First results from Transmission Grating Imaging Spectrometer

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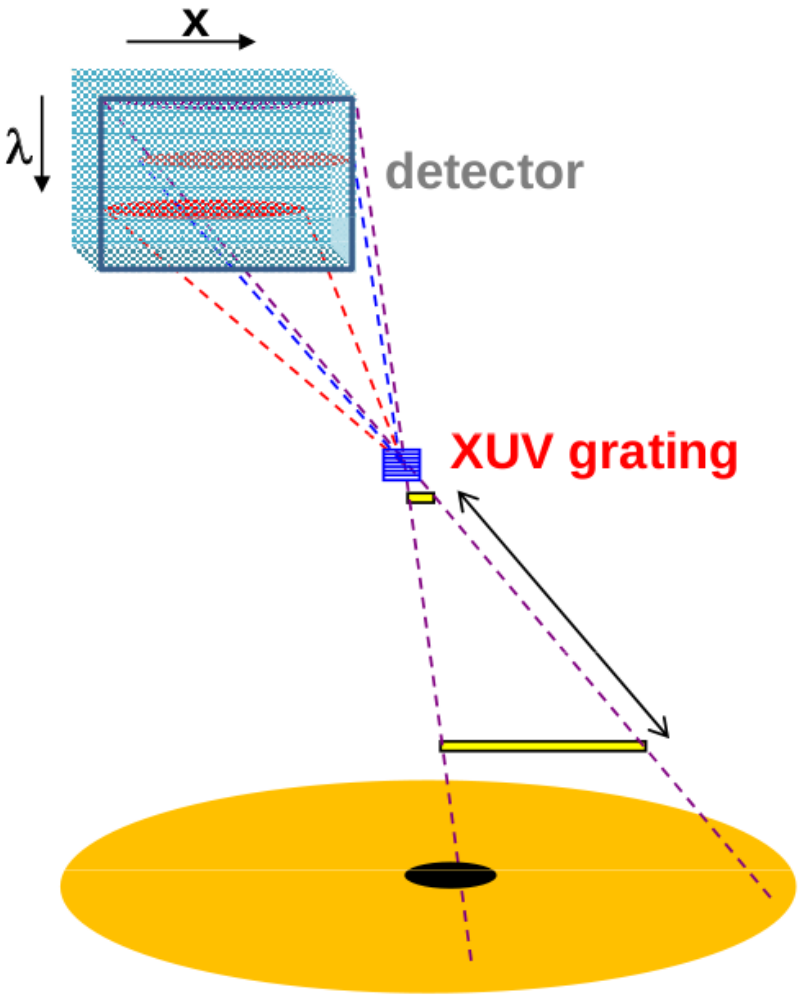
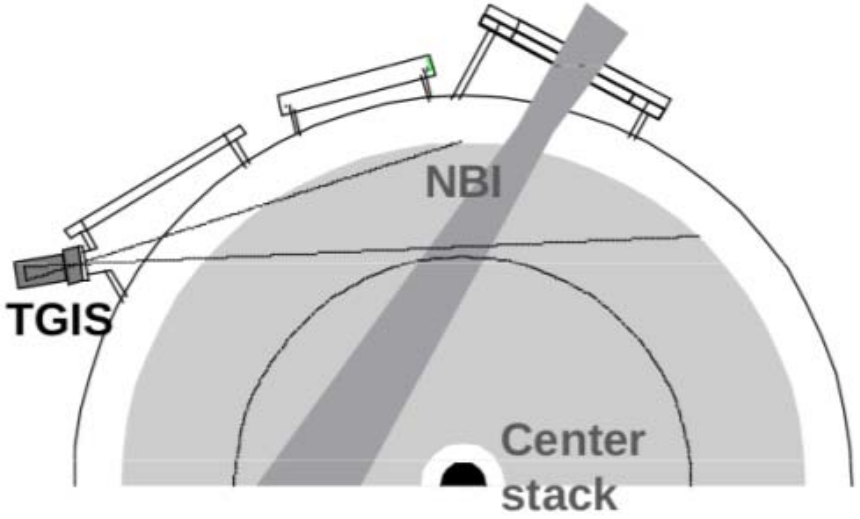
Device Setup



- Motivation
  - Provide impurity measurements for Multi-Energy Soft Xray system
  - Impurity monitor in itself
- Detection
  - CsI coated MCP
  - Phosphor screen
  - CMOS imaging system

Device Setup

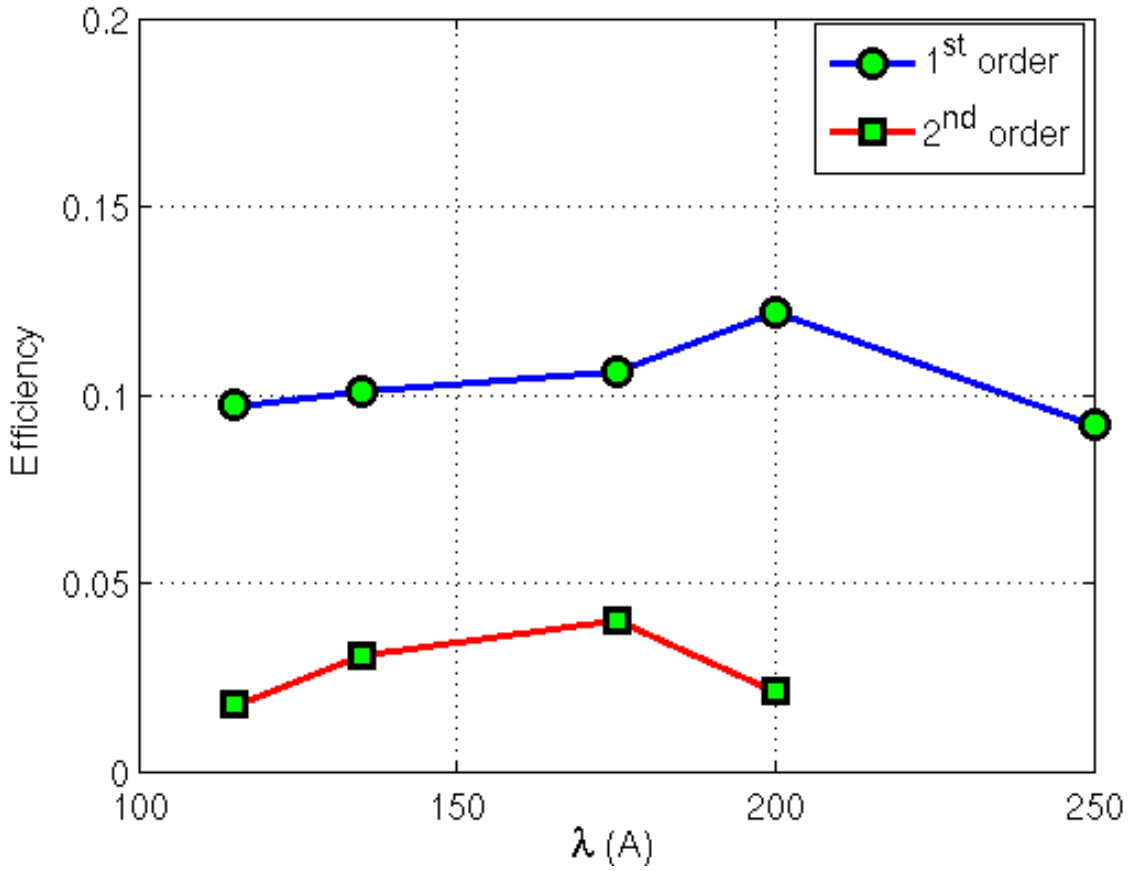


- Beam excited charge exchange emission
- Electron excited emission (edge and core)
- Frame exposure = 380 ms

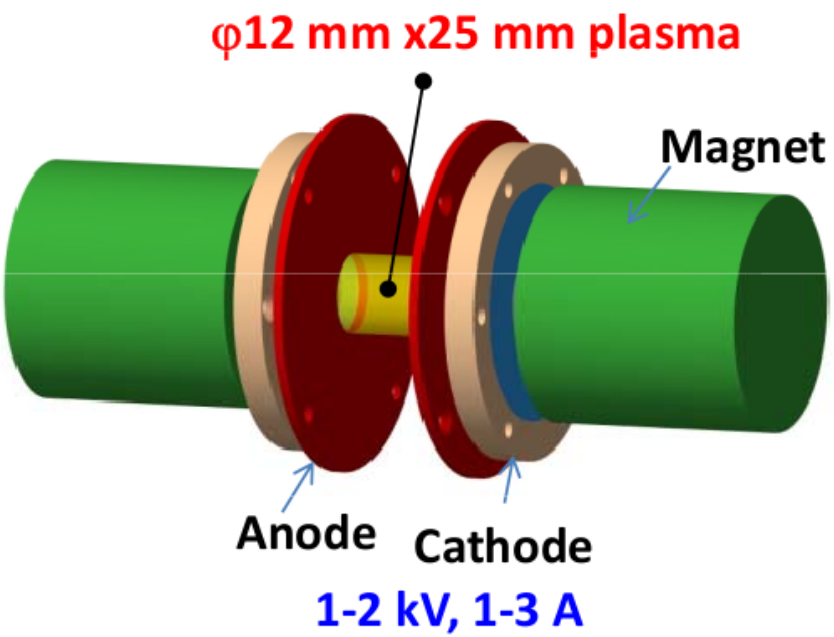
- Design advantages
  - Survey spectrometer (30 A – 700 A)
  - Robust to neutrons
  - Provide spatial impurity distribution

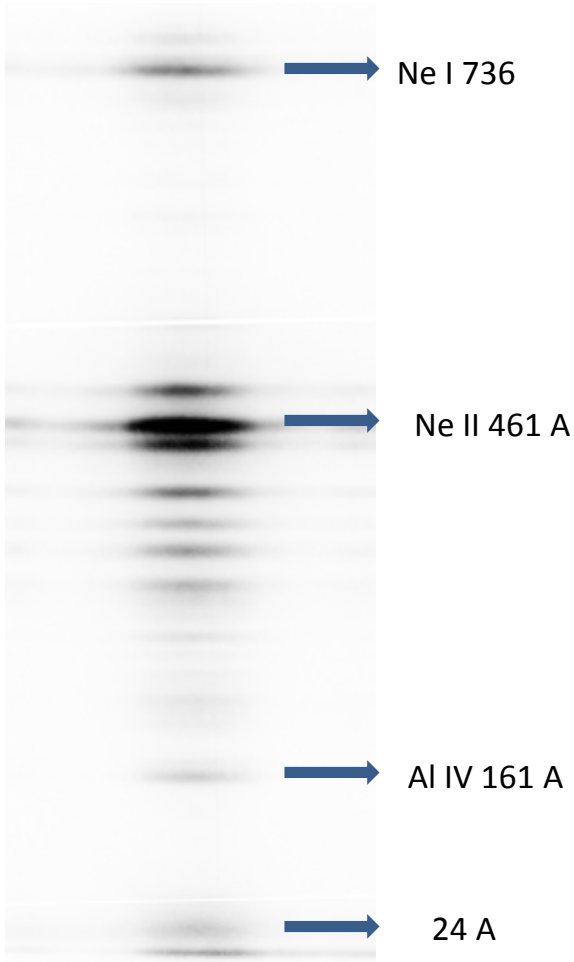
Grating details

- Free standing Grating dimensions
  - 1 mm x 1 mm
  - 200 nm period
- NIST calibrations

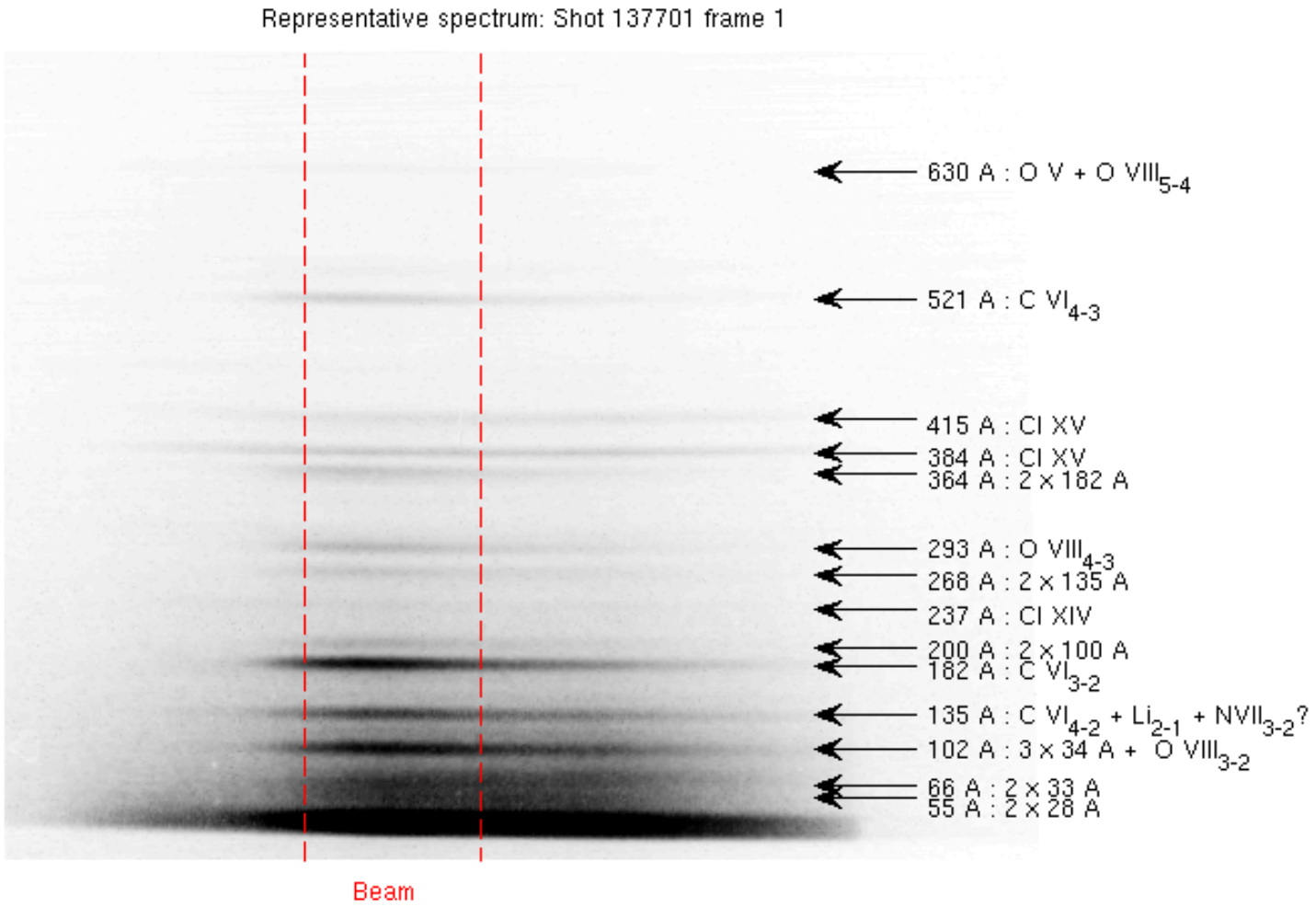


Calibration through PID spectra

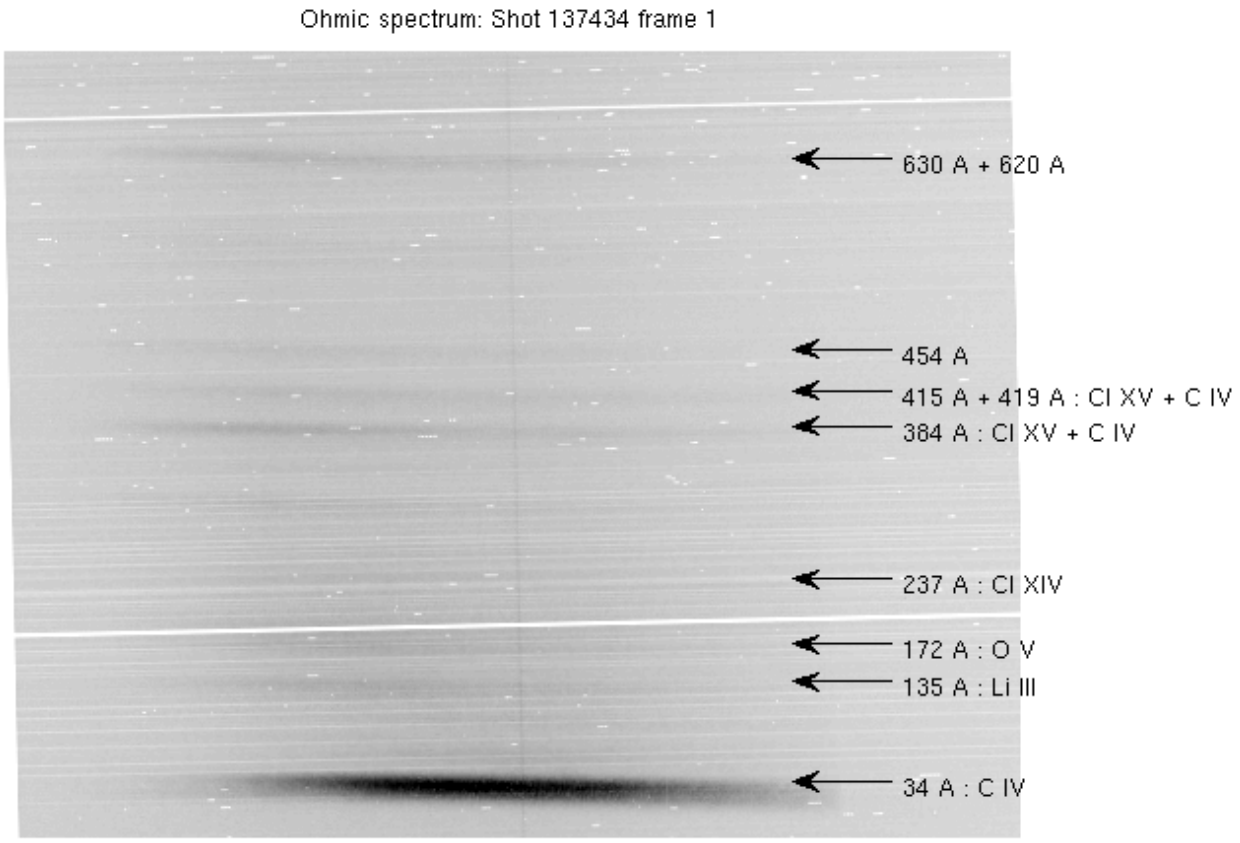




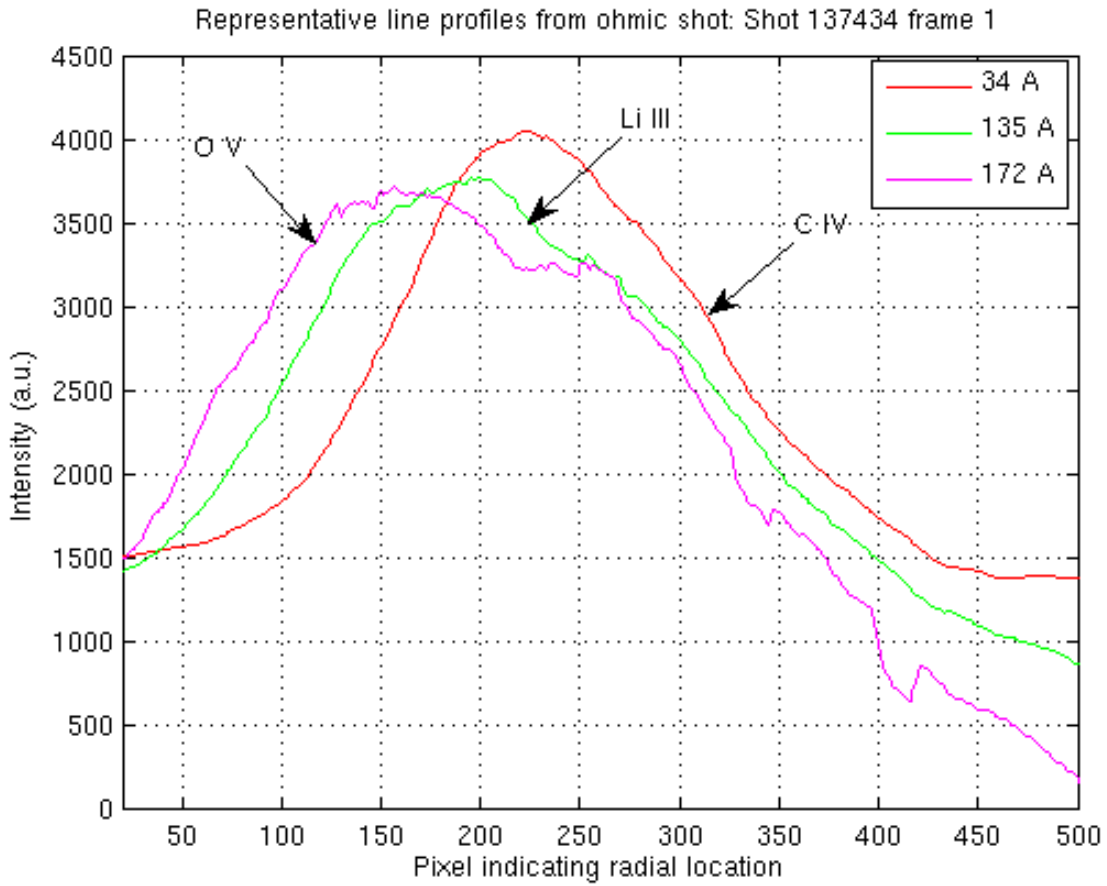
NSTX results – typical spectrum



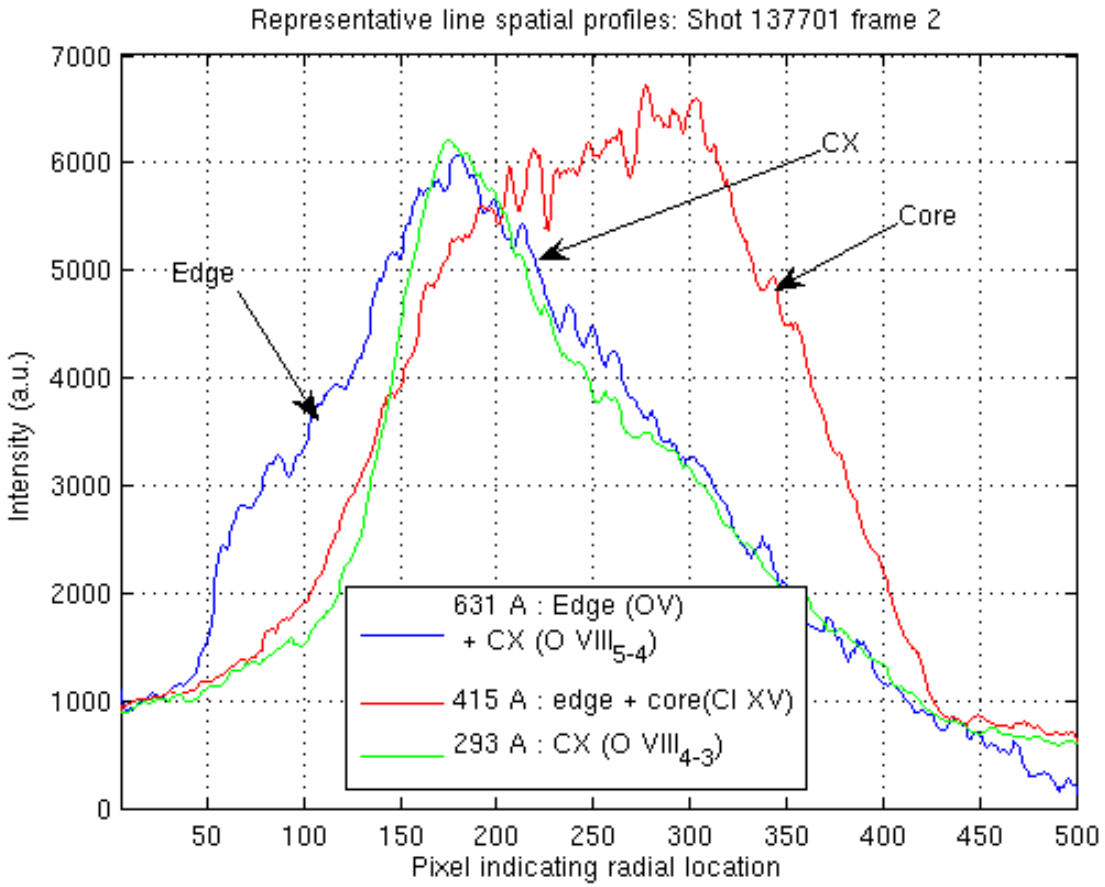
NSTX results – ohmic spectrum



Ohmic shot – spatial profile (edge)



Typical shot – spatial profile (Edge + CX + core)



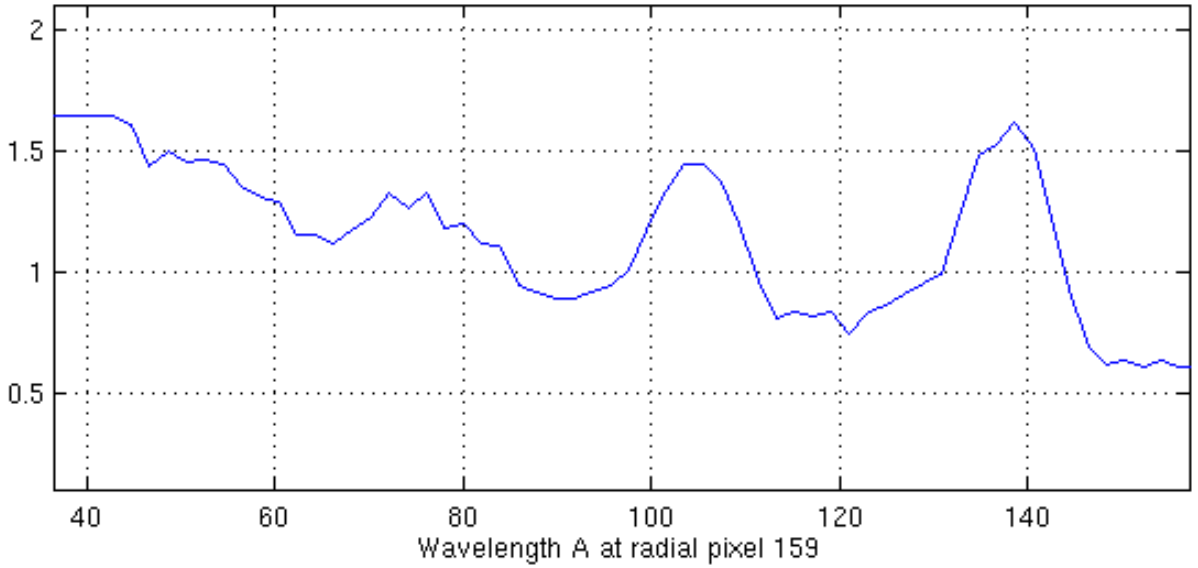
BIG QUESTION – WHAT ABOUT COPPER, MOLY, IRON?

Copper

- No Copper observed.
- Reason – The absence of Cu XIX doublet lines ($2p^6 3s – 2p^6 3p$) at 273 A and 303 A.

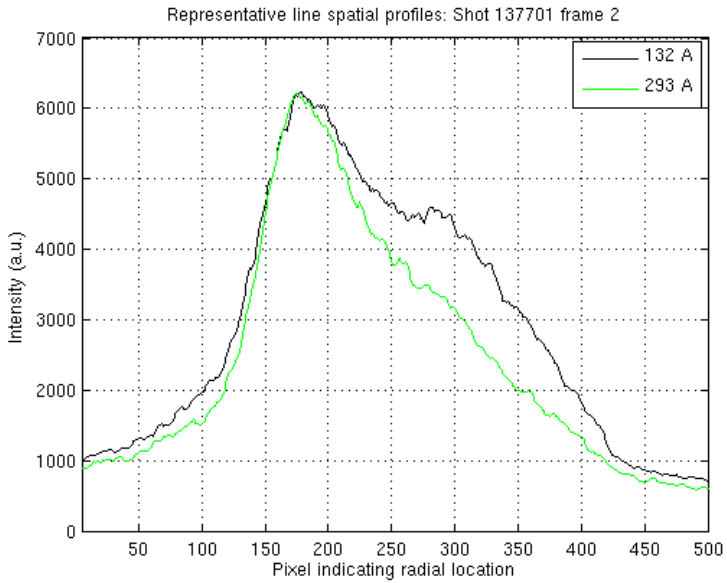
Molybdenum

- 74 A Mo peak correlates with (Mn like Mo)
  - Some shots where DIM observed Mo
  - No LITER and strike points on LLD
- However, no effect of Mo on Z_{eff}
- Data is noisy:



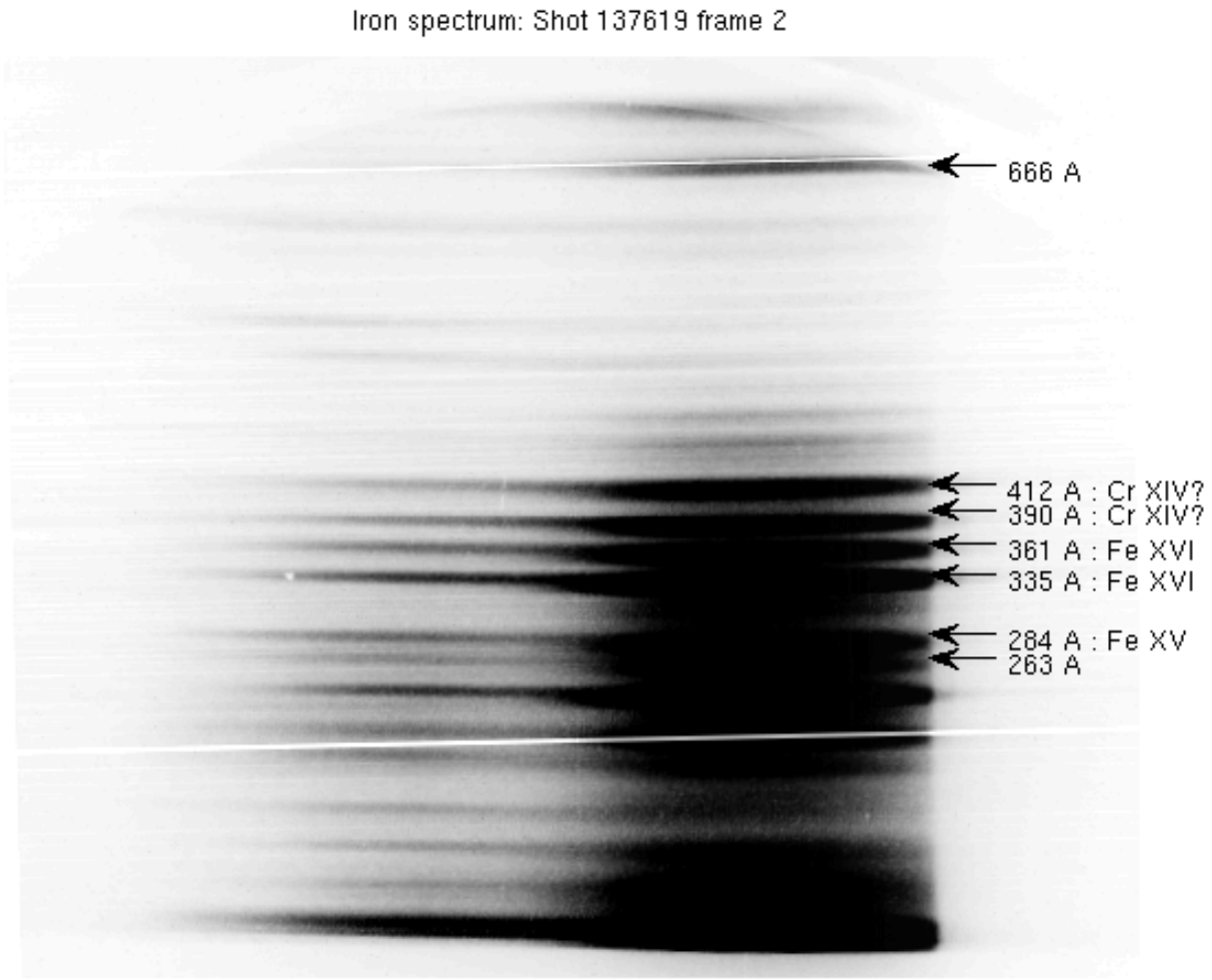
Lithium

- Spatial profile of the ohmic spectrum at 135 A confirms that some Li does get into the plasma.
- With NBI, the spatial profile indicates that there is something in addition to charge exchange.



Iron

- Metals observed sometimes in the second frame when P_{rad} rises.

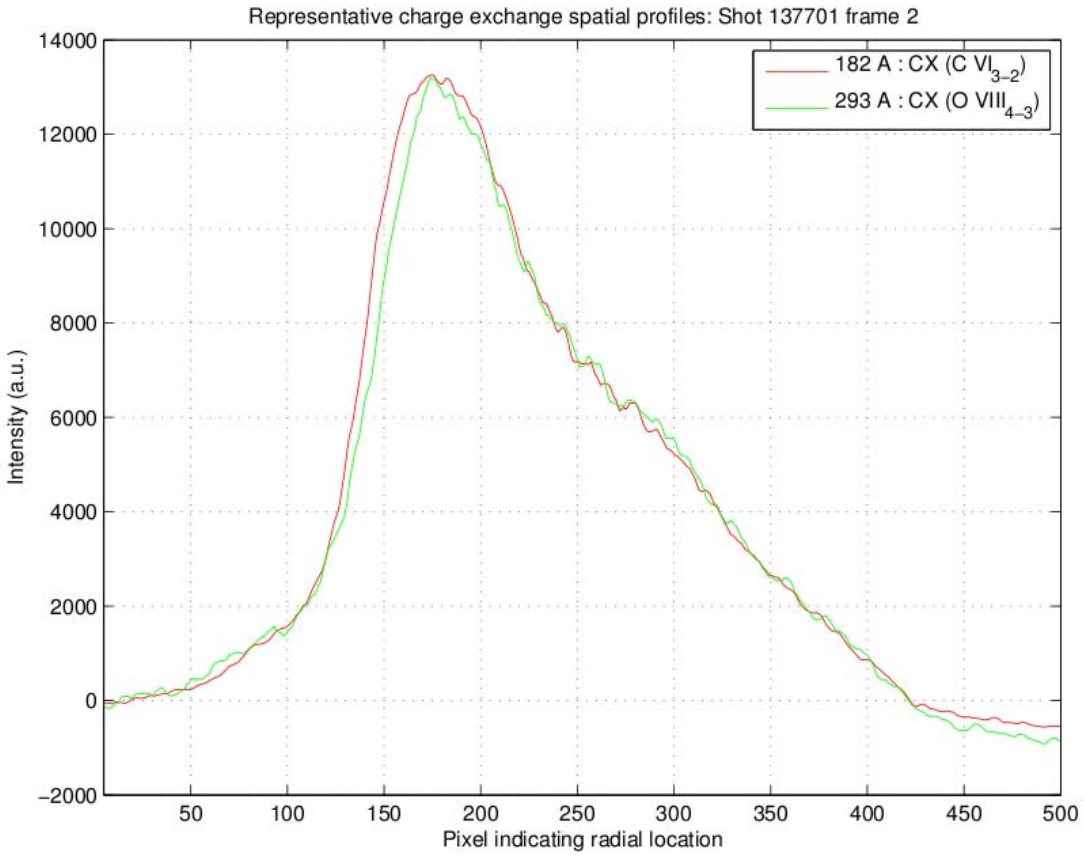


WHAT ABOUT OXYGEN, CHLORINE?

Oxygen

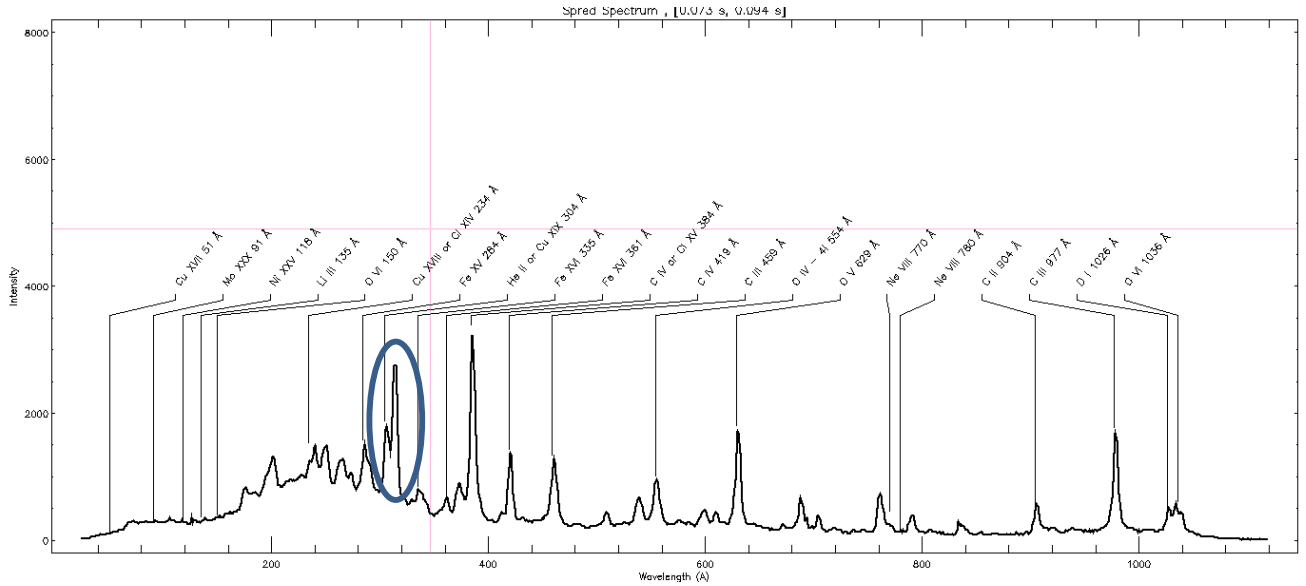
- MCP needs to be calibrated for proper calculations
- From C VI 182 and O VIII 293 $\frac{n(C^{6+})}{n(O^{8+})} = 8.6 \pm 3$
- From C VI 521 and O VIII 293 A:

$$\frac{n(C^{6+})}{n(O^{8+})} = \quad 2.5$$

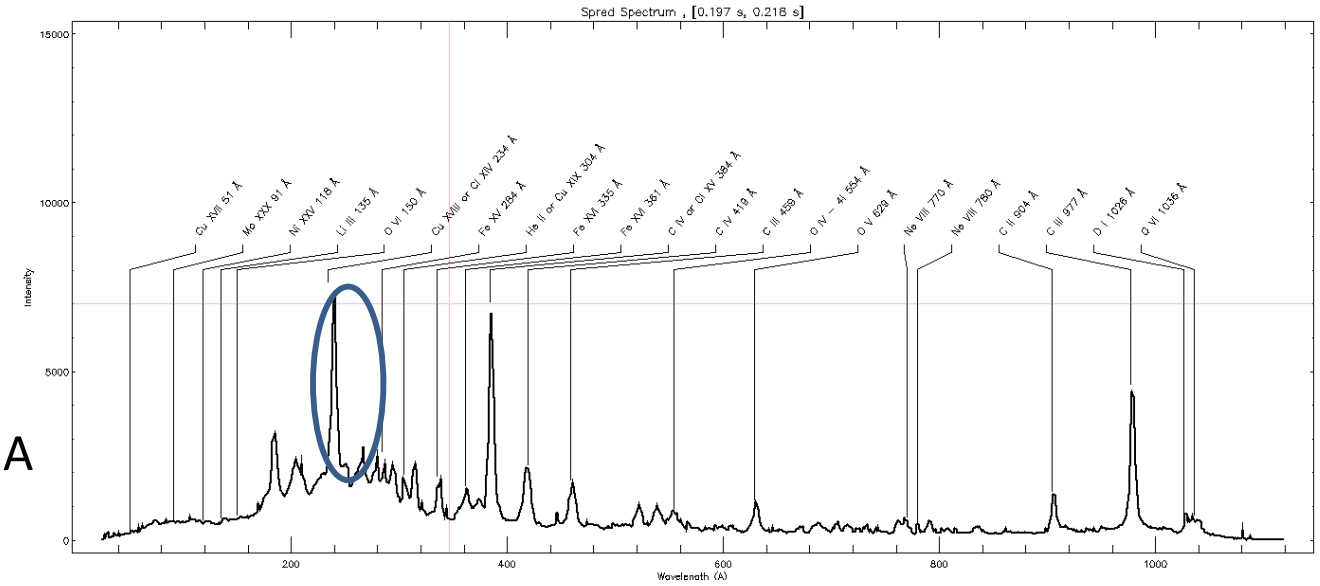


Chlorine (SPRED)

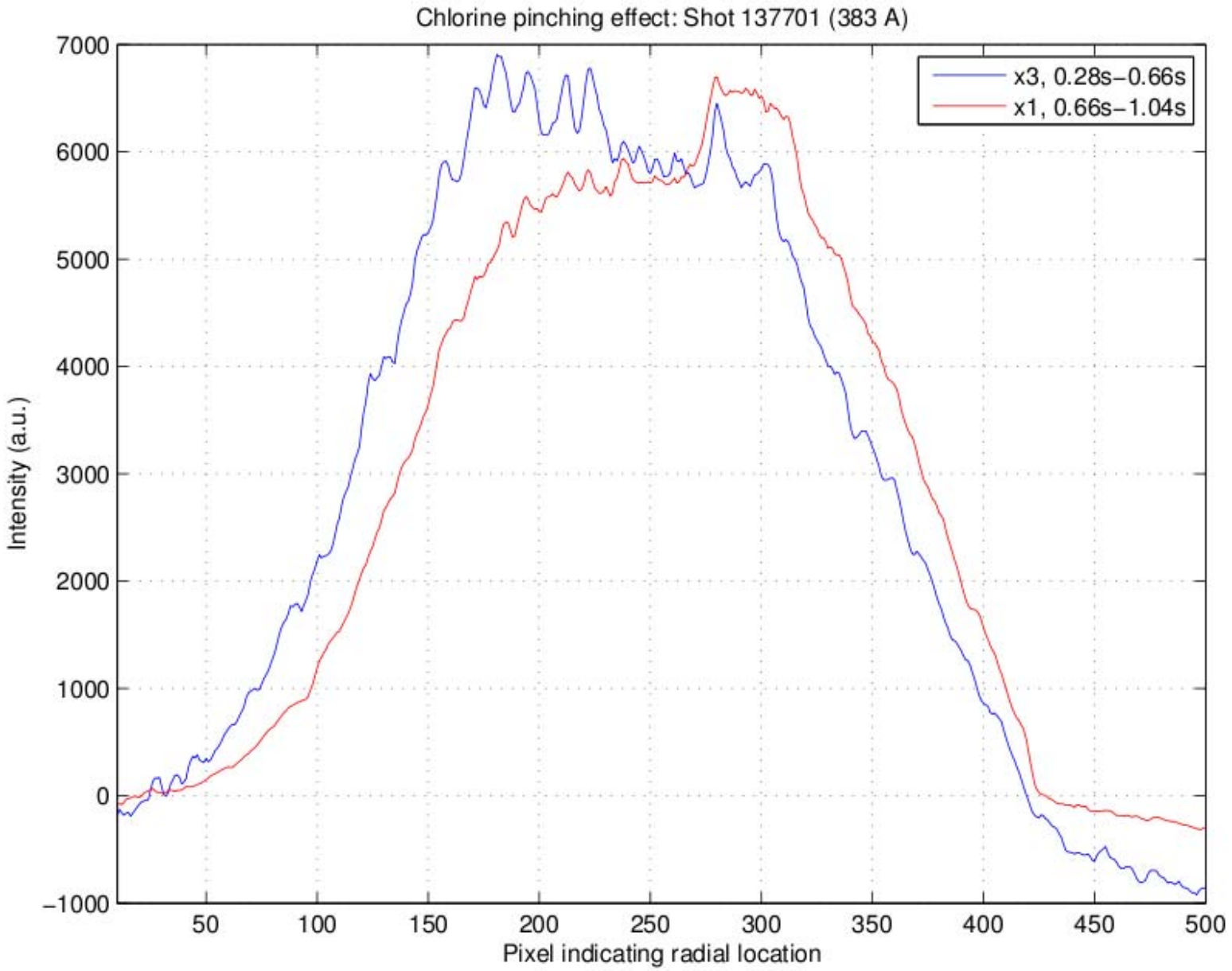
C IV 312 A



Cl XV 237 A



Chlorine (accumulation)



Summary of Cl

- The presence of 237 A Cl XIV along with Cl XV lines at 384 A and 415 A clearly confirms Cl
- Cl emission substantially brighter with NBI
- Cl seems to accumulate (towards core) with time
- SPRED indicates presence of Cl at least since March 2007

Conclusion

- Results – C, O, Cl, Li, Fe, Mo (?), ~~Cu~~
- Future direction
  - Geometric modeling
  - High speed readout
  - After run – Calibration of MCP efficiency

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