

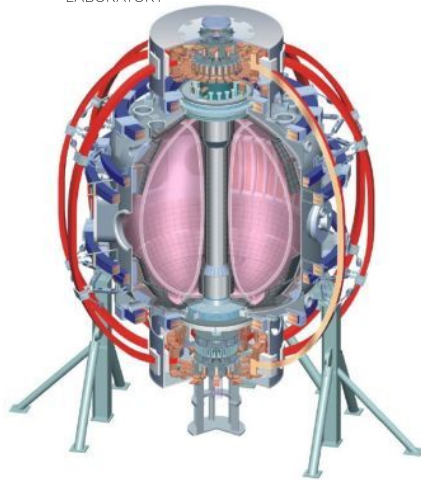
## Proposed Facility Enhancements for FY 2014-18

R. Maingi,   
**J-W. Ahn, J. Canik, J. Lore, A. Sontag**

**NSTX Facility Enhancement Brainstorming Meeting**  
**PPPL - Princeton, NJ**  
**Feb. 7-8, 2012**

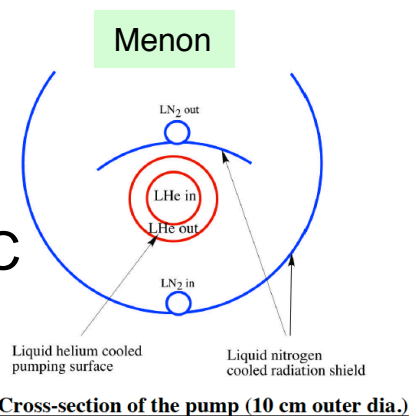
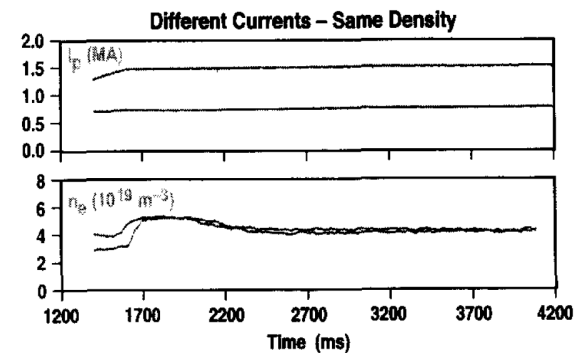
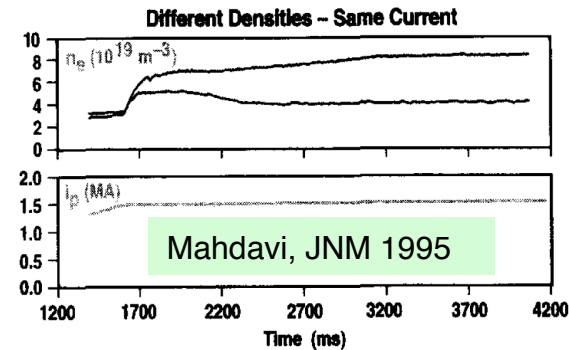
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 CompX  
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 Ioffe Inst  
 RRC Kurchatov Inst  
 TRINITI  
 NFRI  
 KAIST  
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 ASIPP  
 ENEA, Frascati  
 CEA, Cadarache  
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 ASCR, Czech Rep

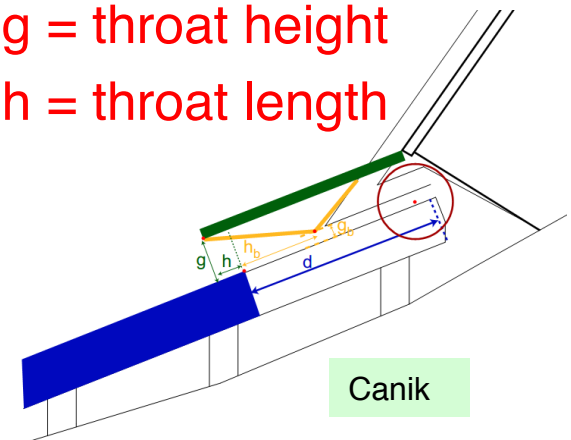


# Divertor Cryopump and Baffle System: A Proven Technology for Long Pulse Particle Control

- Cryopumps have been implemented in a number of devices – *they should be viewed as a tool to provide long pulse density control*
- The basic concept is a liquid He tube surrounded by a liquid Nitrogen shroud
- A plenum system is designed to increase local neutral pressure for efficient pumping
- Preliminary design calculations are being done (by J. Canik) both with semi-analytic models and 2-D calculations, for the April, 2012 PAC meeting



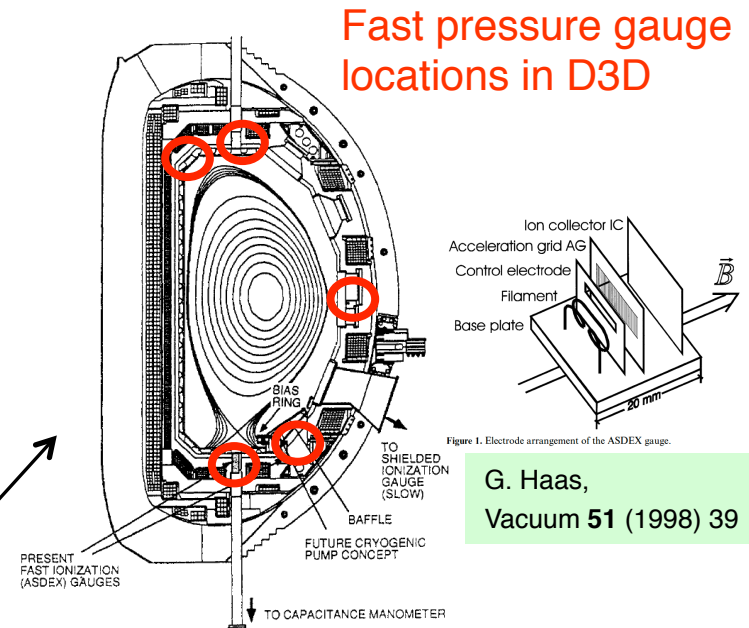
$g$  = throat height  
 $h$  = throat length



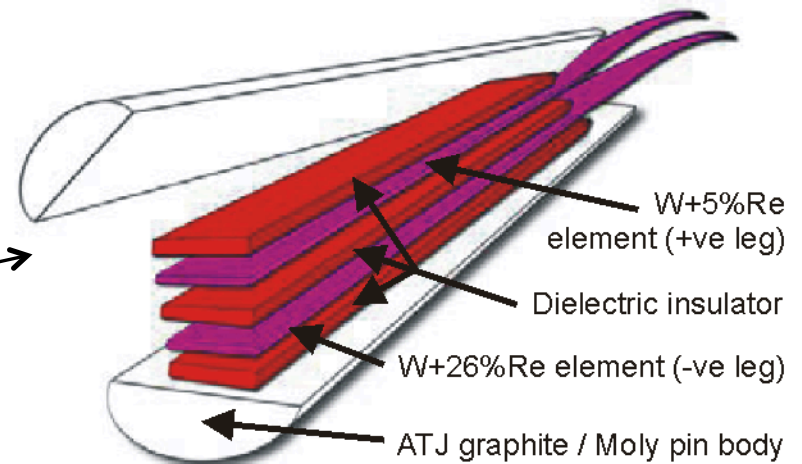
Cross-section of the pump (10 cm outer dia.)

# PCS feedback on divertor temperature or neutral pressure, and associated diagnostics

- Two limits imposed on power handling: 1) critical heat flux that can dig a channel into PFCs and cause coolant leak, and 2) surface temp. below melting point and away from chemical sputtering peaks
- Unmitigated heat flux in NSTX-U predicted to be up to 25 MW/m<sup>2</sup>; requires control of both temp. and heat flux in real time
- Propose PCS control of divertor gas injection on divertor neutral pressure from fast in-situ gauges
- Propose PCS feedback control on temp. and heat flux from fast thermocouples: actuators are  $\delta_r^{sep}$  and OSP radius



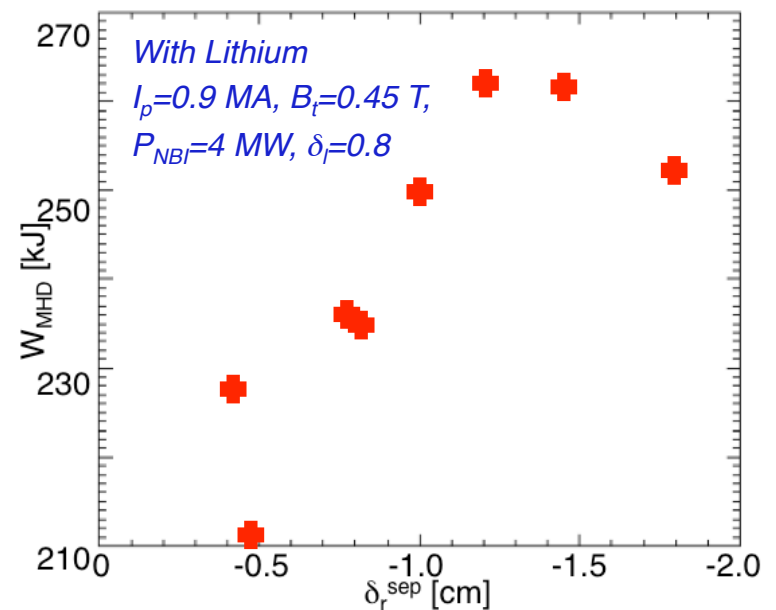
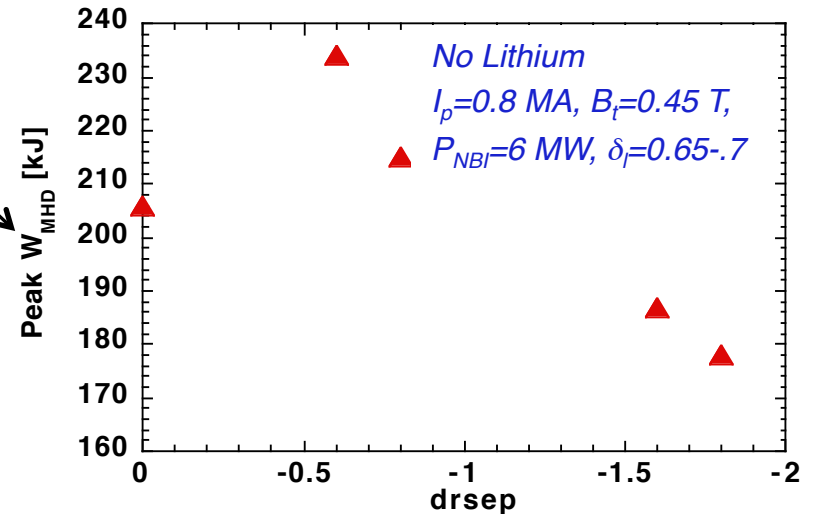
G. Haas,  
Vacuum 51 (1998) 39



McLean, Gray

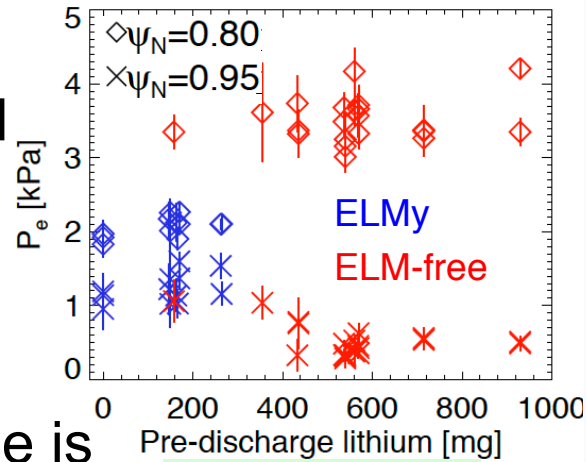
# Upward facing LiTER may further improve performance

- Discharges without lithium showed peak stored energy near  $\delta_r^{\text{sep}} \sim 0$
- Discharges with lithium showed peak stored energy with more negative  $\delta_r^{\text{sep}}$ , i.e. LSN
- Suggests that some method to evaporate into upper divertor should be considered, along with additional upper divertor diagnostics

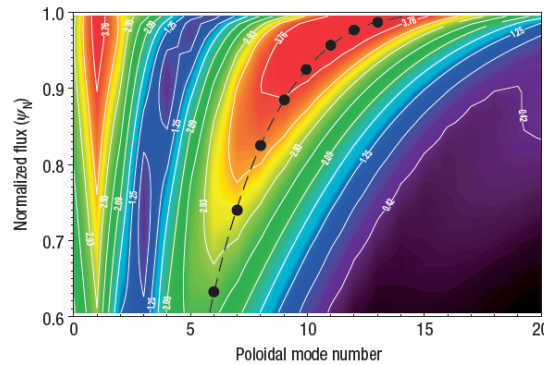
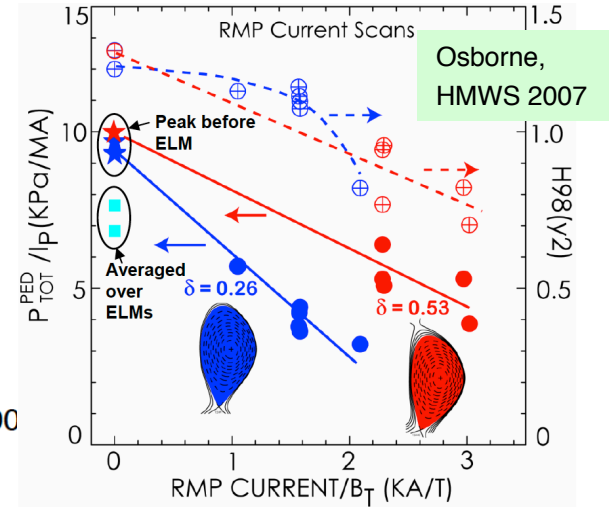


# Off-midplane coils for improved control over poloidal spectrum of magnetic perturbations

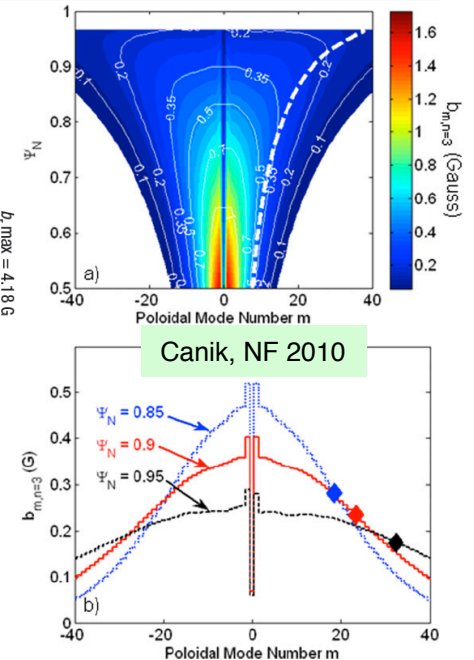
- Lithium coatings work to reduce edge density and pressure and eliminate ELMs, much like RMP
- However the particle/impurity confinement time is too high – true ELM-free H-mode
- Off-midplane coils in NSTX-U should increase particle transport from the improved poloidal spectral control: synergy with lithium?



Maingi, to be submitted



Evans, Nature Phys. 2006



# Backup

# Upward facing LiTER may further improve performance

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- Suggests that some method to evaporate into upper divertor should be considered, along with additional upper divertor diagnostics

