

# Status of the MPTS Thomson Scattering Diagnostic

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*NSTX Research Results*

*Dec 13, 2005*

*Princeton, NJ*

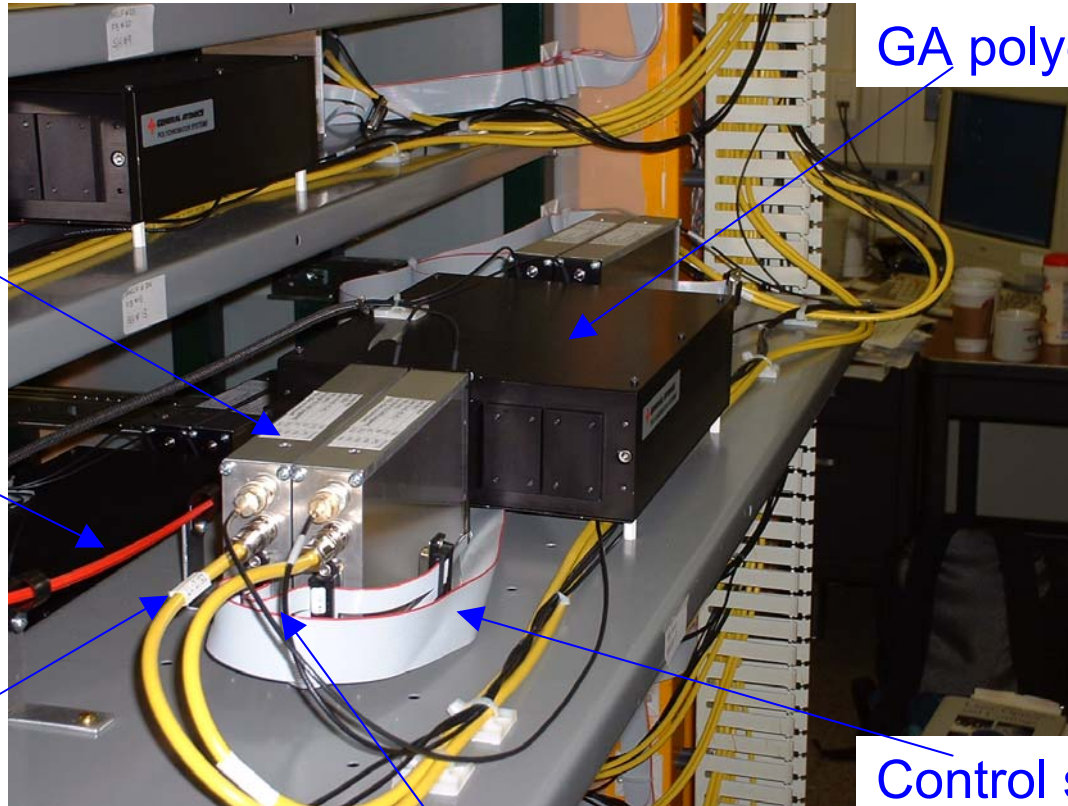
# MPTS



- MPTS is a multi-time multi-spatial point Thomson scattering diagnostic, which routinely provides  $T_e(R,t)$  and  $n_e(R,t)$ .
- *Presently two 30-Hz Nd:YAG lasers*
- *36 fiber bundles already viewing plasma*
  - *Output end can be split for improved resolution*
- *Phased fiber-bundle instrumentation*
  - *Phase I*            *10 bundles*    *10 channels*
  - *Phase II*           *20 bundles*   *20 channels*
  - *Phase III*          *29 bundles*   *30 channels* ←

# Ten 4- $\lambda$ polychromators installed May 2005

## *GA optics & PPPL electronics*



GA polychromator

PPPL preamplifier

Fiber bundle

Fast signal output

Control signals

Slow signal output

# New Radial Channel Allocation



- A collegial decision, mindful of PAC's recommendation
  - Enhance outer edge resolution      8 channels
  - Better inner resolution              2 channels
- Split – for the first time – the output end of a fiber bundle to improve spatial resolution

# Split Fiber Bundle for Better Resolution



Fiber bundle #9 was split in two in order to improve spatial resolution at  $R = 144$  cm

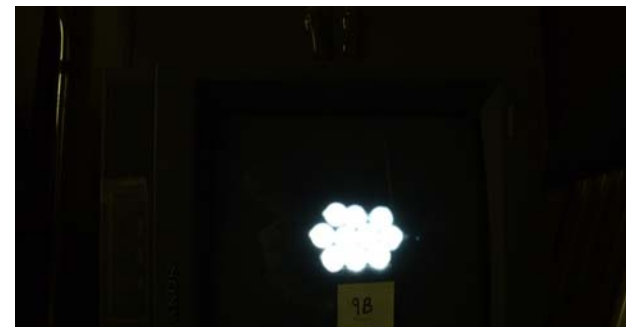
*Right and below:* Photographs of the back illuminated bundle before and after separation



*Original bundle*  
 $R = 144\text{cm} \pm 1\text{cm}$



*Inner split bundle*  
 $R = 143.6\text{cm} \pm 0.5\text{cm}$

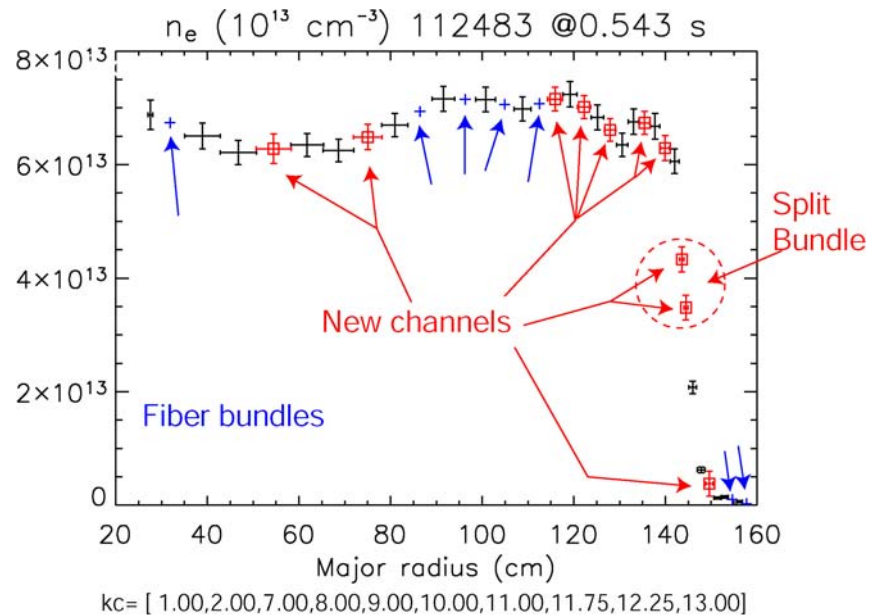
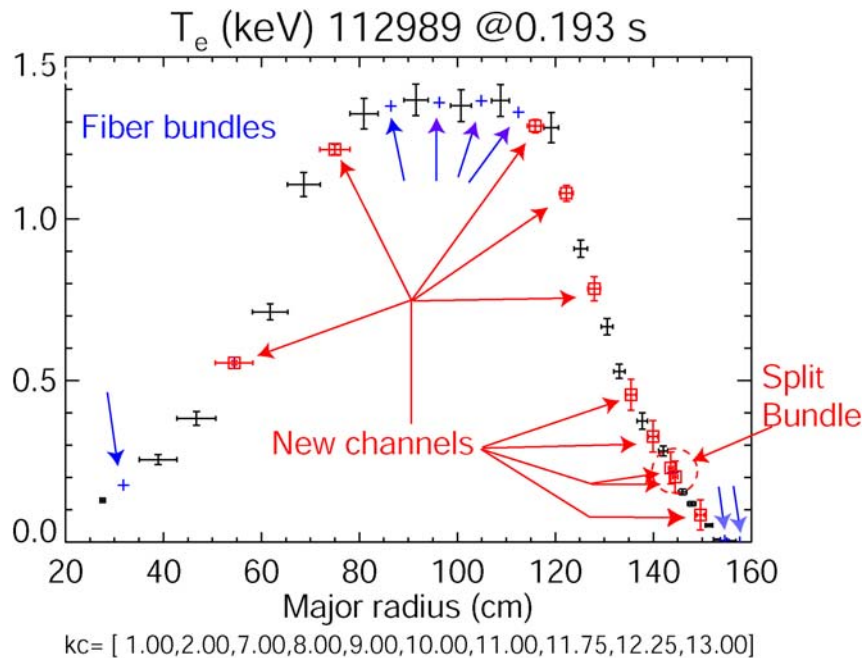


*Outer split bundle*  
 $R = 144.5\text{ cm} \pm 0.5\text{cm}$

# Location of New Radial Position



Simulated 30-point data overlaid on 20-point system



# Calibration/Work Plan



- Raman/Rayleigh scattering → Raw data acquired
- Wavelength calibration using preamplifier slow output → In progress
- APD gain calibration using preamplifier slow output → Pending
- Fast vs. slow output calibration → Preliminary raw data acquired
- Software modification for Raman density calibration → Work initiated

# Rayleigh and Raman Calibration



- Phases I and II polychromators have 6 spectral channels, including one at Rayleigh wavelength
  - So far  $n_e$  calibration done with Rayleigh scattering
  - But could also be done with Raman scattering
- Phase III polychromators have 4 spectral channels, but none at Rayleigh wavelength
  - $n_e$  profile calibration with Raman scattering
- Since Rayleigh signal is much larger than Raman, need to ascertain extinction ratio of Rayleigh light at Raman spectral location.



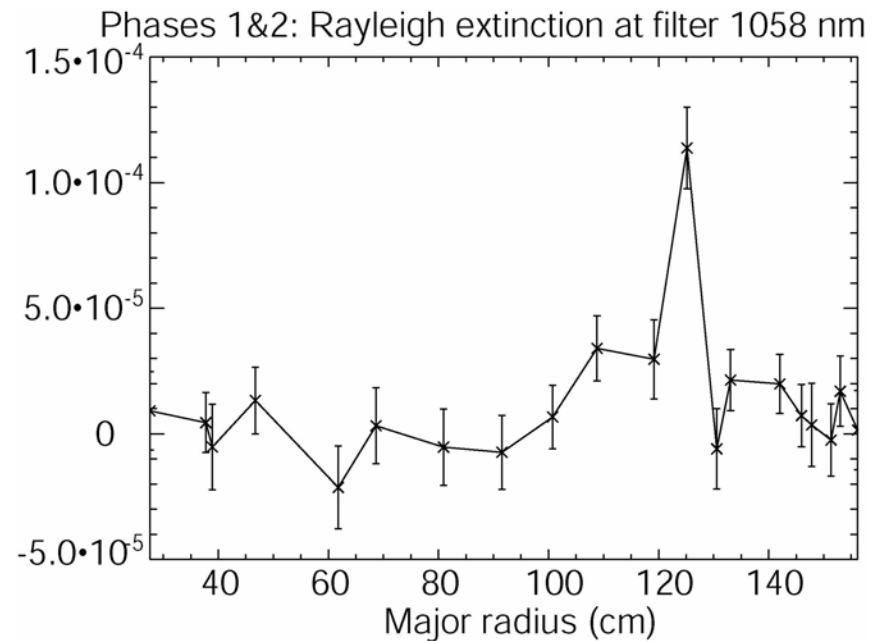
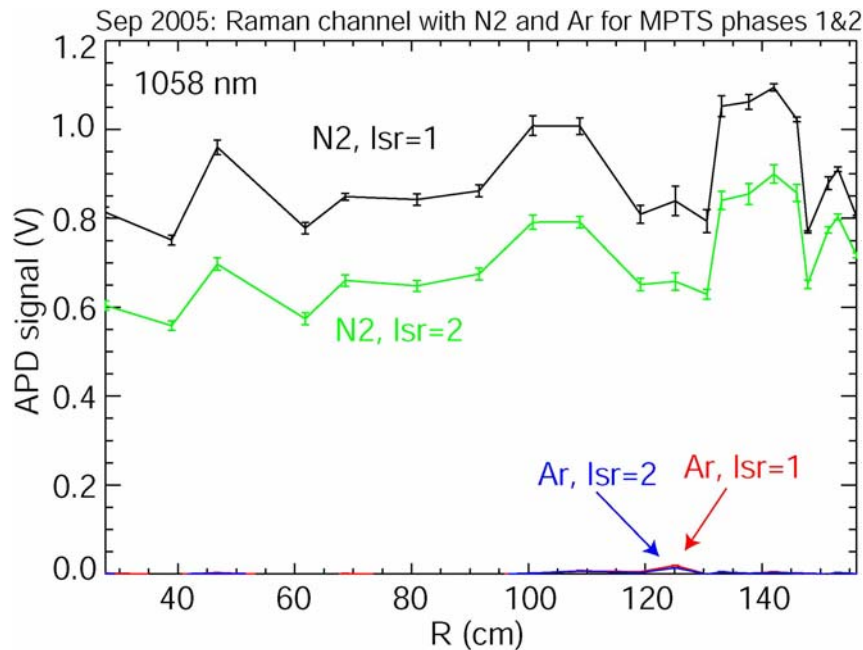
# Extinction Ratio for Phases I and II

$$F_{ext} \leq 1.0 \times 10^{-4}$$



*The 1058-nm blocks  
well the Rayleigh light*

*Extinction ratio for 1064-nm  
light through 1058-nm filter*



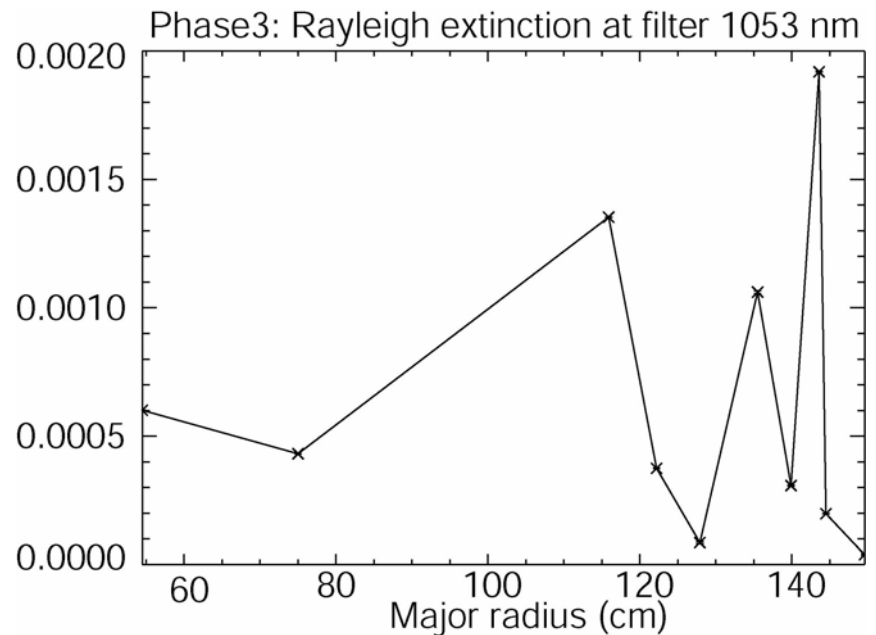
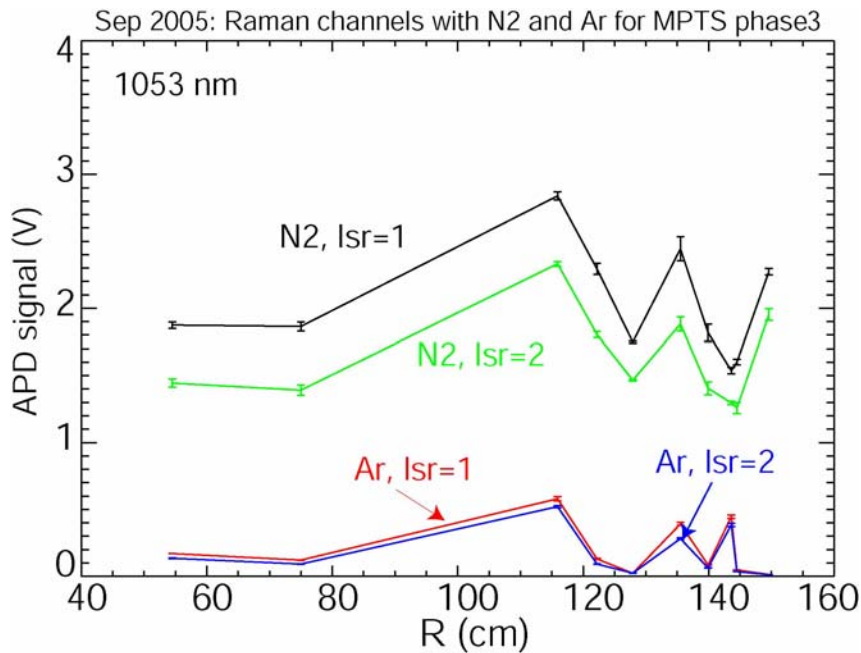
# Extinction for Ratio Phase III

$F_{ext} \gg 1.0 \times 10^{-4}$  for many channels



Significant amount of Rayleigh light enters the 1053-nm filter

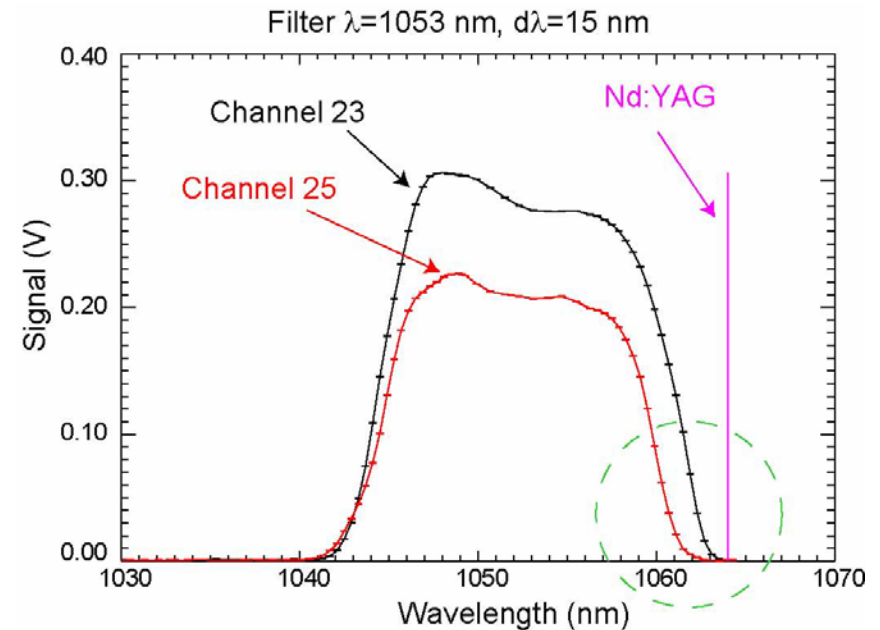
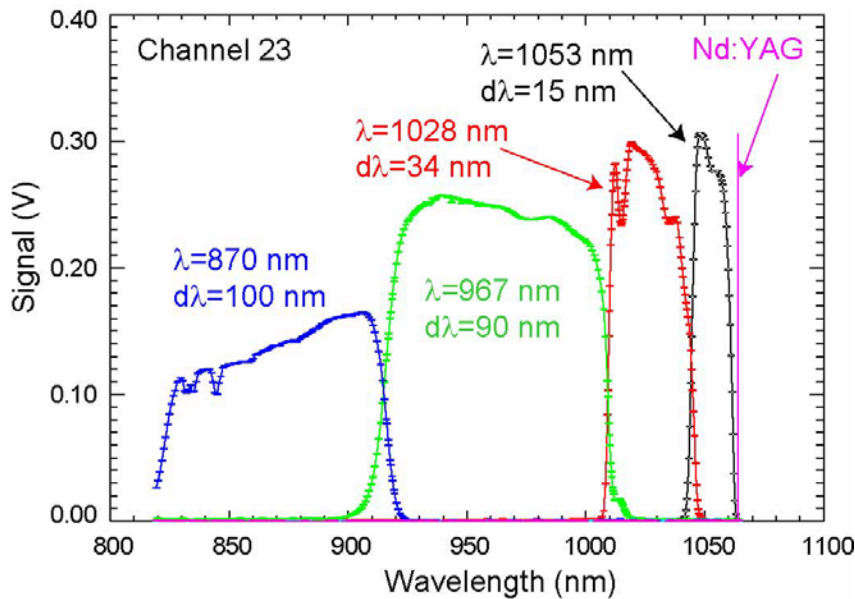
Extinction ratio for 1064-nm light through 1053-nm filter



# Spectral Calibration in Progress



*Variability of the spectral width of filters might explain poor 1064-nm radiation extinction*

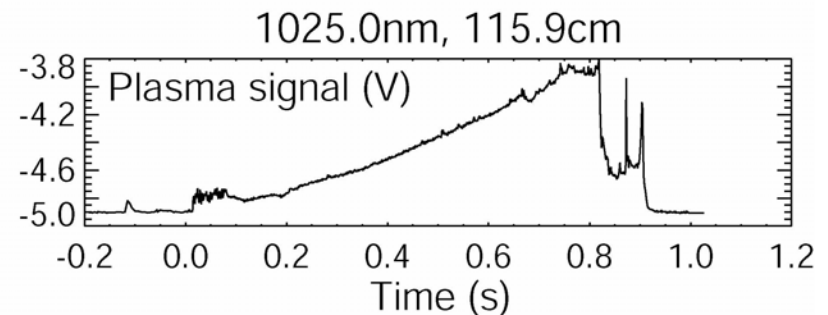
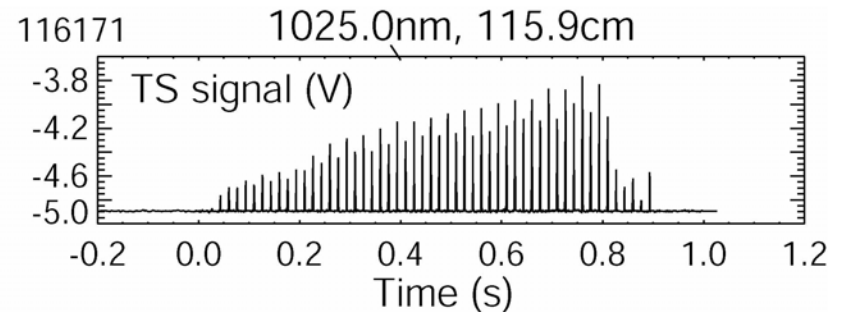


**END OF TALK**

# Raw Data Acquired



- Phase III hardware has acquired data for most of last NSTX experimental run
- Raw data signals
  - *Top*: fast signal (Thomson scattering)
  - *Bottom*: slow signal (plasma light)



# Ad hoc Calibration

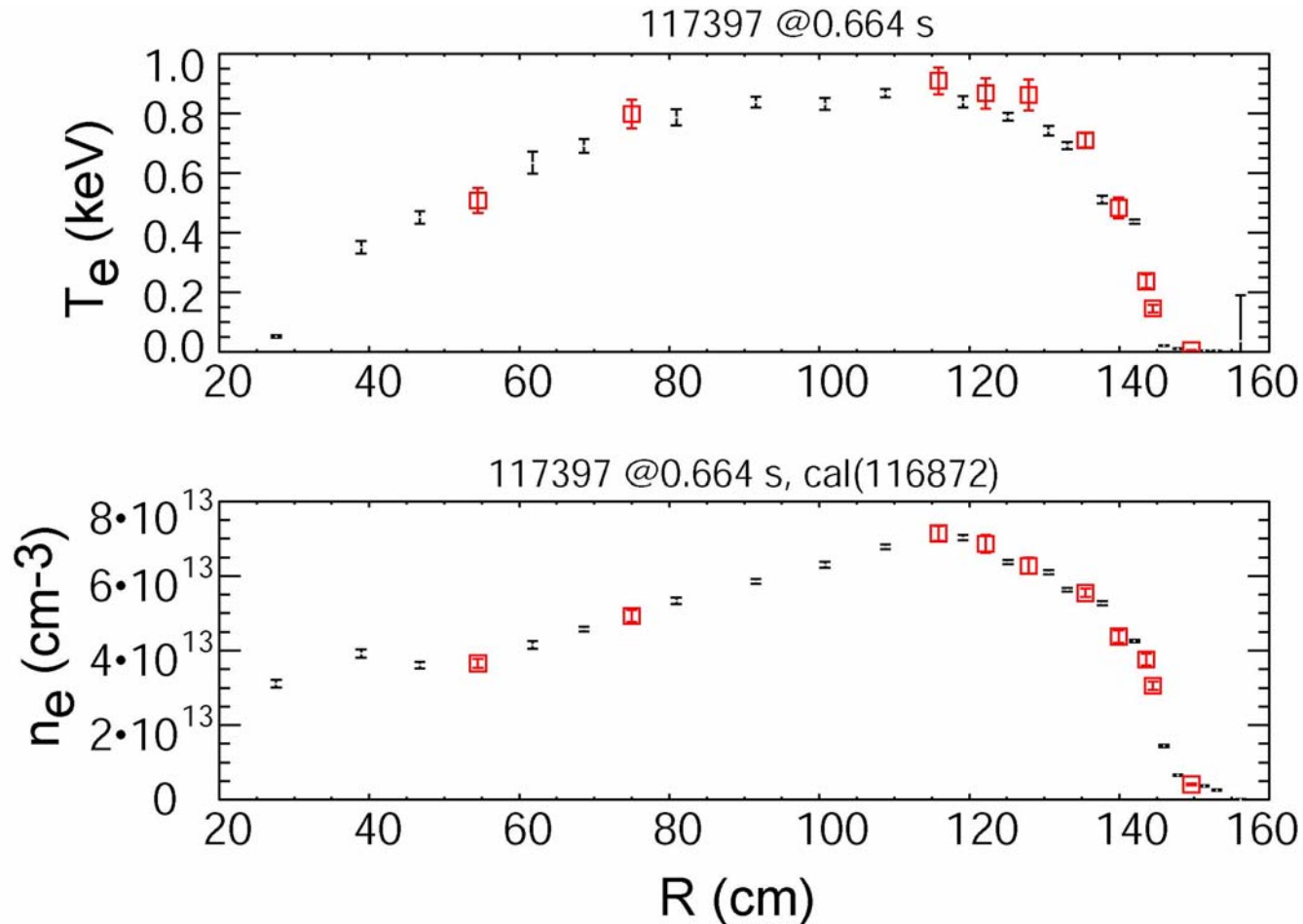


- An ad hoc calibration has been made using ensemble average of the existing 20 channels and assuming that on average the phase-III results can be extrapolated from adjacent channels
- This technique is a temporary expedient and does not replace the ongoing calibration
  - Tendency to overshoot at high  $T_e$
  - Soften spatial features

# Preliminary Results from Ad Hoc Calibration



*New radial points shown in red*



# Spatial Resolution Improvement



30-point spatial resolution is compared to 20-point system

Radial Spacing and Sampling Half-width

