

GPI Measurements of L-H Transition

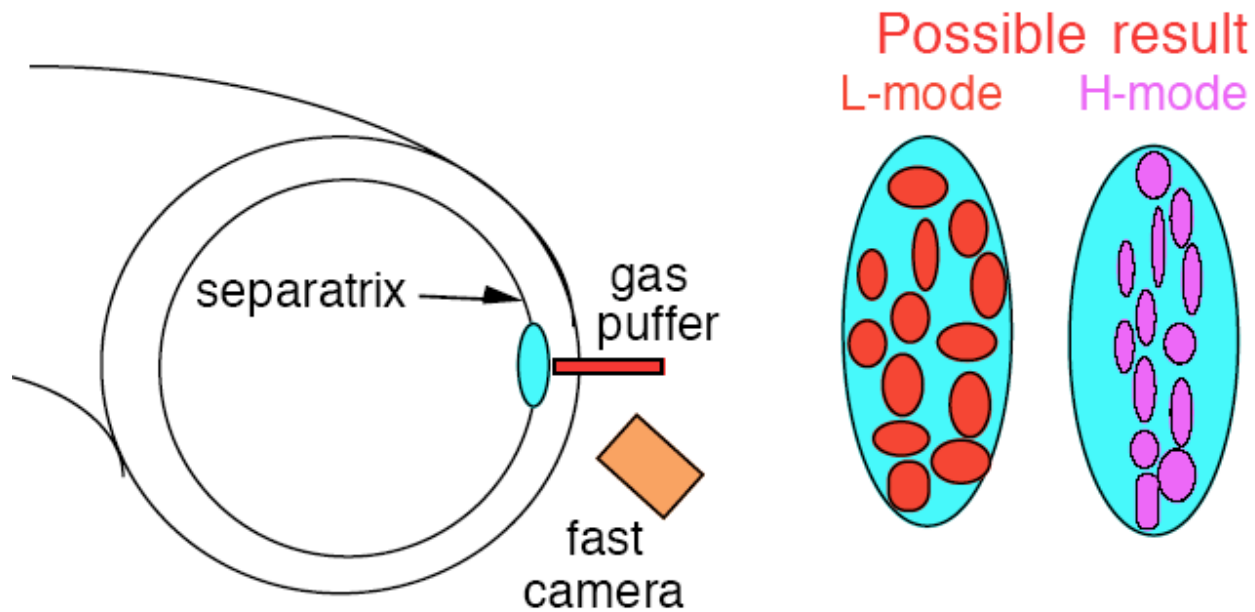
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NSTX Results Review
9/21/04

- Motivation
- GPI diagnostic
- Images, observations, and questions

Motivation

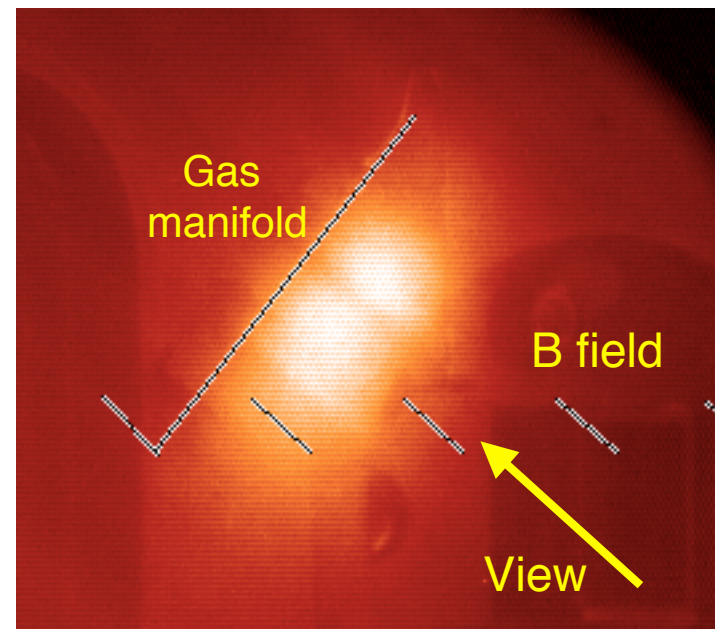
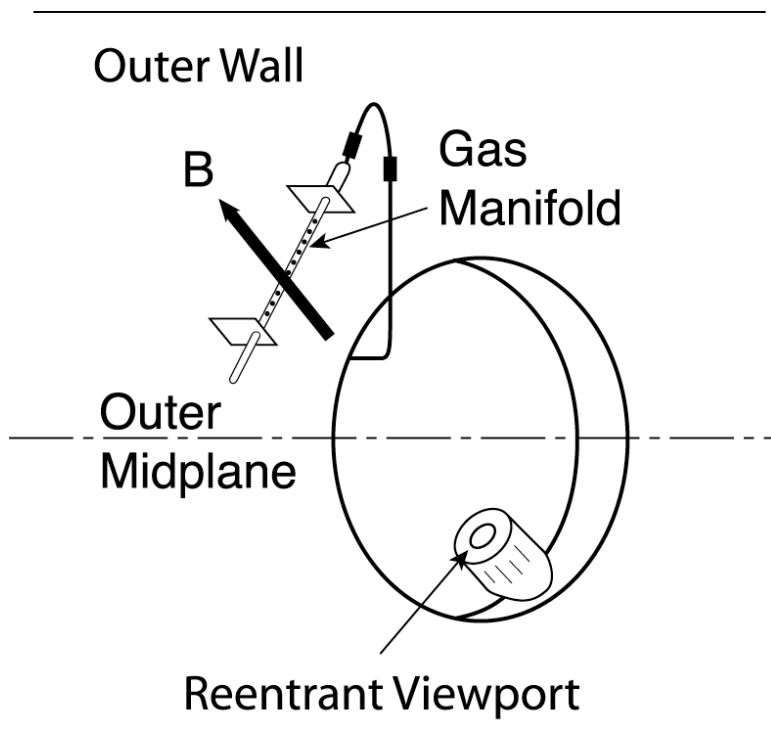
- See whether the L-H transition is really due to the poloidal shearing of edge turbulence, as in most theories (either DC or fluctuating zonal flows)



from TTF '99

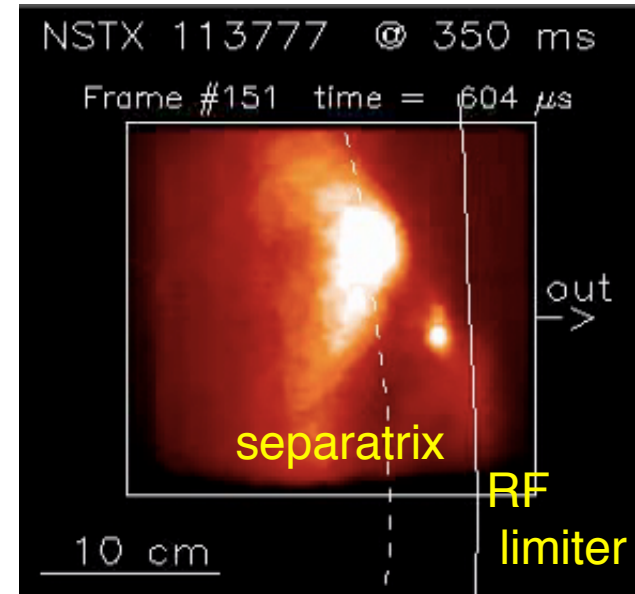
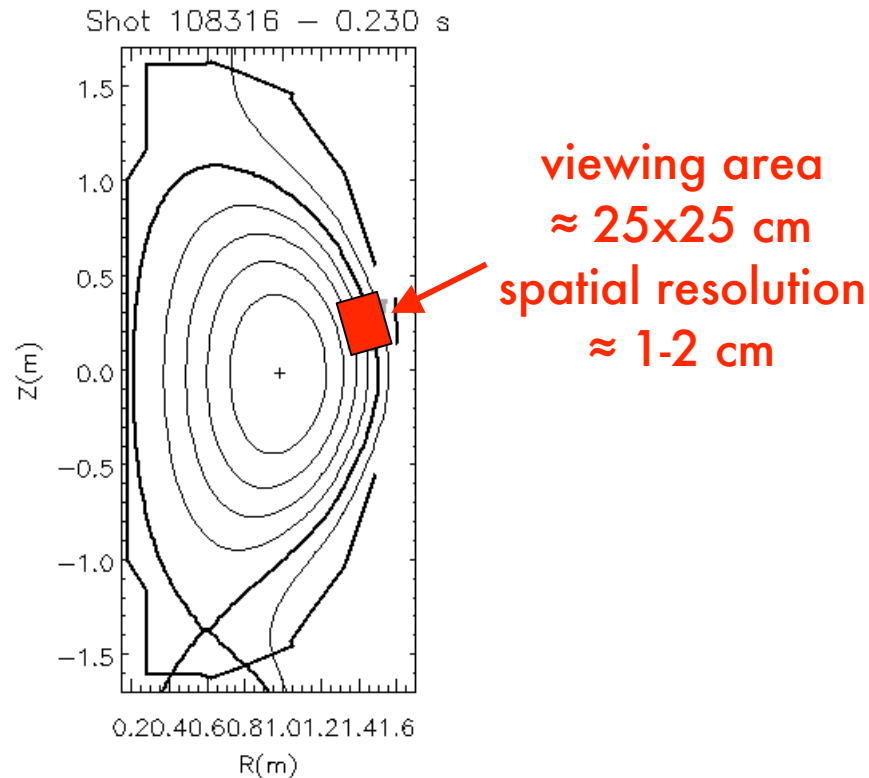
GPI Diagnostic in NSTX

- Looks at D_{α} or HeI light from gas puff $I \propto n_o n_e f(n_e, T_e)$
- View \approx along B field line to see 2-D structure $\perp B$
- Image coupled to camera with 800 x 1000 fiber bundle



GPI gas cloud (Biewer)

GPI Image Orientation



Typical image

Using Princeton Scientific Instruments PSI-5 camera
250,000 frames/sec @ 64 x 64 pixels/frame
300 frames/shot, 14 bit digitizer, intensified

GPI Data in '04

- About 500 shots (almost all with D_α) with:
 - Ohmic, L-mode, H-mode
 - L-H and H-L transitions
 - ELMs and high-n modes
 - LSN vs. USN vs. limited
 - MHD and RF effects
 - High beta and RWM coil
 - He puff and CIII light
- Shot list and sample movies at:

http://www.pppl.gov/~szweben/NSTX04/NSTX_04.html

L-H Transition Cases

L-H Transition

NSTX #113079

B=4.4 kG, I=800 kA, 2.8 MW NBI

$\langle n \rangle = 1.9 \times 10^{13} \text{ cm}^{-3}$

250,000 frames/sec

Just Before L-H Transition

1 msec Before L-H Transition

NSTX #113735

B=3.0 kG, I=790 kA, 4.4 MW NBI

$\langle n \rangle = 2.3 \times 10^{13} \text{ cm}^{-3}$

250,000 frames/sec

H-L Transition Cases

Dithering H-L Transition

NSTX #113062

B=4.4 kG, I=780 kA, 2.6 MW NBI

$\langle n \rangle = 2.1 \times 10^{13} \text{ cm}^{-3}$

100,000 frames/sec

Observations on L-H Transitions

- L-H transitions look like a continuous evolution from turbulent blobs to a quiescent state in ≤ 0.1 ms, apparently without new spatial features or flows
- Transient periods of H-like quiescence occur well before the main L-H transition
- H-L transitions generally appear as high-n poloidal modes which evolve into radially moving blobs

Questions for Image Analysis

- Is there an increase in poloidal flows (shear or zonal) just before the L-H transition (as in theory) ?
- How much does the turbulence “dither” from L- to H-type as a function of time before the main L-H transition ?
- Is there a consistent instability pattern leading from H-L ?
- How do the transitions seen in GPI compare with those in the reflectometer, Firetip and probe diagnostics ?