



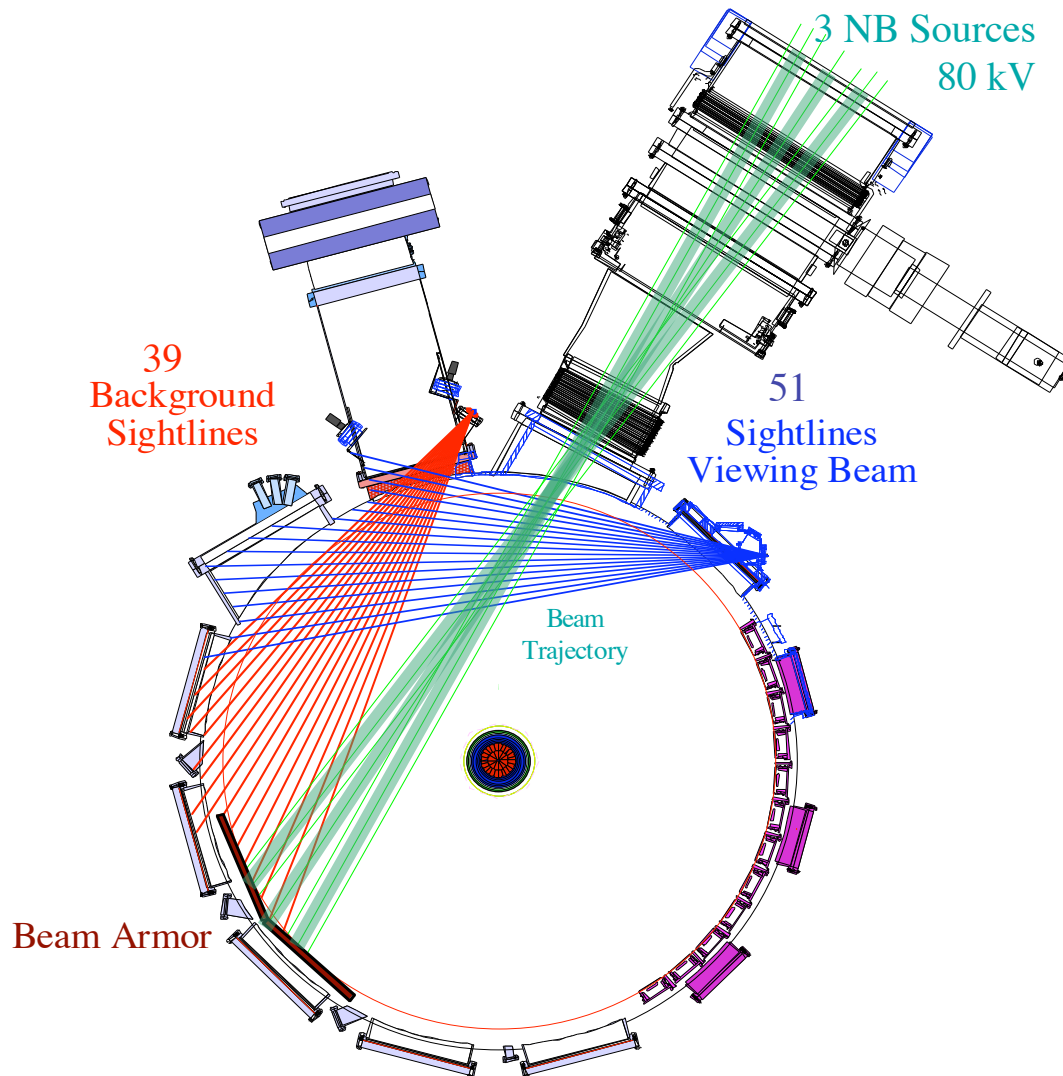
# ***NSTX CHERS***

Ron Bell

NSTX Results Review

13 December 2005

# CHERS Viewing Geometry

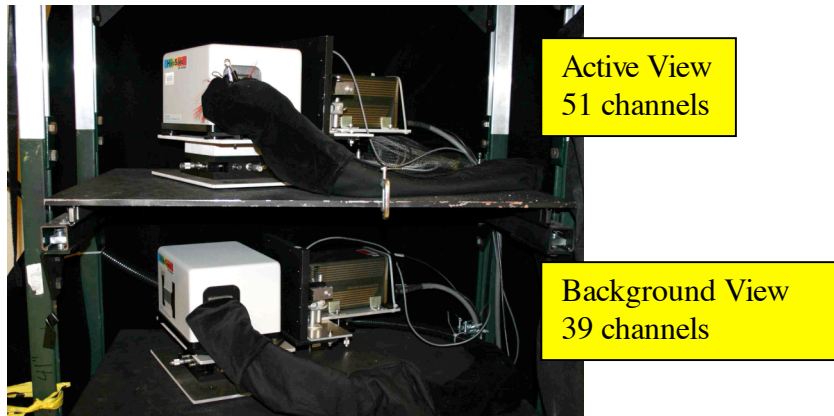


- C VI emission, 5290 Å
- 51 spatial channels, Bay B, viewing Neutral Beam
- 39 background channels, Bay L
- 0.5-3 cm spatial resolution
- 10 ms integration time
- $T_i(R)$ ,  $V_\phi(R)$ ,  $N_{\text{carbon}}(R)$ , corrected for atomic physics
- Automated between-shot analysis

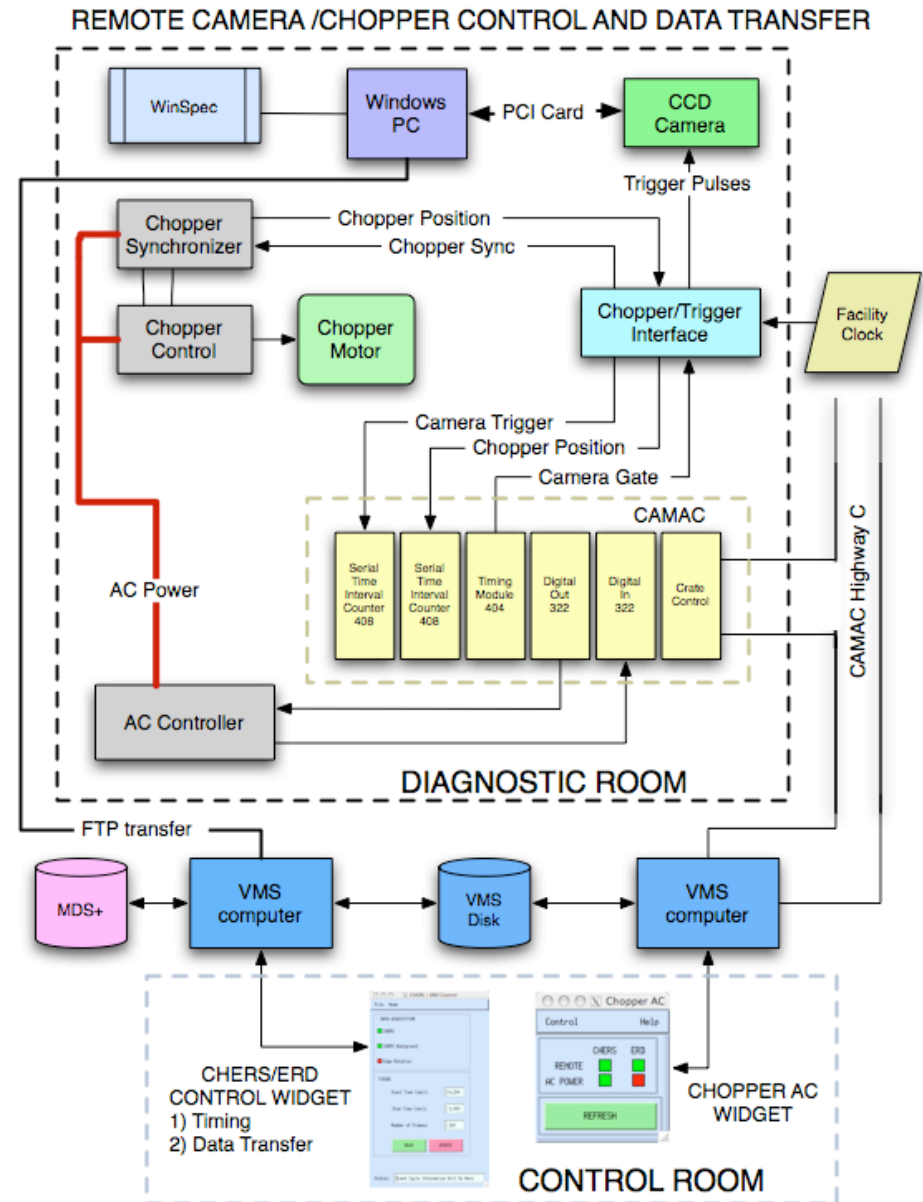
# CHERS Data Acquisition



- 2 Holospec spectrometers
- 2 Pentamax CCD cameras
- Fiber optics from Test Cell

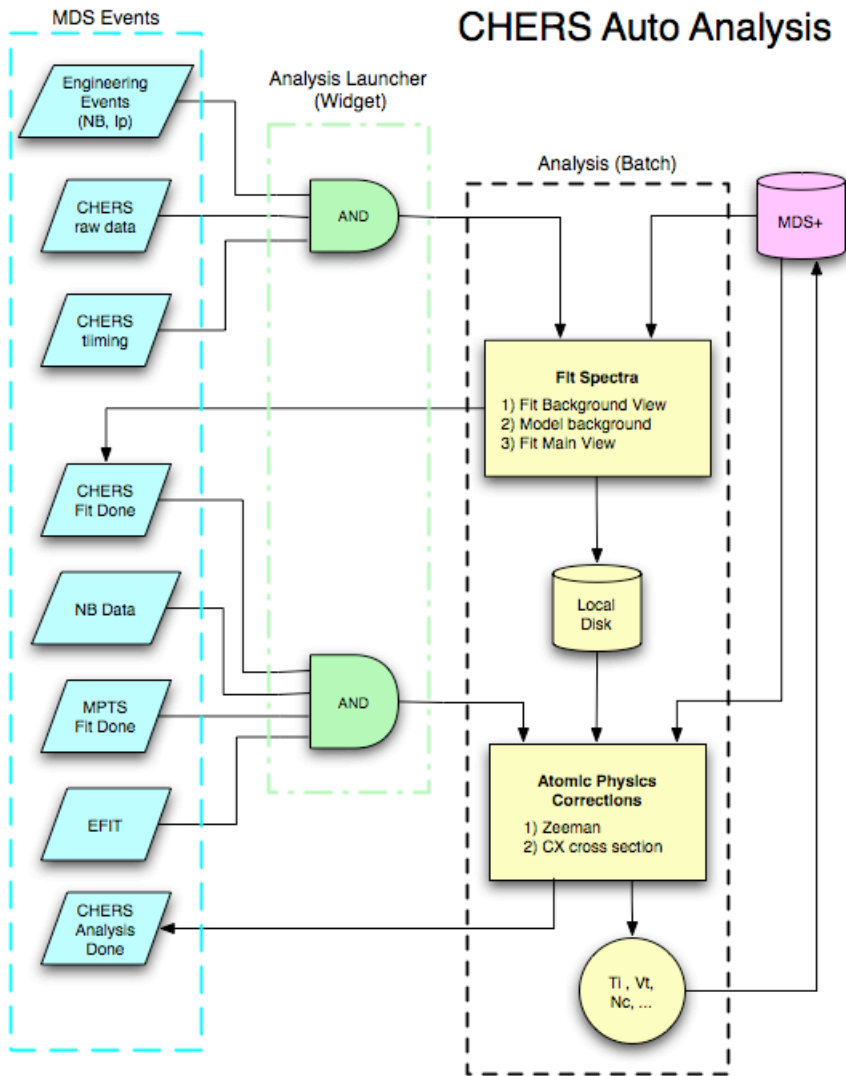


Pentium 266 MHz computers running WinSpec software with MACRO for remote camera control

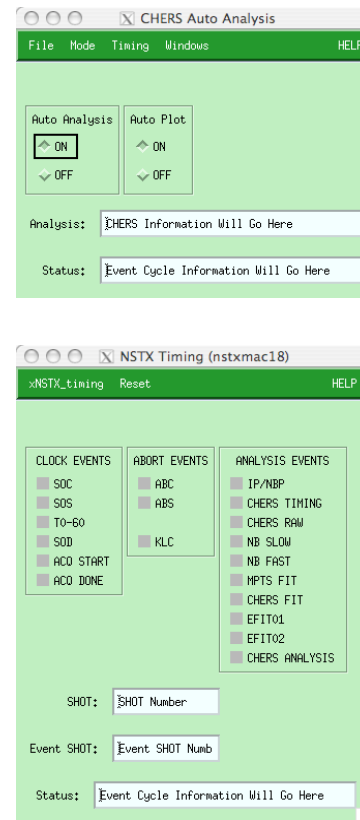




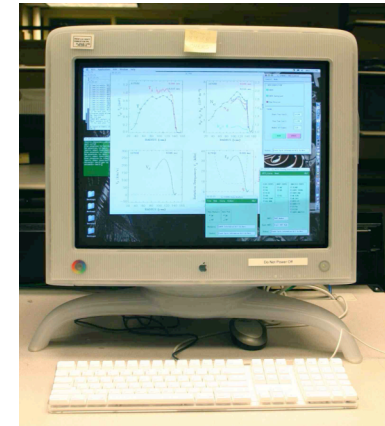
# CHERS Analysis



## CHERS Auto Analysis Widget



NSTX Timing Widget



CHERS operation on G5 MAC in control room

# CHERS data on MDSplus tree



```

SHOT          LONG          117820      ; shot number
TIME          FLOAT        Array[23]   ; time (sec)
RADIUS        FLOAT        Array[51]   ; radius of fitted data (cm)
TI            FLOAT        Array[51, 23] ; Ion temperature (keV)
DTI           FLOAT        Array[51, 23] ; Corrected ion temperature (keV)
VT            FLOAT        Array[51, 23] ; Corrected toroidal velocity (km/s)
DVT           FLOAT        Array[51, 23] ; Error in toroidal velocity (km/s)
NC            FLOAT        Array[51, 23] ; Carbon density (cm^-3)
DNC           FLOAT        Array[51, 23] ; Error in carbon density (cm^-3)
FT            FLOAT        Array[51, 23] ; Rotation frequency (kHz)
DFT           FLOAT        Array[51, 23] ; Error in rotation frequency (kHz)
ZEFF          FLOAT        Array[51, 23] ; Effective charge (assuming C VII is only impurity)
DZEFF         FLOAT        Array[51, 23] ; Error in effective charge
ND            FLOAT        Array[51, 23] ; Deuteron density (kPa)
DND           FLOAT        Array[51, 23] ; Error in deuteron density (kPa)
TIS           FLOAT        Array[101, 23] ; Spline fit to ion temperature (keV)
VTS           FLOAT        Array[101, 23] ; Spline fit to toroidal velocity (km/s)
NCS           FLOAT        Array[101, 23] ; Spline fit to carbon density (cm^-3)
ZEFFS         FLOAT        Array[101, 23] ; Spline fit to Zeff
VALID         INT          Array[51, 23] ; Matrix of valid fitted data
SVALID        FLOAT        Array[101, 23] ; Matrix of valid spline data

WARNING       STRING       ''           ; Warnings
VERSION       STRING       Array[2]     ; Versions number of fitting/correction software
DATE          STRING       'Thu Aug 18 14:26:20 2005' ; Date of analysis
UNITS         STRING       'Ti(keV), Vt(km/s), Nc(cm-3), Ft(kHz), Pi(kPa), Mden(kg/m^3), Pt(kPa)' ; Units used

PI            FLOAT        Array[51, 23] ; Ion pressure (kPa)
DPI           FLOAT        Array[51, 23] ; Error in ion pressure (kPa)
PT            FLOAT        Array[51, 23] ; Dynamic pressure (due to toroidal rotation) (kPa)
DPT           FLOAT        Array[51, 23] ; Error in dynamic pressure
MDEN          FLOAT        Array[51, 23] ; Mass density (kg/m^3)
DMDEN         FLOAT        Array[51, 23] ; Error in mass density (kg/m^3)

ZTI           FLOAT        Array[51, 23] ; Zeeman corrected ion temperature (keV)
ATI           FLOAT        Array[51, 23] ; Error in Zeeman corrected ion temperature (keV)
AVT           FLOAT        Array[51, 23] ; Apparent toroidal velocity (km/s)
AW            FLOAT        Array[51, 23] ; Fitted CX brightness (A.U.)
DAW           FLOAT        Array[51, 23] ; Error in fitted CX brightness
RT_B          FLOAT        Array[39]   ; Tangency radii of background array (cm)
AWB           FLOAT        Array[39, 23] ; Fitted background brightness (A.U.)
DAWB          FLOAT        Array[39, 23] ; Error in fitted background brightness
RS            FLOAT        Array[101]  ; Spline radii (cm)
DEN           FLOAT        Array[51, 23] ; Interpolated MPTS electron density
DDEN          FLOAT        Array[51, 23] ; Error in interpolated MPTS electron density
TDEN          FLOAT        Array[23]   ; Time of interpolated MPTS electron density

CAL_FILES     STRING       Array[3]     ; CHERS calibration filenames
RADIUS_FILES  STRING       Array[2]     ; CHERS radius filenames
WHITE_FILES   STRING       Array[2]     ; CHERS white calibration files
WS_FILES      STRING       ''           ; CHERS white shutter calibration files
    
```

idl> ct=ct(shot)

idl> help,/str,ct

General use

EFIT use

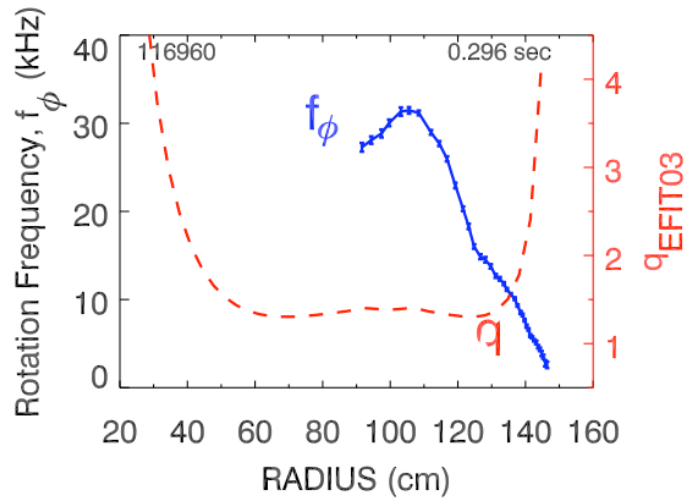
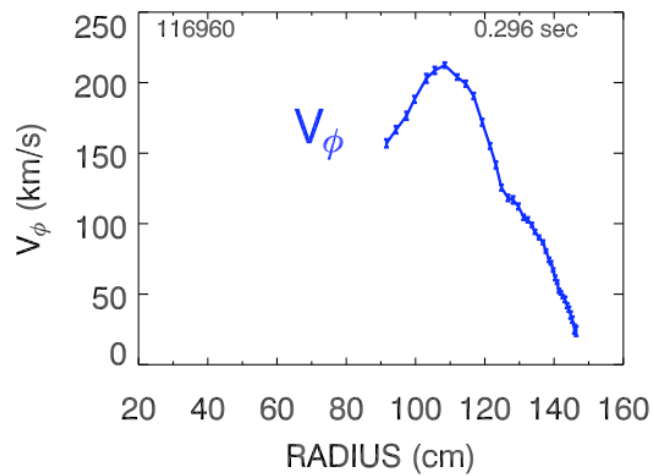
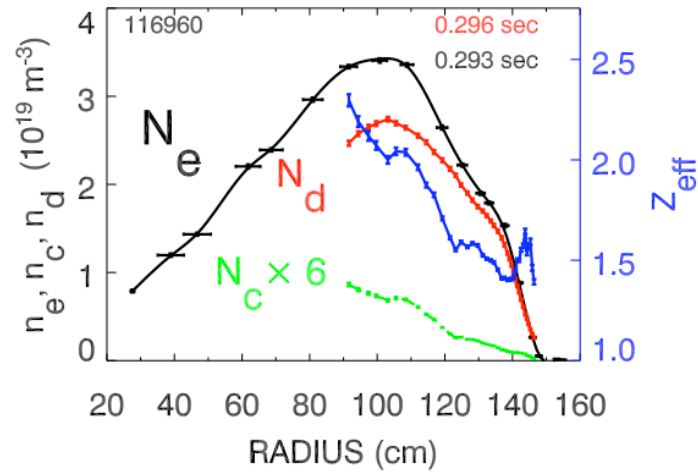
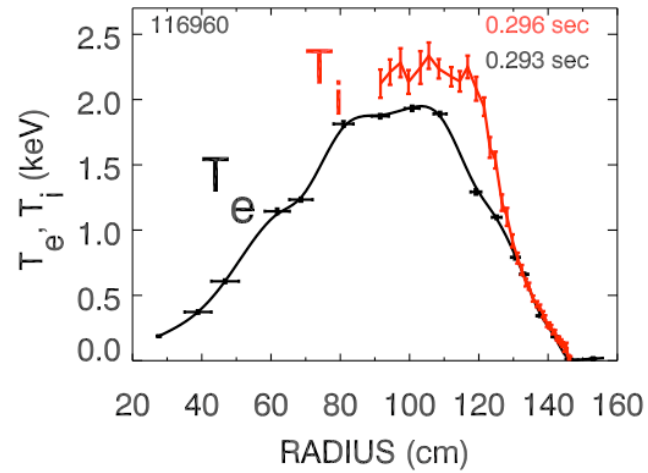
CHERS operator use

# CHERS Results



L mode example: 116960

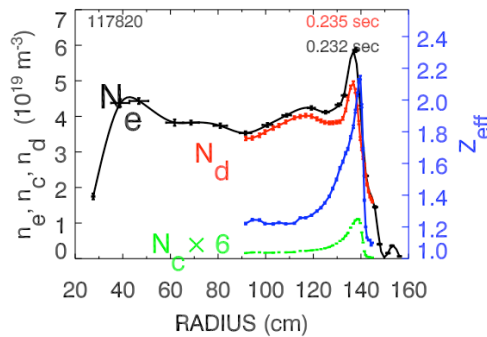
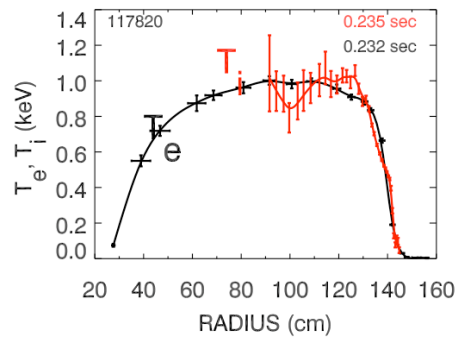
idl > Ti9, shot



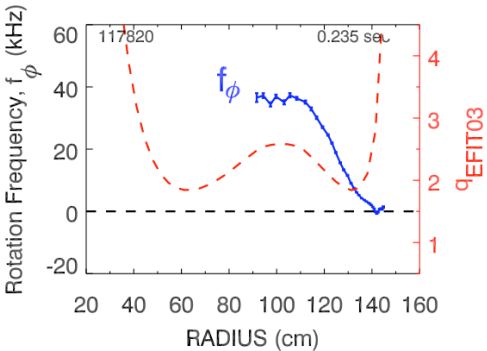
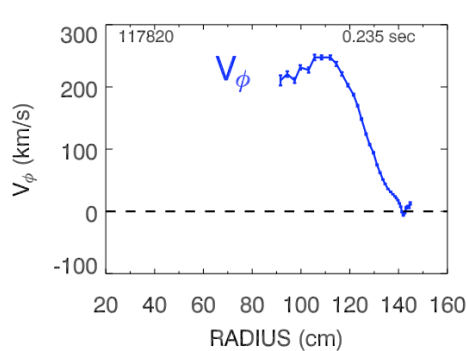
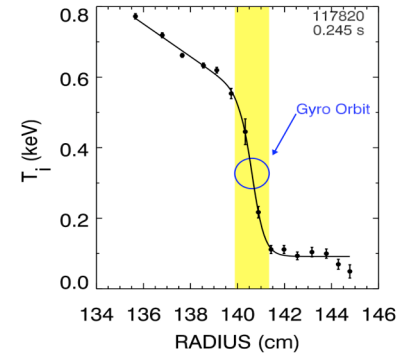
# CHERS Results



## H mode example: 117820

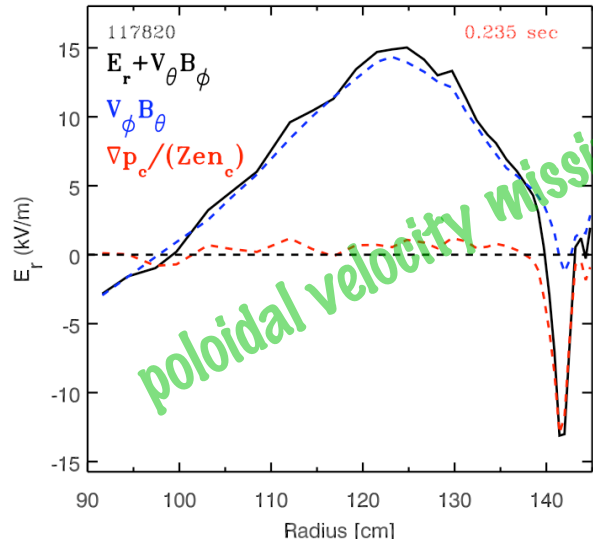


- Width of  $T_i$  gradient is consistent with gyro orbit diameter



- H mode discharge with strong central reverse shear
- A characteristic build up of carbon is observed near the plasma edge as core  $N_c$  decreases
- An uncharacteristically steep edge  $T_i$  gradient develops

CHERS  $E_r$  Profile

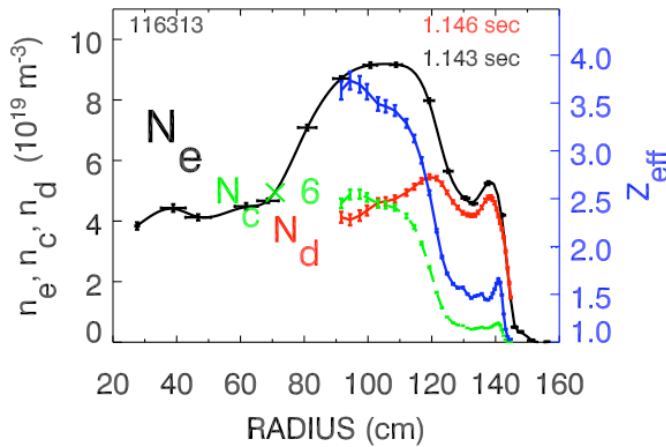
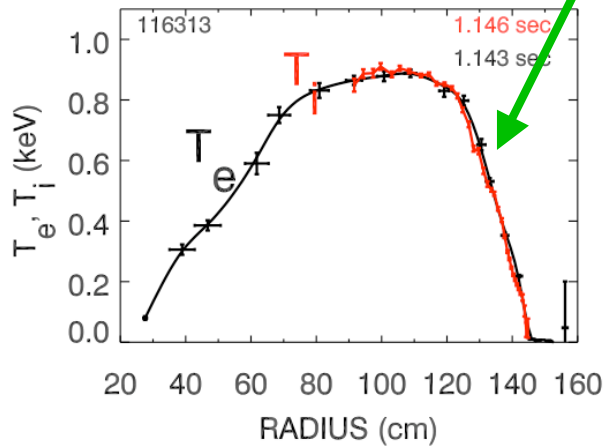


- Toroidal rotation leads to positive  $E_r$  in core
- Here an unusually steep pressure gradient leads to a negative  $E_r$  at edge.

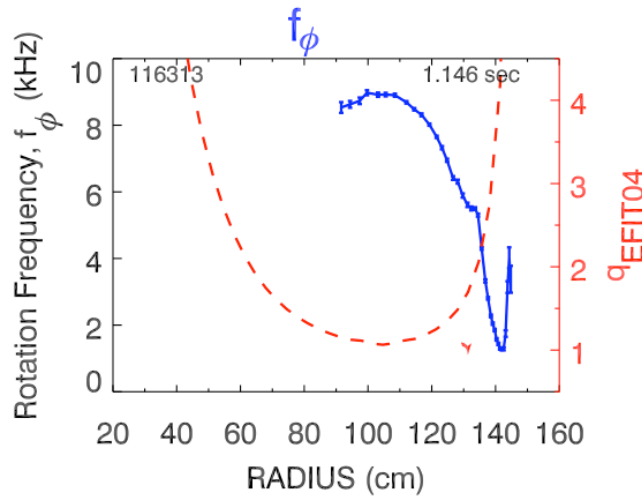
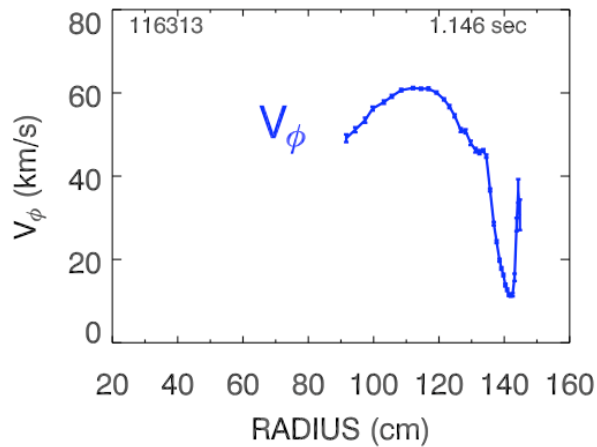
# CHERS Results



$$T_i(R) = T_e(R)$$



- Long pulse discharge 116313
- Late in discharge with degraded confinement and high density
- $T_i = T_e$ , giving cross check of calibration of two diagnostics
- Accumulation of carbon in core yield flat  $N_d$  profile despite peaked  $N_e$





# CHERS Status



- 1028 discharges analyzed in 2005 run  
(some shots missed early in run with manual analysis)
- New absolute calibration of white plate, Nov 2005
- All 1028 discharges re-analyzed 7-9 Dec 2005  
ct.version= cxf0.4 cx1.3A
- Need power with diagnostic ground installed  
for chopper motors
- Need Neon glow after start of run
- **CHERS diagnostic ready for FY2006 run**