FIDA diagnostic, principles

- **F**ast **I**on **D**-**A**lpha diagnostic
  - Based on charge-exchange recombination spectroscopy
  - Measure Doppler-shifted D_α emission from re-neutralizing fast ions
    - **Measure wings of D_α line $\rightarrow$ signal buried into high background (cold Da, bremsstrahlung, …)**

- Vertical views, perpendicular to **B**
  - 2 views for each channel (<=> radial position)
    - Intercepting/missing the beam for **direct background subtraction**

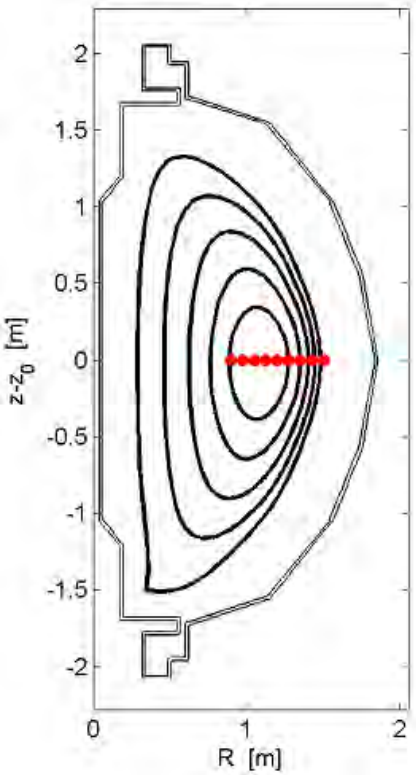
- Measured signal: $s(\mathbf{r}, t, E') \propto n_{\text{fast ions}}\, n_b \langle\sigma v\rangle_{CX}\, W \Longrightarrow n_{\text{fast ions}}(\mathbf{r}, t, E')$
  - 1D sampling of fast ion distribution function, F(E, p)
  - Effective integration over phase-space
    - Weight function W: (E,p)$\rightarrow$E'
  - $n_b \langle\sigma v\rangle_{CX}$ from experiment
  - W from simulation

2008 setup: two complementary instruments

- Spectrometer:
  - 2x16 channels (active and passive views)
  - CCD detector
  - Spatial calibration done
  - Final assembly, alignment and spectral calibration expected before end of December

- "Fast" system
  - 2x3 channels (active and passive views)
  - PMT detector
  - Spatial calibration done
  - Final assembly and alignment done

Control and acquisition GUI, interface with MDS under way

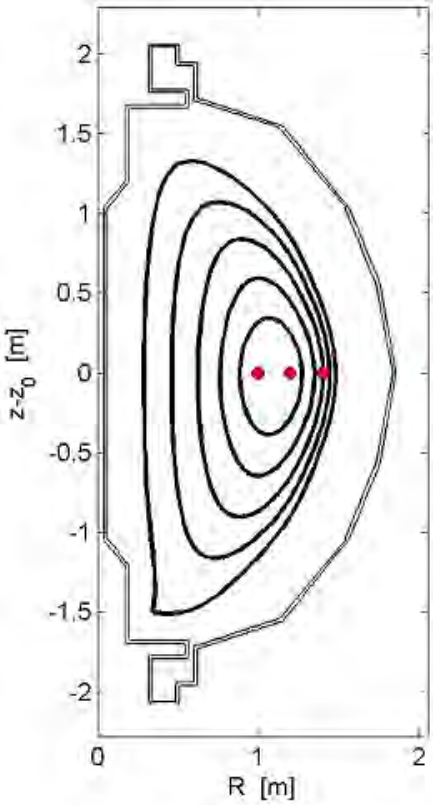


Resolution: 10keV, 5cm, >5ms

Covered radial range:
85cm -> 150cm

Resolution:

- **Energy-integrated (typ. 30-80keV)**
- **Views at 100cm, 120cm and 140cm**
- **Time 8μs (max)**



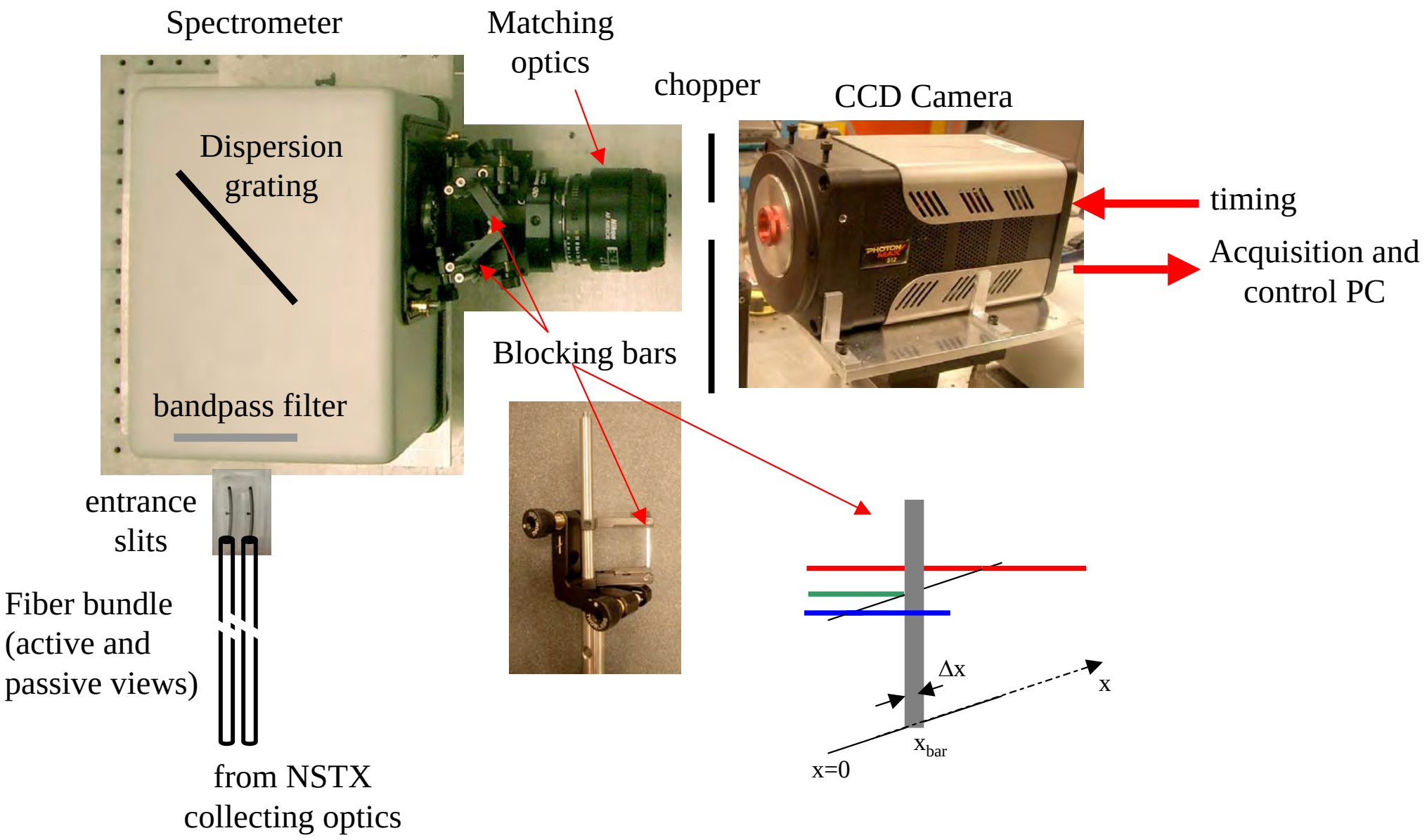
Goals -- 2008 Run

- Validate interpretation of FIDA signals (extend 2007 work)
  - Check dependence upon plasma parameters (n, T_e, Z_{eff}, ...)
  - Comparison with other diagnostics (sFLIP, NPA, neutron rate, ...)
  - Comparison with simulations
    - Need “quiet” discharges
    - L-mode, Deuterium plasmas, low-density preferred ($n < 5x10^{19}\ m^{-3}$)
    - Shots with beam modulation highly desired (check response time-scales)

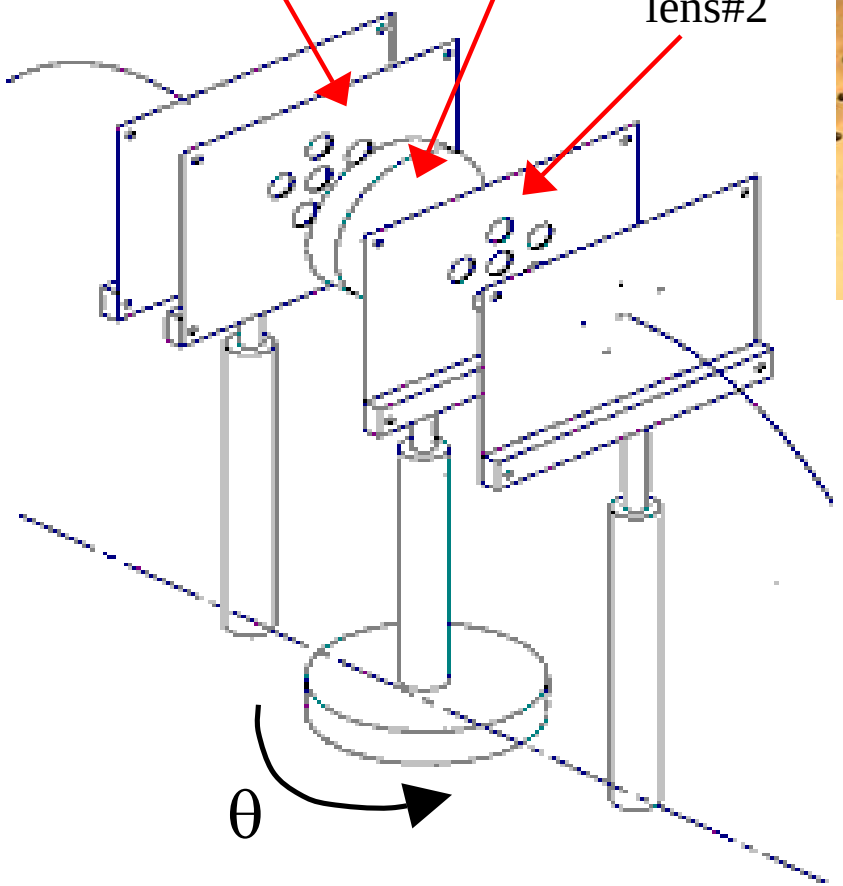
- Study of fast ion transport
  - Effects of Alfvén instabilities
    - Single-, multi-mode induced losses/redistribution
    - Reference: XP705
      - Repeat same shot 3x (qualitative spectral scan with *fast system*)

- Fast ion dynamics with additional ion heating (?)
  - Compare with recent DIII-D results for ICRH
    - Discharges with HHFWH

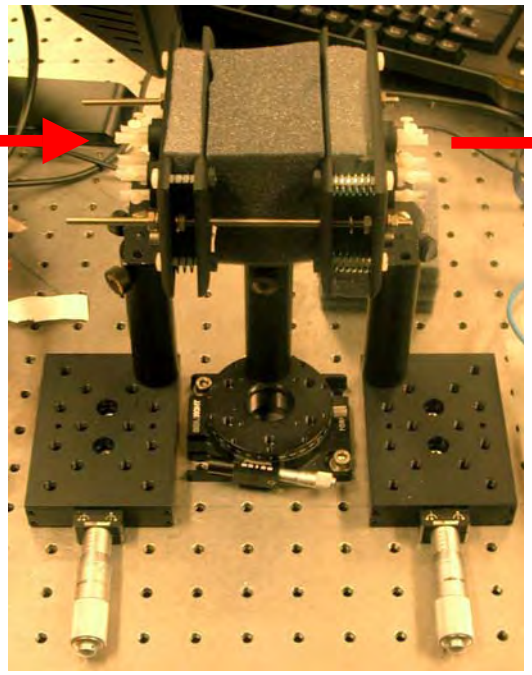
2008 setup: spectrometer



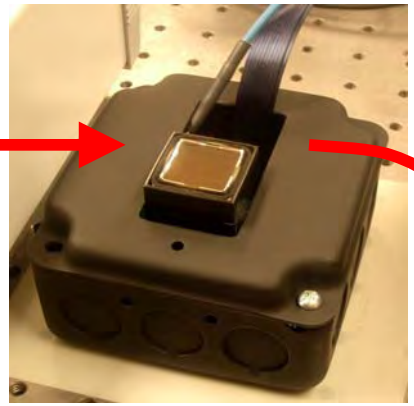
2008 setup: ‘fast’ system



Optics + bandpass filter



Detector



Acquisition and control PC

timing

MDSplus database