no spikiness.
- Added J_ϕ contour plot capability.
- MFIT is now well developed and used routinely.

Illustrative MFIT Pl ots of Poloidal Flux and Toroidal Cu rrent Density

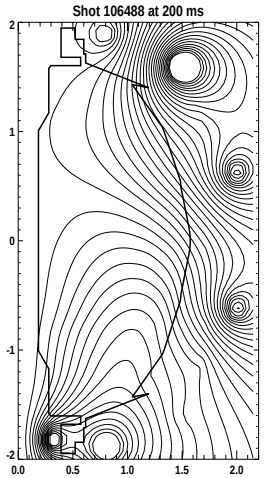
NSTX

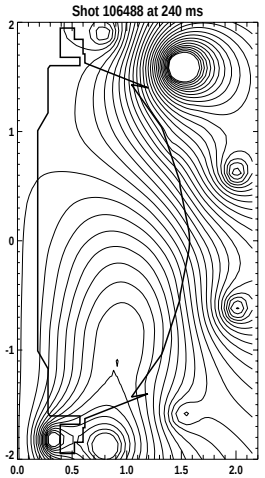


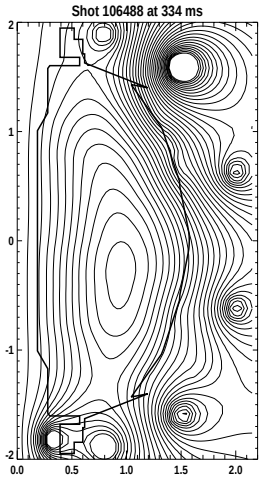
Old MFIT with negative current in plasma near upper passive plate.

t = 200 t = 240 t = 334 ms

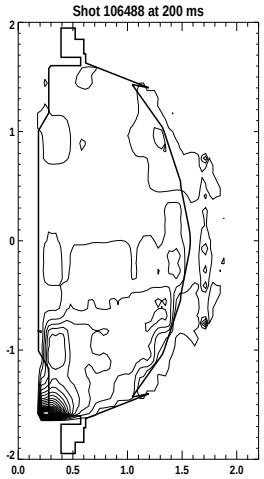
Flux contours

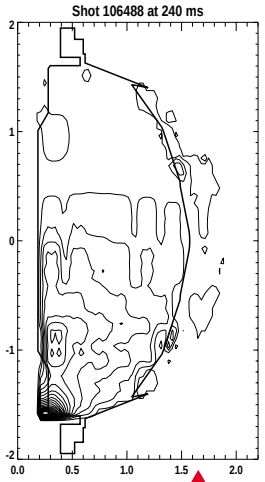


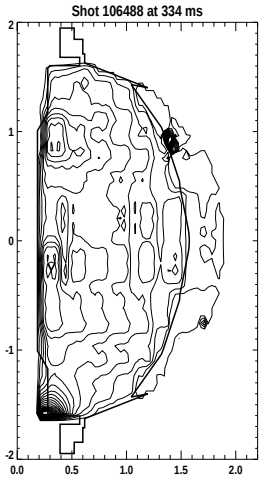




J_ϕ contours







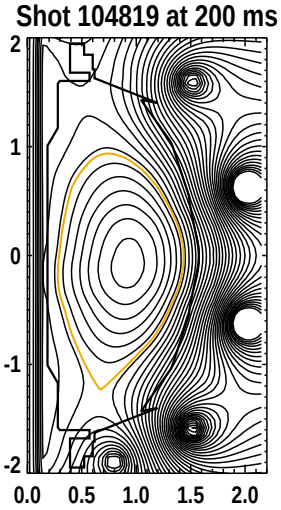
GENERAL ATOMICS

What Does MFIT Tell Us About Existence of Closed Surfaces in CHI?

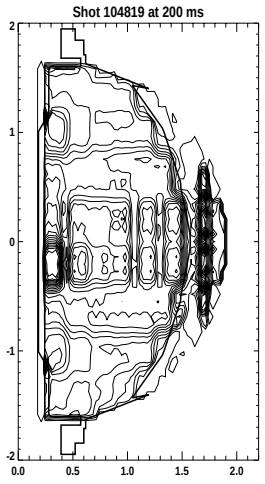
NSTX

- MFIT run with anti current spike parameters yields broad current profiles, hence less closed flux, than EFIT.
  - Cf. MFIT vs. EFIT fits to OH plasma.

MFIT

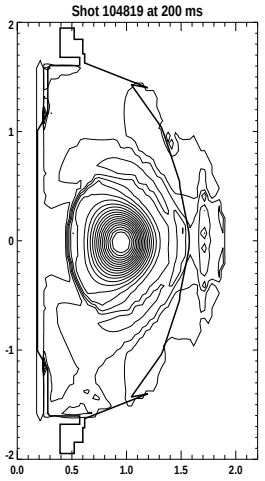


Flux

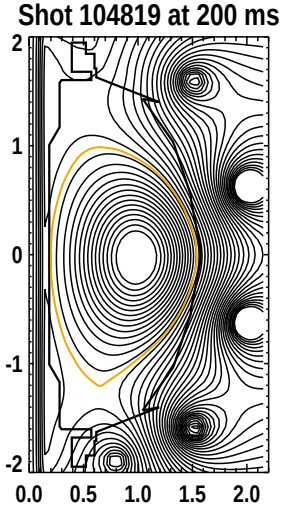


J

EFIT



J



Flux

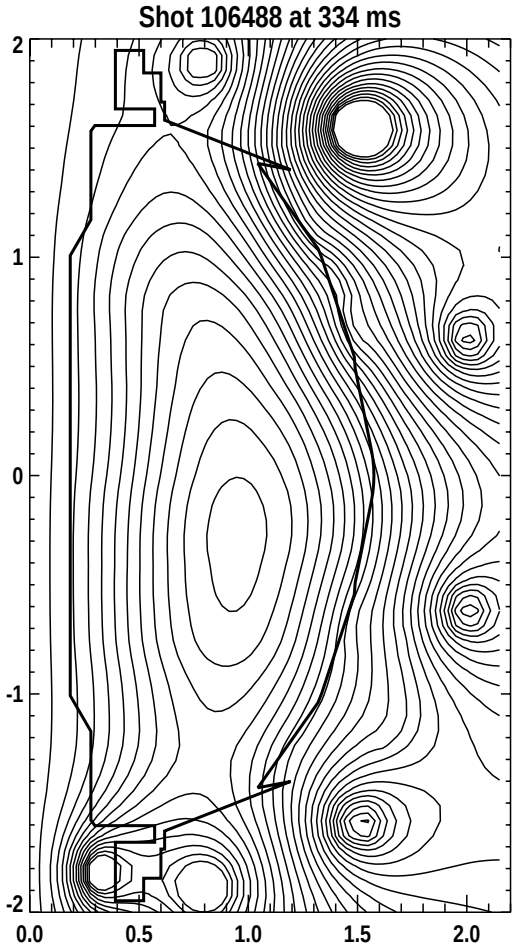
- Note: MFIT is closer to EFIT when more freedom to peak current is allowed.

GENERAL ATOMICS

What Does MFIT Tell Us About Existence of Closed Surfaces in CHI?

NSTX

Ip = 390 kA



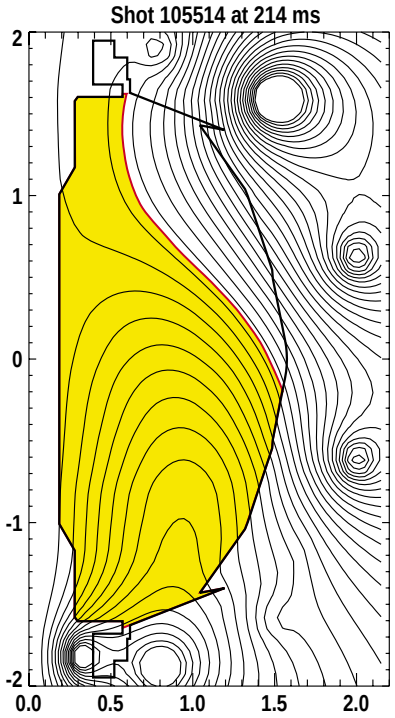
- MFIT consistently returns modest closed flux regions when CHI-driven current is sufficiently high.
  - Despite the current broadening and closed-flux-reducing effects of anti spike parameters.
- This is a very encouraging result, but it is not proof of closed mean-field surfaces.

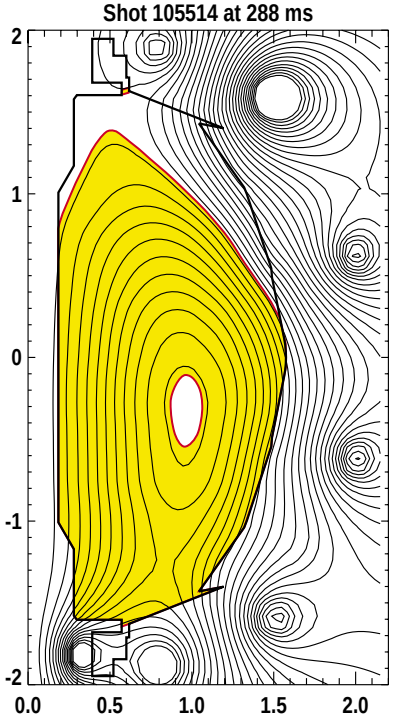
GENERAL ATOMICS

What Does EFIT Tell Us About Existence of Closed Surfaces in CHI?

- EFIT has been run with force-free current in a thick SOL.
  - With SOL current out to 2nd (upper) X–point.
- When the closed flux volume is small, EFIT sometimes gets fairly good fits to magnetic data, but the solution never converges and is far from equilibrium.
- Therefore, we cannot conclude from these EFIT attempts that closed mean-flux configurations exist yet during CHI in NSTX.

A Concept to Define Curren t-Carrying Flux for Open-Line EFIT is Being Coded





- Use insulated gaps to define mi nimum and maximum flux values th at bound the current-carrying flux.
  - This works for some common topologies and geom etries.
  - It does not work once the closed flux is large.

Conclusions

- MFIT was improved.
  - Much less susceptible to spiky c urrent distributions.
  - Well developed and in routine use.
- MFIT consistently shows mod est closed mean-field flux during high-current CHI.
  - There is reason to believe that MFIT is pes simistic about flux closure.
  - Together with observations of n=1 MHD activity, t his gives cautious optimism that CHI plasmas with mean-fie ld closed surfaces are produced in NSTX.
- EFIT has not been able to reliabl y confirm flux closure.
- EFIT is presently being modified to fit current in large open-line vol umes.