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OH-Solenoid free plasma startup program plans on NSTX for the Fy 04 run period

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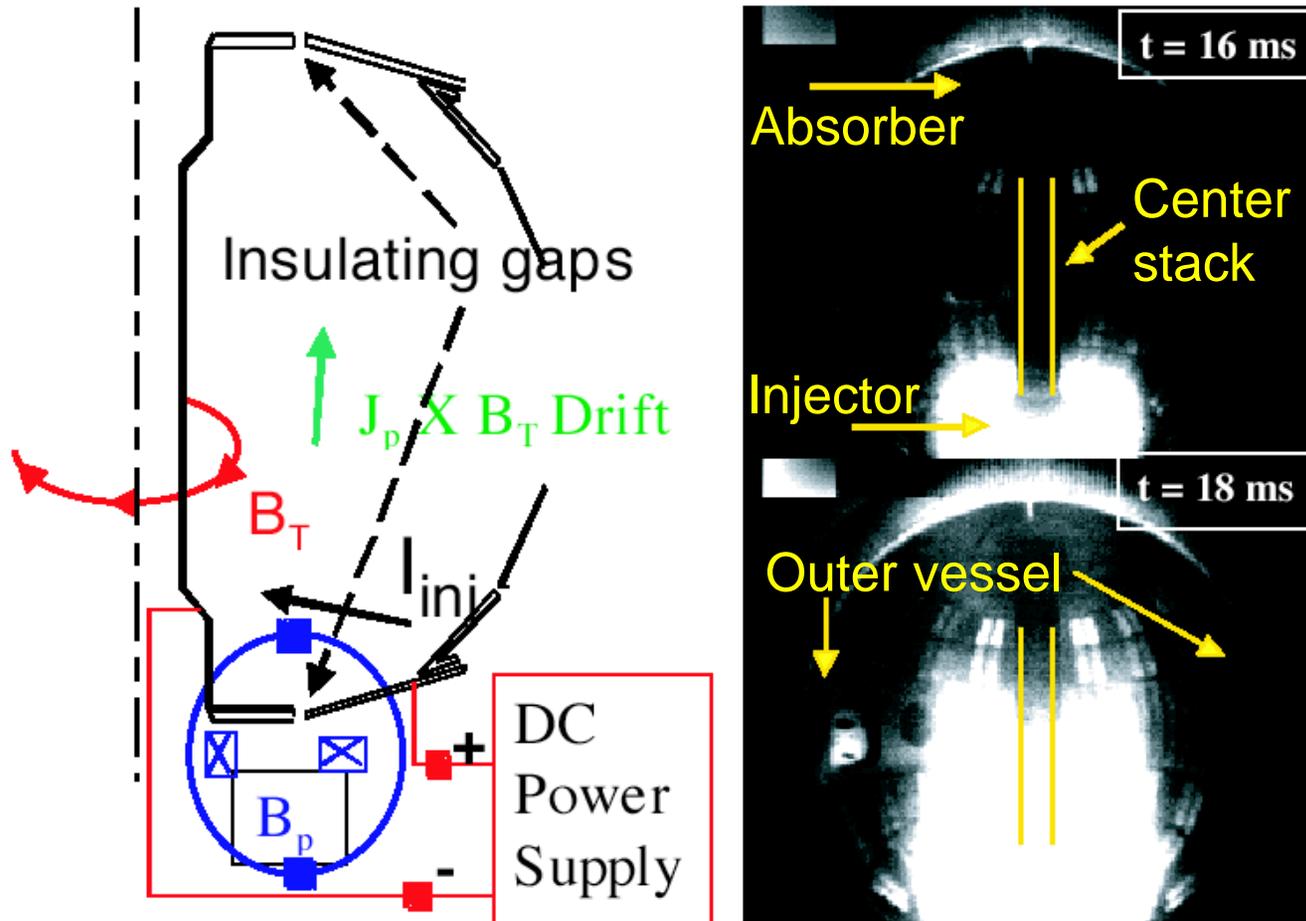
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Solenoid-free startup is an essential part of NSTX research



- IPPA goal 3.2.1.4 for the ST:
“Characterize the integration of noninductive plasma startup via magnetic reconnection such as using Coaxial Helicity Injection (CHI) with other noninductive and inductive current drive techniques. Investigate a number of noninductive techniques to start and to increase the plasma current in ST plasmas while at the same time minimizing magnetic flux and helicity injection.”
- NSTX Program Milestone FY04-04
“Conduct initial tests combining available techniques to achieve solenoid-free initiation to substantial plasma currents.”
- Techniques available:
 - CHI
 - Outer PF coil startup

CHI has initiated toroidal currents up to 400kA in NSTX



- Reconnection processes can redistribute edge current to the interior, forming closed flux surfaces

Revised strategy for CHI research on NSTX



- Decouple objectives for plasma startup and steady-state current sustainment :

- ***Transient CHI*** for plasma startup

- Based on developments on HIT-II in 2002-3

- ***Steady-state CHI*** for edge modification

- Edge current profile modification
- Favorably modify SOL flows
- Induce edge rotation

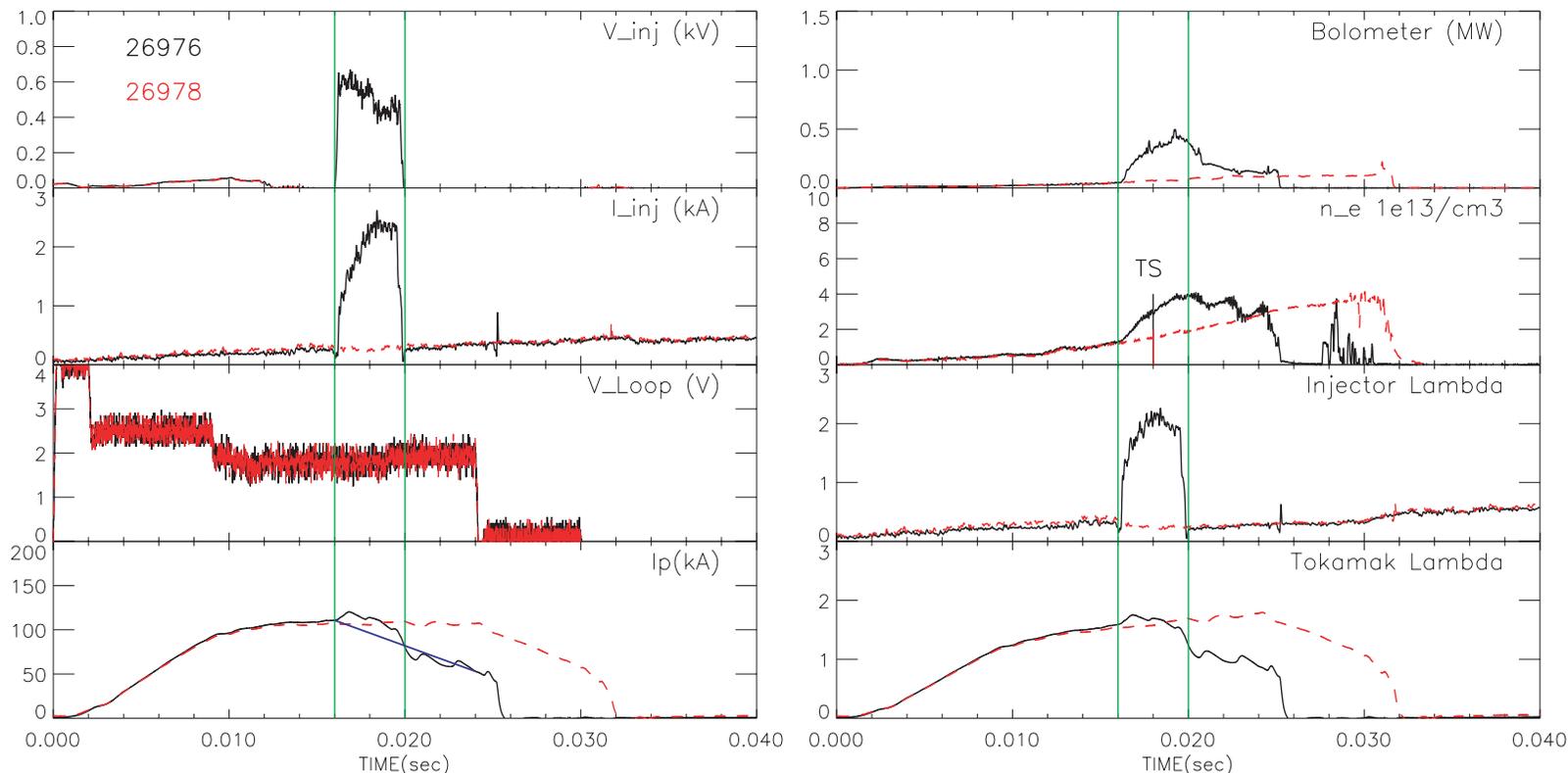
Overlap with edge biasing studies

“Transient CHI” Experiments Began in Feb 03



- New absorber insulator installed in '02
 - Indications of improved resistance to absorber arcs in initial tests of previous CHI scenarios in Feb 03
- Tried transient CHI with brief 1kV pulses applied by standard CHI rectifier supply
 - Observed jitter in supply output at low current
 - breakdown was unreliable
 - After breakdown, inductance in CHI circuit limited rate of current rise below optimum level
 - inductance required to limit fault current
- Analysis indicated that a small capacitor bank would be a better matched supply for transient CHI
 - Now designing and making a capacitor bank
 - aim for installation early in '04

HIT-II results show CHI can drive edge current



- Application of CHI increases density, especially in the edge region
- Edge current drive can be seen if one subtracts out the effect of increased resistivity due to density
- NSTX should be able to resolve changes to edge current profile. Auxiliary heating may reduce resistivity.

D. Mueller (PPPL)

Plasma Start-up Using Outer Poloidal Field Coils



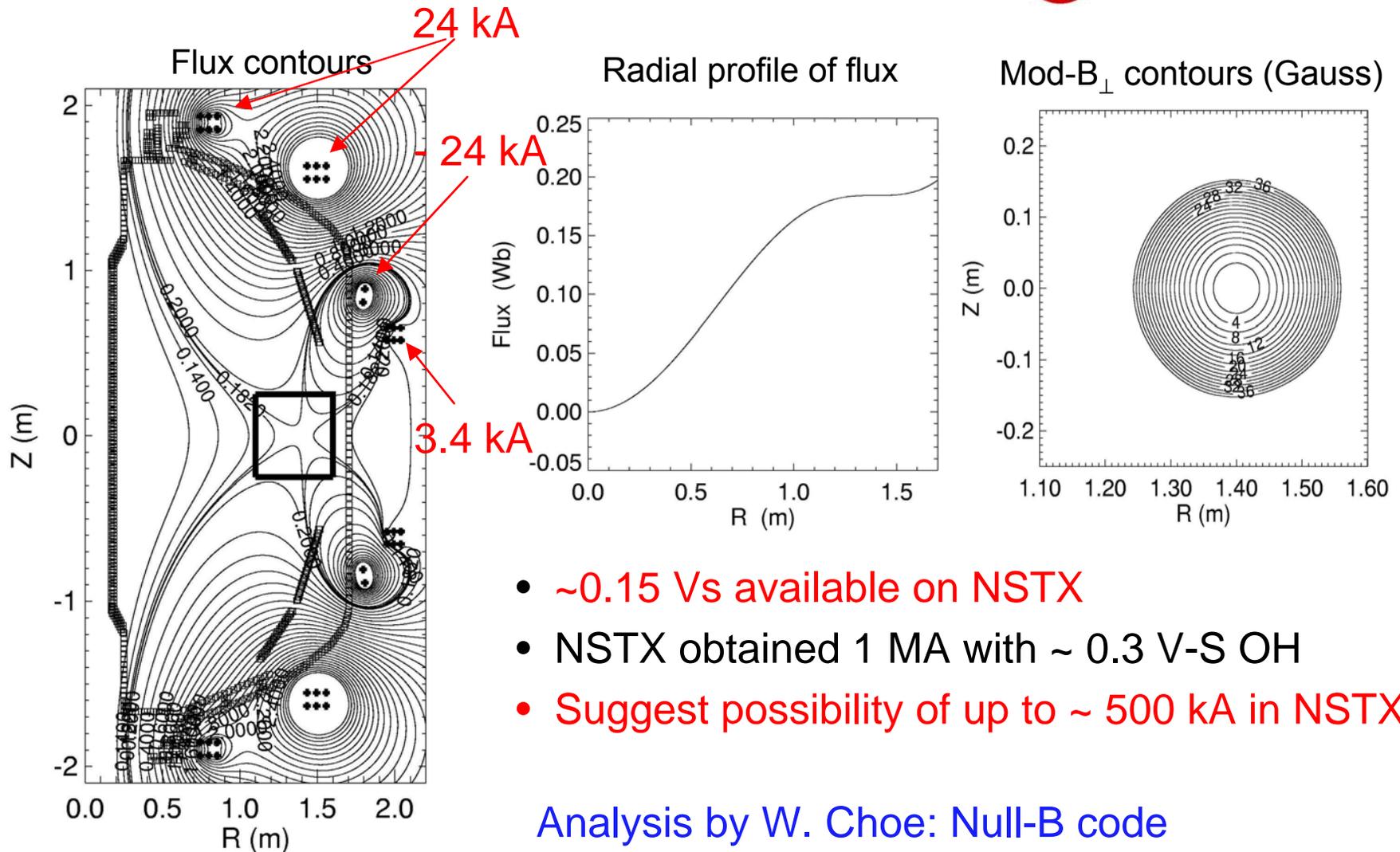
Outer PFs have been used to start-up the plasma:

- MAST (START) - poloidal field coils + radial compression
- JT-60U - Aggressive application of rf heating and current drive

Three approaches for outer PF start-up in NSTX:

- # 1. Outer PF ramp from near zero flux and current
- # 2. JT-60U approach
- # 3. Poloidal field minimization by employing opposing coils to satisfy “Lloyd condition” for initiation of current

Creation of suitable field null by energizing the presently unused PF 4 (Method #3)



- ~0.15 Vs available on NSTX
- NSTX obtained 1 MA with ~ 0.3 V-S OH
- Suggest possibility of up to ~ 500 kA in NSTX

Analysis by W. Choe: Null-B code

Presentations at CHI & AS session (Tuesday morning)



8:30am	M. Ono	Outer PF startup
8:45am	J. Menard	HHFW + Outer PF startup
9:00am	Y. Takase	Outer PF startup
9:15am	R. Raman	Transient CHI startup
9:30am	D. Mueller	Edge current drive using CHI
9:45am	H. Ji	Dynamo CD studies of CHI plasmas Mag.fluctuation induced momentum transport
10:05am	S. Zweben	FRC startup
10:20am		Break
10:35am	G. Wurden	Magnetic Field mapping of CHI plasmas
10:50am	A. Redd	Impedance studies on HIT-II CHI plasmas
11:05am	M. Schaffer	Helicity studies during CHI Equilibrium modeling of CHI plasmas
11:25am	D. Brennan	Equilibrium & stability analysis of CHI plasmas
11:40am	X. Tang	MHD Modeling of CHI plasmas
11:55am	P. West	Solenoid-free startup
12:10pm		Discussions and summary preparation