CXRS at W7-X - Current status

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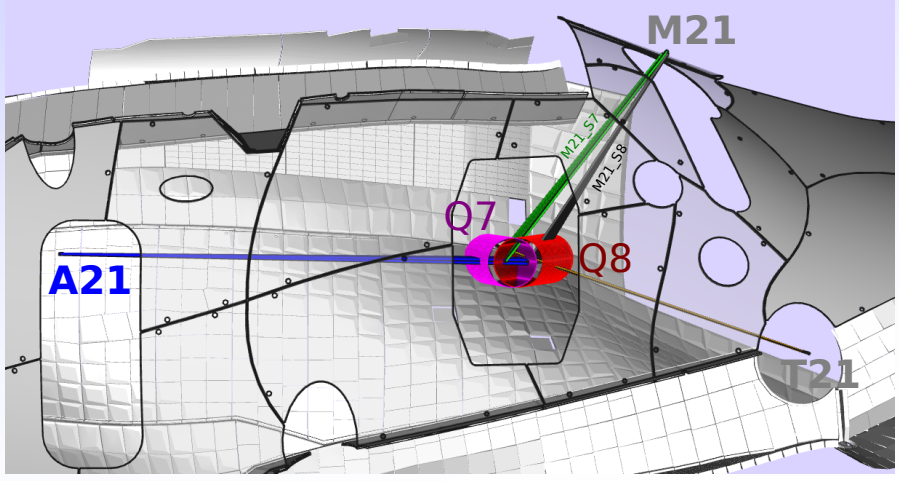
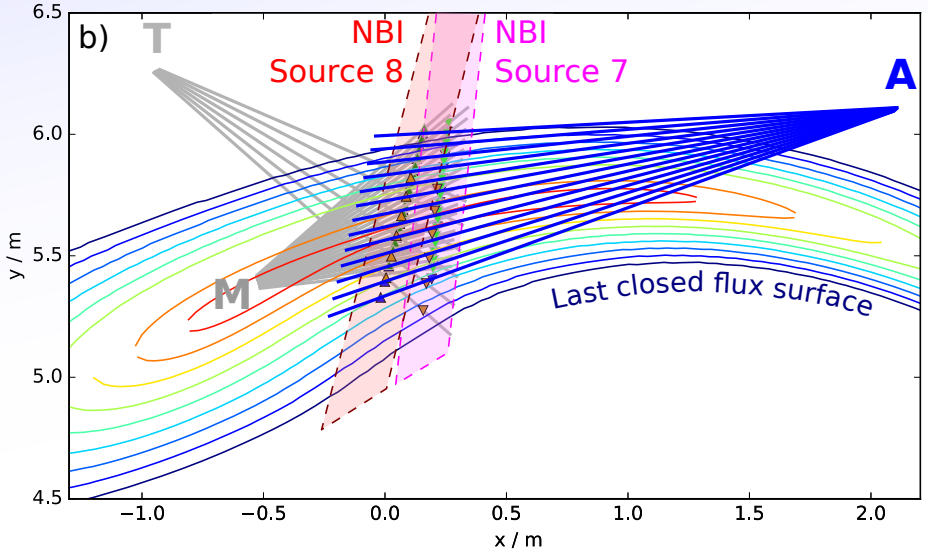
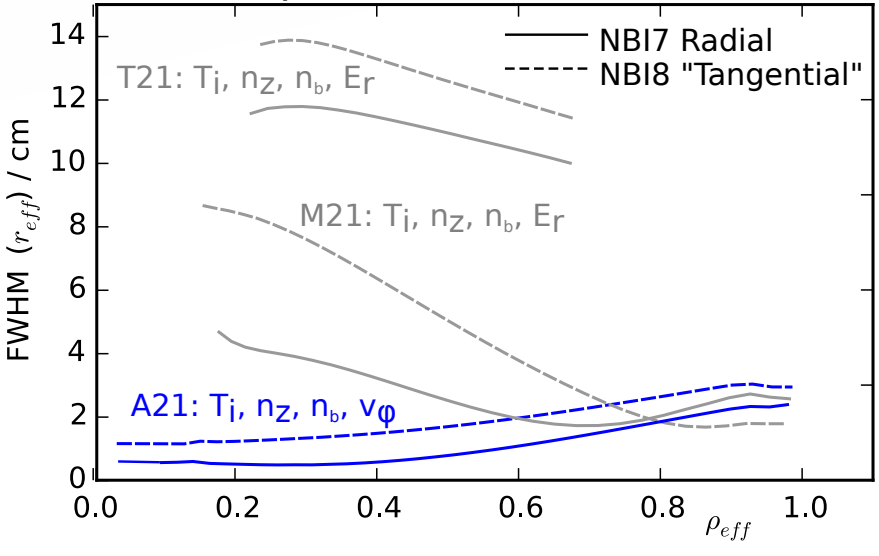
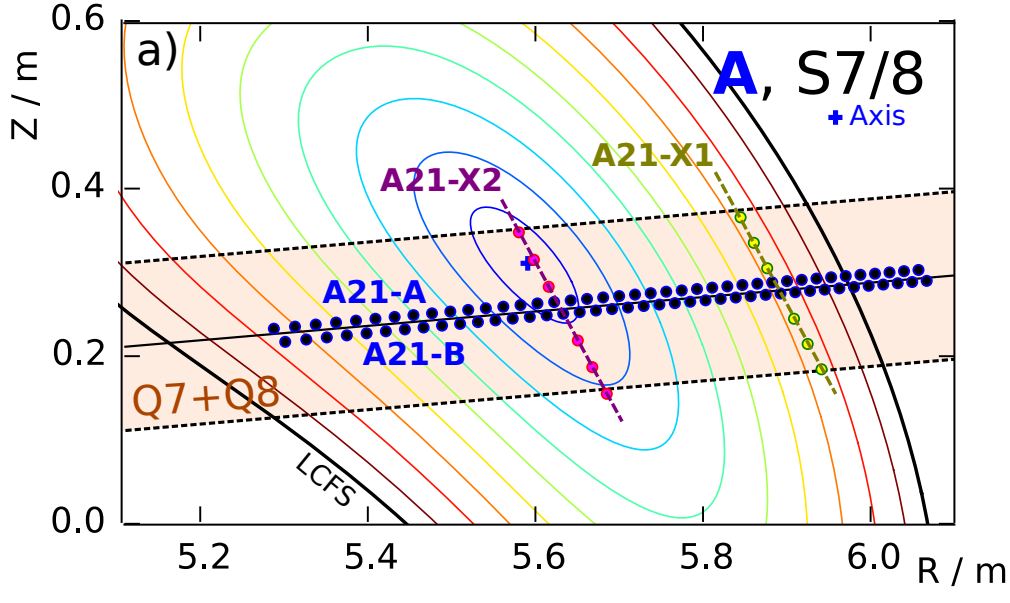
Observation Systems





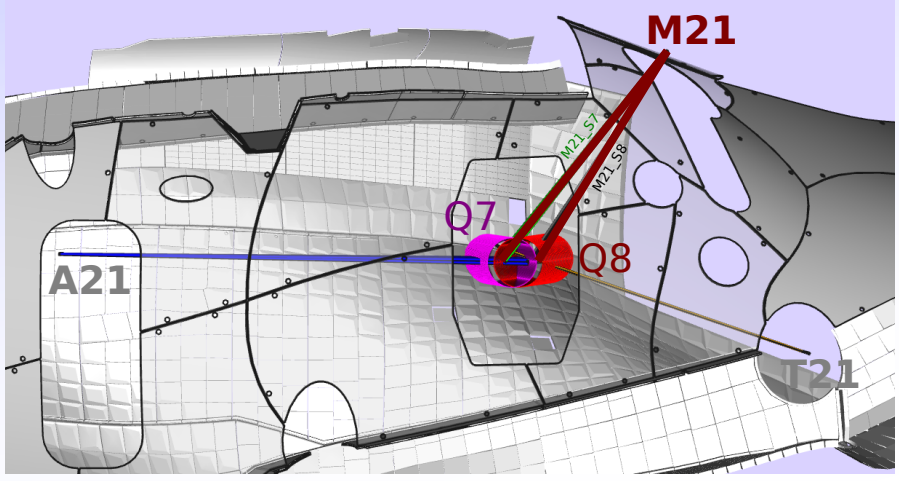
Spatial resolution

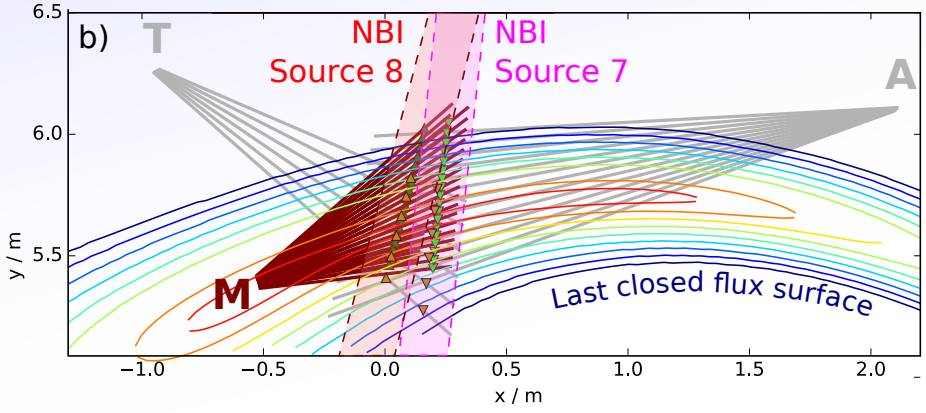




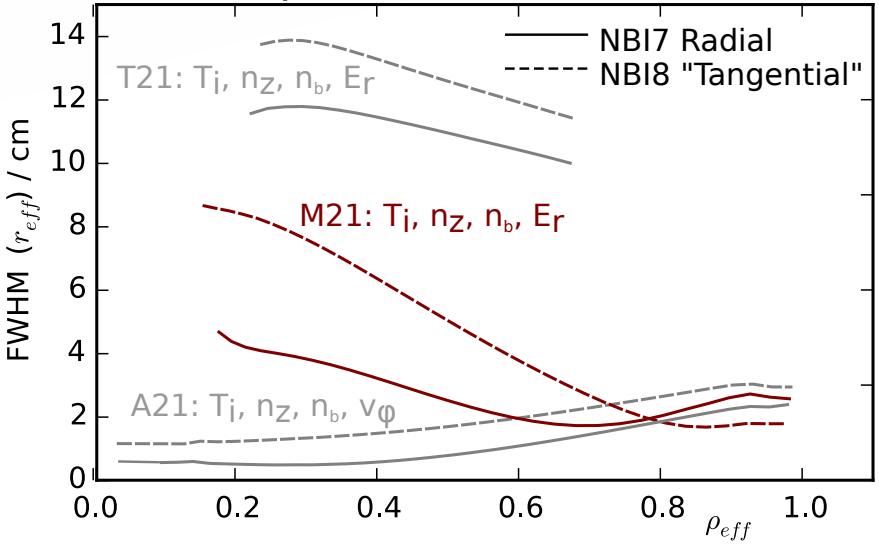
AEA21: High resolution, toroidally viewing system.
AEM21: 45° to toroidal. Primarily for Er.
AET21: Low resolution overview/cross-check. -45° to toroidal.

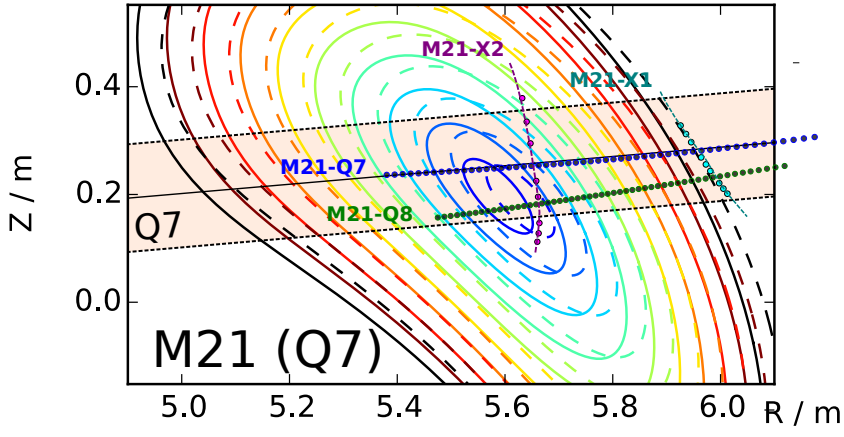
Observation Systems

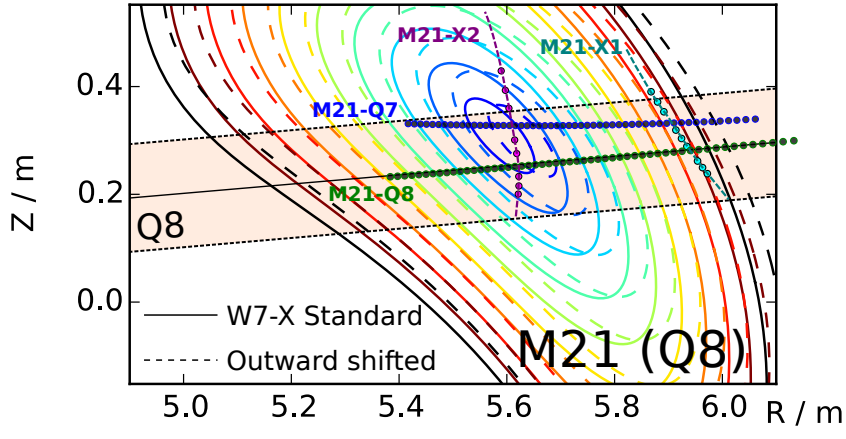




Spatial resolution







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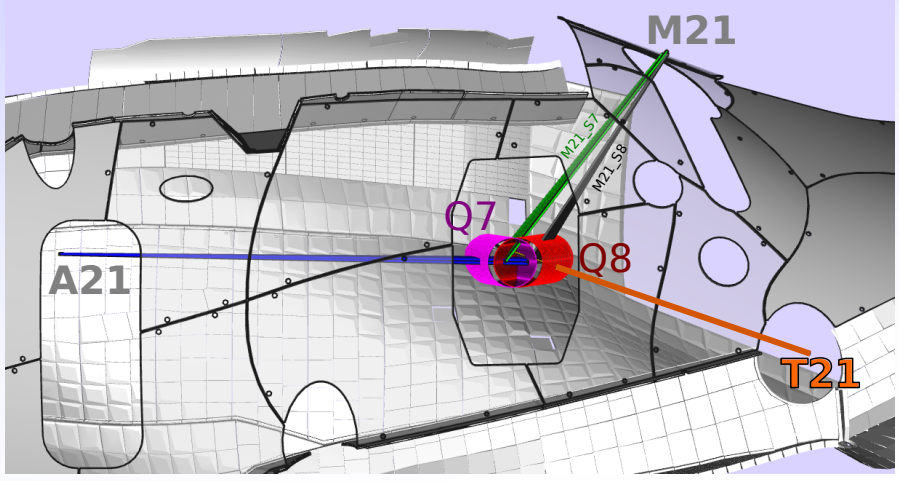
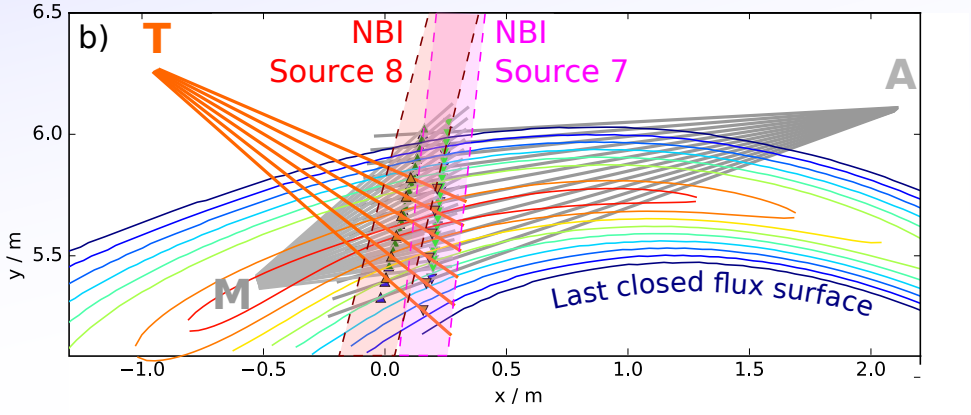
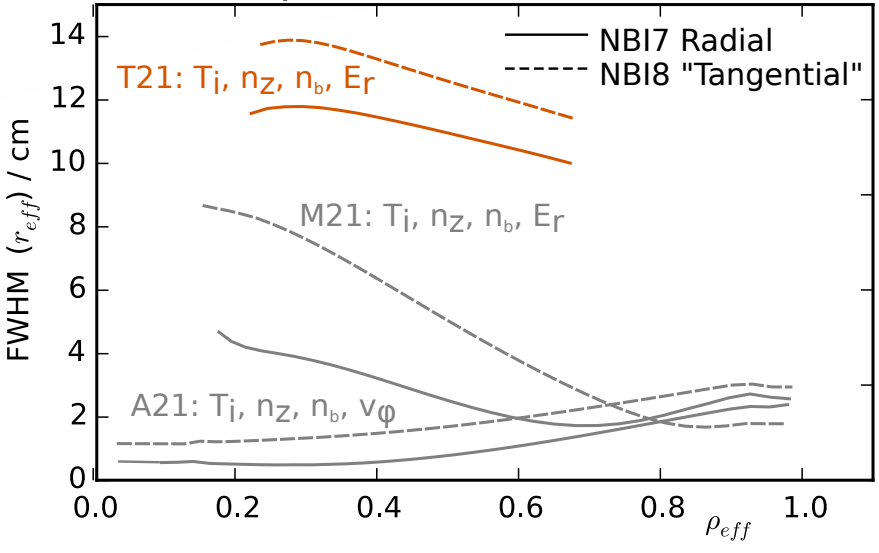
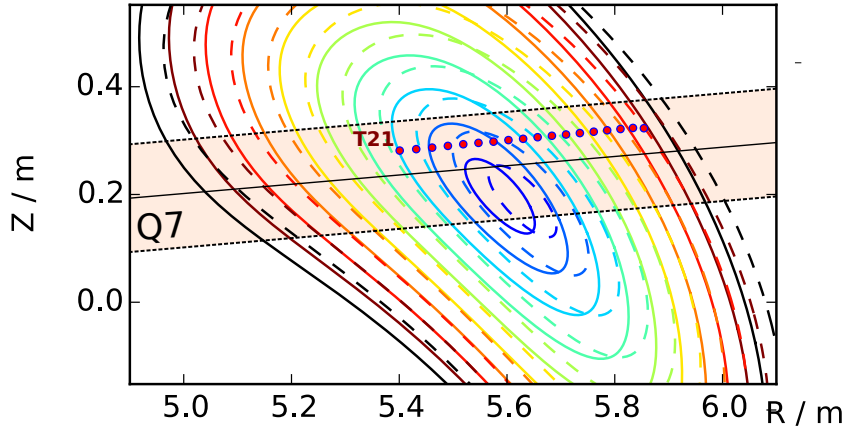
Observation Systems

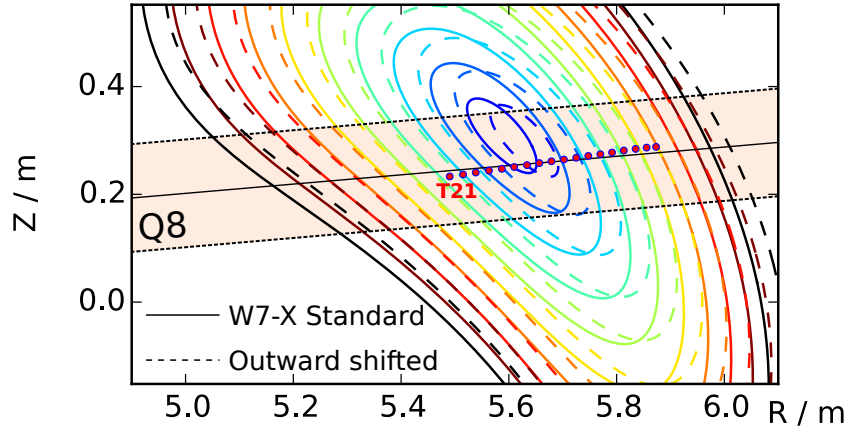




Spatial resolution







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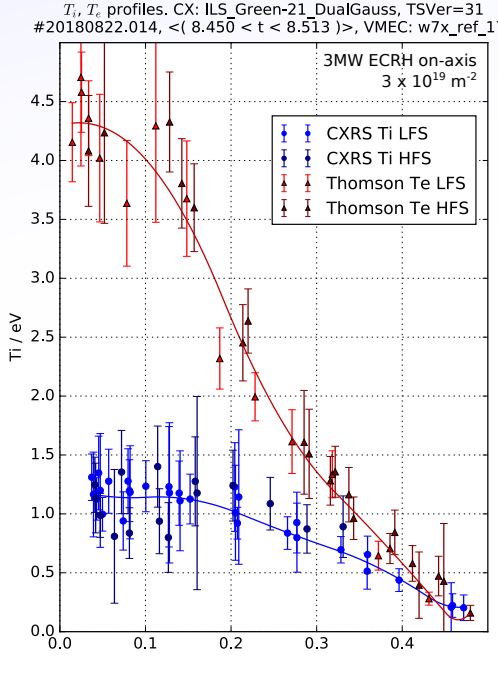
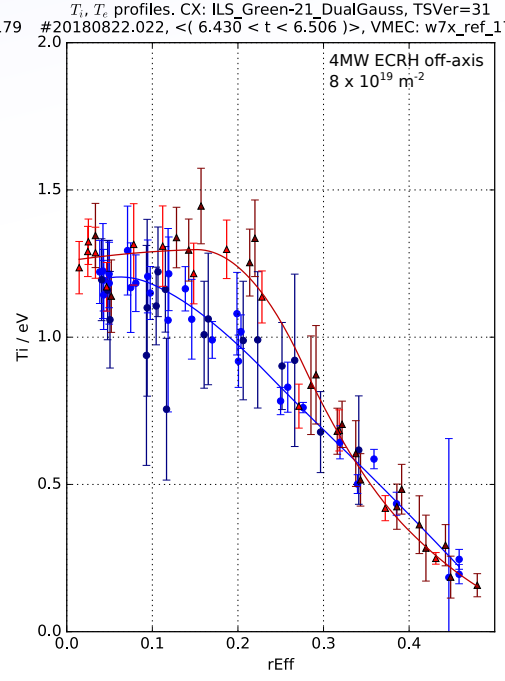
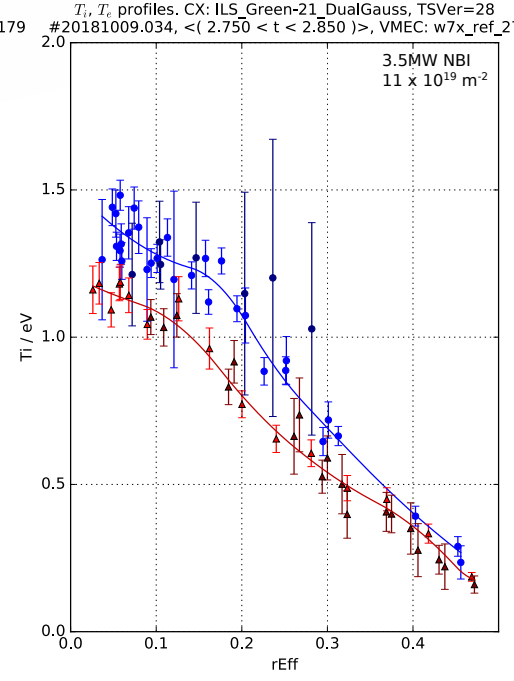
Ti Profiles

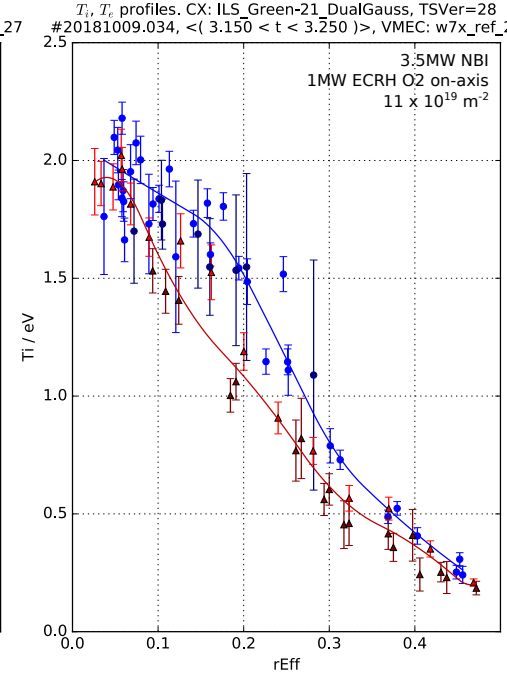
- Ti profiles now available for almost all OP1.2b NBI shots.
- Generally good agreement with Thomson Scattering and expectations.

- Processed with simple Gaussian fitting program.
- Good for blips but long NBI shots difficult.
  - Only forward modelling of whole profiles will solve this --> Minerva







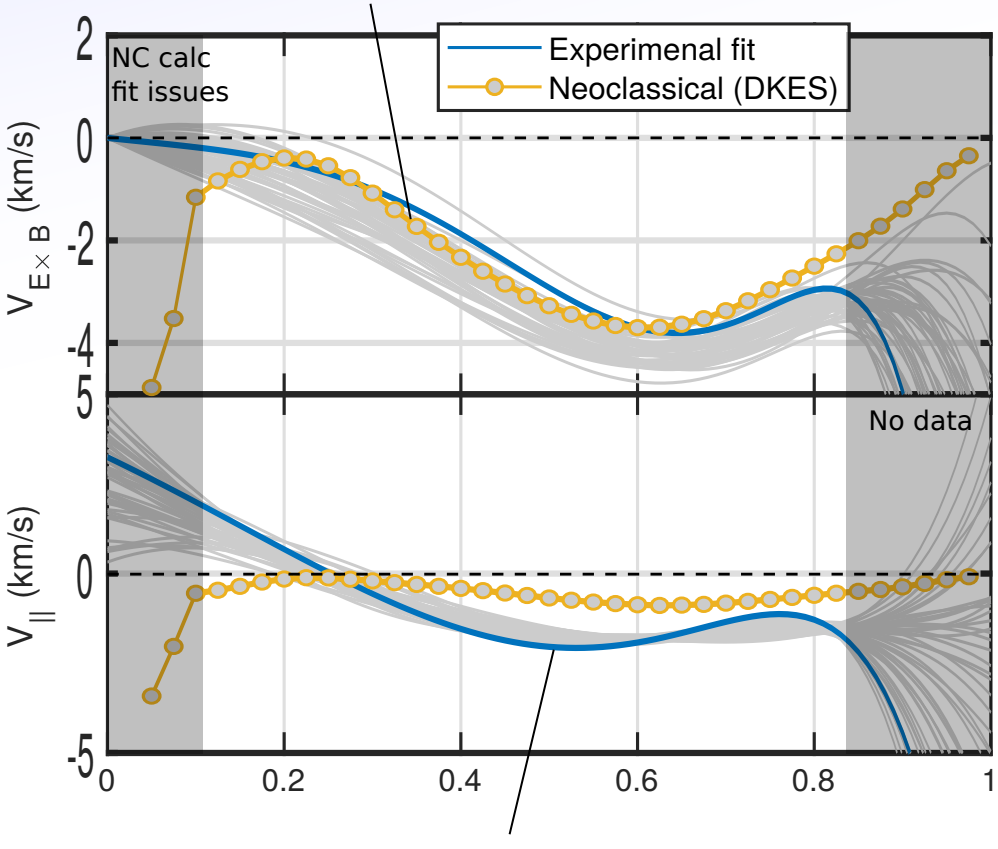


- Good quality profiles produced for normal uses.
- Special mode for high resolution gradient measurements (all spectrometers on C_VI)

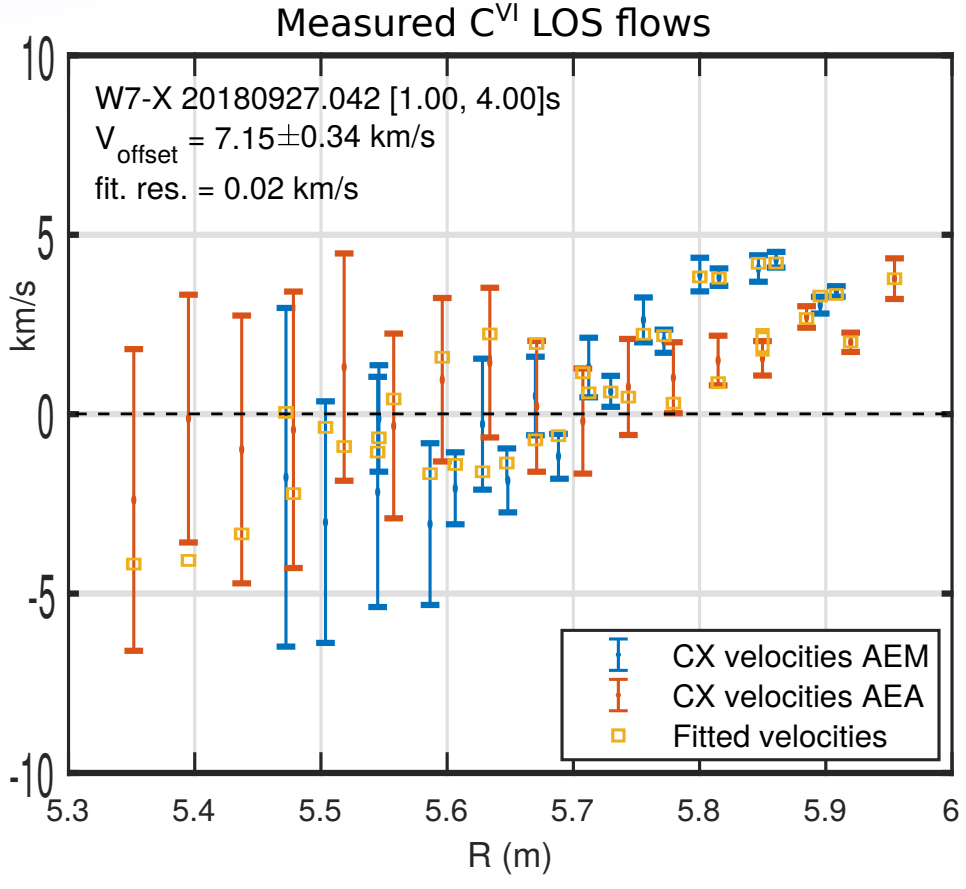
E_r Profiles (A.Alonso)

- Work is on-going to produce Er profiles (A. Alonso):
  - Measured flows into magnetic coordinates --> Potential + Toroidal flow
  - Correction of CX cross-section effects and finite lifetime orbit effects

NC predicted Er strongly affected by choice of fits of profiles

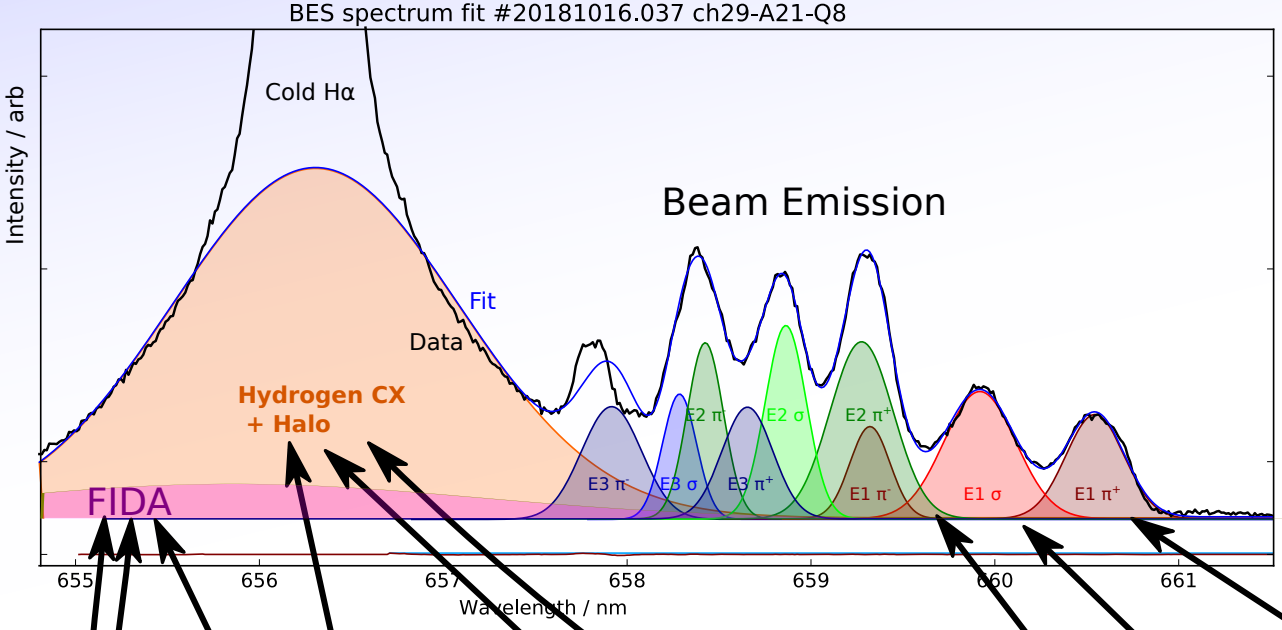


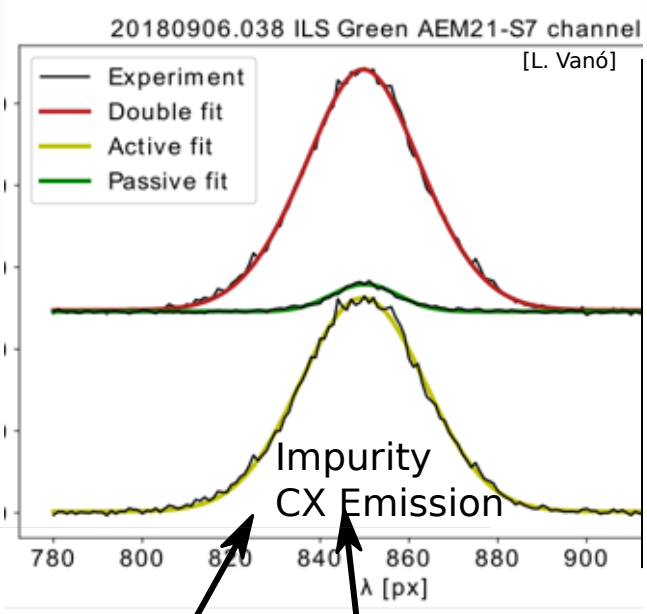
Parallel flows strongly affected by assumed NBI energy component fractions.

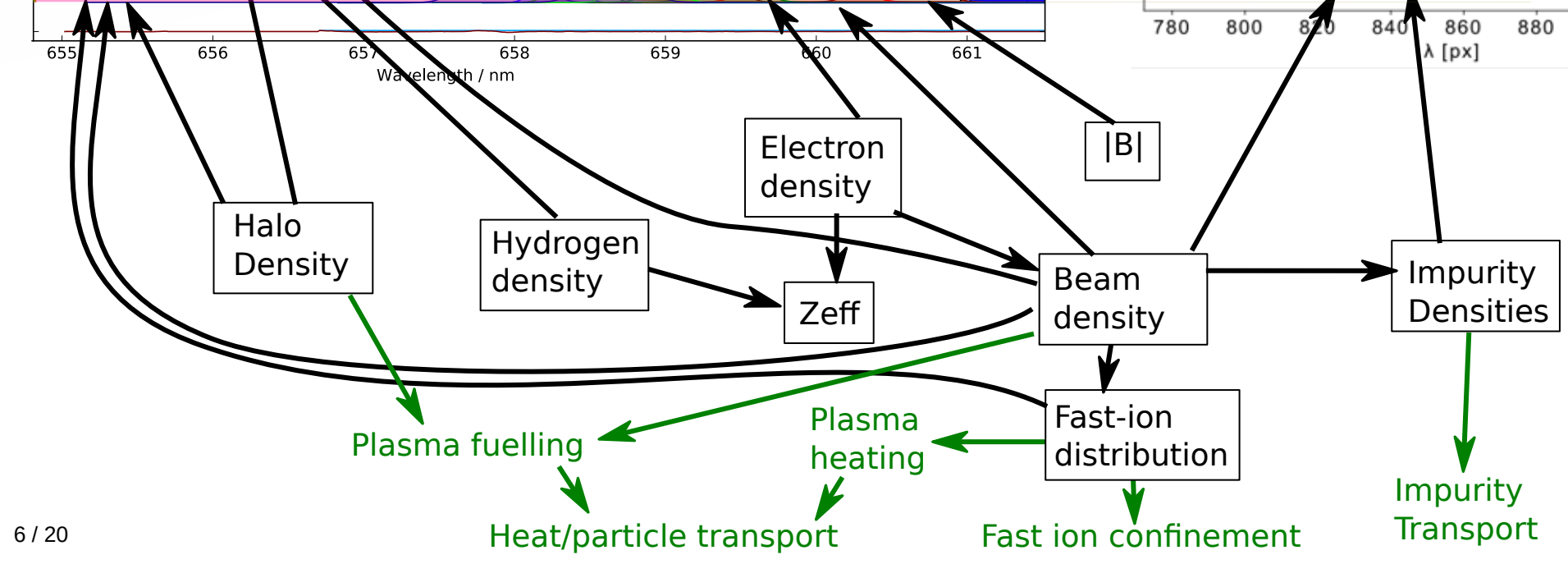


OP1.2b: BES Measurements

BES (Beam Emission Spectroscopy) and Halpha spectrum can deliver lots of information



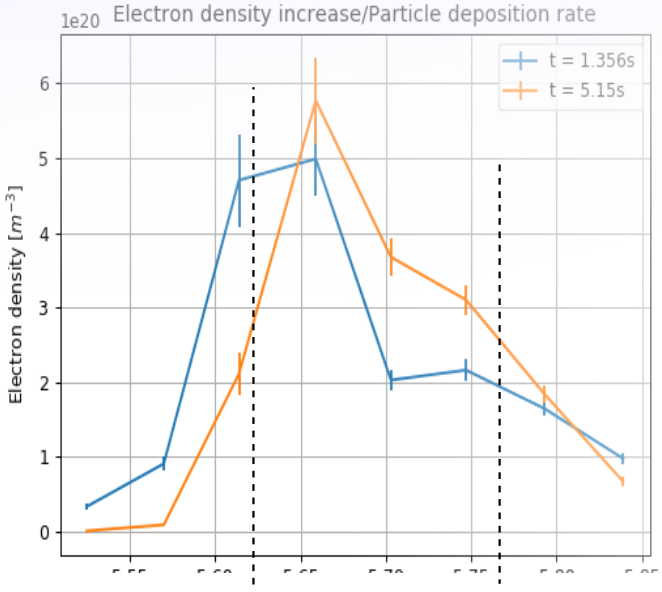


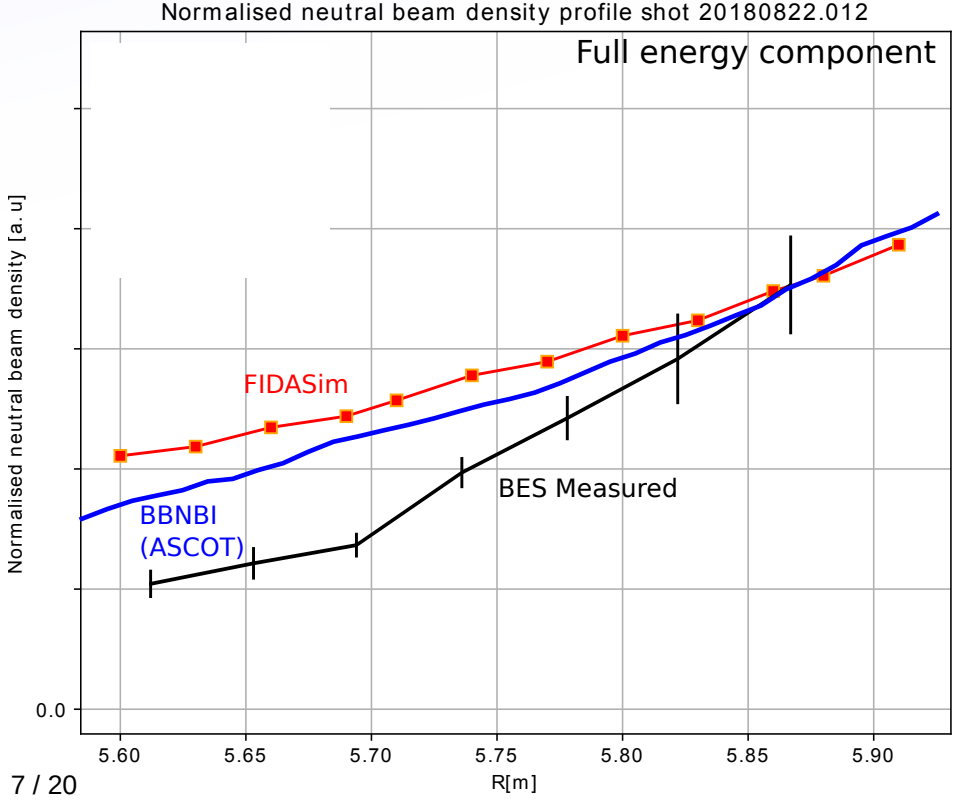


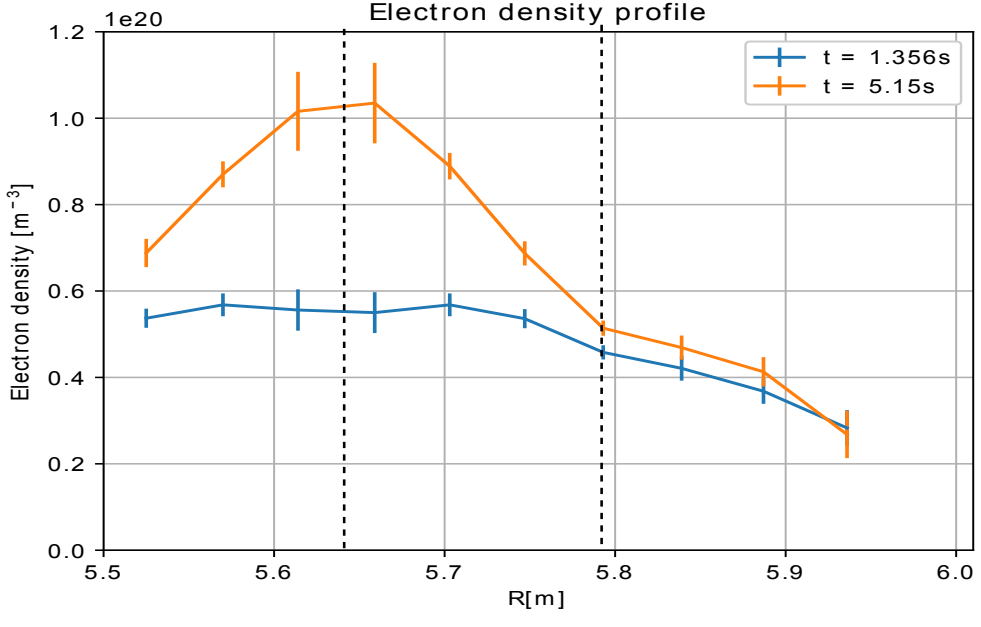
Beam deposition (T.W.C.Neelis)

Measured beam deposition (ignoring Halo CX broadening) now calculated.

- Comparison to models (see talk S. Äkäslompolo)
- Fast ion birth profile
- Particle source profile

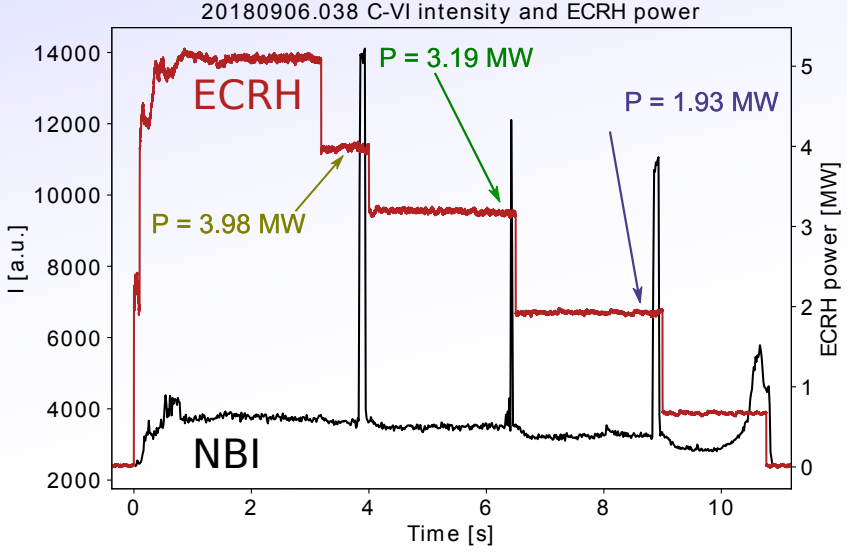


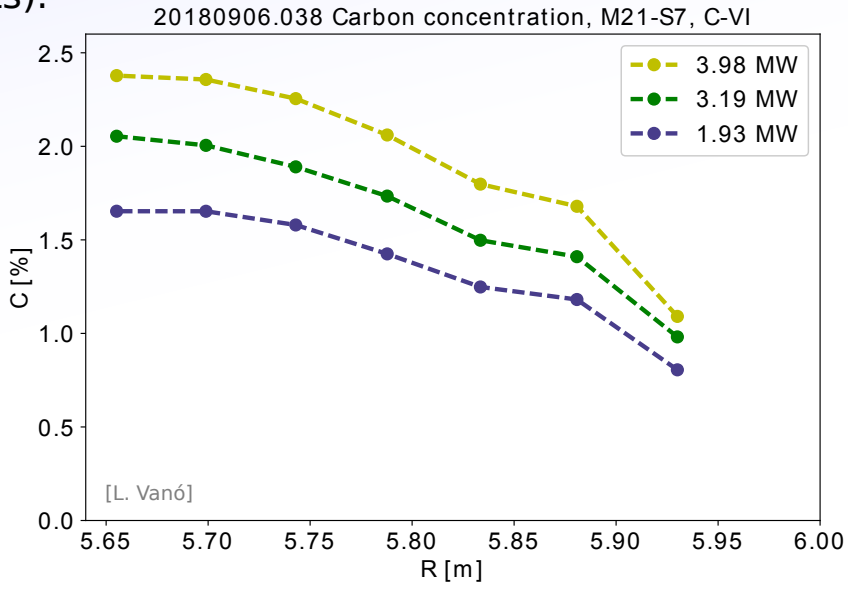




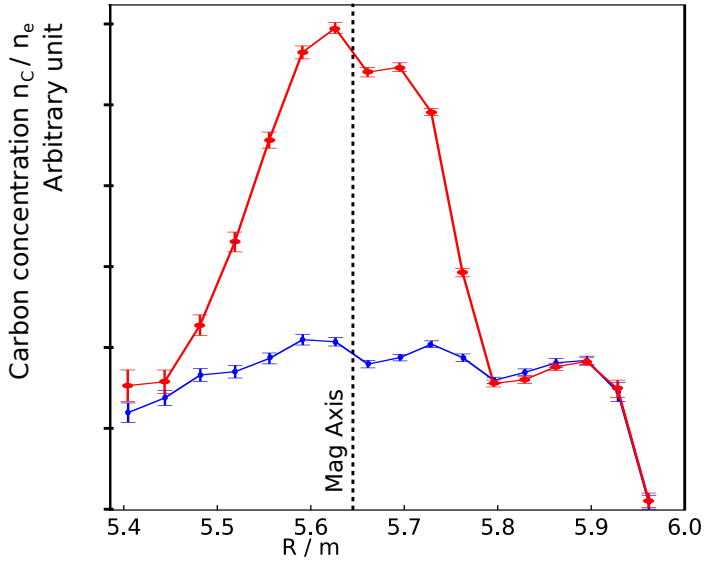
Carbon Profiles (L. Vanó)

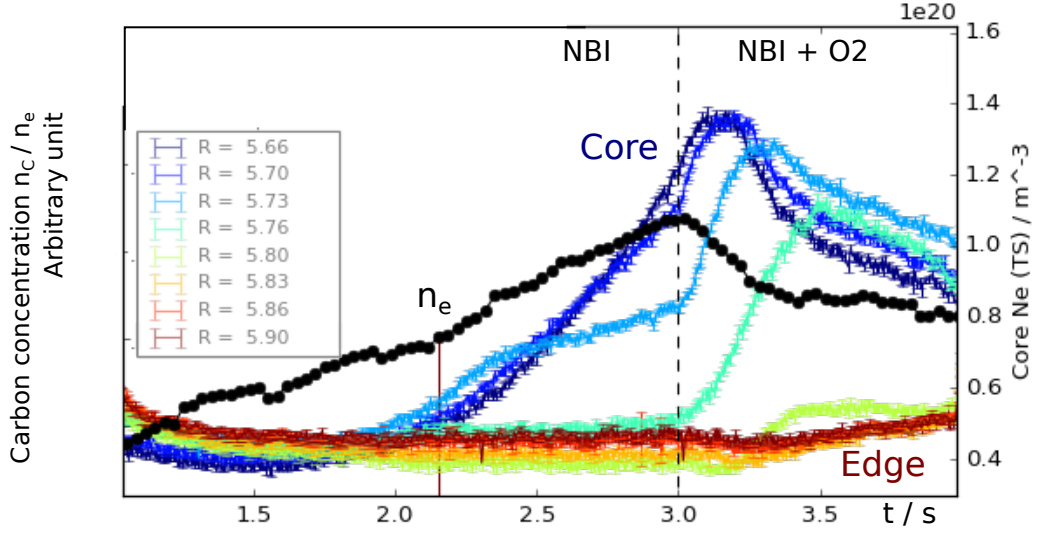
- Now able to produce carbon concentration profiles for NBI blips.
- Very soon somewhat routinely (Requires accurate BES fits).





Strongly peaked carbon concentrations seen in pure NBI shots:





OP1.2b: FIDA

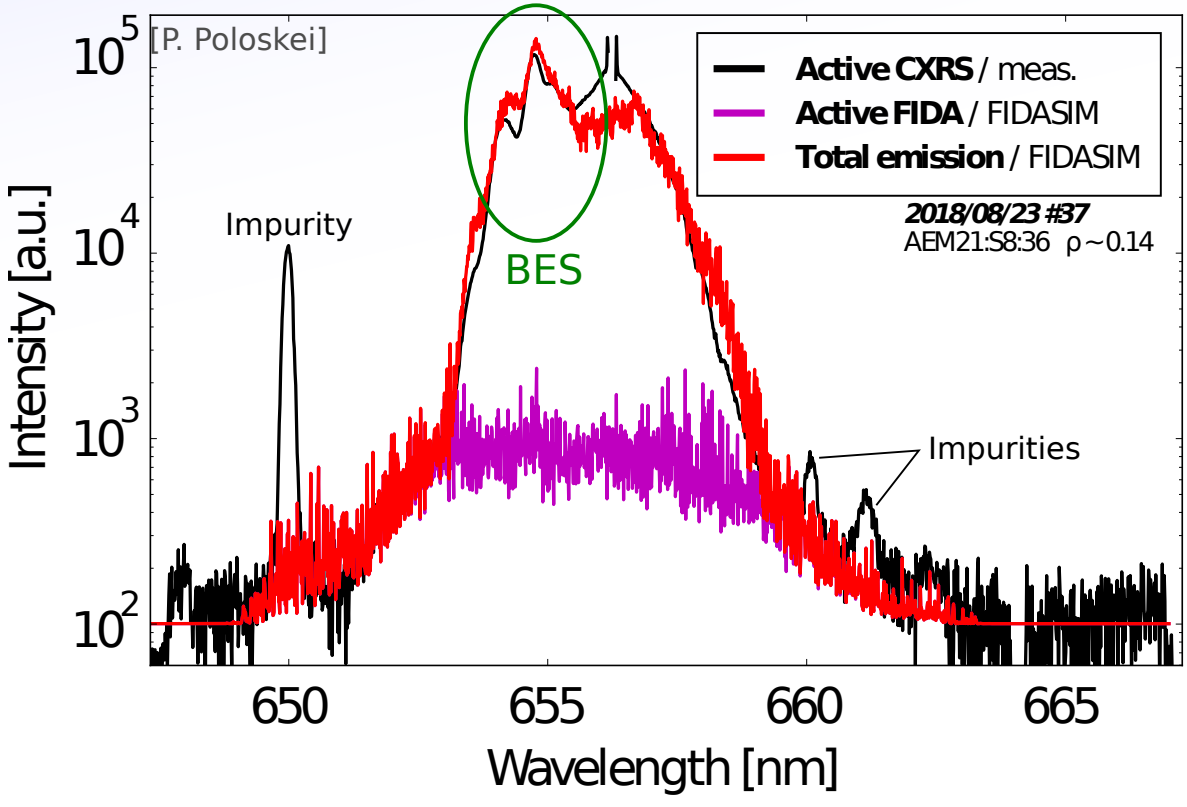
- FIDA Measurements planned with 'AUG' variable wavelength spectrometers: Unsucessful due to insufficient dynamic range but ILS Hα channel fortunately sees FIDA signal very well.

- Comparisons with ASCOT / FIDASIM underway
(P. Poloskei, S. Äkäslompolo)

- Bachelor Student (~Summer, with S. Bozhenkov) to look systematically at data and consider FIDA options for OP2.

- Dedicated spectrometer?, but unlikely to improve on ILS.

- ILS Hα can be optimised for much higher speed (~2ms)



- Offered use of very high speed spectromter for OP2 (~µs, but 1-channel) for FIDA from Garching (B.Geiger, A. v. Vuuren). Passive FIDA mesaurements planned.

CXRS vs XICS Ti comparison

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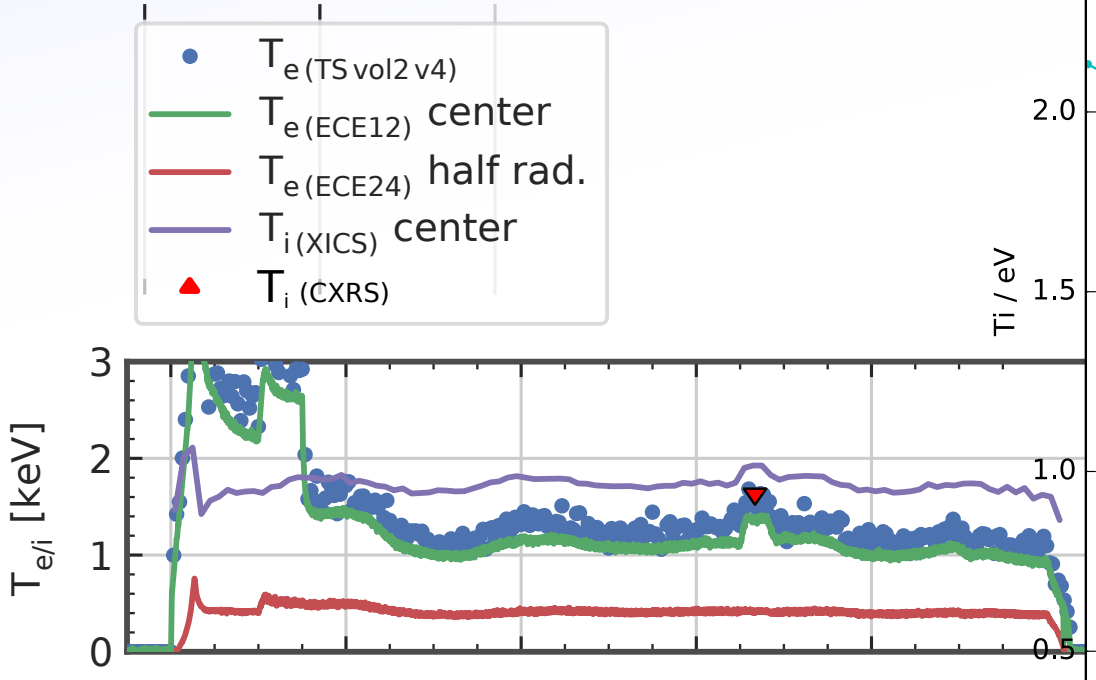
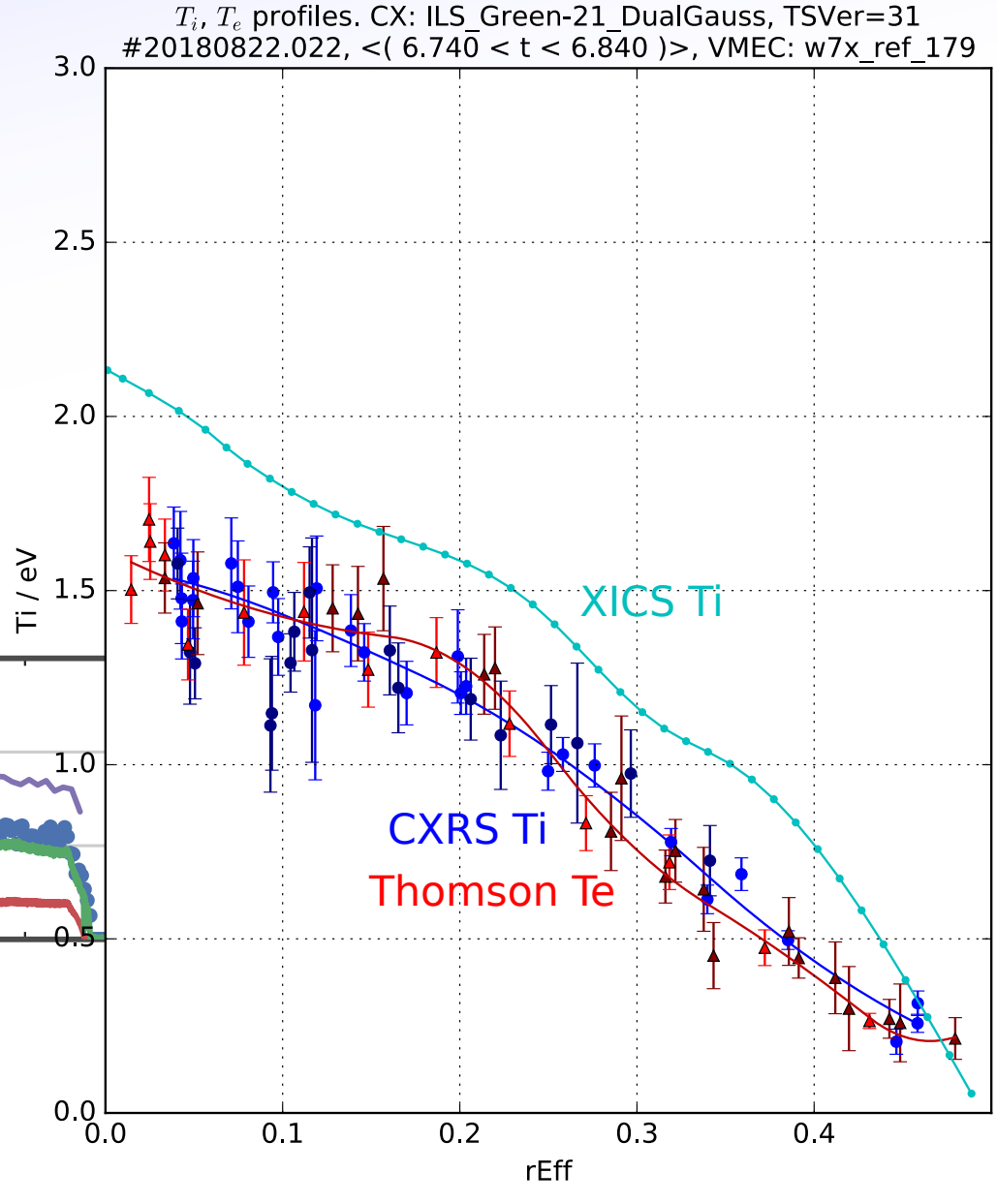
XICS vs CXRS

Typical examples.
Well coupled high-ne off-axis ECRH
--> Should have Ti=Te

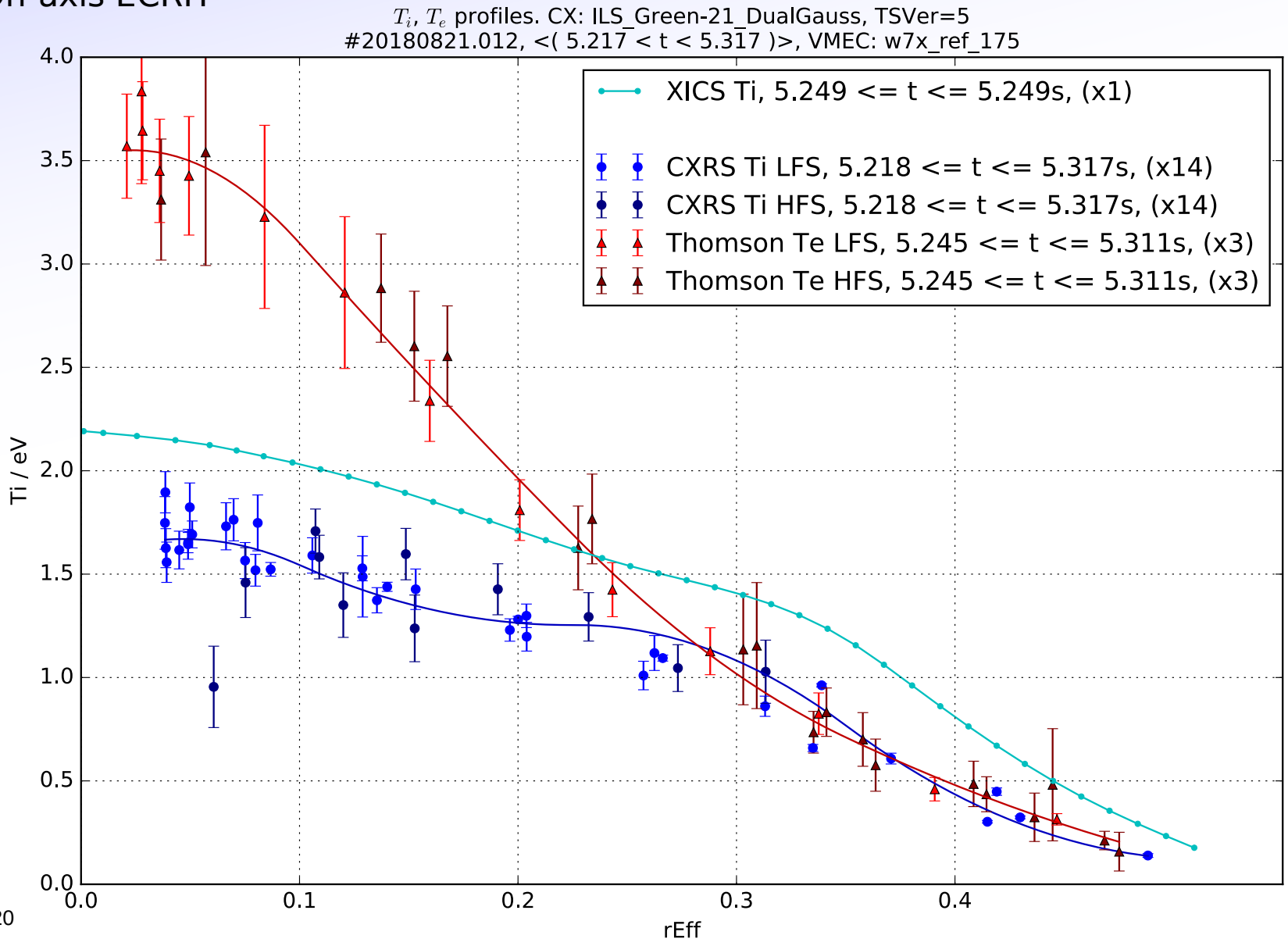




O. Ford
S. Bozhenkov
M. Beurskens

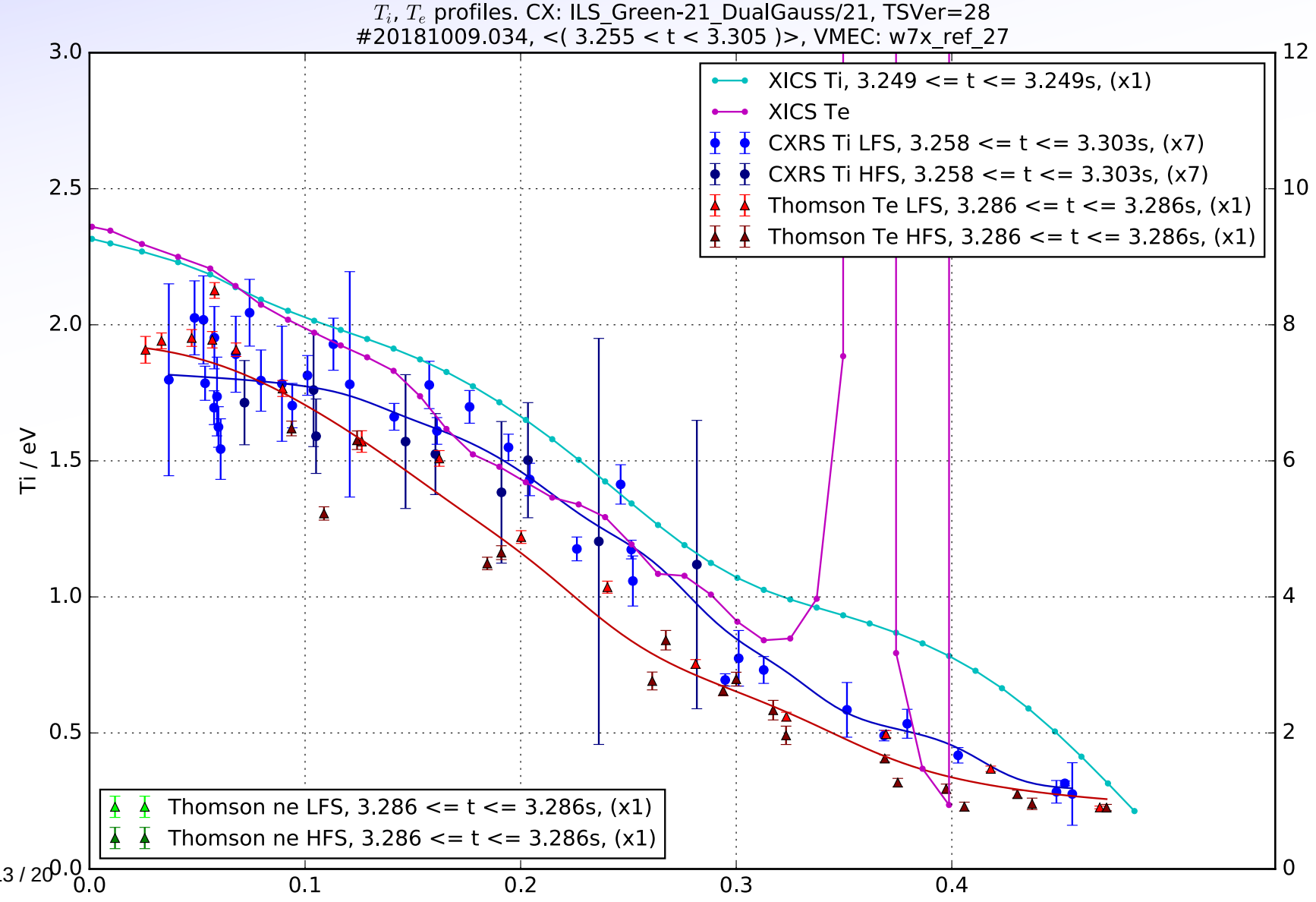
XICS vs CXRS

Typical examples.
On-axis ECRH



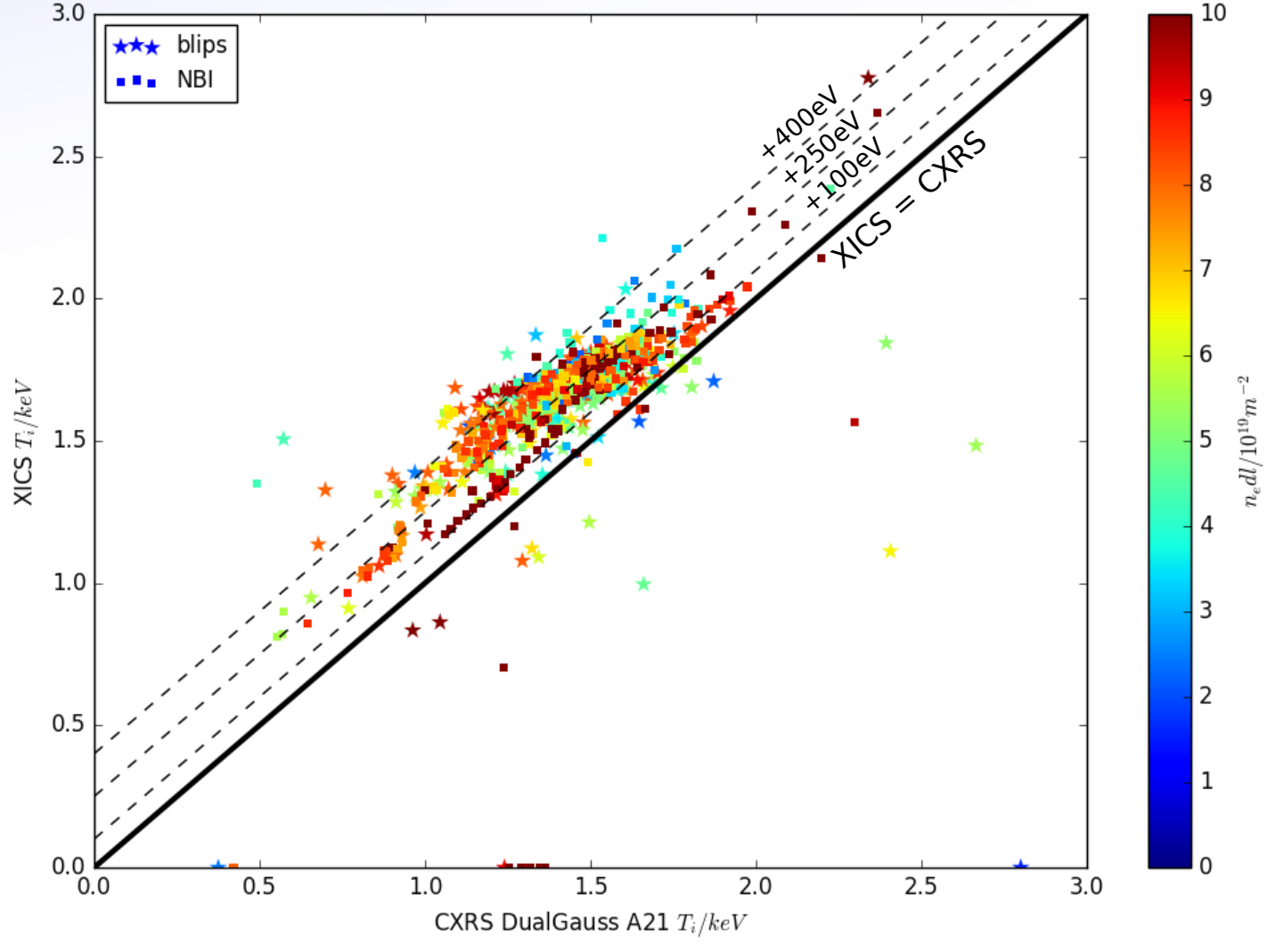
XICS vs CXRS

Typical examples.
NBI --> Ion heating --> Ti > Te



XICS --> CXRS

Rough statistical view for all NBI plasmas.
- Improper treatment of mapping (Vacuum field only)
- Appears to give ~250±150eV

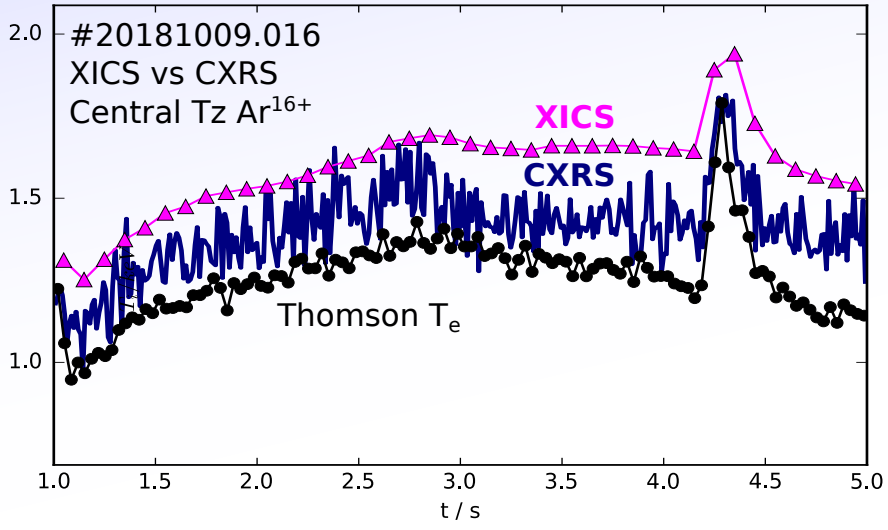


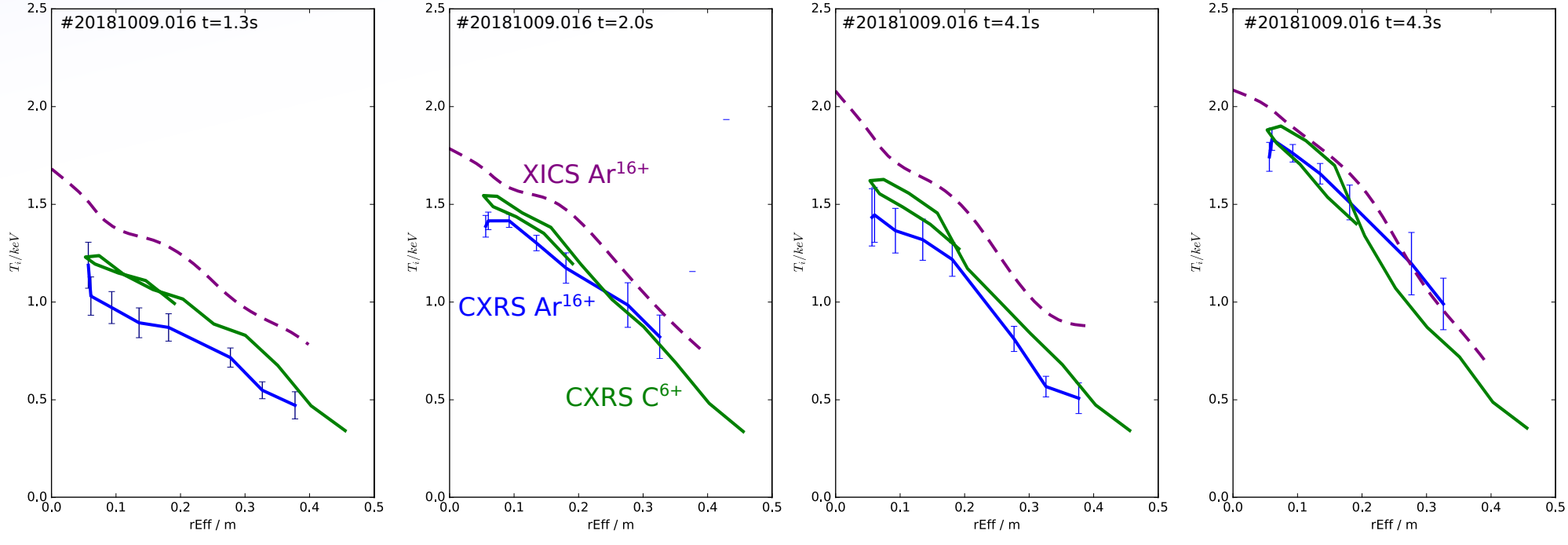
XICS cross-calibration

Argon (Ar^{15+}) for cross-calibration with XICS.
(Ar^{16+} + H --> Ar^{15+*} + p, n=14 - 13, 436.6nm)

- Investigate CXRS XICS T_i discrepancies - Is it T_C vs T_{Ar16+}? or diagnostic?

- Absolute Ar^{16+} intensity to support XICS calibration (if CX cross-sections are OK)





Argon^{16+} CXRS measurements more consistent with Carbon^{6+}. XICS Ar^{16+} usually higher. Gradients always consistent --> Supports XICS inversions.

Iota profile measurements on W7-X

O. P. Ford[1], R. Wolf[1]

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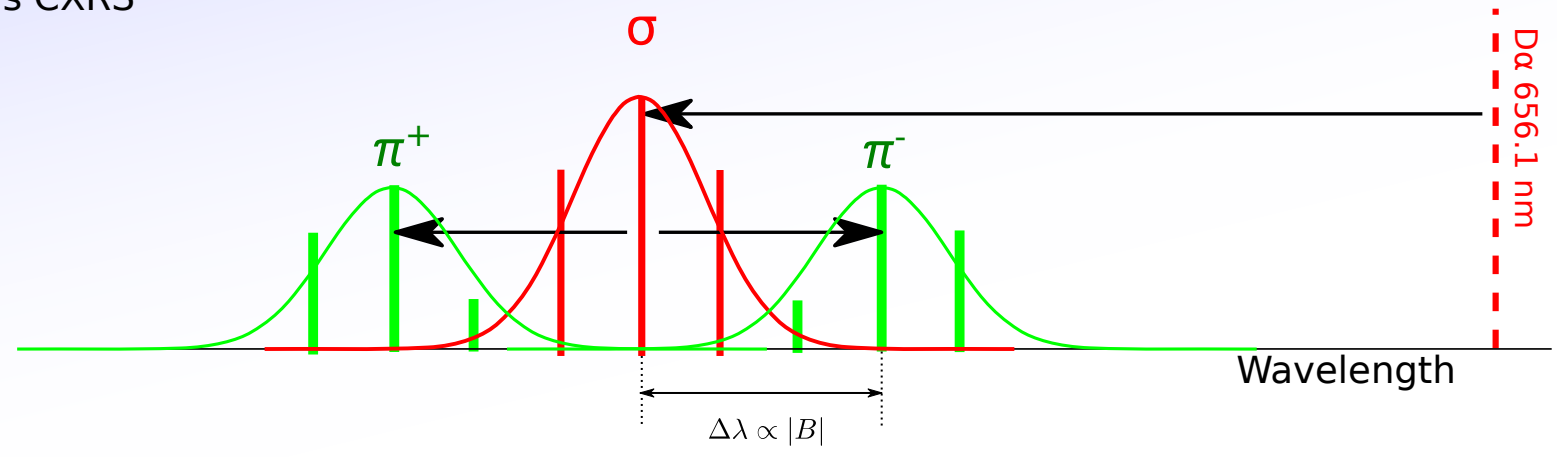
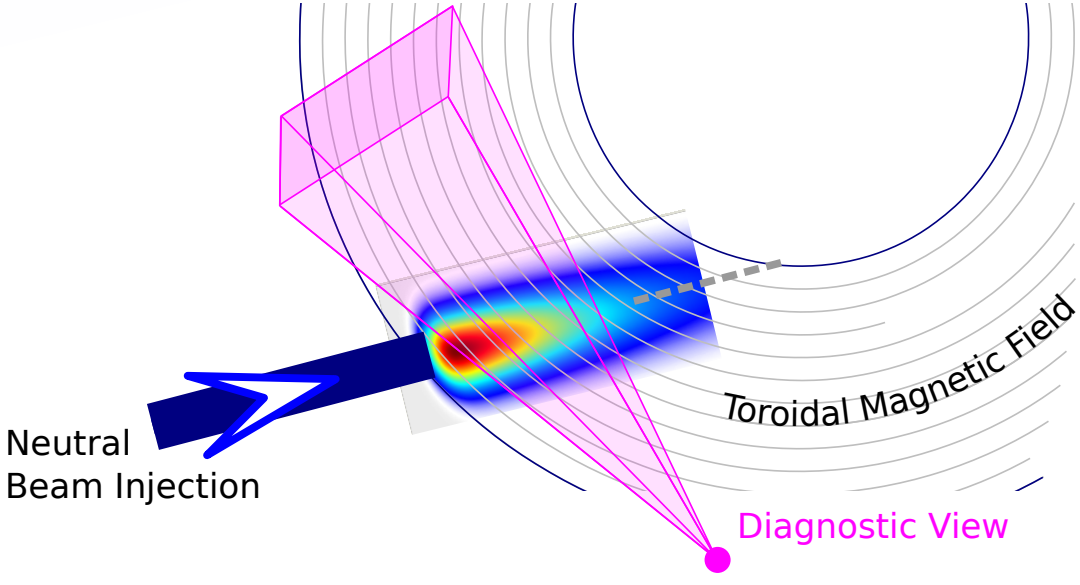
Motional Stark Effect

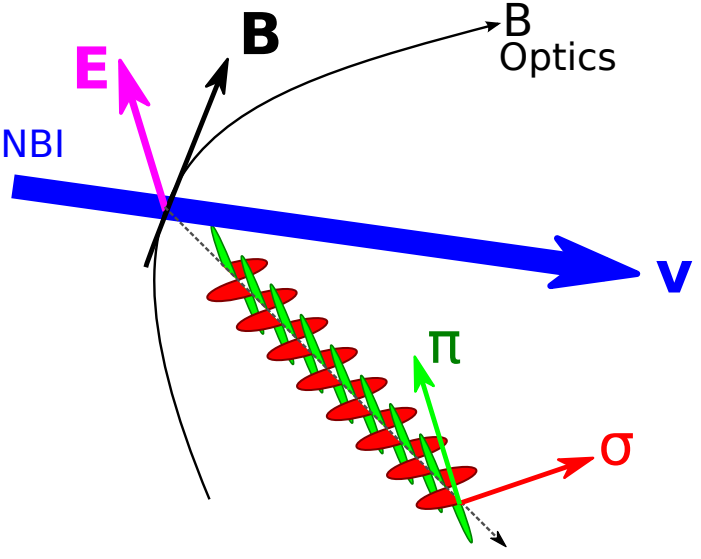
- Active beam spectroscopy gives internal measurements B through motional stark effect.
- Same optics/LOSs as CXRS

- Splitting: $\Delta\lambda \propto |B|$



- Polarisation angle --> $\frac{B_z}{B_\phi}$

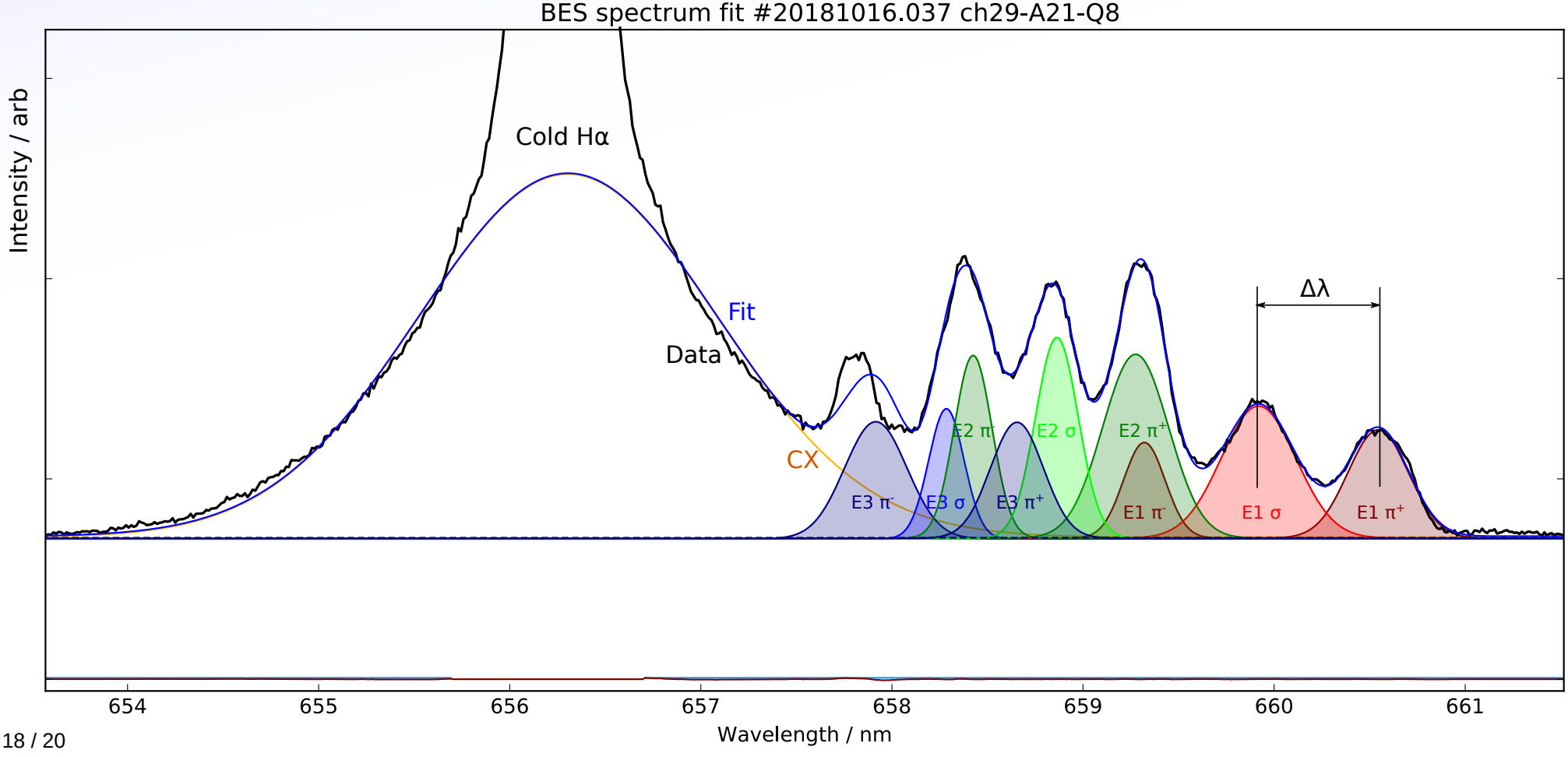




OP1.2b: BES |B| Measurements

CXRS/BES (Beam Emission Spectroscopy) in OP1.2b measured Hα spectrum of beam for purpose of beam density + FIDA measurements.

Unexpectedly good signal allows accurate fitting of MSE E1 σ and π^+ components.
Possible to derive |B| from this:



OP1.2b: BES |B| Measurements

Only examined one shot so far: High-performance pelletrs discharge #20181016.037
- |B| Measurement mostly follows W_{dia} and |B| predicted by VMEC, apart from at crash.

(and a factor of 2 in variation, with arbitrary offset, for some reason)