Balmer lines measurements on ASDEX Upgrade

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with contribution from:
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- Motivation and Experimental setup
- First analysis and preliminary results
- Conclusion and outlook

Motivation

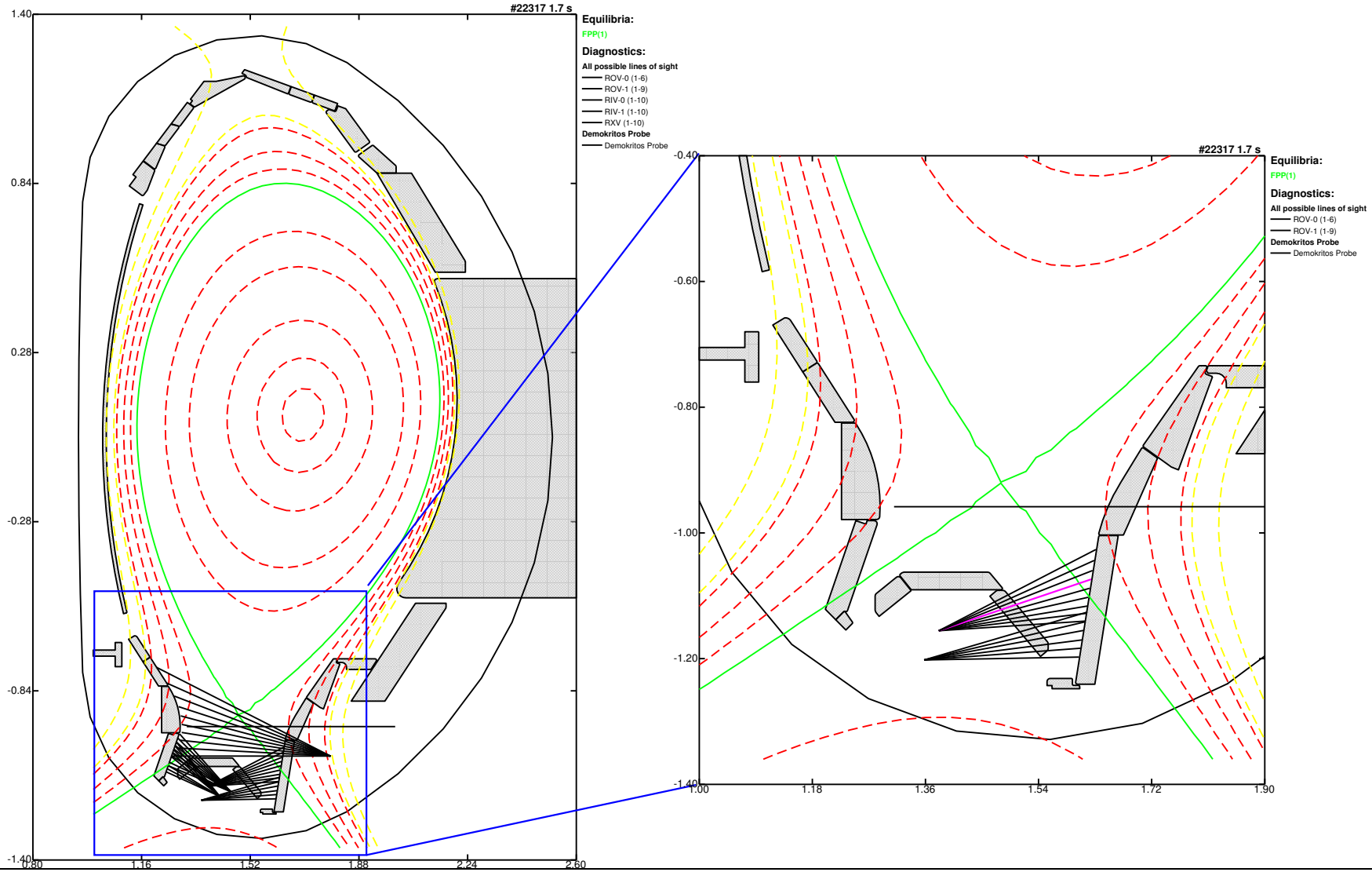
Main diagnostic in divertor for measuring Te and ne are Langmuir probes but in detached plasma and during ELMs are not reliable!

Spectroscopic techniques have to be used to get information from the plasma volume

- line ratios	Te,ne
- doppler broadening	Ti
- stark broadening	ne

In the following Stark broadening analysis have been used the tabulation from C.Sthele,R.Hutcheon, Astron. Astrophys. Suppl. Ser. 140, 93 (1999).

Plasma configuration and lines of sight: intensities are line-integrated



Diagnostic system

About 60 LOS in the inner and outer divertor across the separatrix
to be coupled to:

2 x 1-m Czerny-Turner spectrometers each with 6 channels $\Delta\lambda/\lambda$ = 3e-5

1 x 1.5 Fastie-Ebert spectrometer with Echelle grating with 6 channels $\Delta\lambda/\lambda$=3e-6

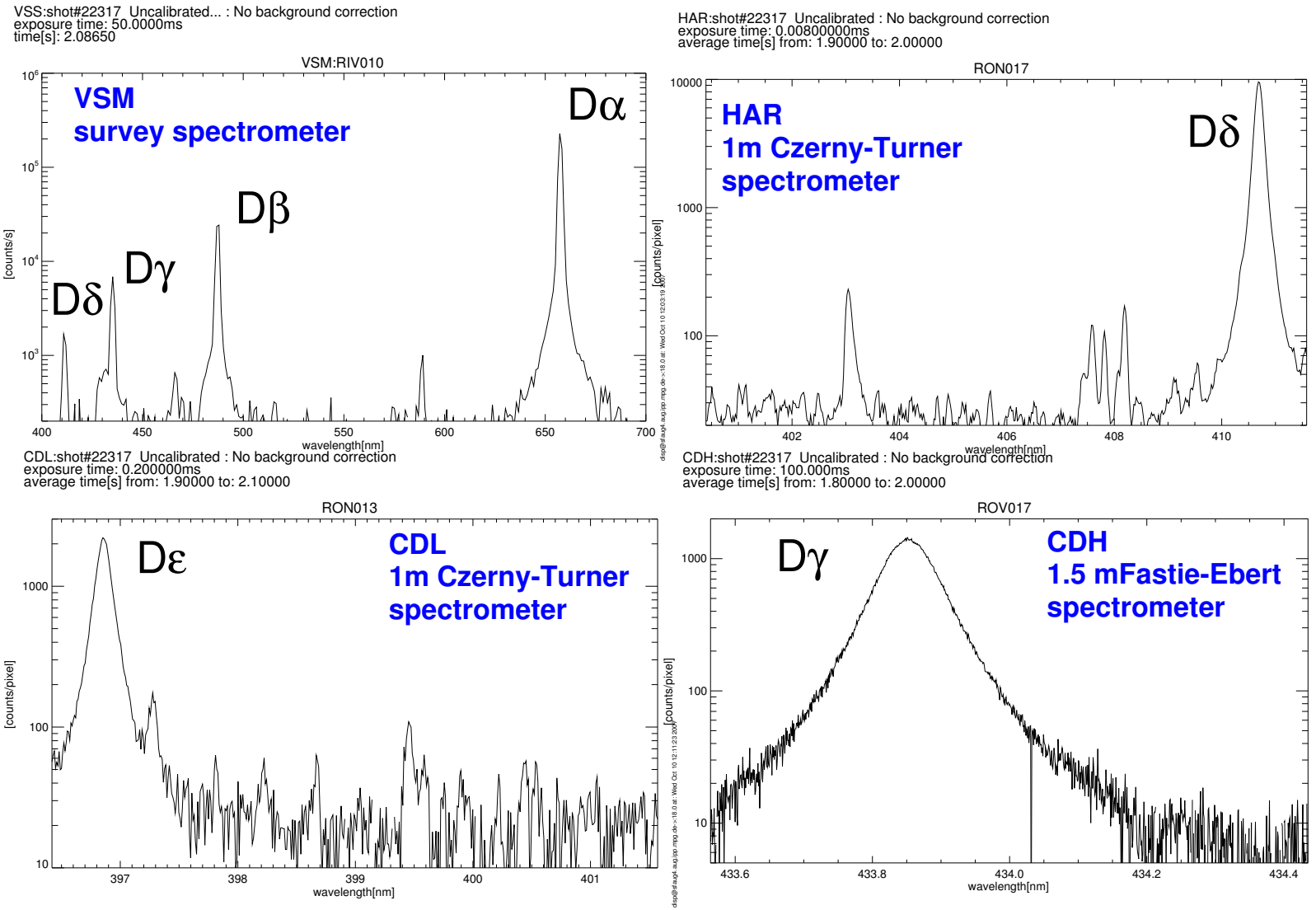
30 x Photomultiplier with interference filters

2 x Survey spectrometers for inner/outer divertor

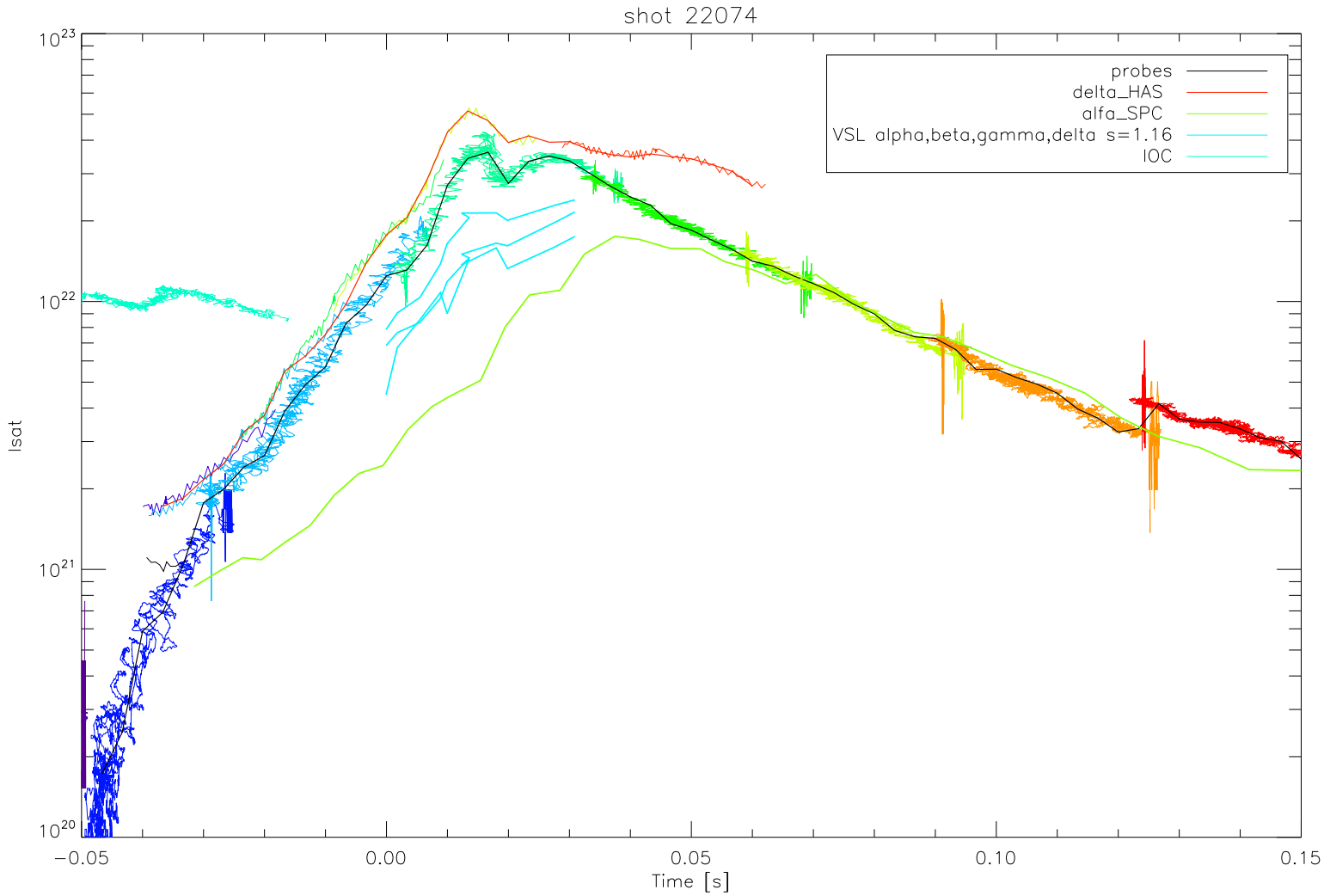
Arrays in the outer and inner divertor with Dα interference filter on CCD camera

Diagnostic gas injection system with wide angle observation LOS

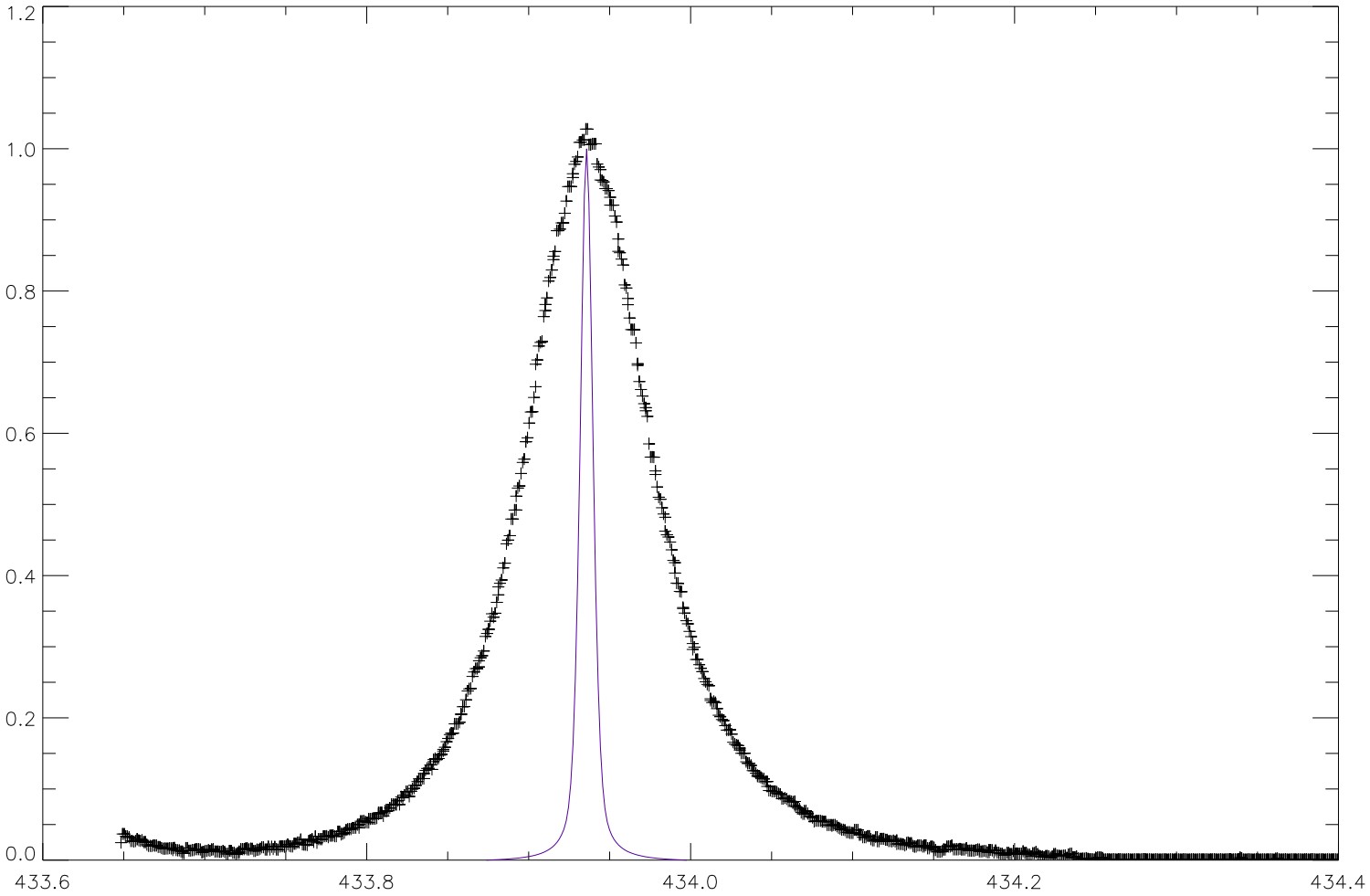
Balmer lines spectra from 4 different spectrometer



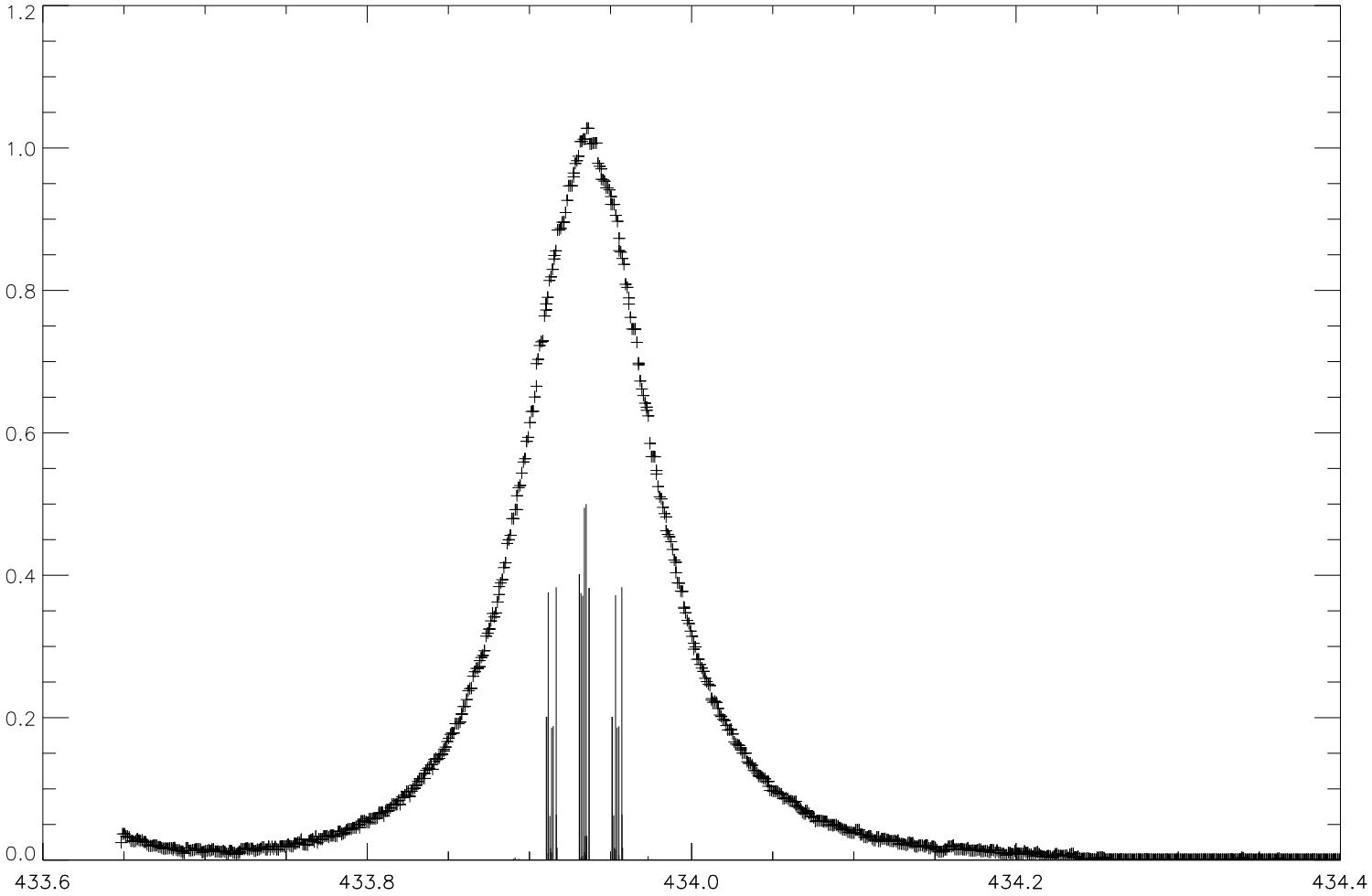
Reconstructed ion/D fluxes vs the distance from the separatrix: but are the S/XB from Langmuir's ne/Te correct ?



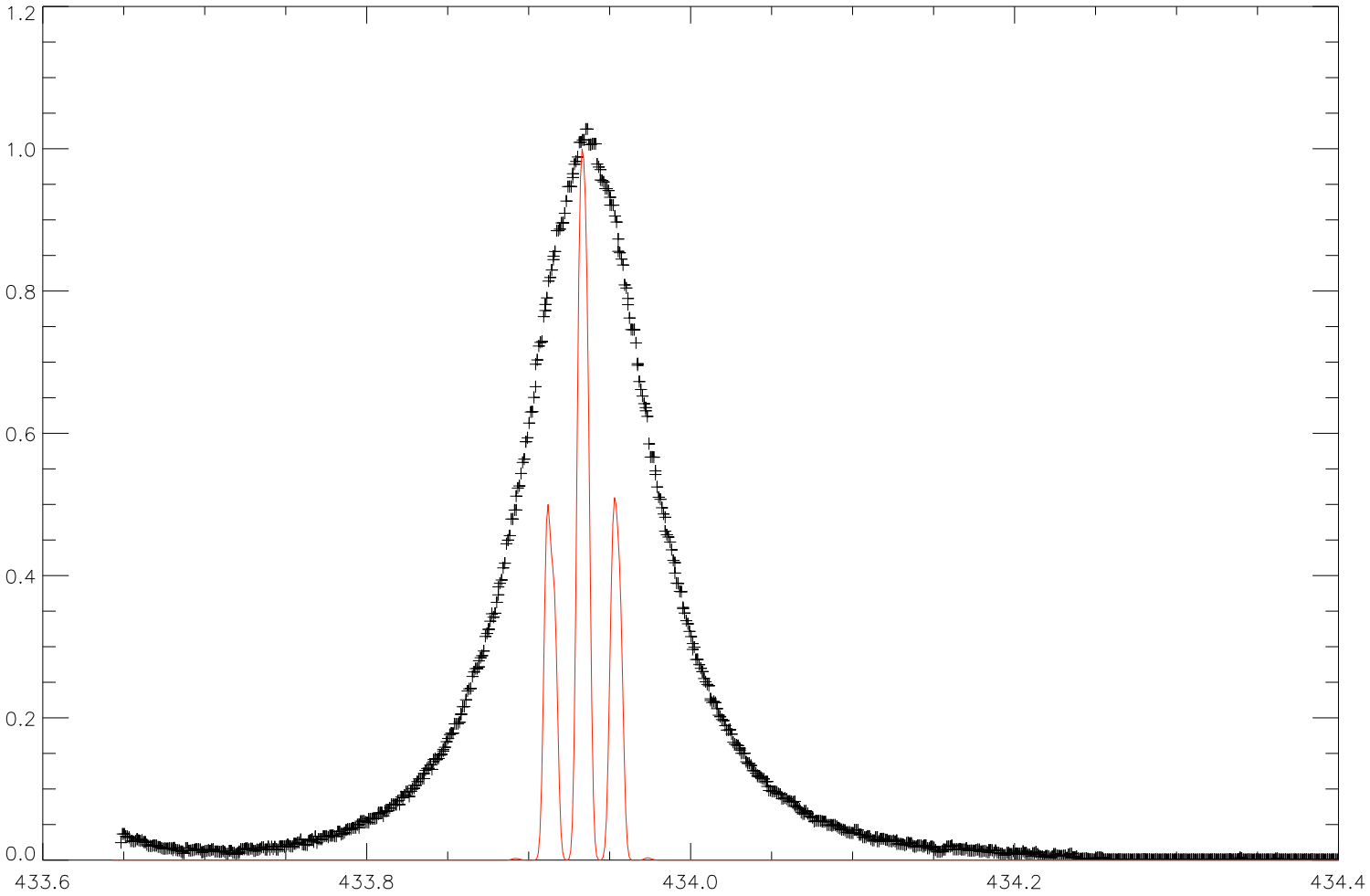
Dγ experimental profile and instrumental function



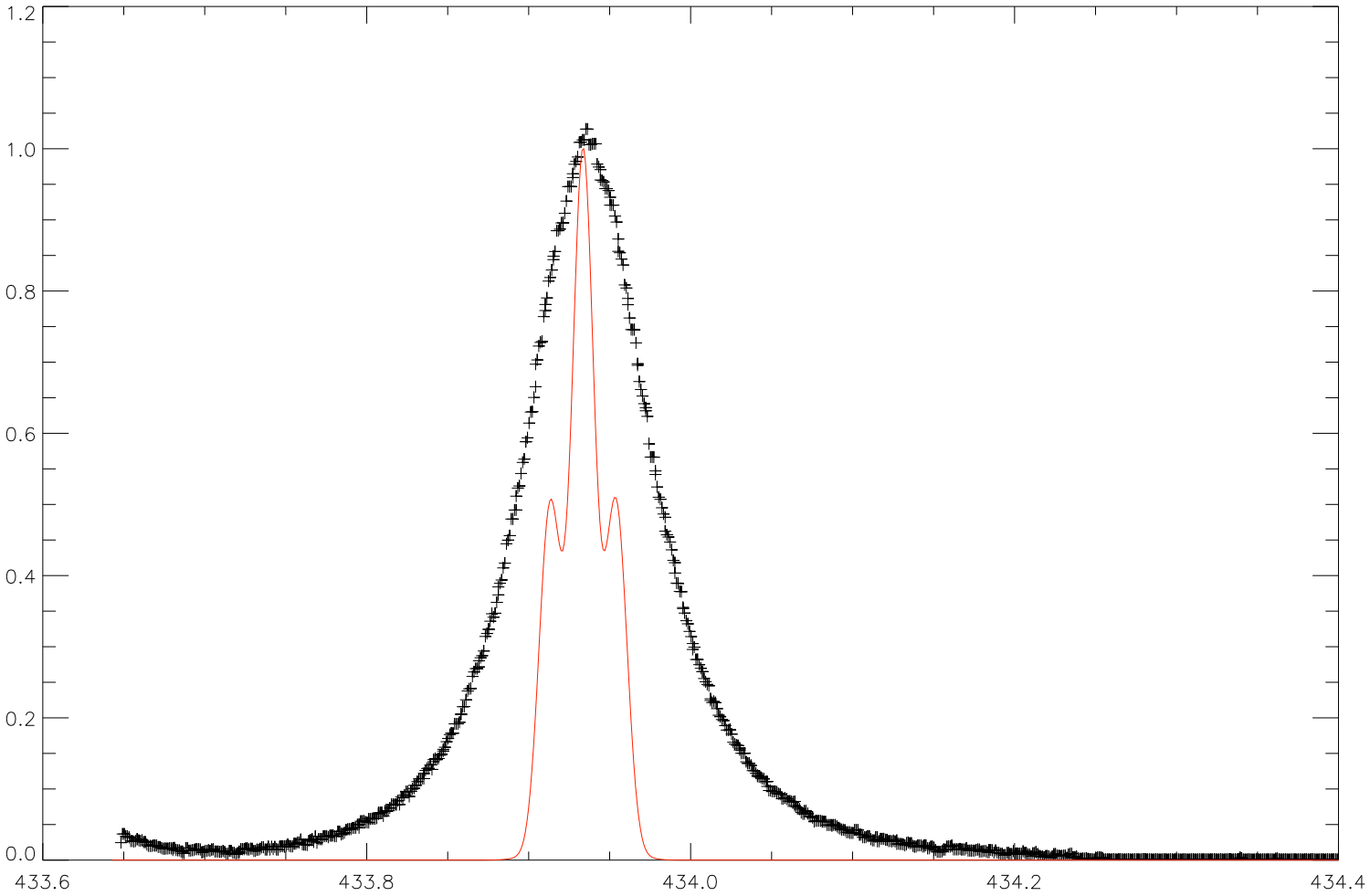
Dγ experimental profile and Zeeman components (B=2 T)



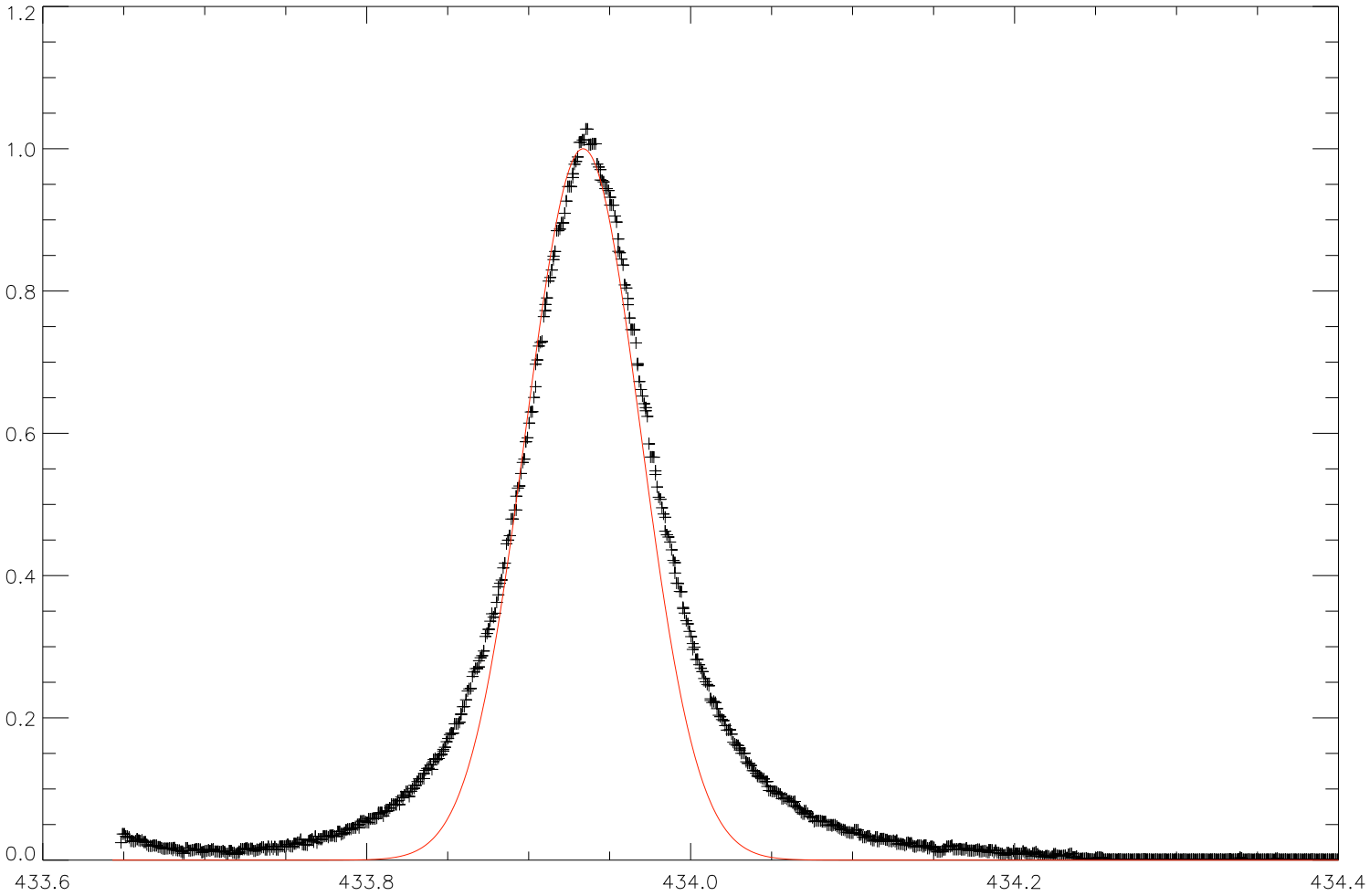
Dγ experimental profile and convolution of Zeeman component with the instrumental function



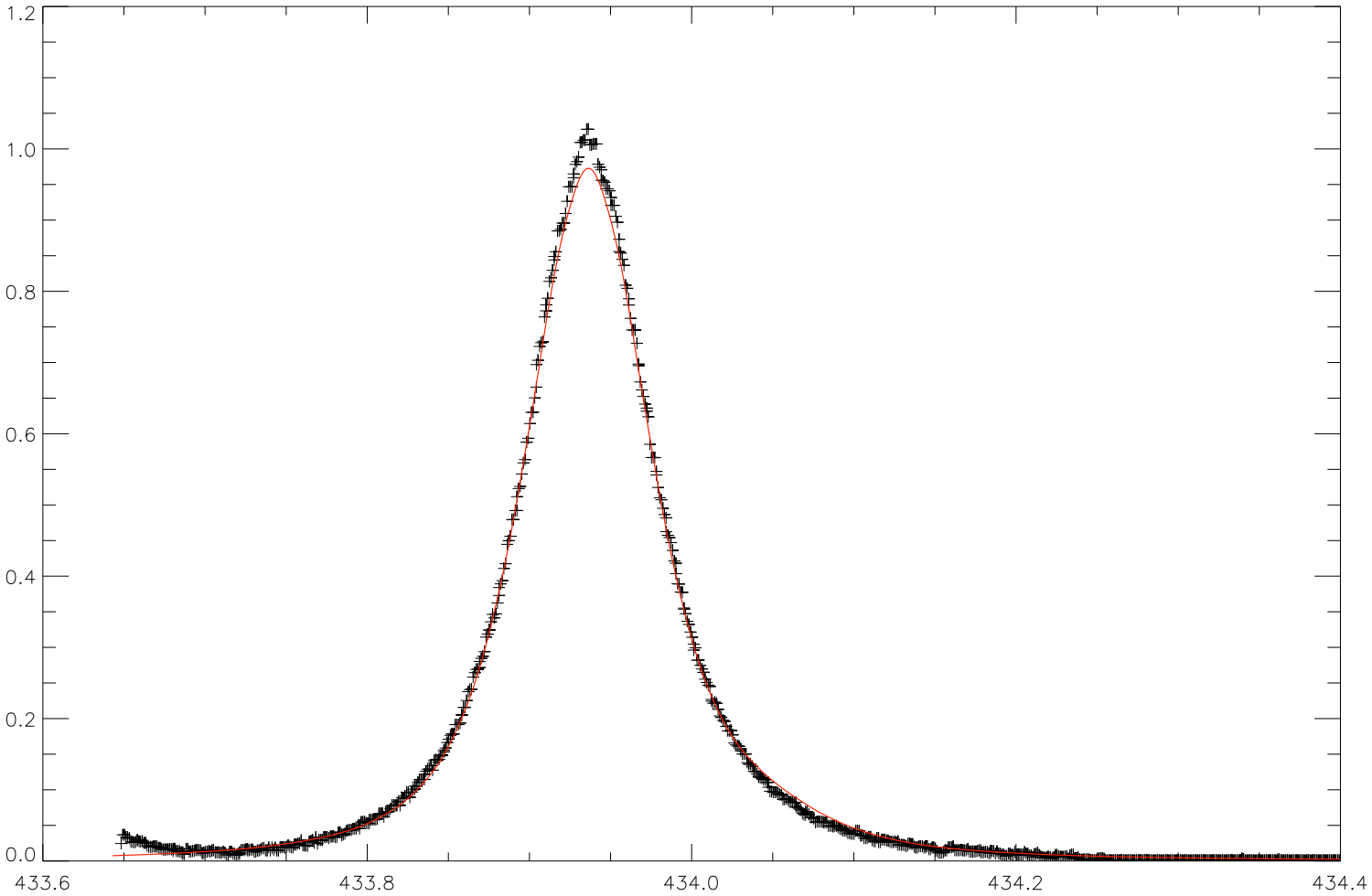
Dγ experimental profile and doppler broadening for Ti = 0.4 eV



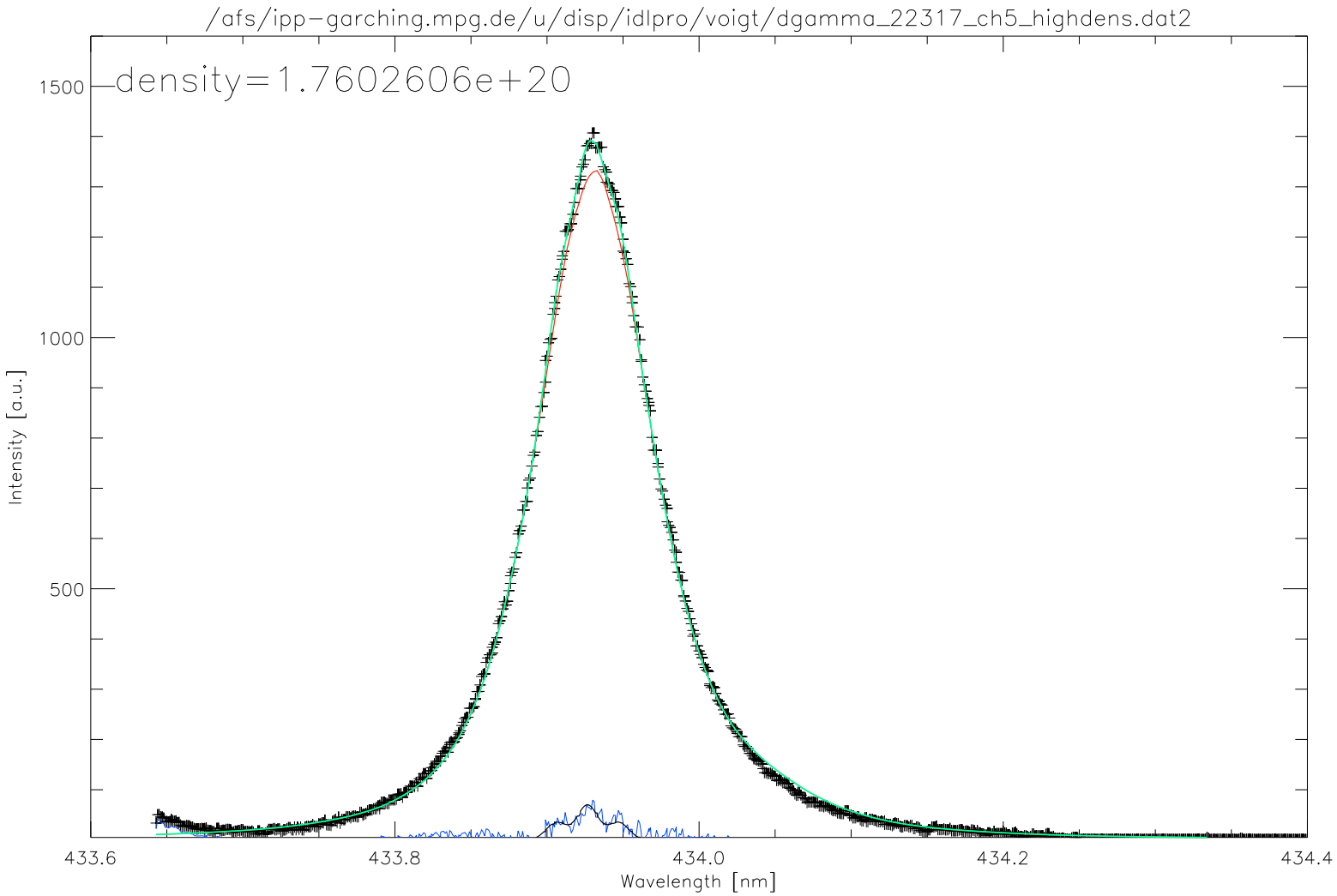
Dγ experimental profile and doppler broadening for Ti = 10 eV



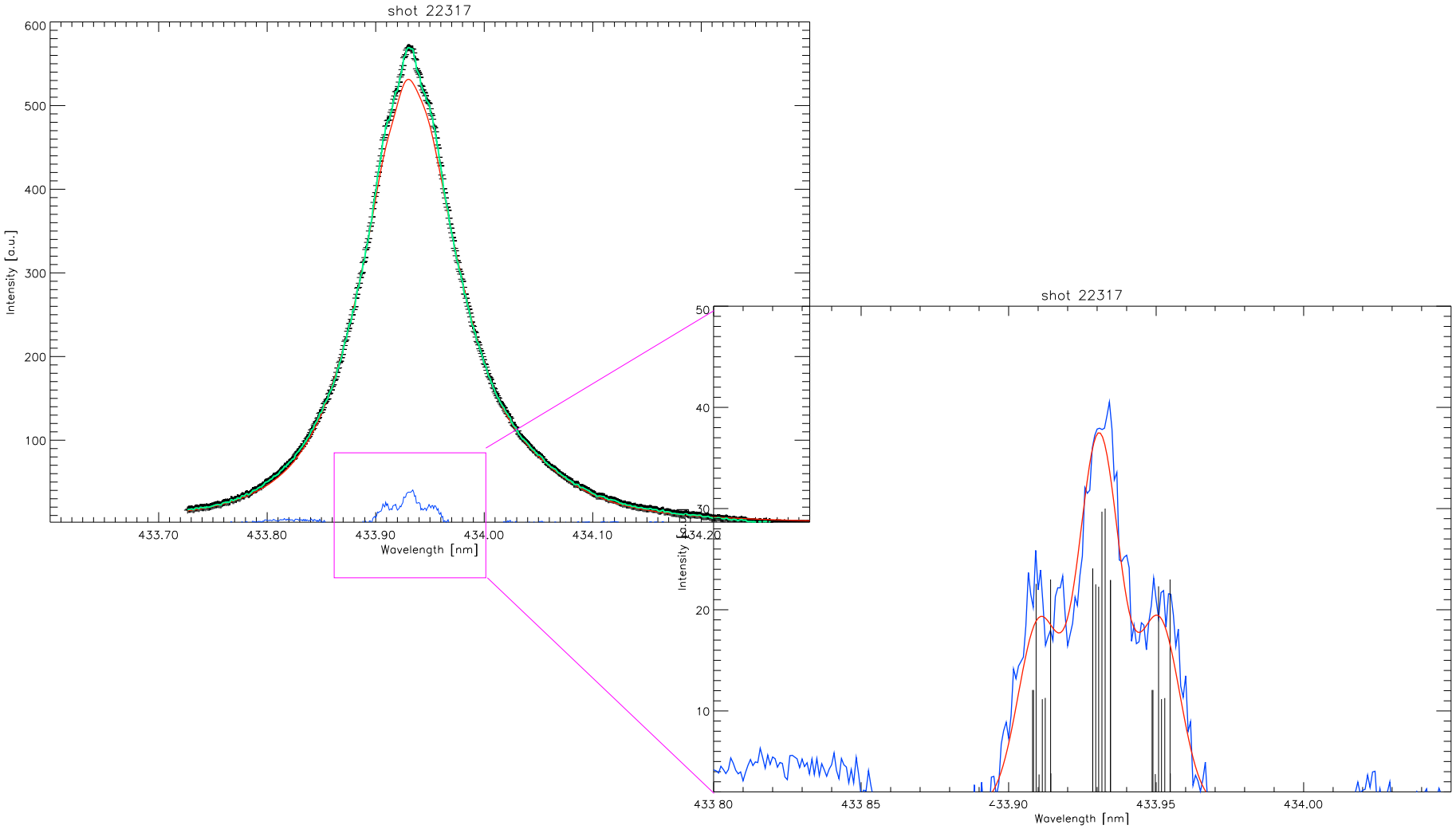
Dγ experimental profile and Stark profile fitting the spectrum wings for ne = 1.8e20 and Te = 0.4 eV



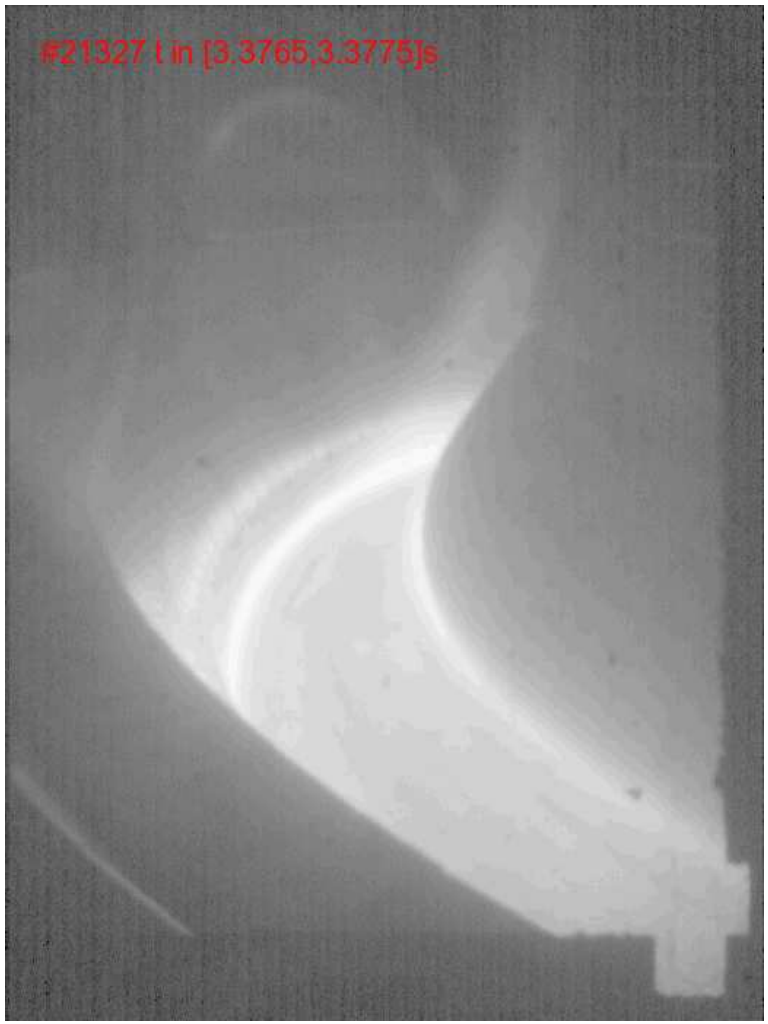
Subtracting the Dγ experimental profile and Stark profile: a low density/low temperature component remain

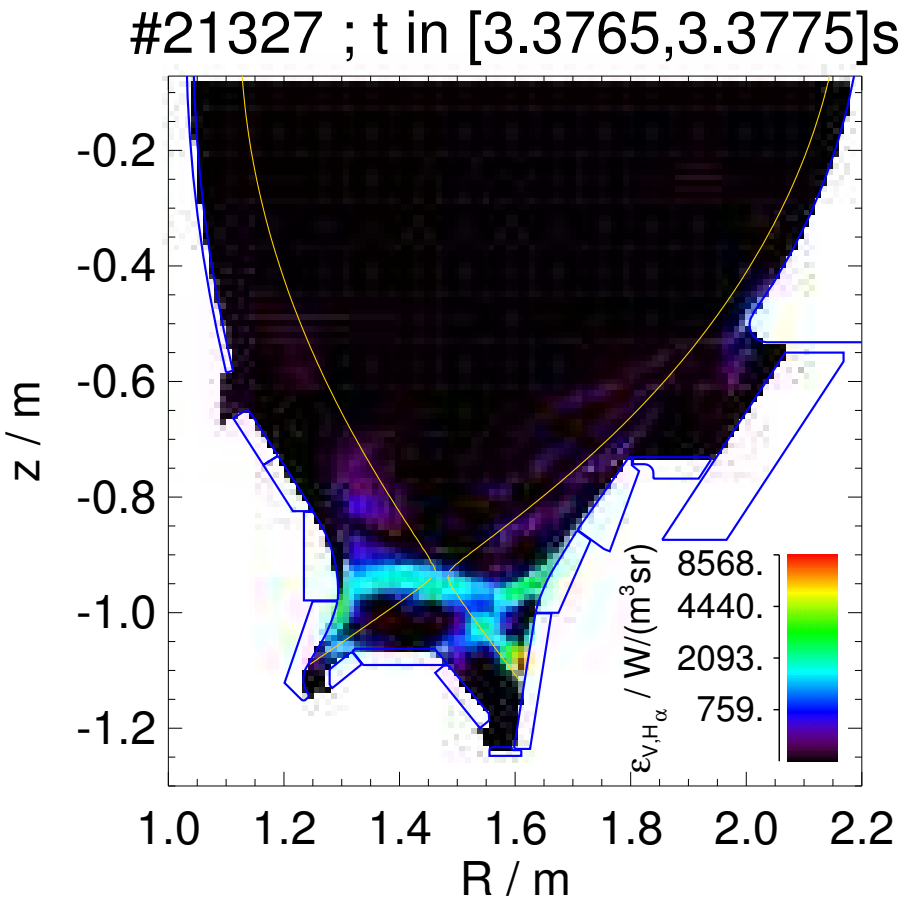


The low density/low temperature component: Te < 0.4 eV

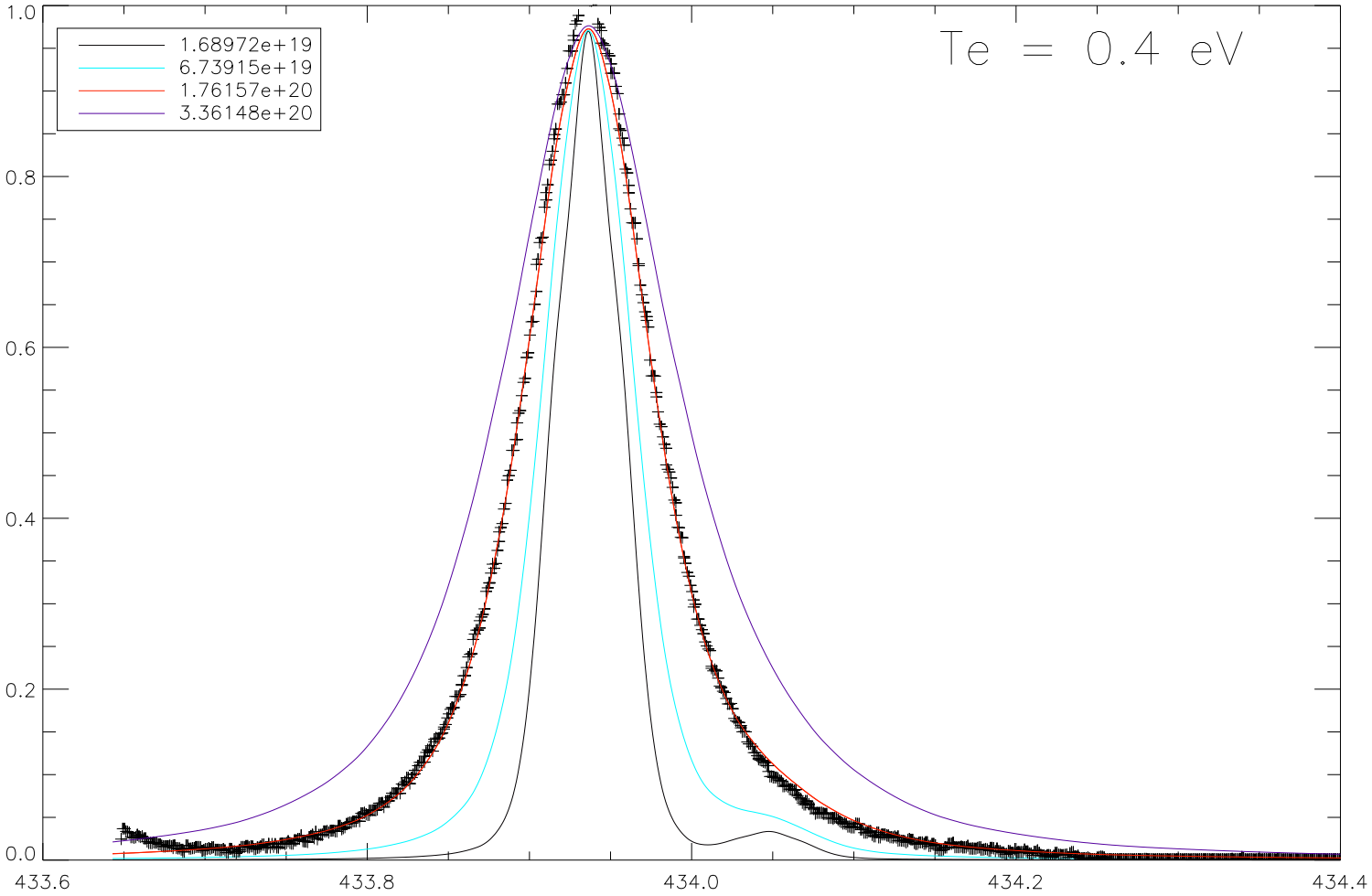


Dα CCD image and poloidal emission distribution reconstruction: emission from separatrix and from the target surface





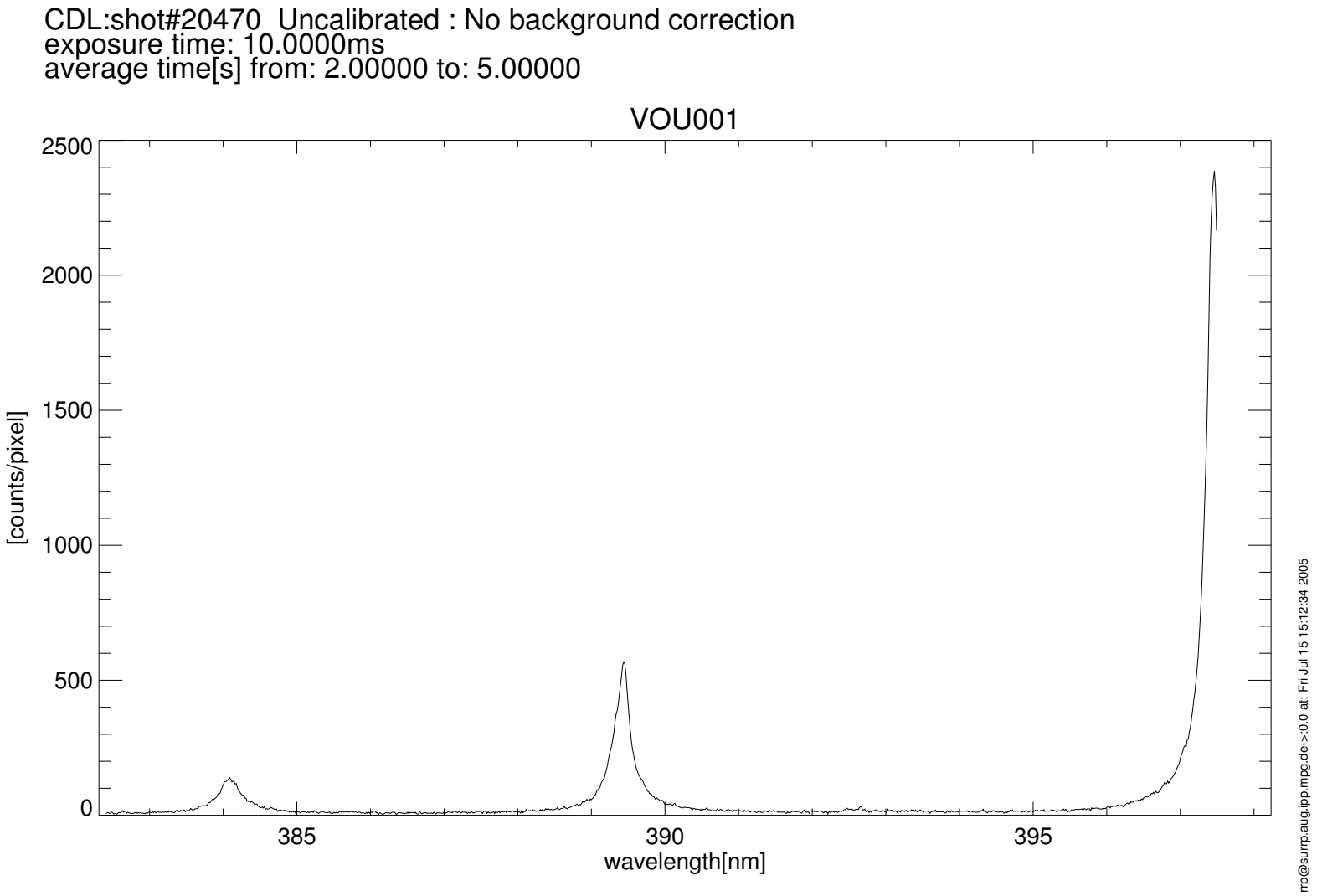
Stark broadening for different densities and experimental profile



Outlook and conclusion

- It looks promising but a lot of work more to do: delta, epsilon, alpha -> delta, ELM resolved, ...
- Calibrated He puffing to cross check Te and ne from Langmuir probes and line-ratios
- Calibrated D puffing to verify Stark broadening and measuring Ti of released thermal D
- ADAS balmer fitting routine available ?
- Other suggestion ?

Balmer 7->2,8->2 and 9->2



Balmer limit

CDL:shot#20479 Uncalibrated : No background correction
exposure time: 10.0000ms
average time[s] from: 0.200000 to: 7.00000