

Variation of Edge Density Fluctuation during L/H transition on NSTX

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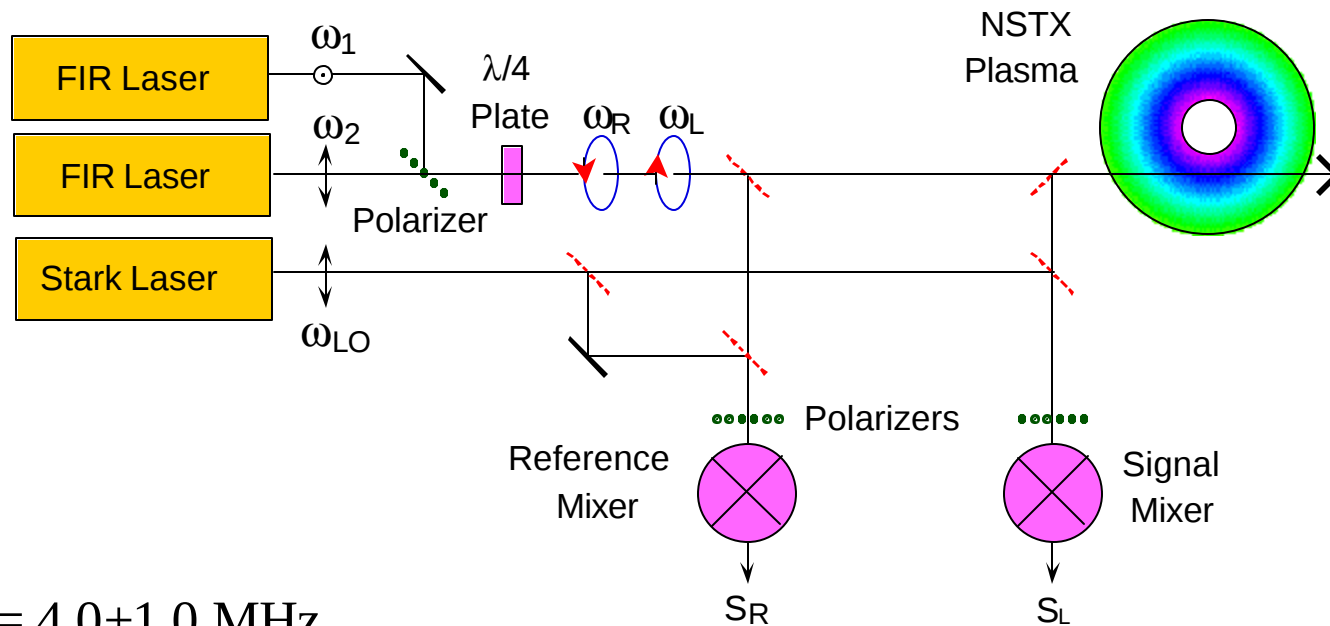


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FIReTIP system on NSTX



$$W_{LO} - W_1 = 4.0 \pm 1.0 \text{ MHz}$$

$$W_{LO} - W_2 = 7.0 \pm 1.0 \text{ MHz}$$

$$\frac{df(t)}{dt} \ll \omega_{if}$$

after Rommers & Howard



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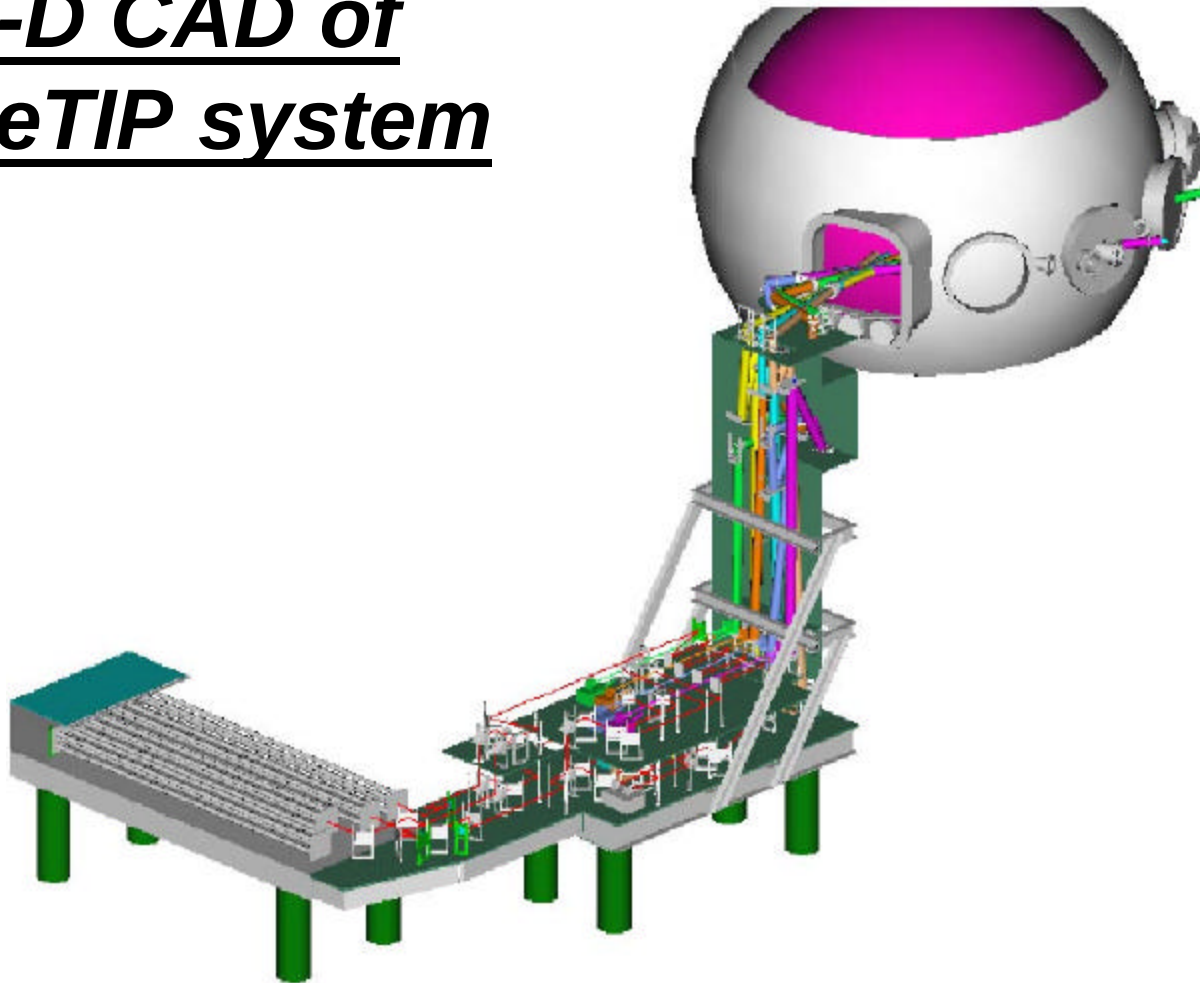


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3-D CAD of FIReTIP system



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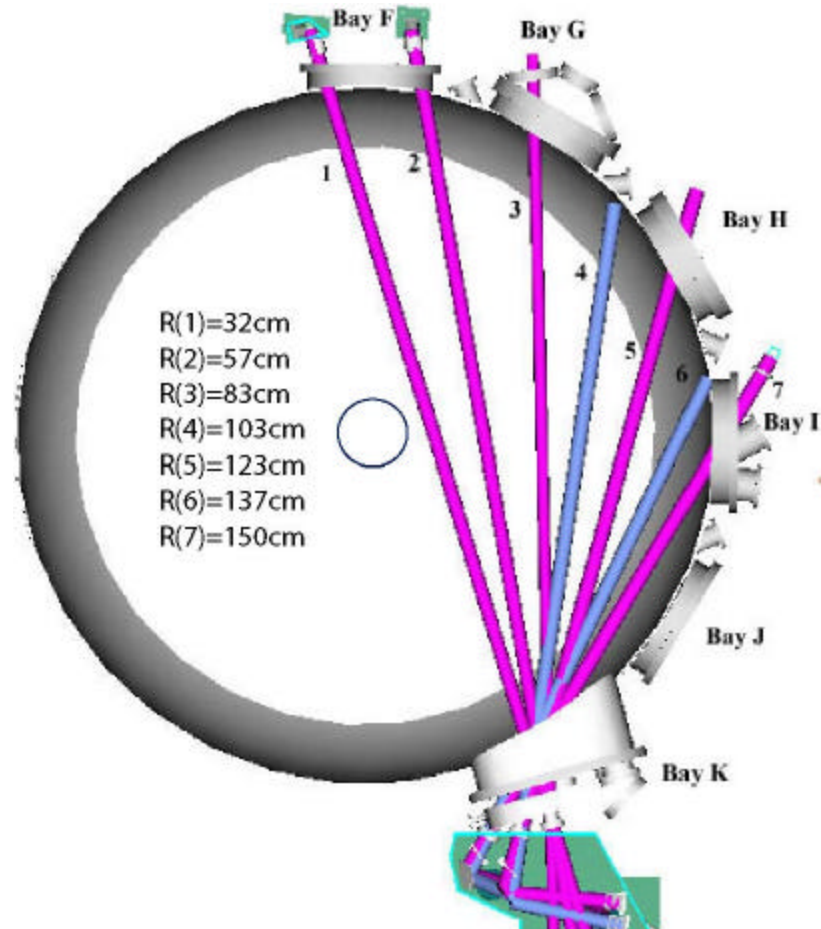


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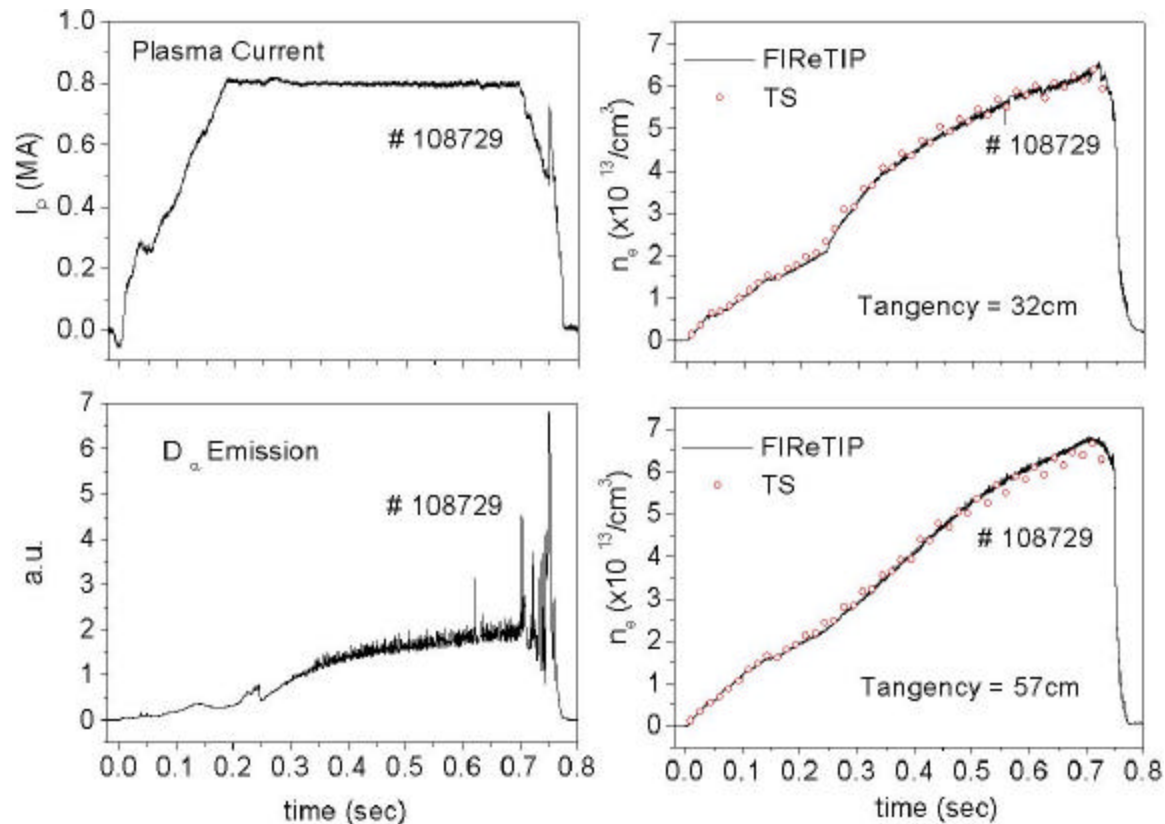
Channel arrangement

- Seven channel of tangential view
 - Bay K has three entrance windows
 - Seven retro-reflectors will be posted on the other side of vessel
 - Two channels in 2001 (#1 and #2)
 - Two additional channels in 2002 (#3 and #7)



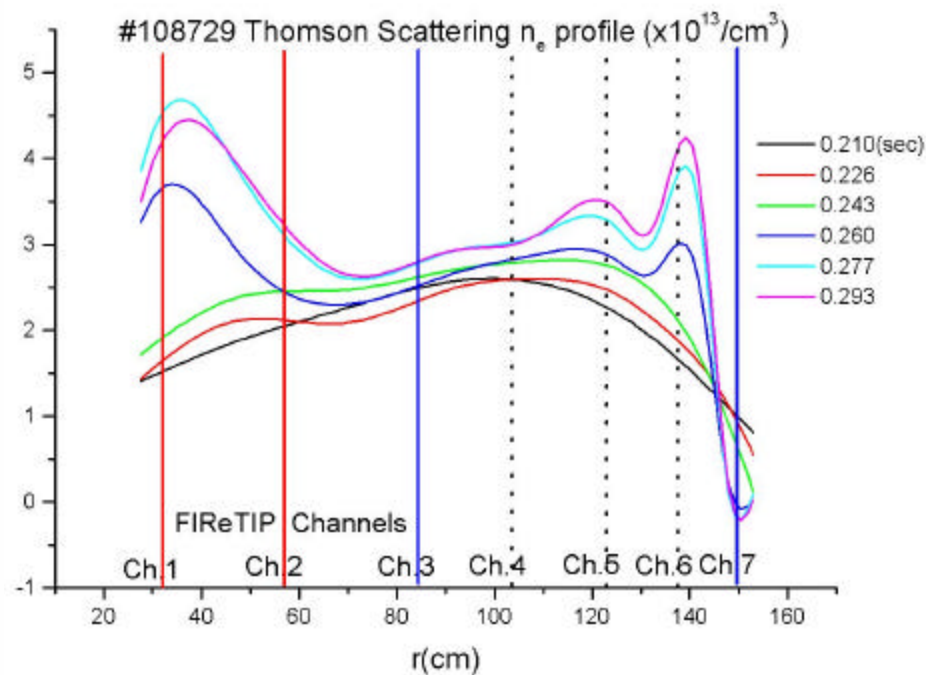
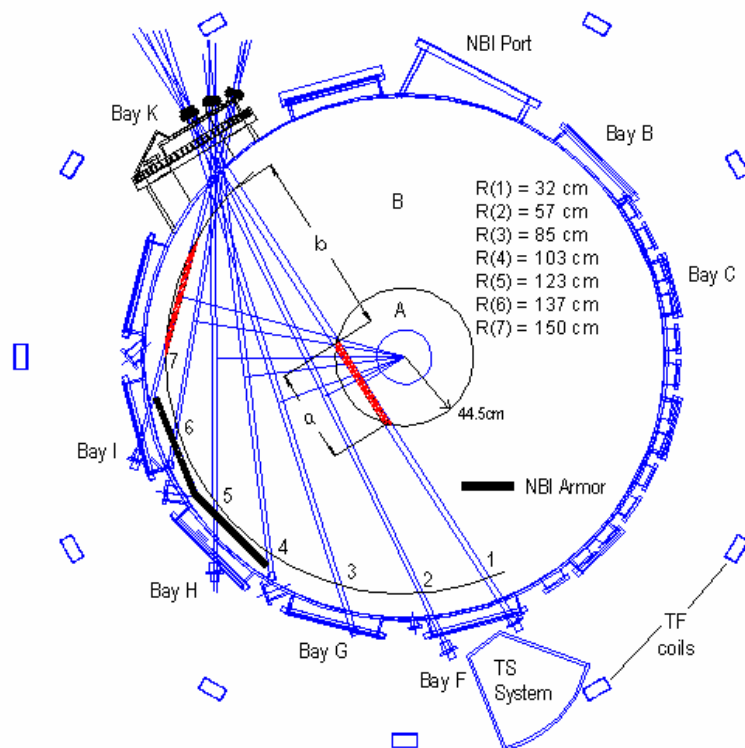
Effect of the compact vibration isolator

- Implementation of CVI on channels #1 and #2 eliminated residual mechanical vibration



Edge density and fluctuation study

- Edge channels (inside and outside) are used to study edge density and corresponding fluctuation spectra
- Provides an absolute measure of density fluctuation level (semi local measurement)



Application to H-mode physics

- ❑ *Edge density pedestal development*
- ❑ *Source of edge density pedestal build up*
 - ❑ *Inner wall ?*
 - ❑ *Divertors (inner or outer) ?*
- ❑ *Role of edge density fluctuation in confinement*
 - ❑ *Standard scenario works ??*
 - *$E \times B$ shear break up eddies – reduction of fluctuation – confinement improvement (L to H transition)*
 - ❑ *Different types of fluctuation behaviors in H-mode??*
 - ❑ *Edge density fluctuation in L-mode discharge ??*



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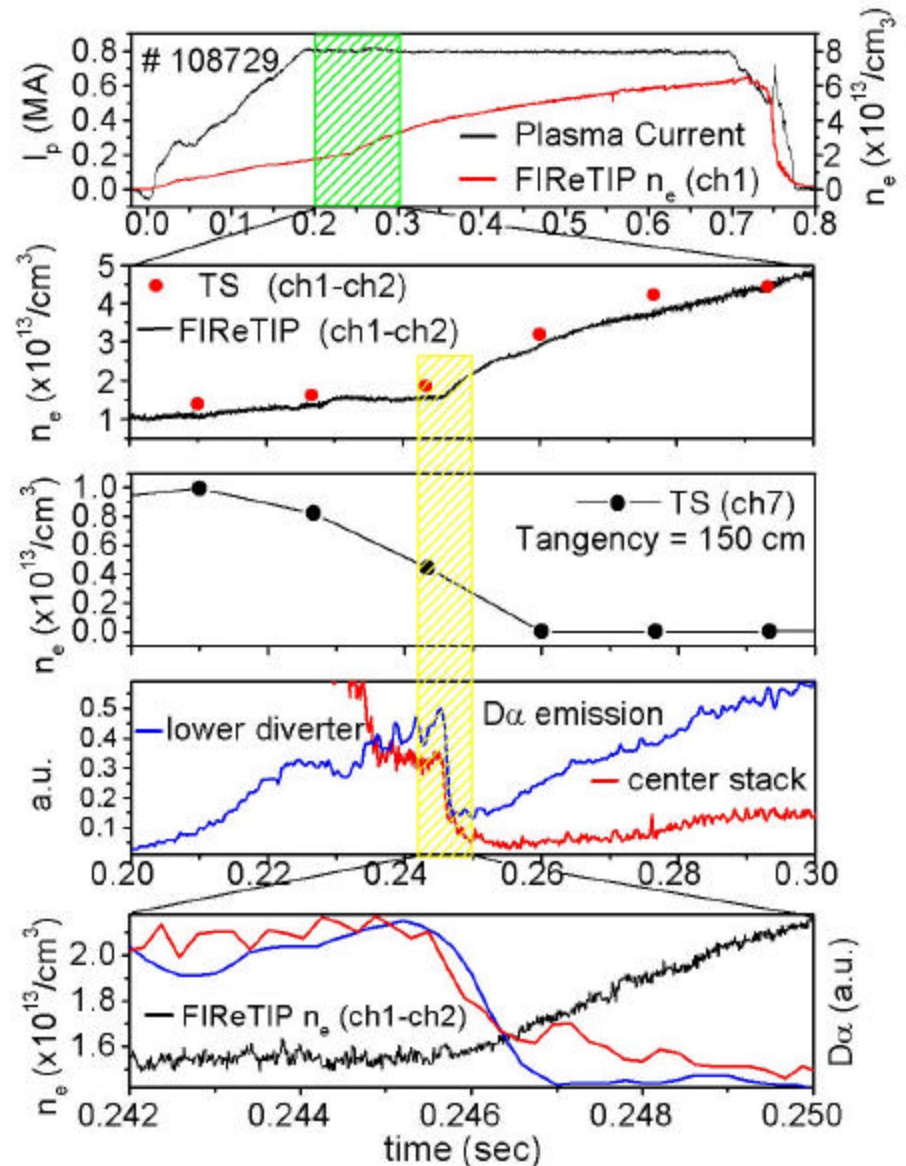
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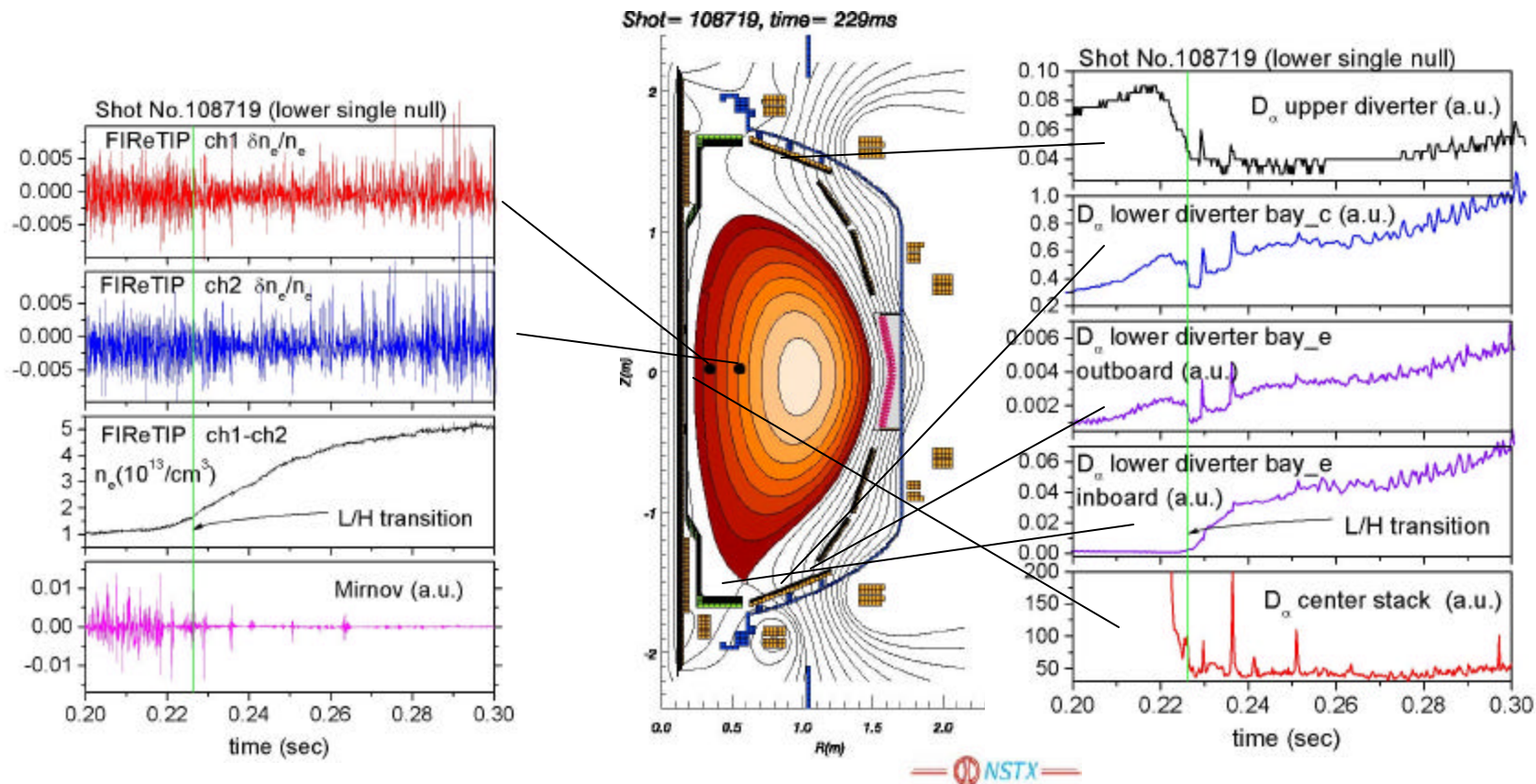
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Standard H-mode scenario

- Sudden increase of edge density (difference between #1 and #2) correlates with D_α lights
- Fluctuation level is also reduced at transition time as shown in standard H-mode transition



Source of edge density rise in H-mode



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Continue

- ❑ *Correlation between fueling source and density rise*
 - ❑ *No correlation between D_a light near the inner limiter where density is measured.*
 - ❑ *Strong correlation of edge density rise with D_a from inner lower divertor only*
 - ❑ *Confinement improvement or strong fueling ??*
- ❑ *Fluctuation suppression is notable at transition time*
 - ❑ *Suppression only last for a short time*



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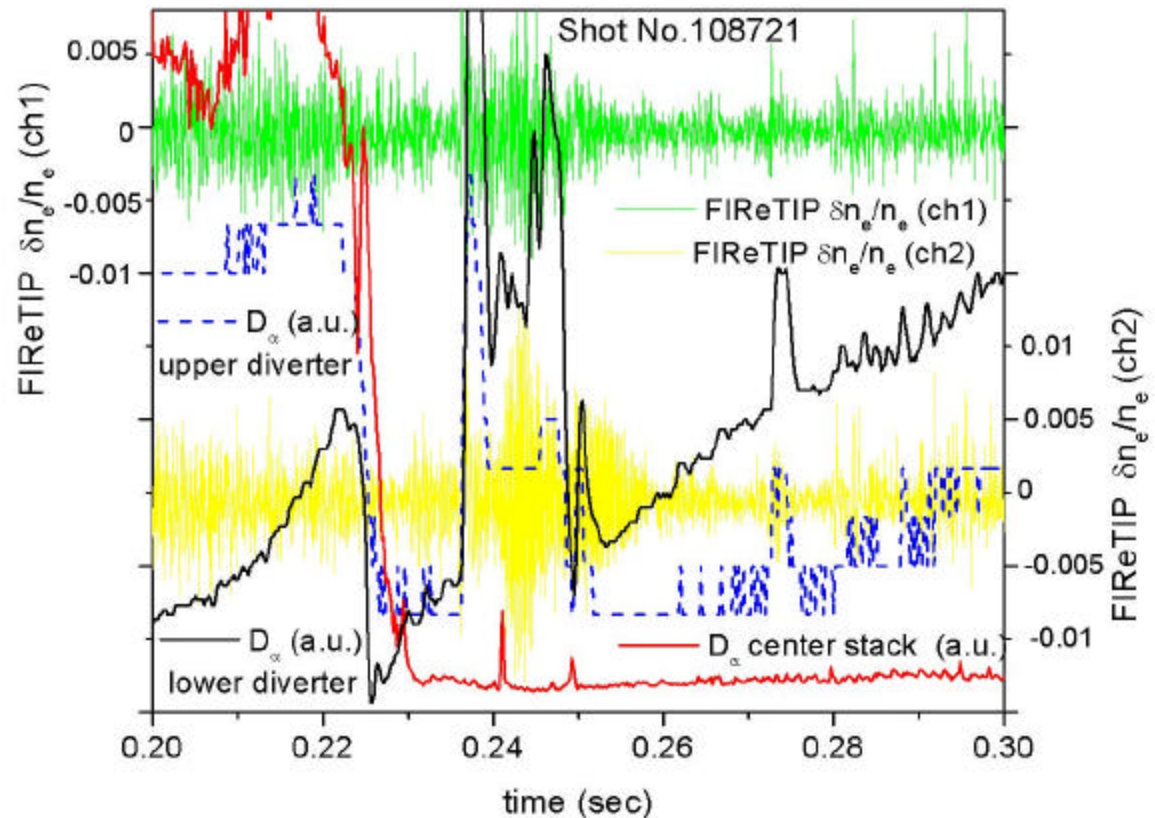
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Typical L/H mode transition

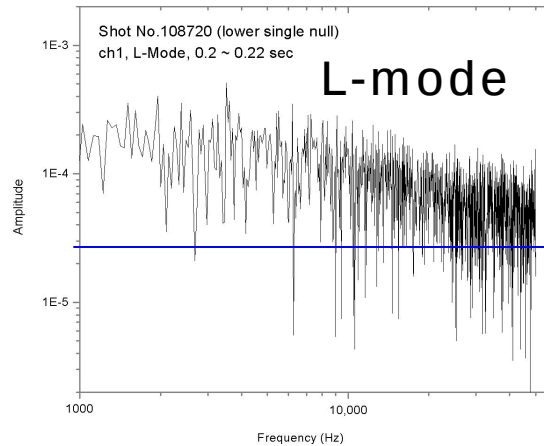
- Fluctuation suppression is clear before and after transitions
- ELM signal from lower divertor is well correlated with burst of density fluctuation



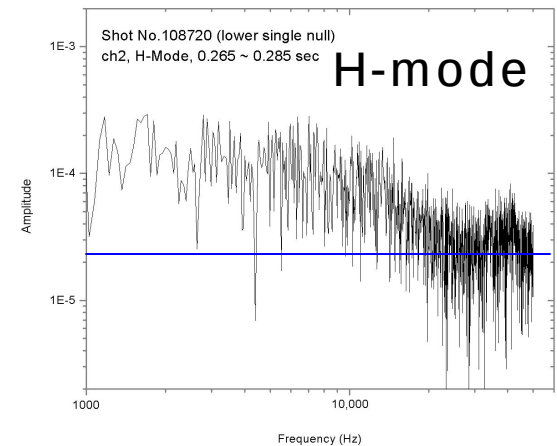
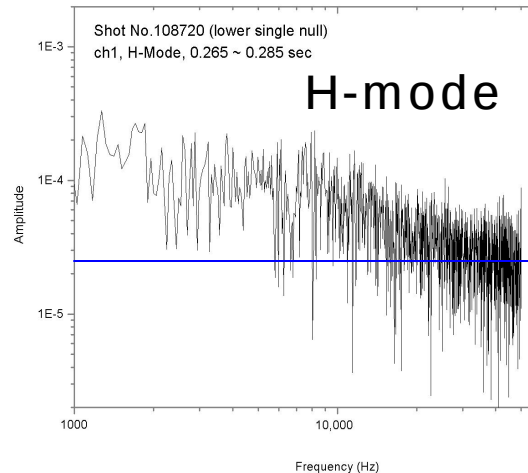
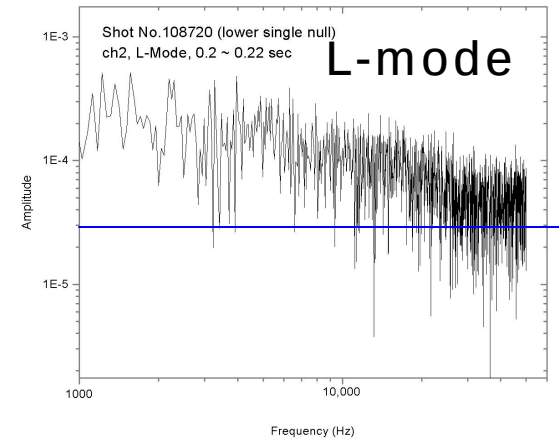
Frequency spectra changes (L/H)

- *In H-phase, non-MHD spectra are reduced*
- *10 ~ 40 kHz are reduced*
- *MHD (TAE and Fishbones) is evident in #2*

Channel #1

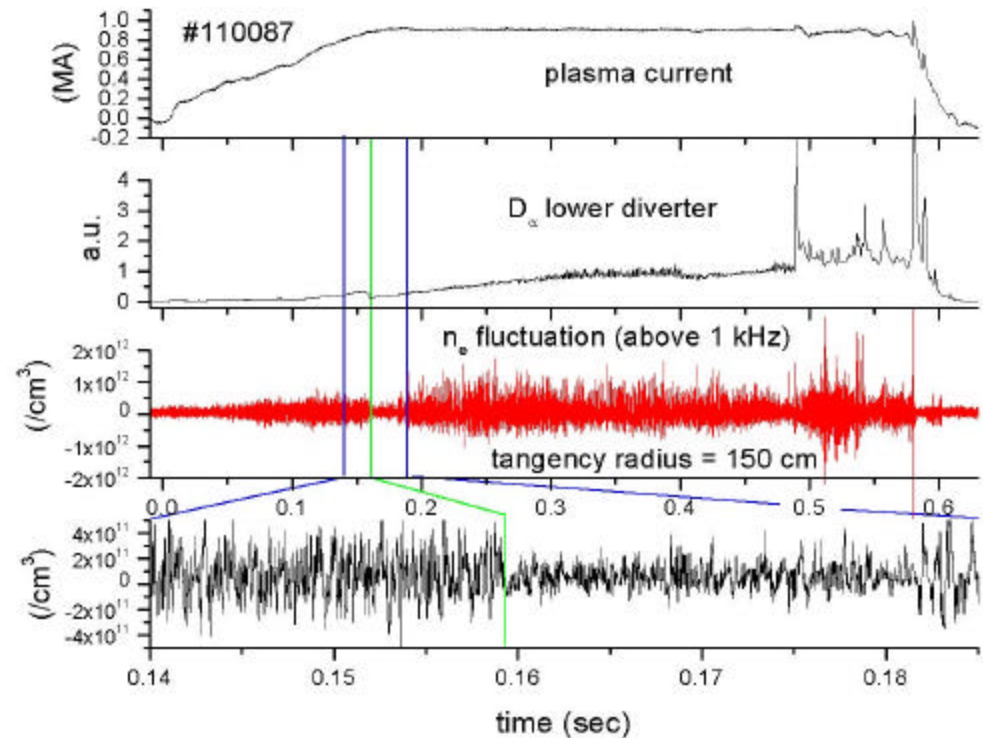


Channel #2



Standard (?) L/H fluctuation spectra at outer edge channel

- ❑ Fluctuations are reduced at transition time where the outer edge density ($R=150$ cm) is reduced further
- ❑ Onset of strong fluctuation; ~20 msec later after transition time

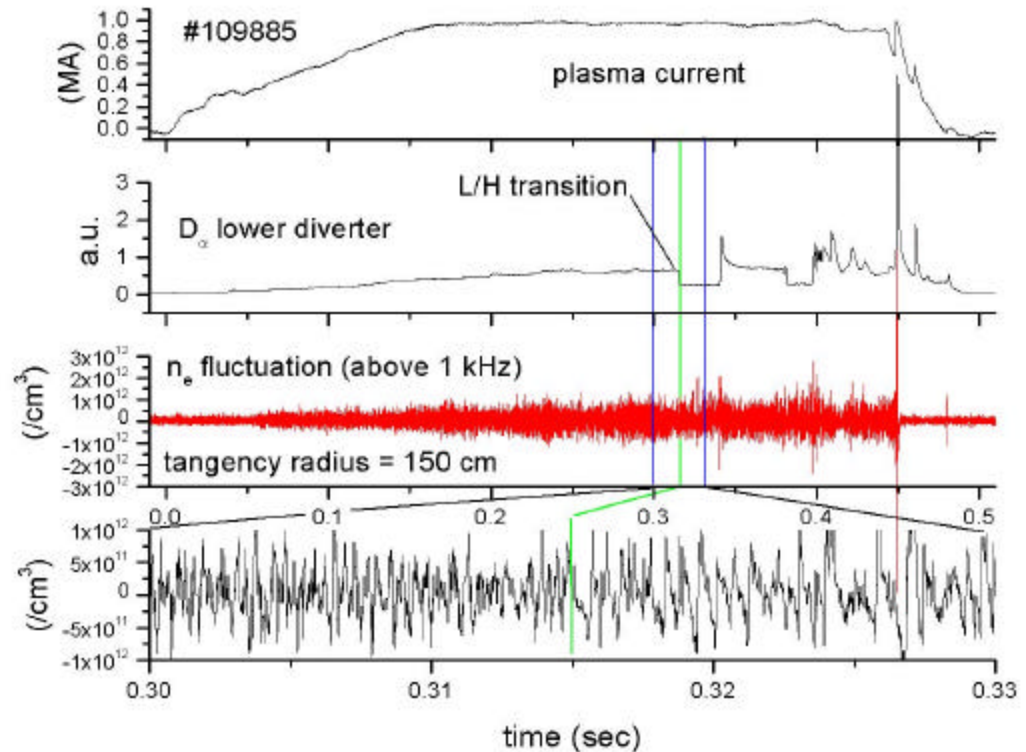


Variations of Fluctuation behavior in H-mode

- Increased low frequency spectra after transition at ch #7 (outer edge)

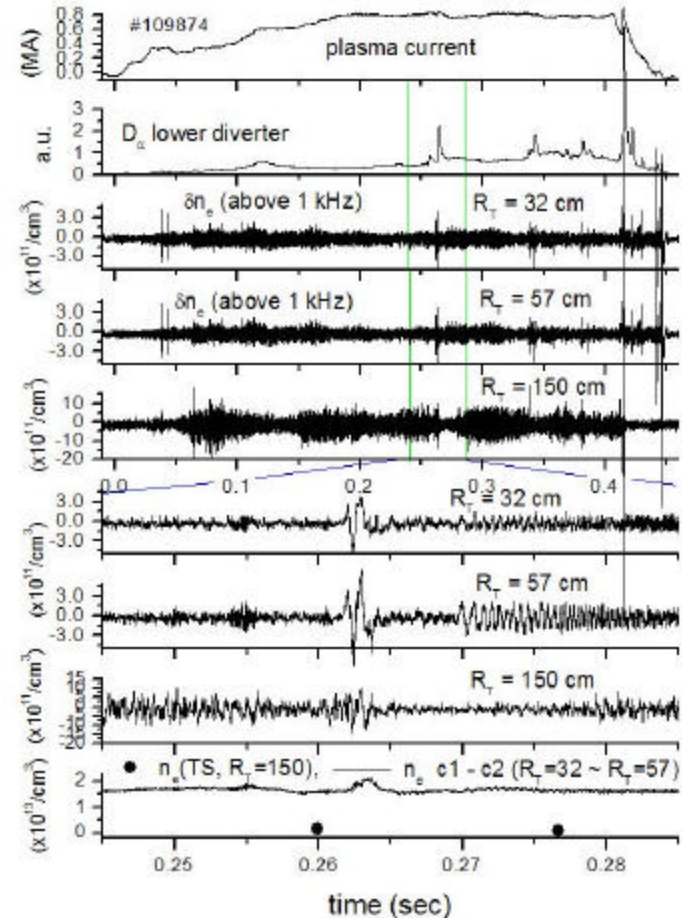
□ Edge MHD ??

- After transition, confinement is continuously improved



L-mode plasma

- ❑ After IRE event, plasma confinement is reduced
- ❑ Fluctuation levels at both edges (inside and outside) are reduced too.
- ❑ Edge densities did not change at all
- ❑ Fluctuation reduction responsible for confinement loss ??



Summary

- ❑ *Fast density and density fluctuation measurement via FReTIP system is used for transition physics study on NSTX*
 - ❑ *Edge density build up after transition to H-mode has potential particle source from inner divertor*
 - ❑ *Edge fluctuation measurement is useful tool for fluctuation physics study*
 - *Transition event in H-mode : Variations of fluctuation type in H-mode phase*
 - *Transition event in L-mode : correlation between fluctuation level and confinement improvement is not all clear*



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