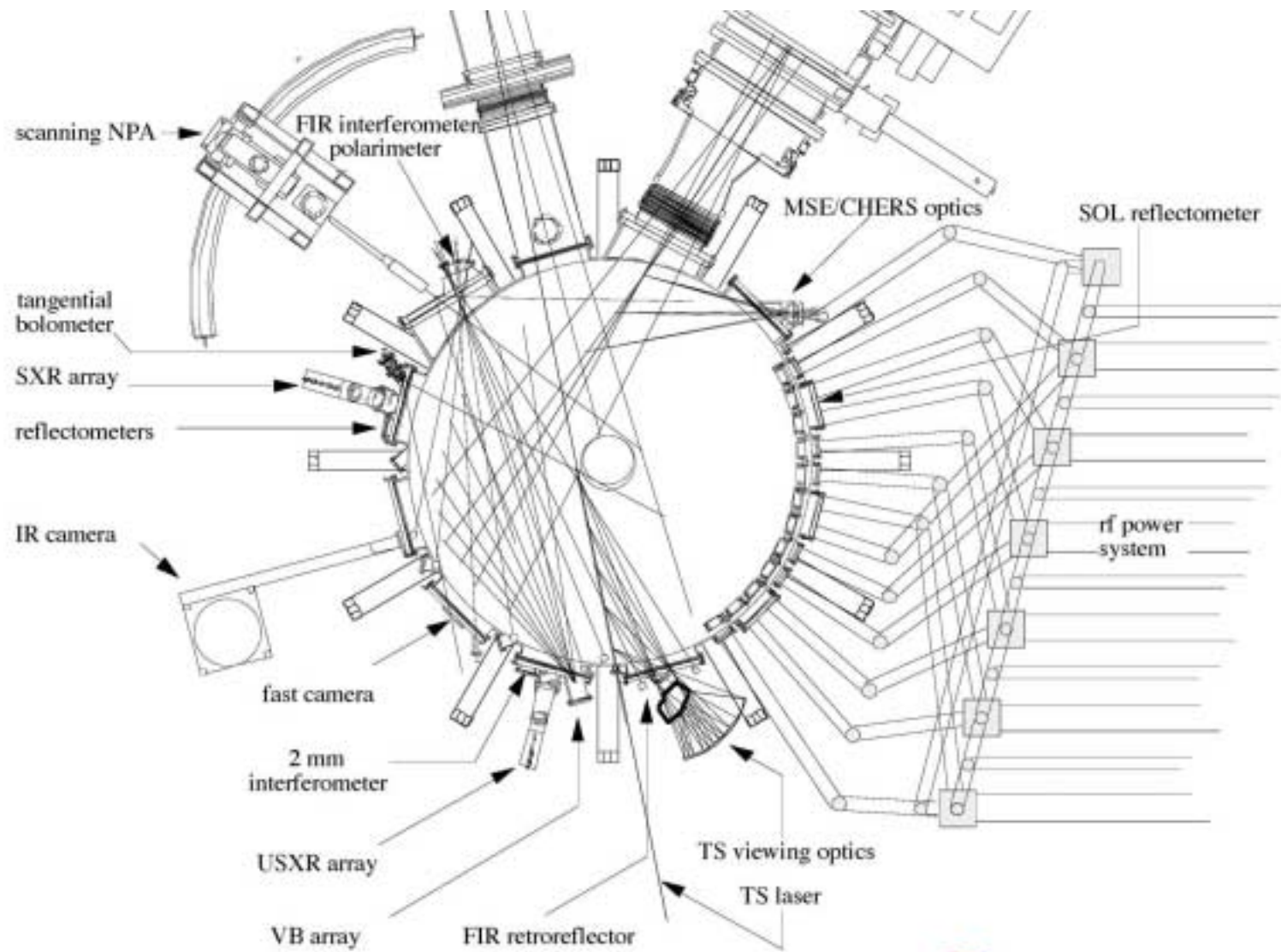




First results of NSTX fast divertor camera

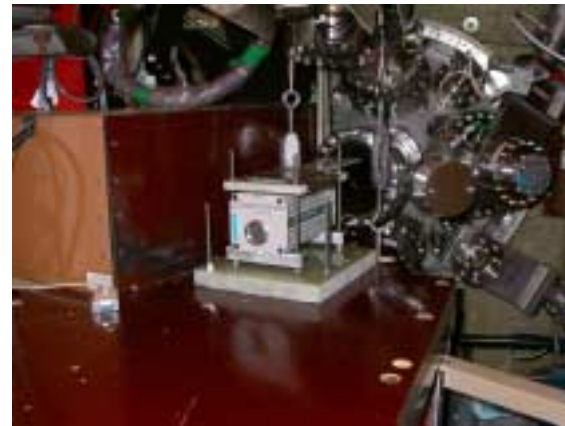
N.Nishino¹⁾, L.Roquemore, R.Kaita, S.Zweben,
D.Johnson, H.Kugel, R.Maqueda²⁾, C.Bush³⁾,
R.Mangi³⁾, V.Soukhanovskii
and NSTX team

PPPL, 1) Hiroshima Univ., 2) LANL, 3) ORNL



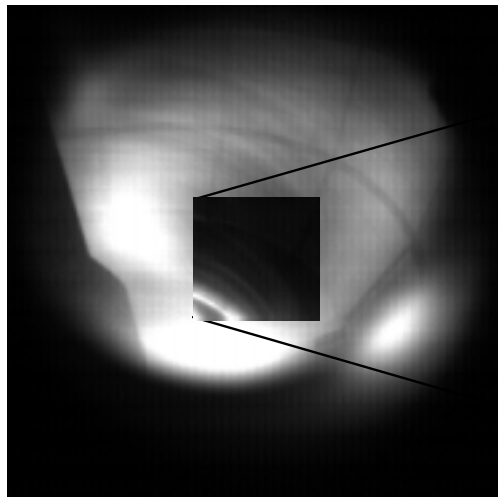
Camera installation

- Using NSTX Bay G
 - Decline port for divertor view
 - Mid plane port for GPI (to see between Bay A and B and center stack)
- Camera
 - FASTCAM ultima-SE (up to 40500fps)

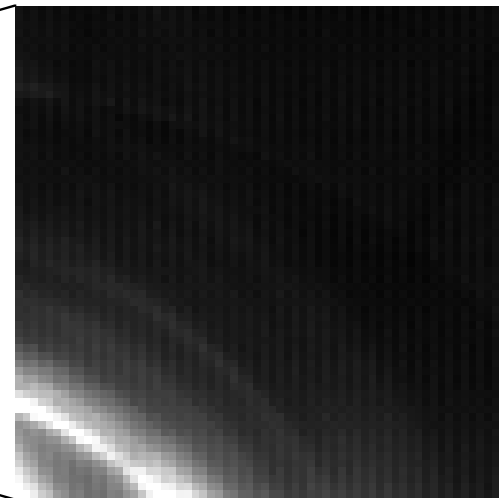


Typical camera view of NSTX plasmas

- Light strings (filamentations) can be seen clearly



4500fps with $D\alpha$ filter
(#109005) 256x256 pixels



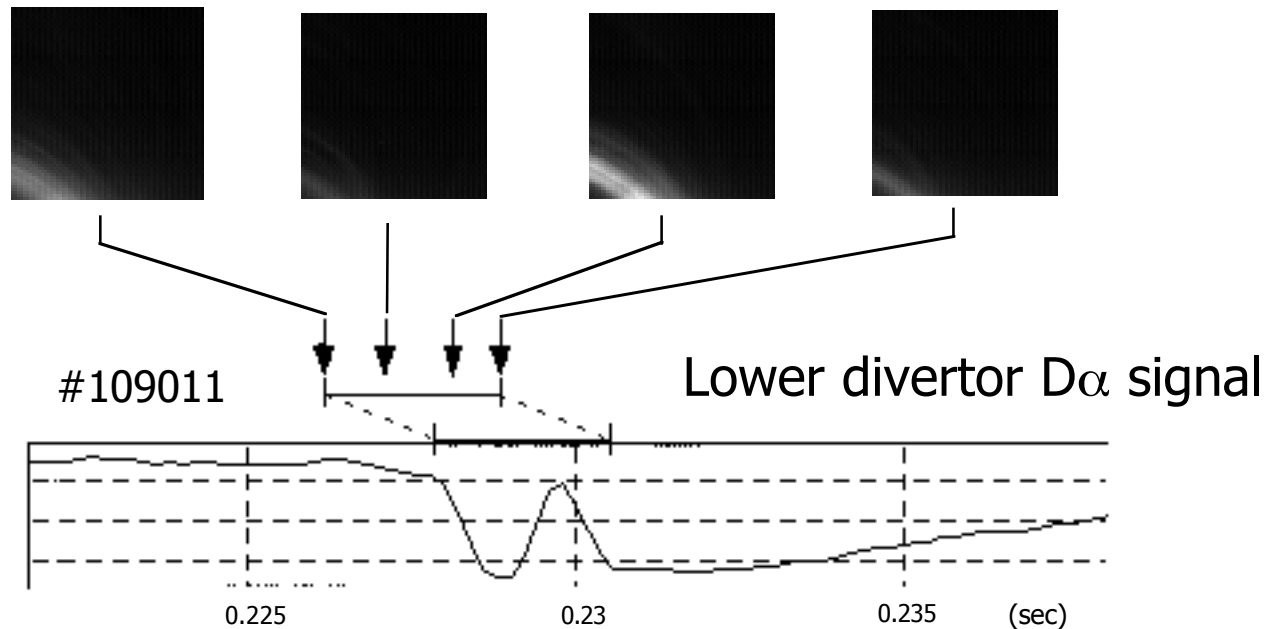
40500fps with $D\alpha$ filter
(#109022) 64x64 pixels

View pixels are changed due to the shutter speed

click left picture to
see movie

Behavior of filamentations during L-H transition

- There are low number filamentations in H-mode and many numbers filamentations in L-mode
 - Time delay is due to trigger problem



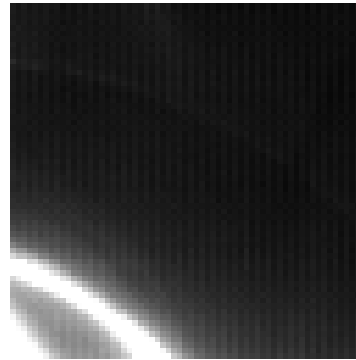
Click picture to see
movie

Giant ELM (Type I)

- Filamentations appears clearly on Giant ELM

#109075

Giant ELM



40500fps with $D\alpha$ filter (wide)

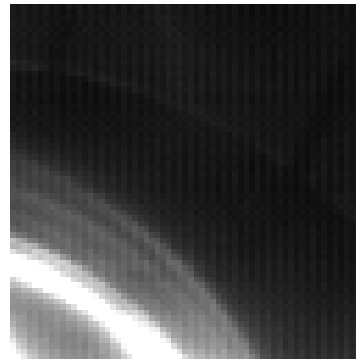
Click picture to
see movie

Grassy ELM (Type II)

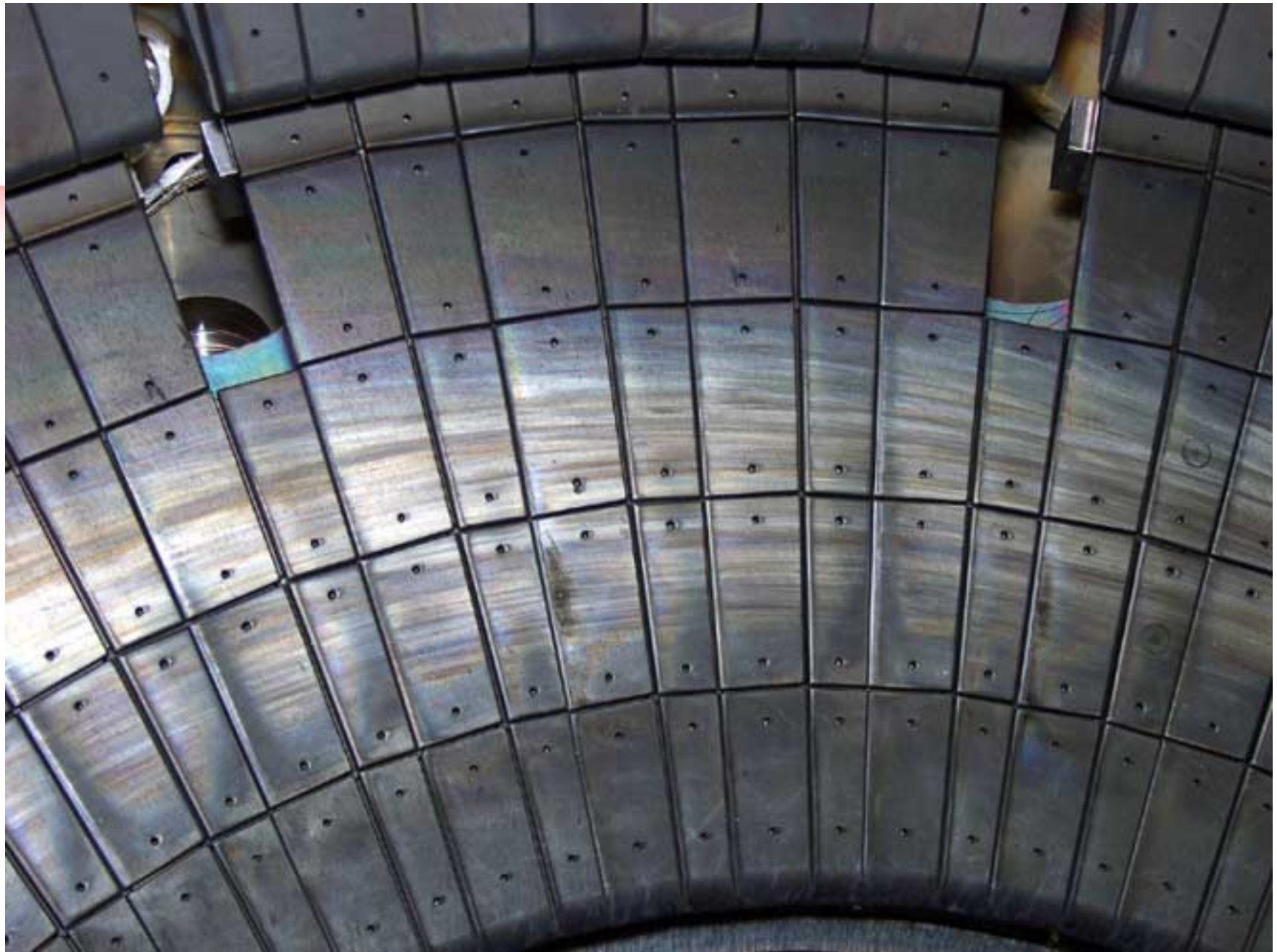
- Filamentations repeat to appear frequently

#109069

Grassy ELM



40500fps with $D\alpha$ filter (wide)



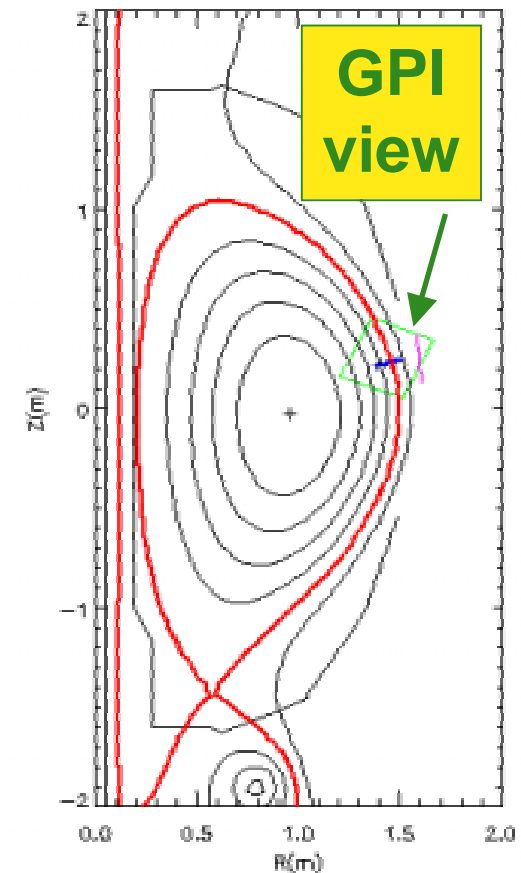
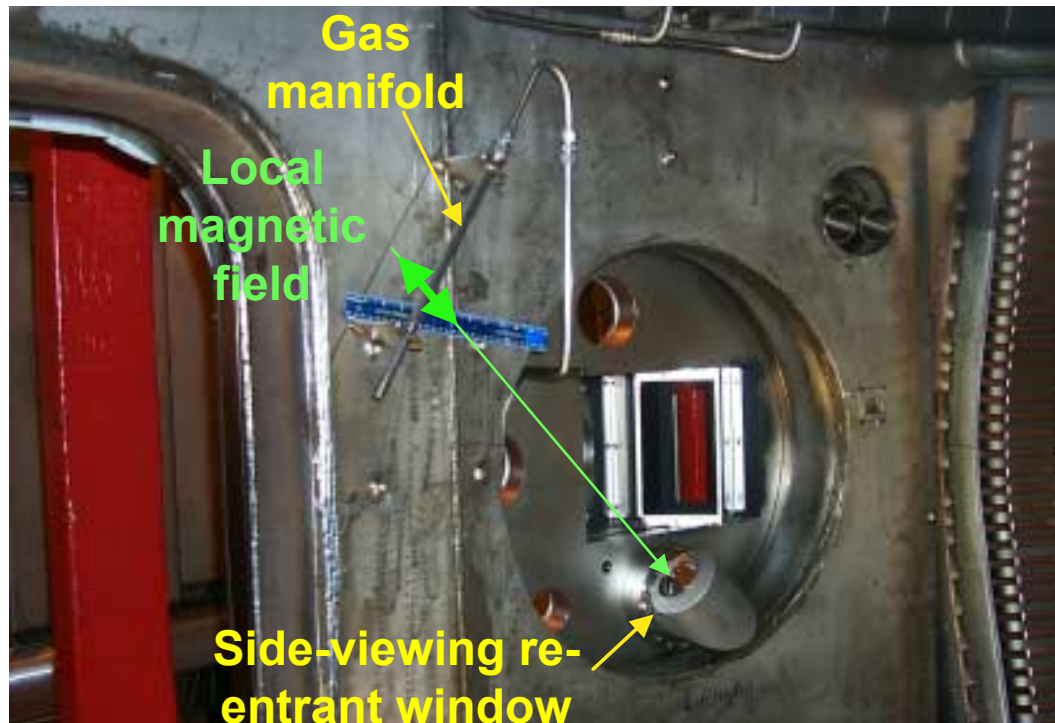


Remarks !?

- Almost always the same structure is measured by divertor camera !?
- To confirm this !?
 - Need to look the other divertor position
 - Possible reason
 - Due to toroidal field ripple or error field? Or the divertor tiles displacement?
 - If this is true
 - Is ELM position identified?
 - Possibility to control ELM position or ELM itself to control heat flux on divertor tile

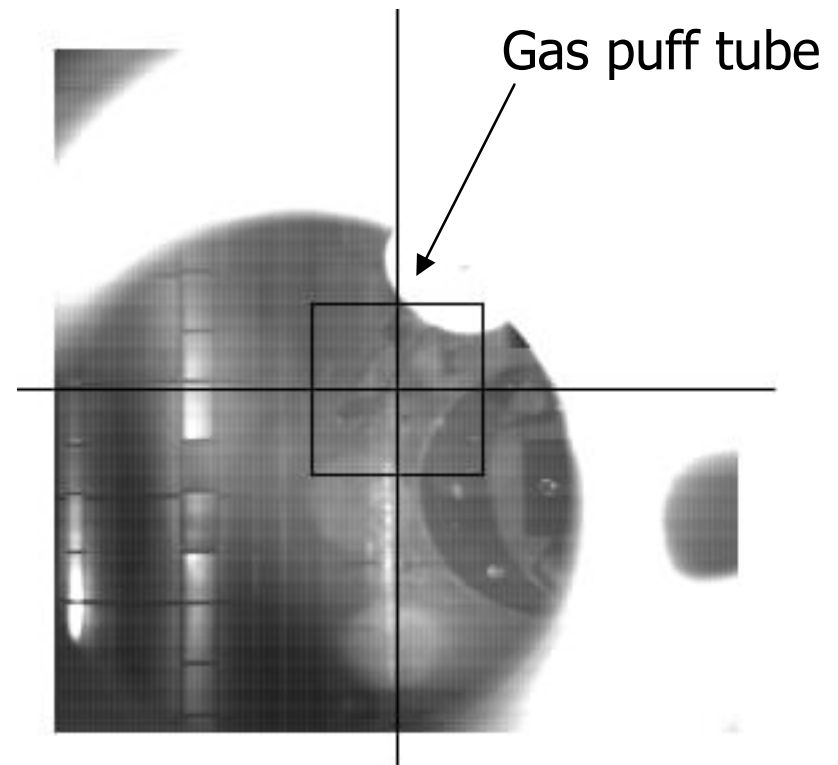
GPI Diagnostic setup in NSTX

- Use re-entrant port and linear gas manifold.
- Use **He**, D_2 , or Ar puffs.
- Use beam-splitter and PMTs (100 kHz bandwidth) for discrete fast chords.



Typical camera view of GPI experiment

- From Bay G to Bay A&B
- View size variation
 - Full size (4500fps)
 - 256x256pixels
 - Minimum size (40500fps)
 - 64x64pixels

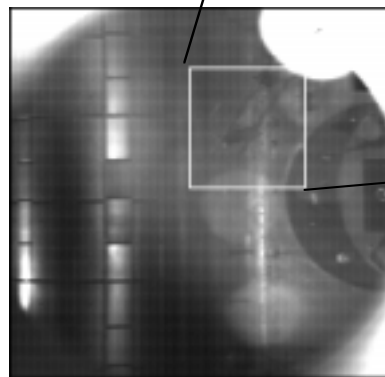
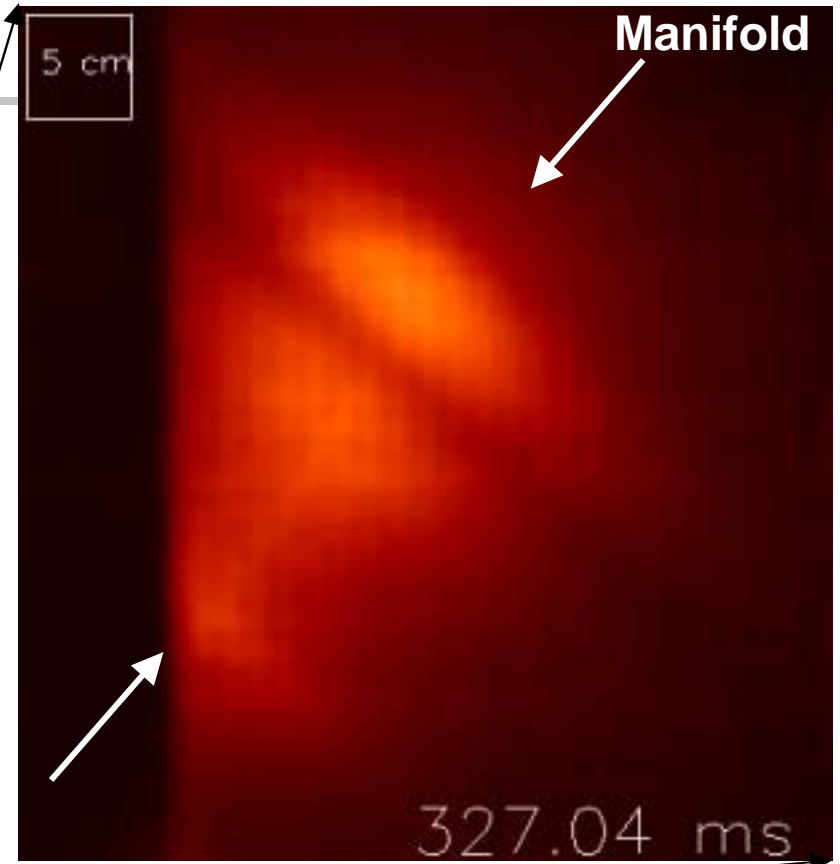


Gas puff from linear manifold viewed across torus

NSTX

Shot 108975
0.9 MA - 0.35 T
HeI filter (587.6 nm)
74 μ s exposure

Photron
Fastcam-Ultima SE



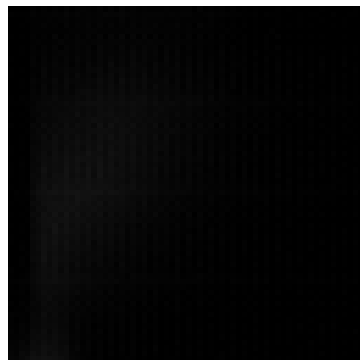
Click picture to
see movie

GPI experiment

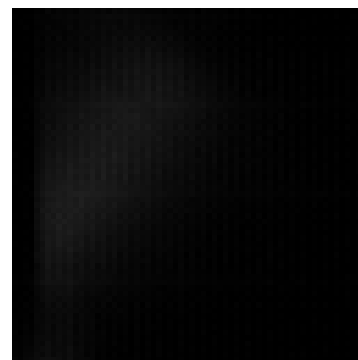
- Three dimensional view of fluctuation can be reconstructed by more than two cameras
- View image of L and H-mode during He gas puff by mid plane port

#108979

40500fps with He I filter (587.6nm)



H-mode



L-mode



Further issue and needs

- Plasma parameter dependence
- Relationship to plasma confinement ?
- 3D reconstruction from next run
- Fluctuation model & theory !?
- Possibility to control ELM position by coils ???



Conclusions

- Filamentations can be seen clearly by fast divertor camera with optical filter.
- L-H transition and Giant ELM, Grassy ELM can be distinguished by the number (or strength?) of filamentations.
- Fast camera with optical filter is very useful tool for fluctuation measurement and peripheral phenomena
- Reconstruction of three dimensional view of the fluctuation will be held at next run of NSTX