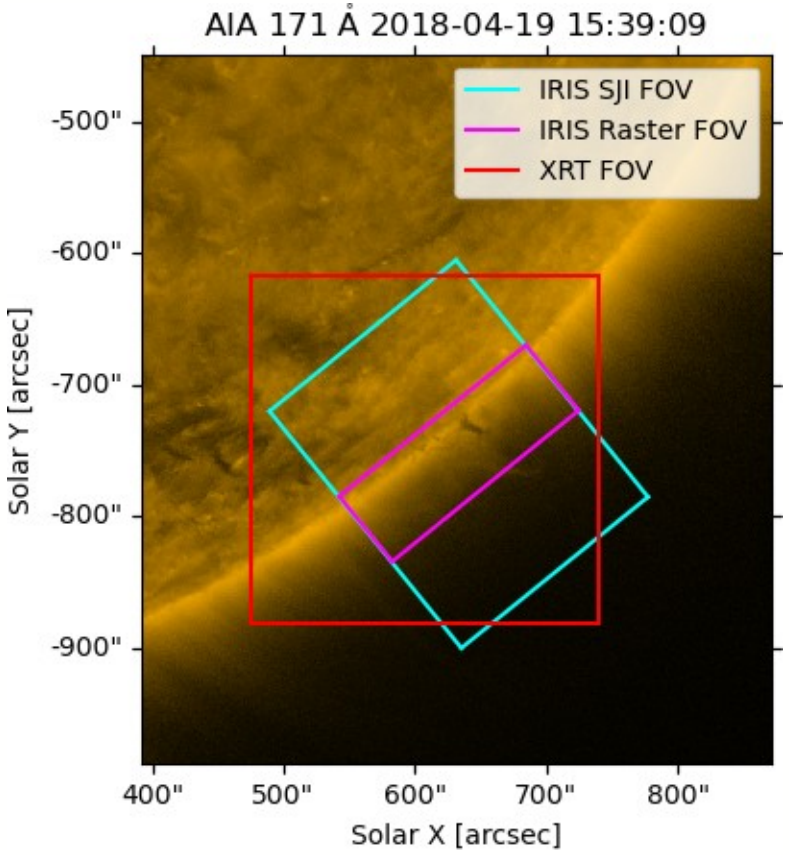
Solar prominence diagnostics from non-LTE modelling of Mg II h&k line profiles

A. W. Peat

N. Labrosse, B. Schmieder, K. Barczynski

Observations



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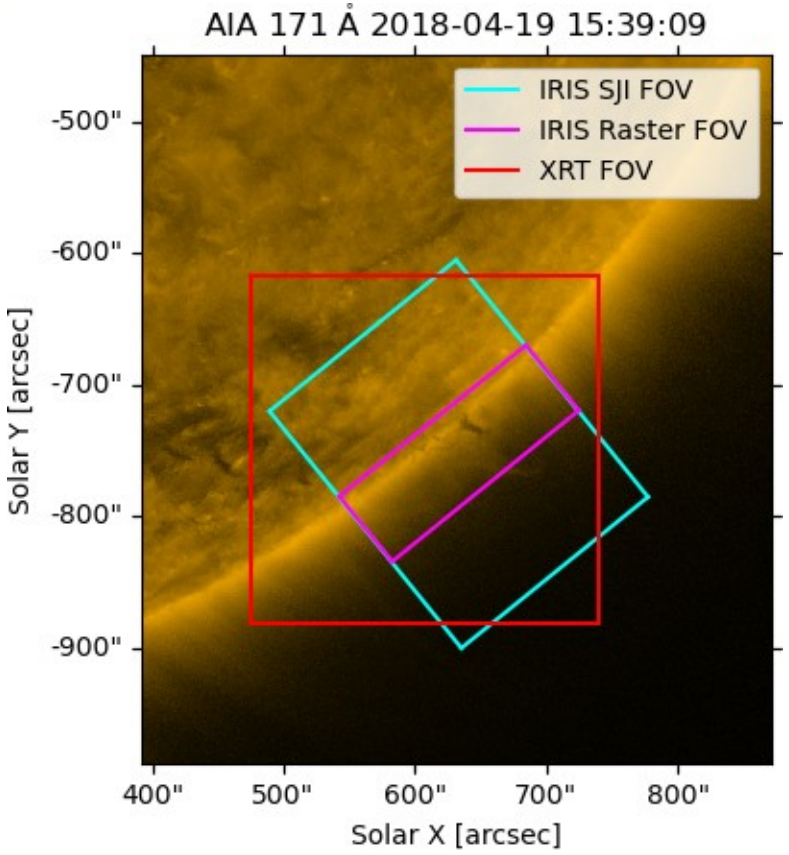

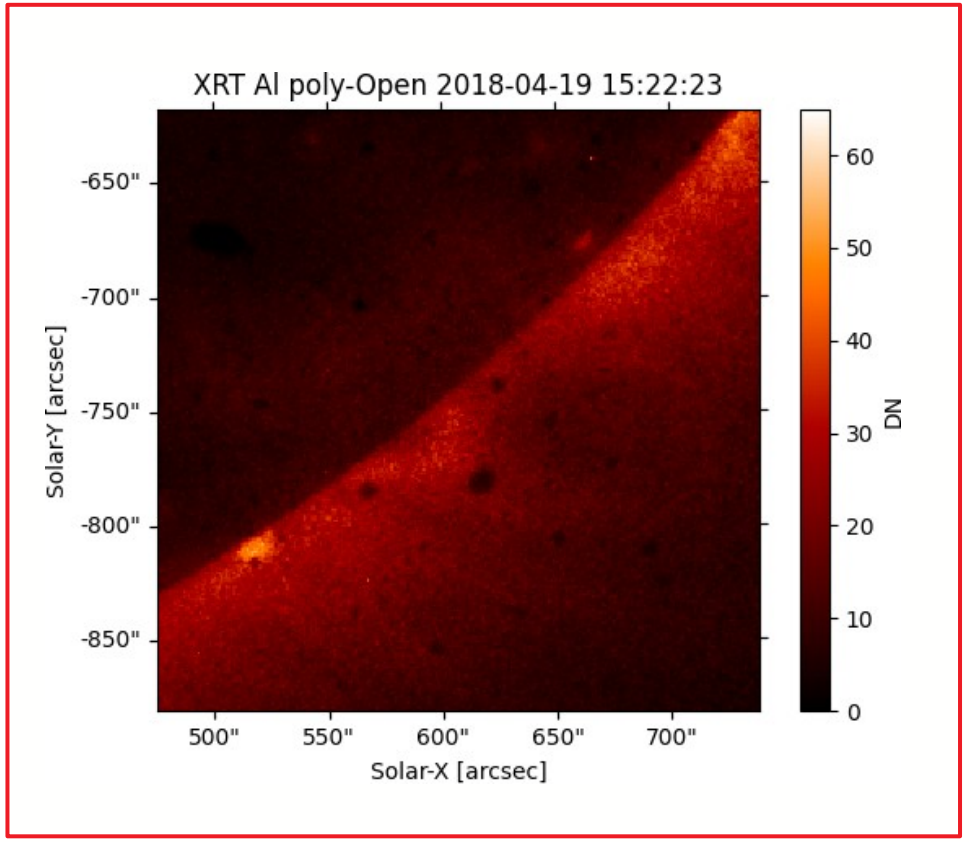

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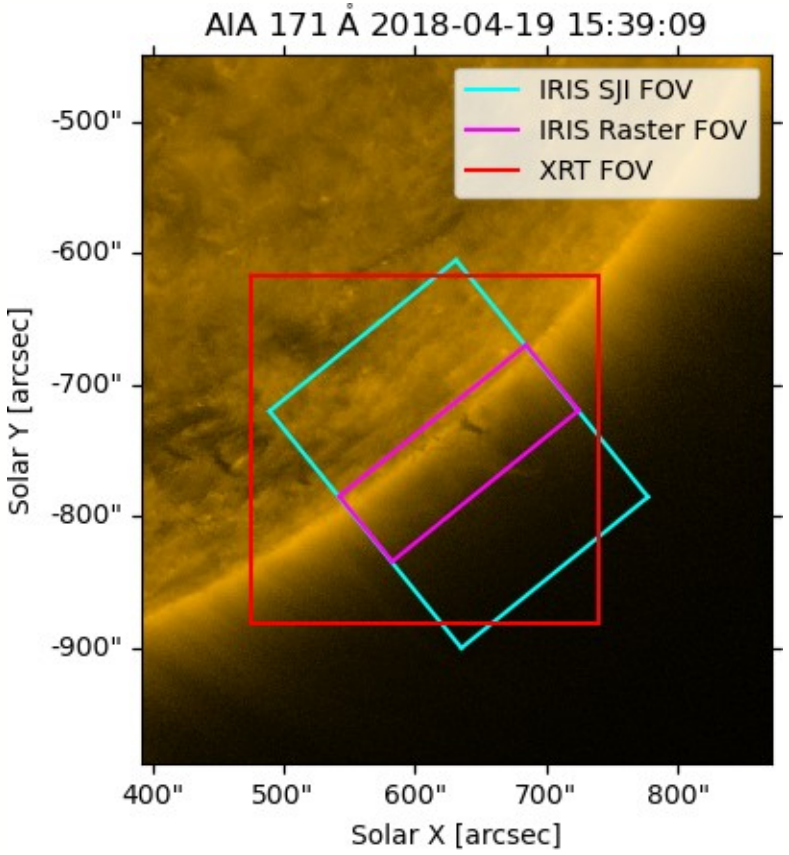

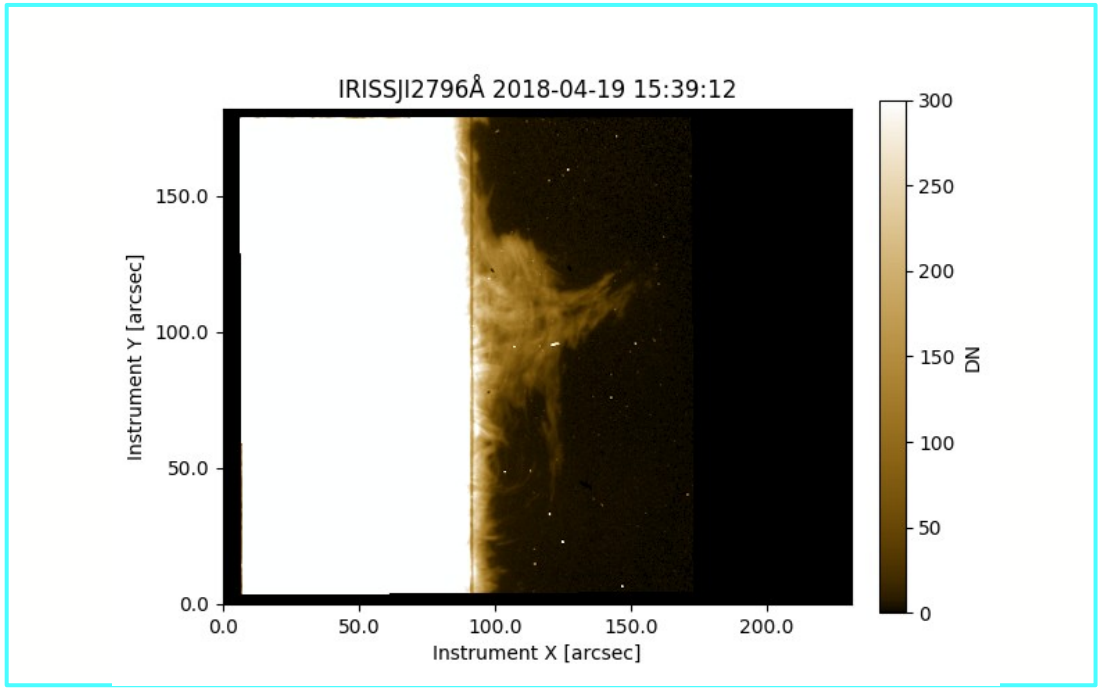

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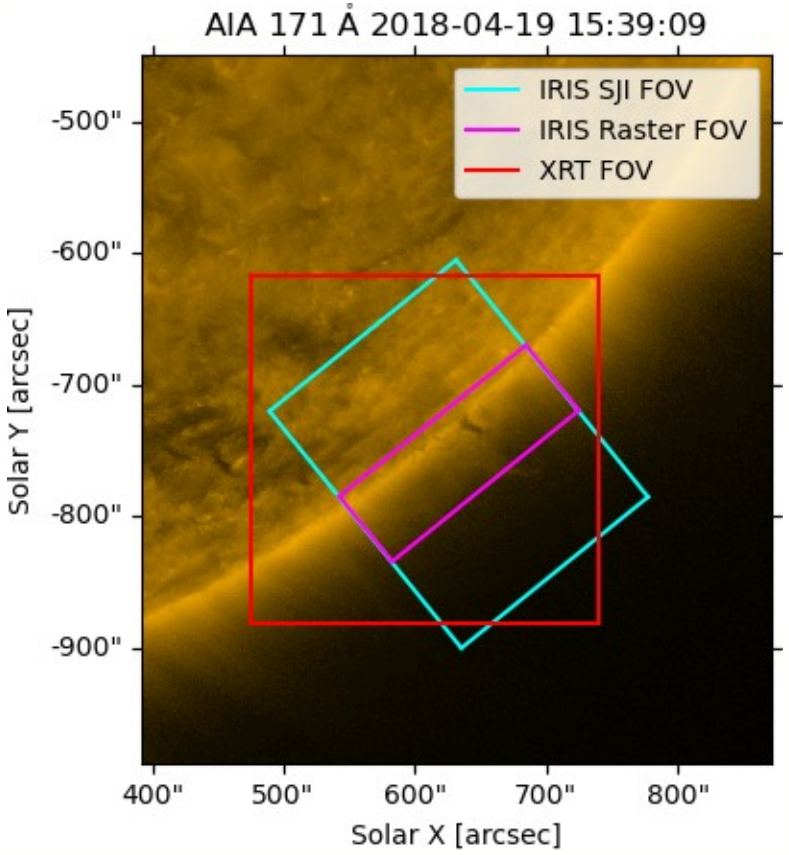

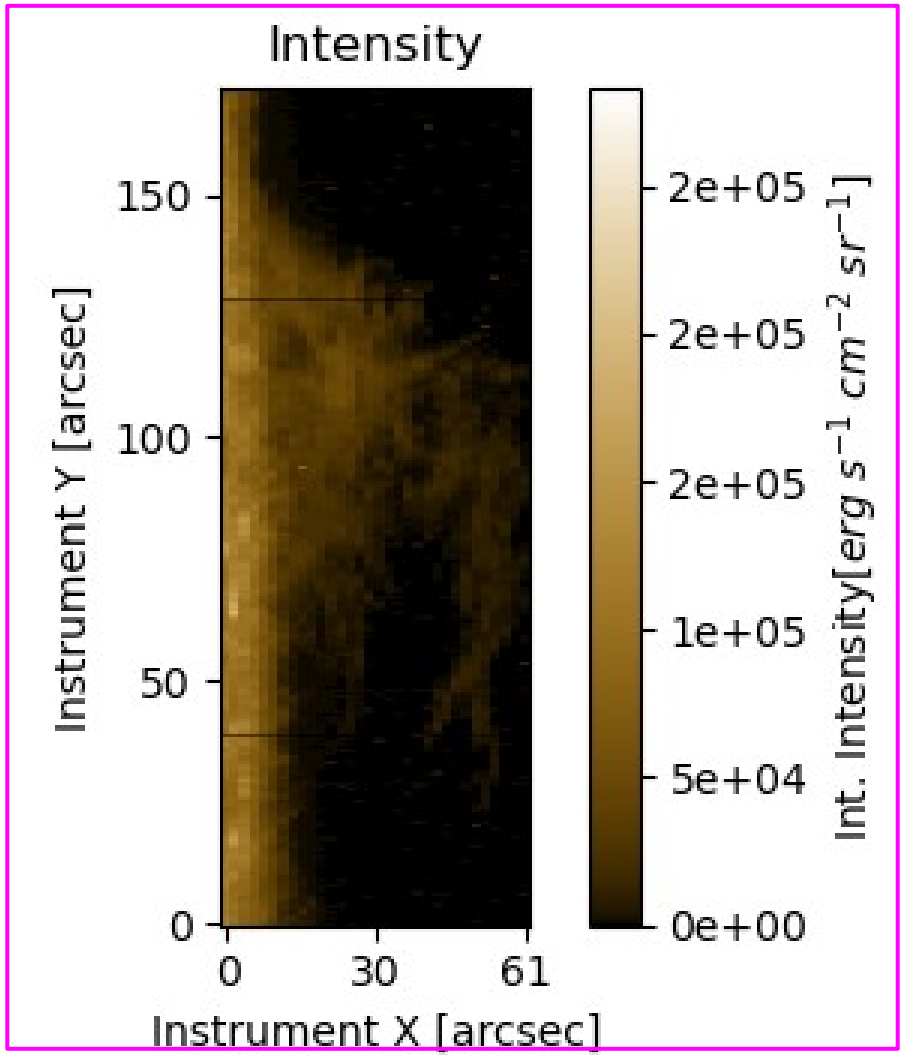

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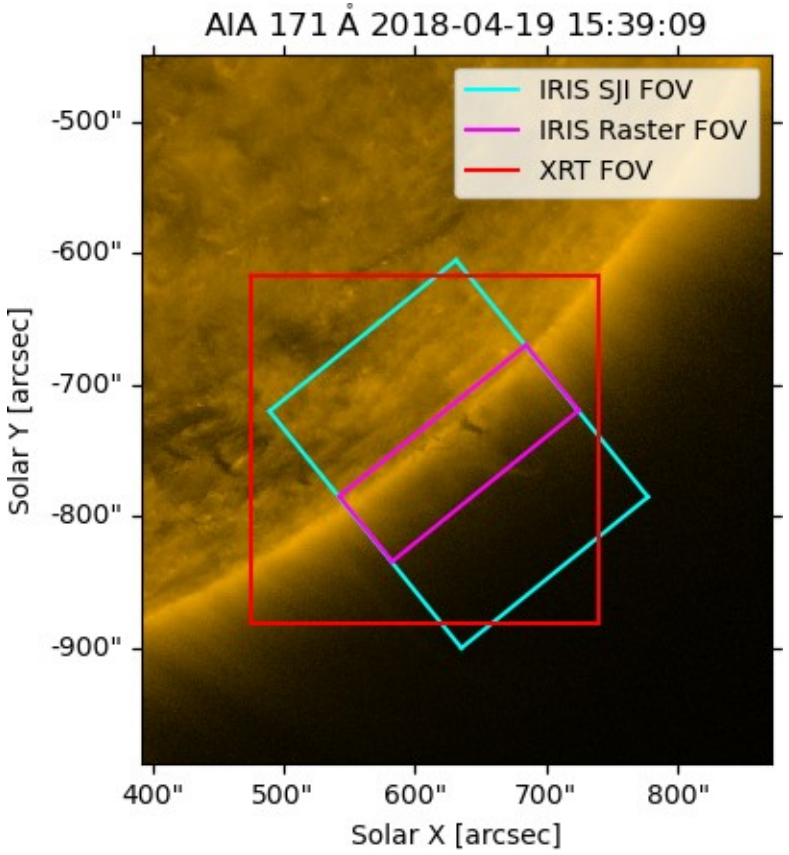
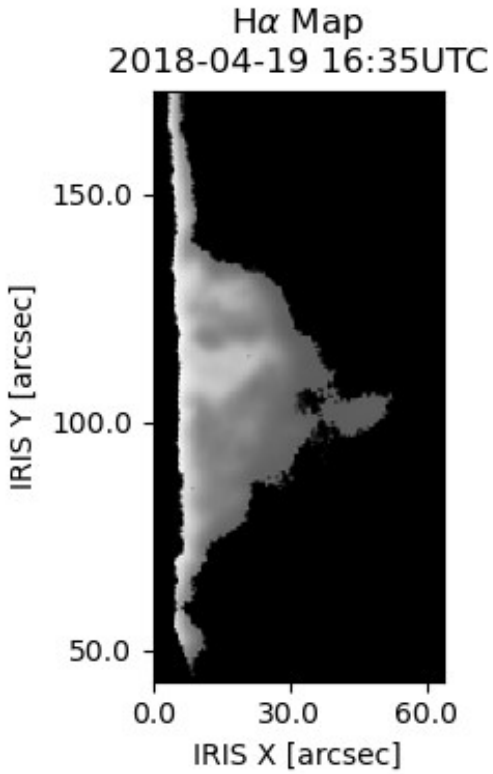
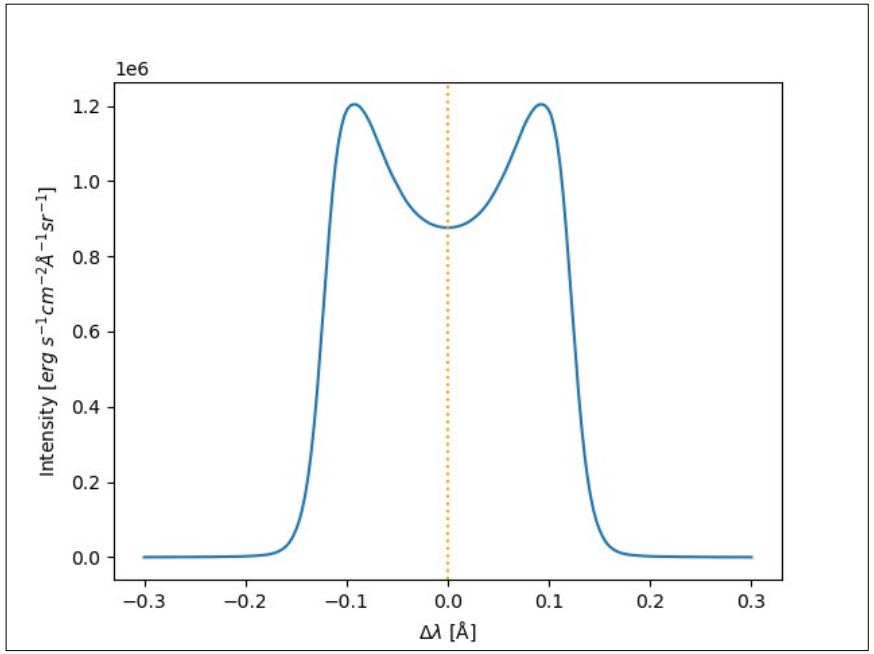




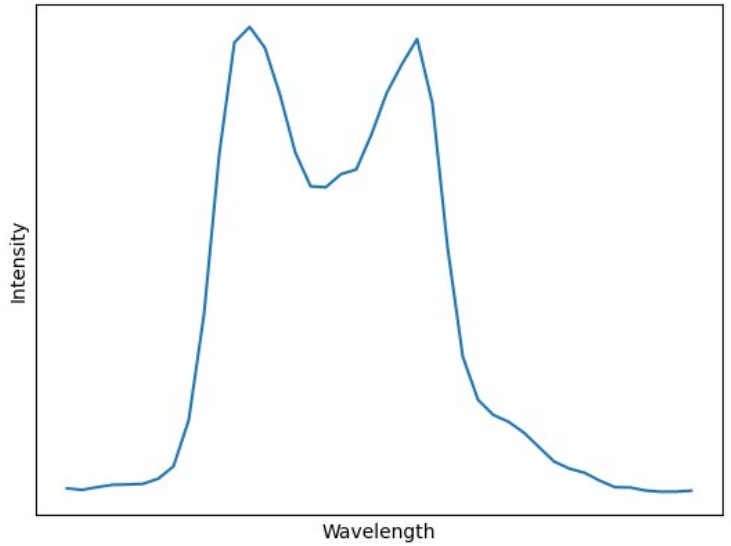
PROM

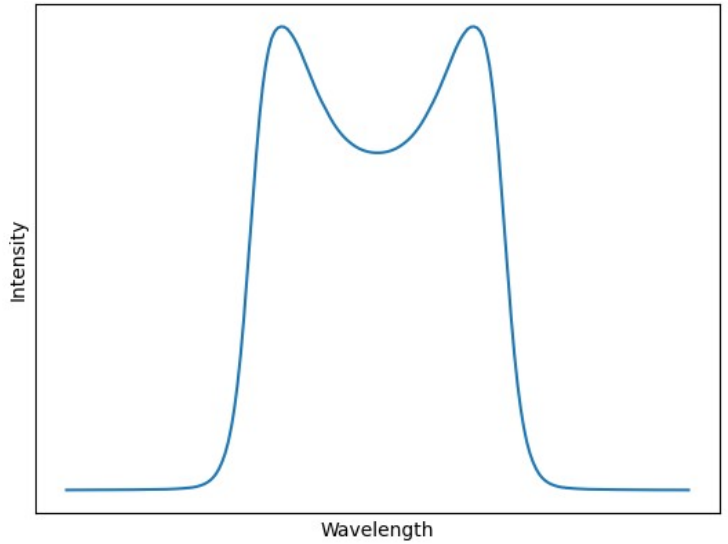
- PROM is a 1D NLTE radiative transfer code.
- By Gouttebroze, Heinzel & Vial (1993)
- Extension by Labrosse & Gouttebroze (2004) added a PCTR
- An extension by Levens & Labrosse (2019) allows for the synthesis of MgII spectra.
  - Generating both the h&k lines and the three triplet lines.
  - These spectra are symmetrical around the line centre.



Prominence Inversions

- Usually, match the full width half maximum and integrated intensities of synthesised line profiles to that of observations.
  - This approach has some obvious flaws
- By doing this, you reduce your profiles to two parameters.
- A better approach would be to match the profiles directly with one another.





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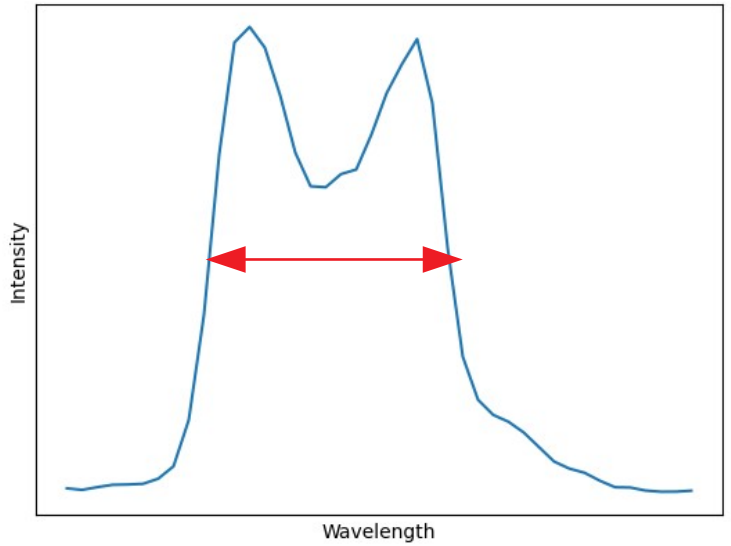

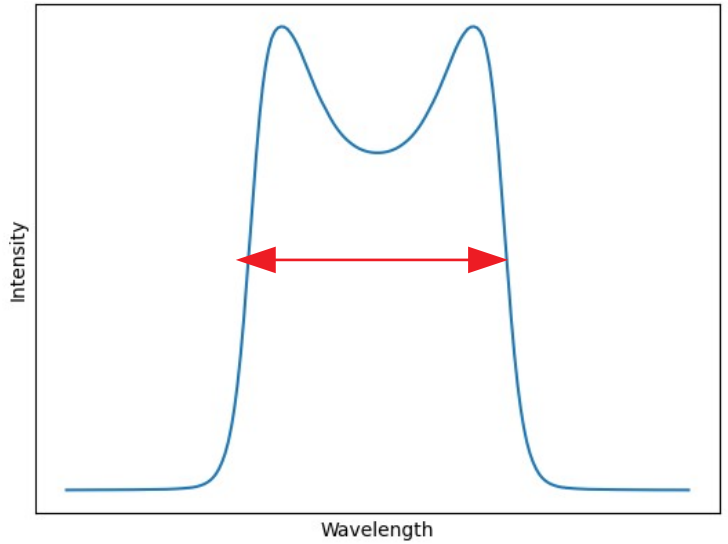

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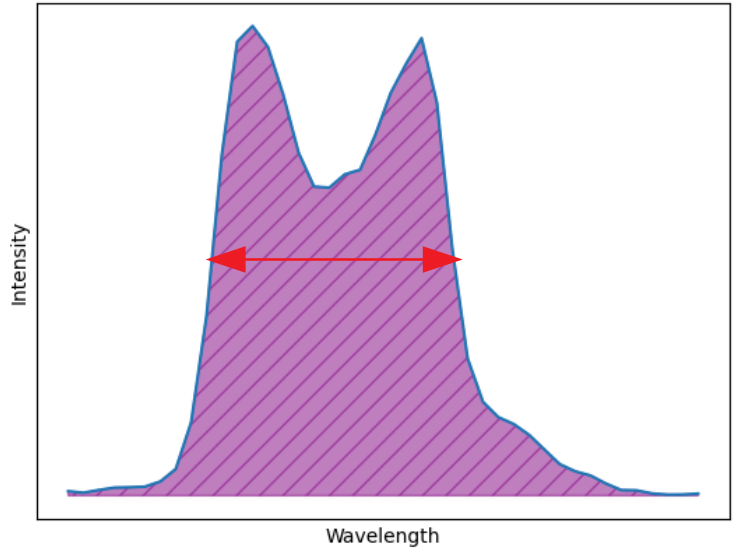
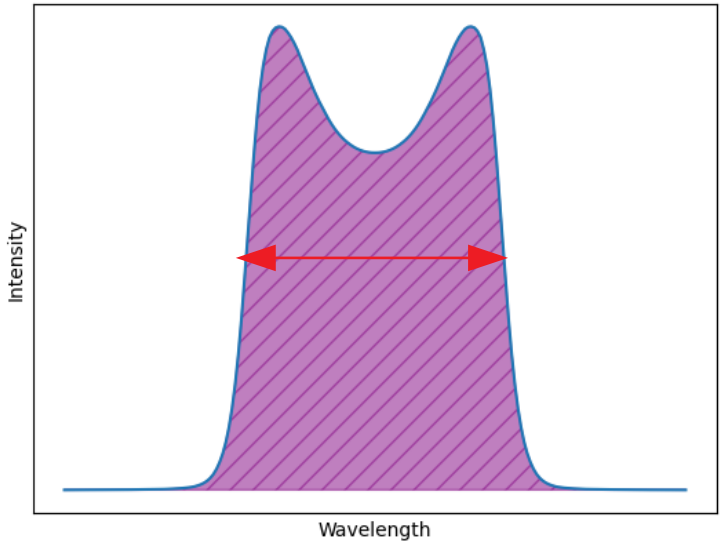
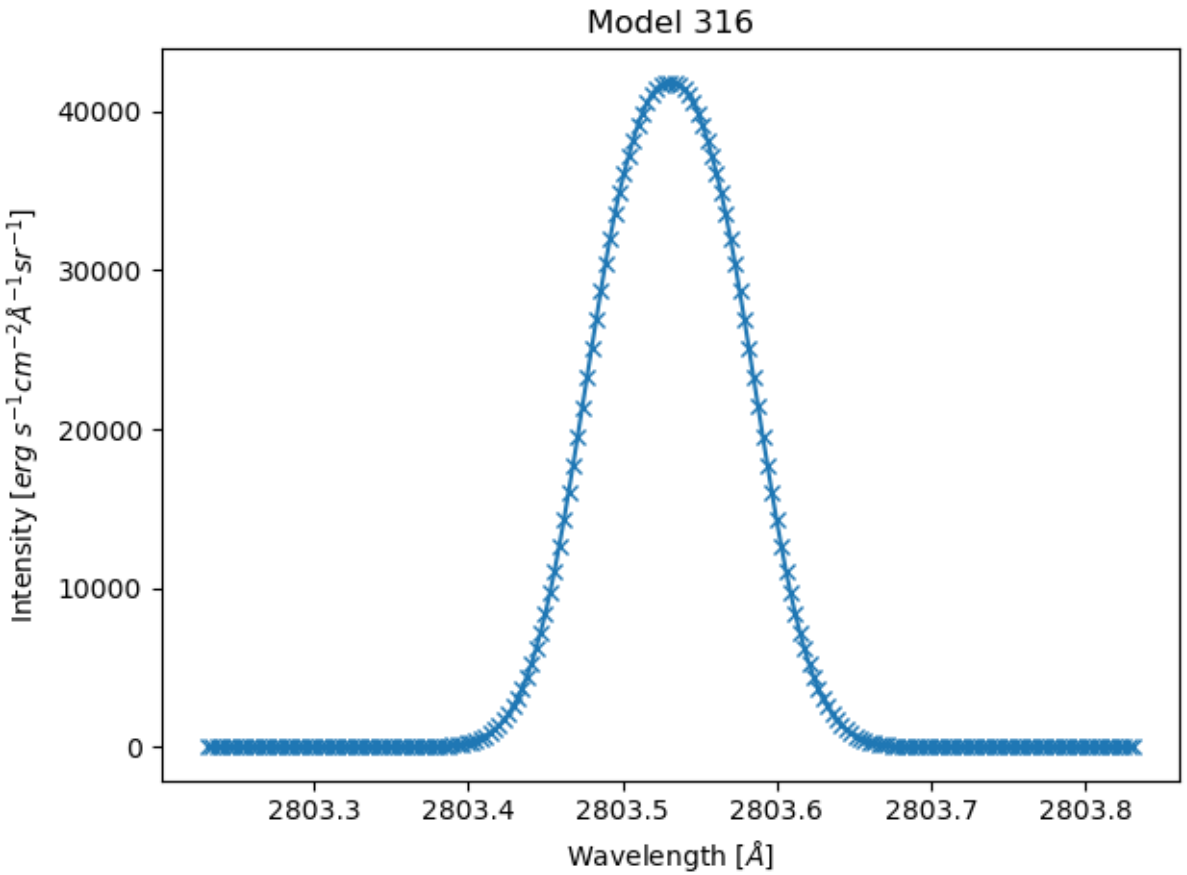
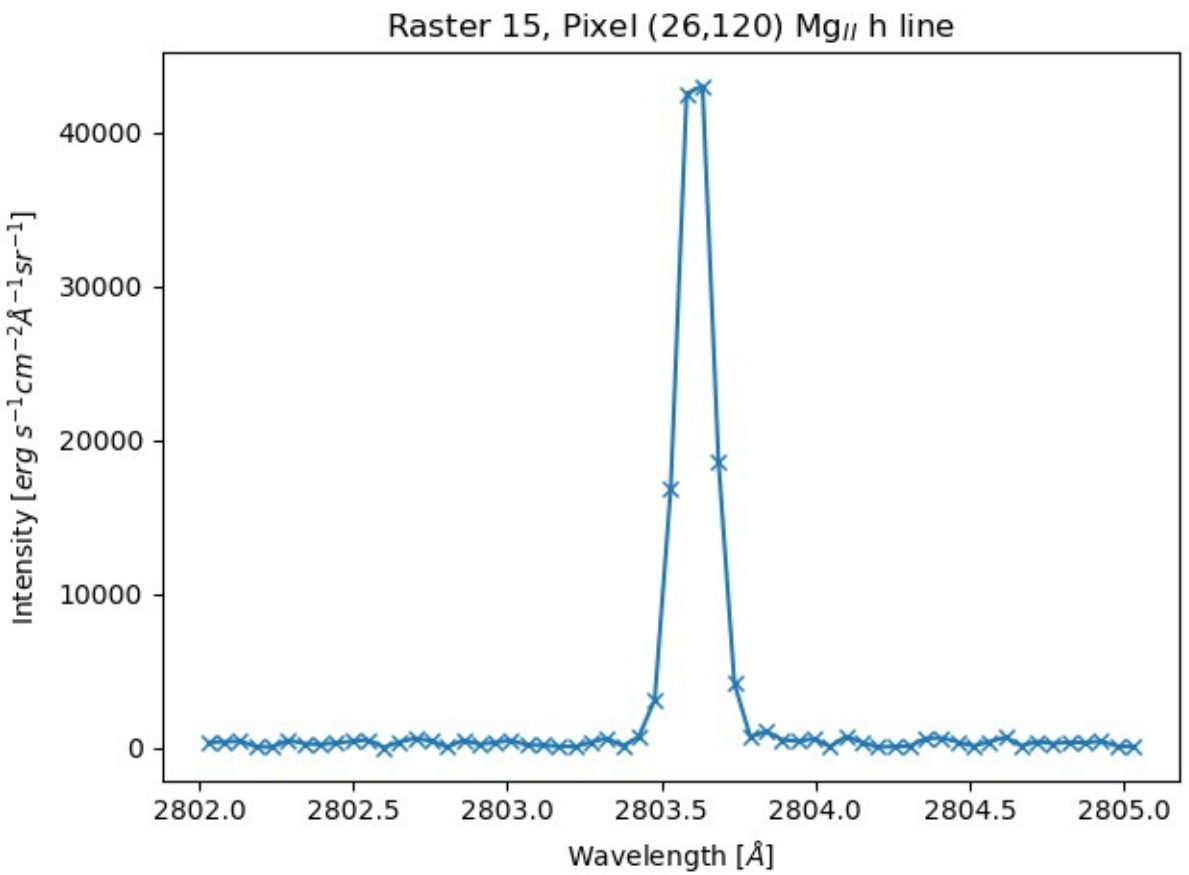




Rolling RMS (rRMS): Preparation





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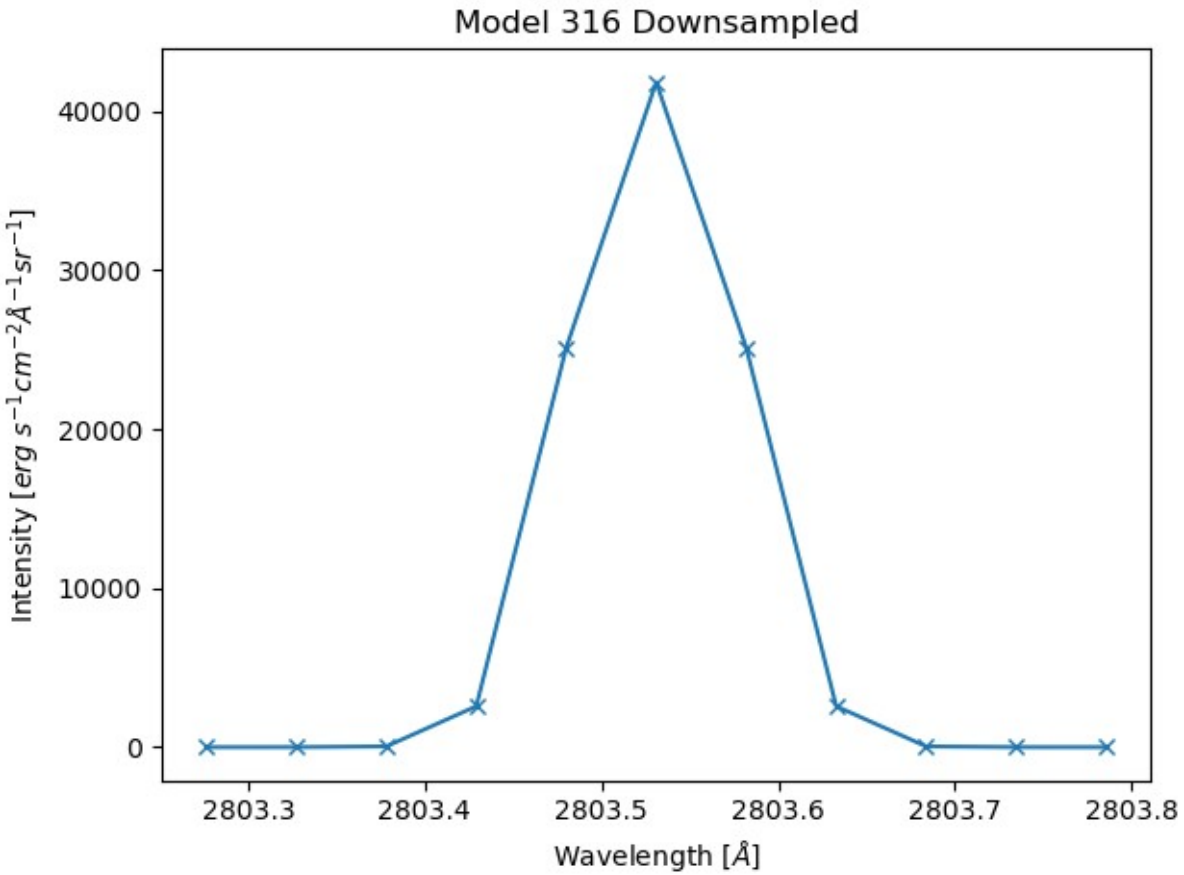

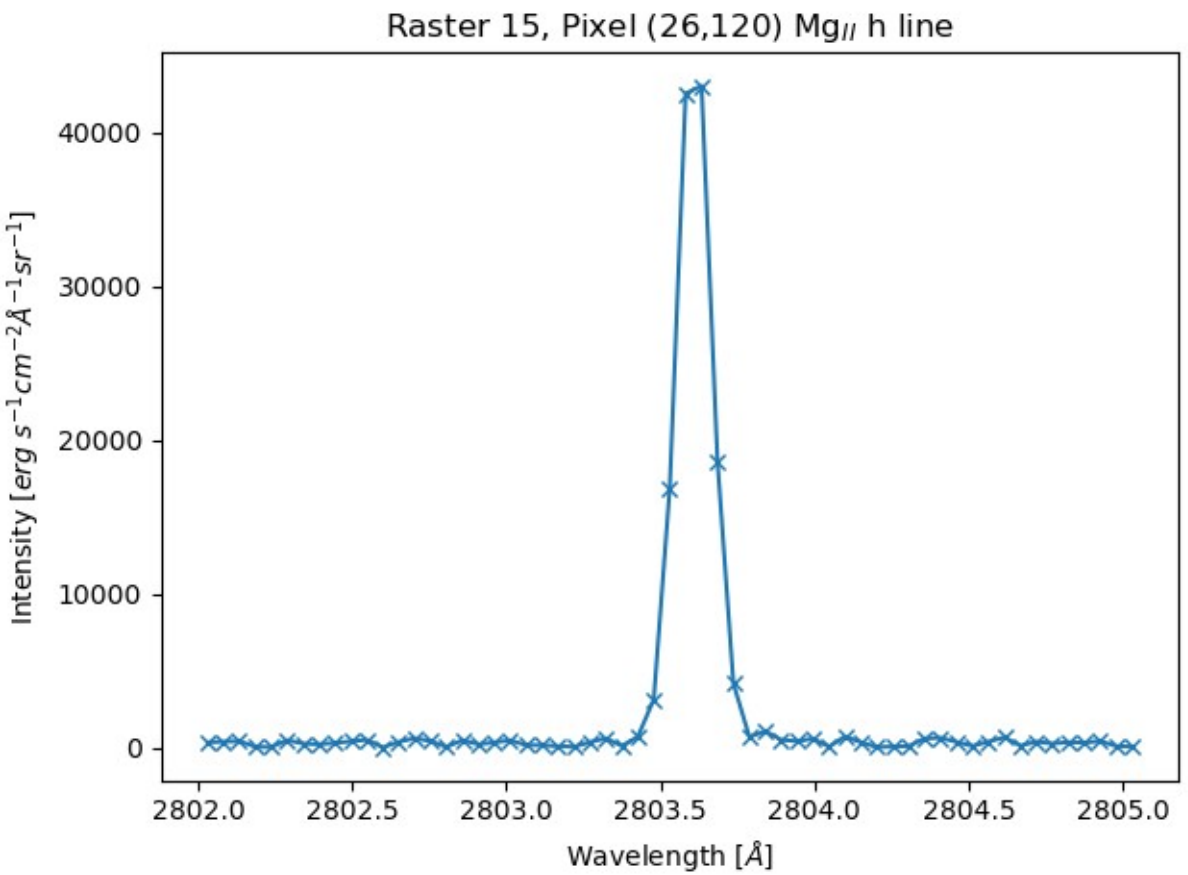

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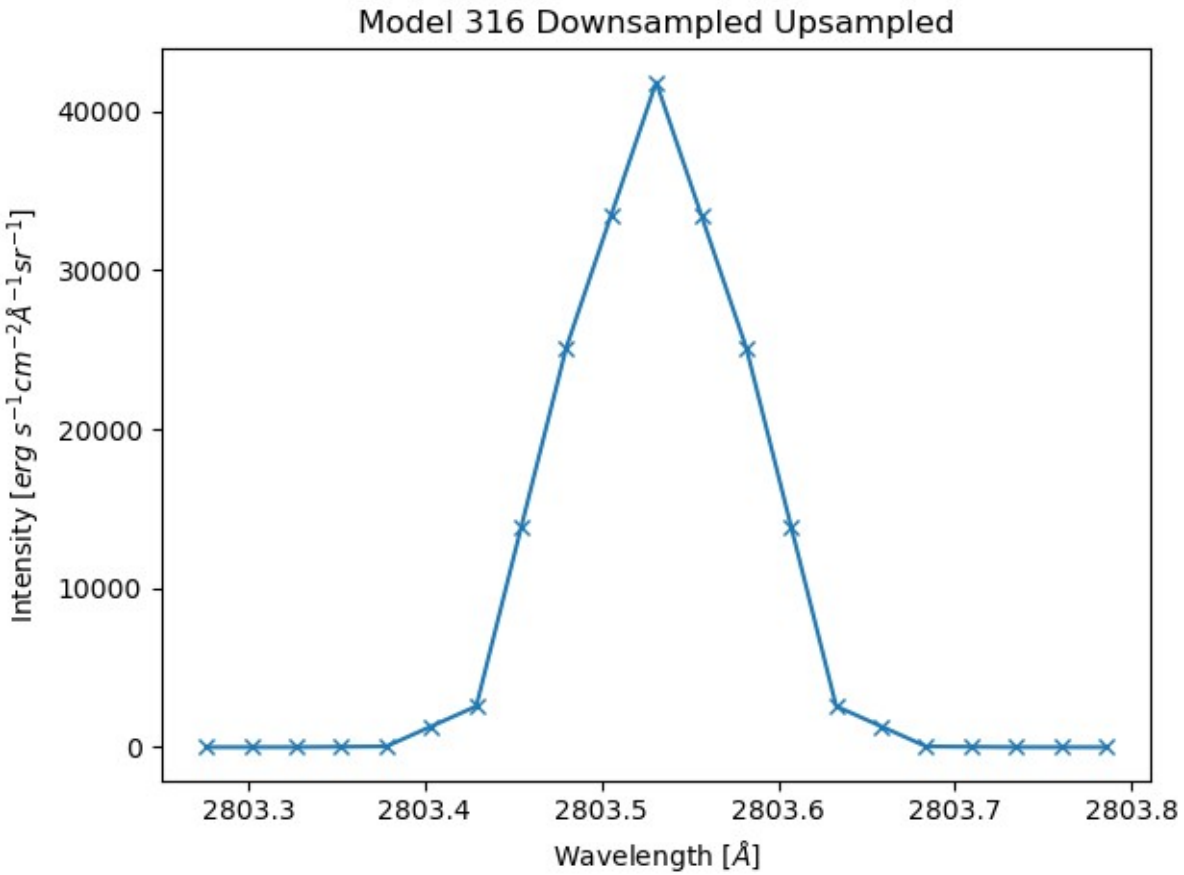
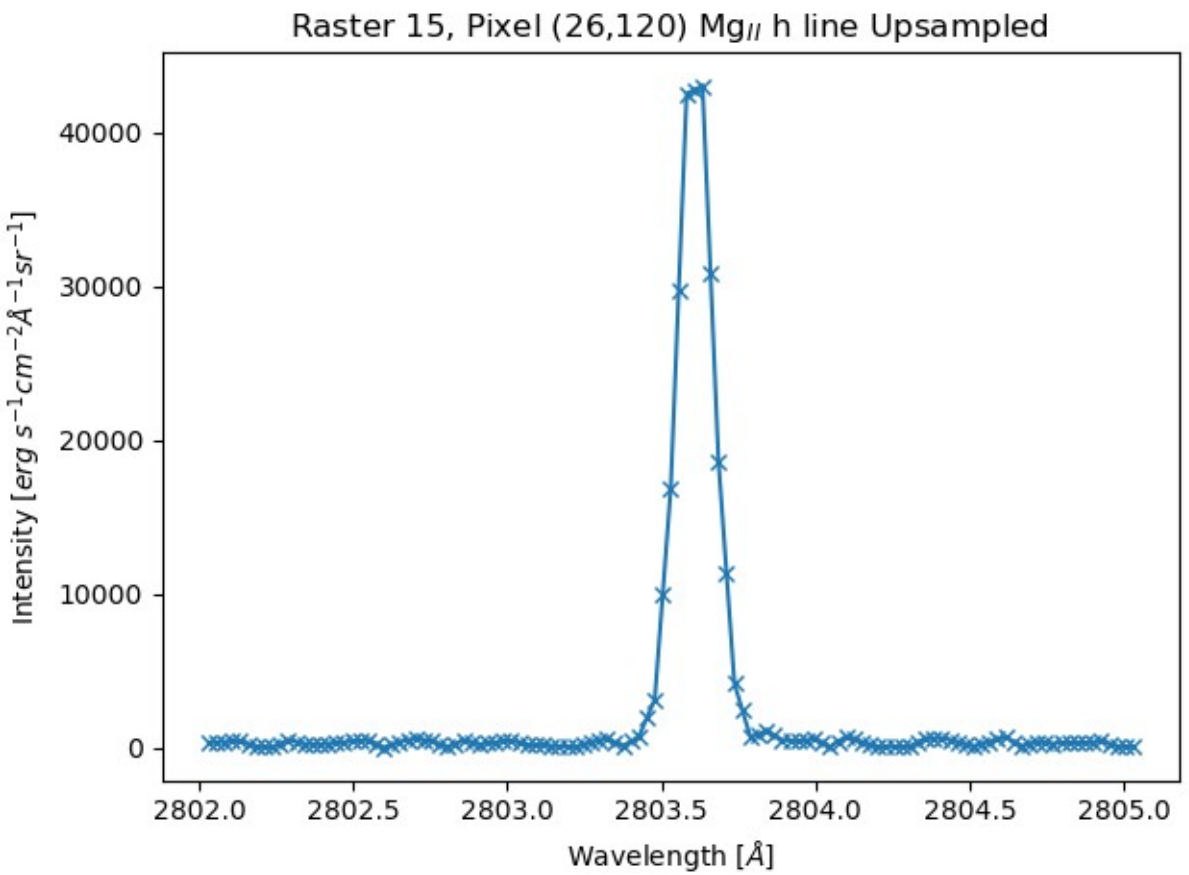
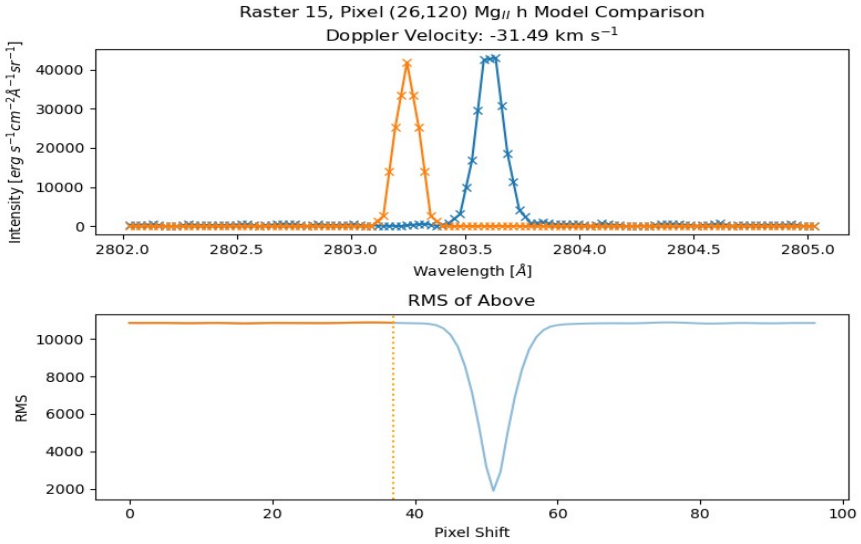
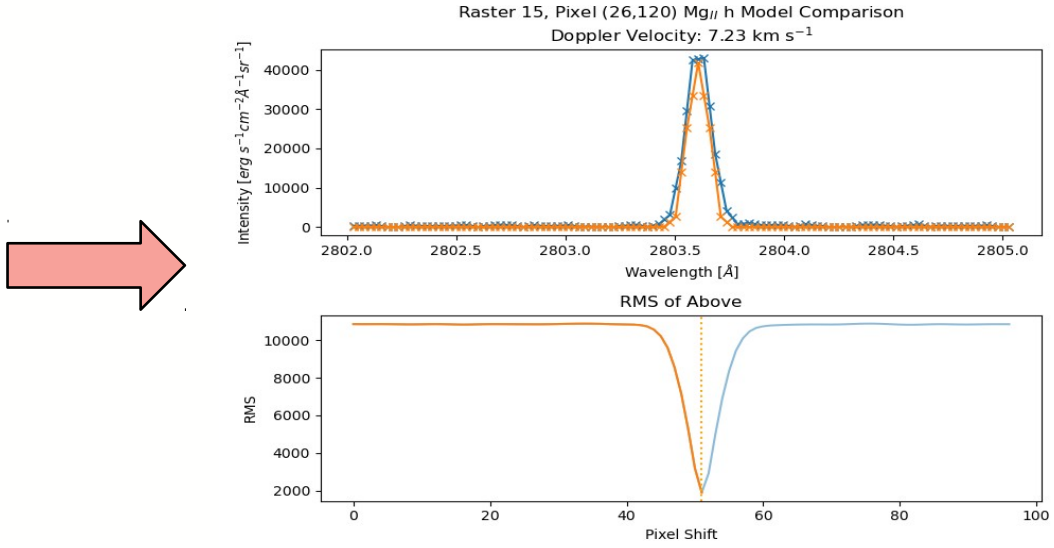


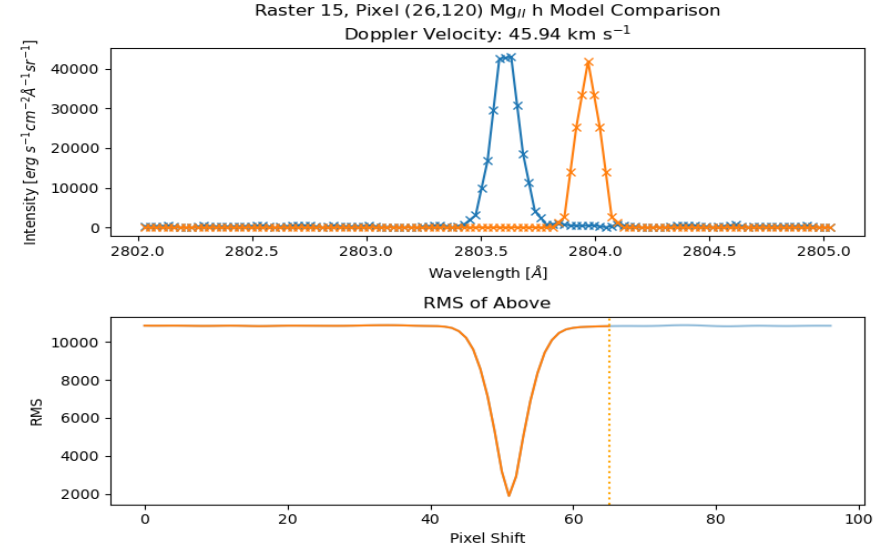


Rolling RMS (rRMS): The Operation

- Measure RMS at every position along wavelength window.
- Repeat for every model.
- Model which produces lowest sum of RMS of h and k lines selected as best fit.
- Associated Doppler velocity also recorded







Rolling RMS (rRMS): Results

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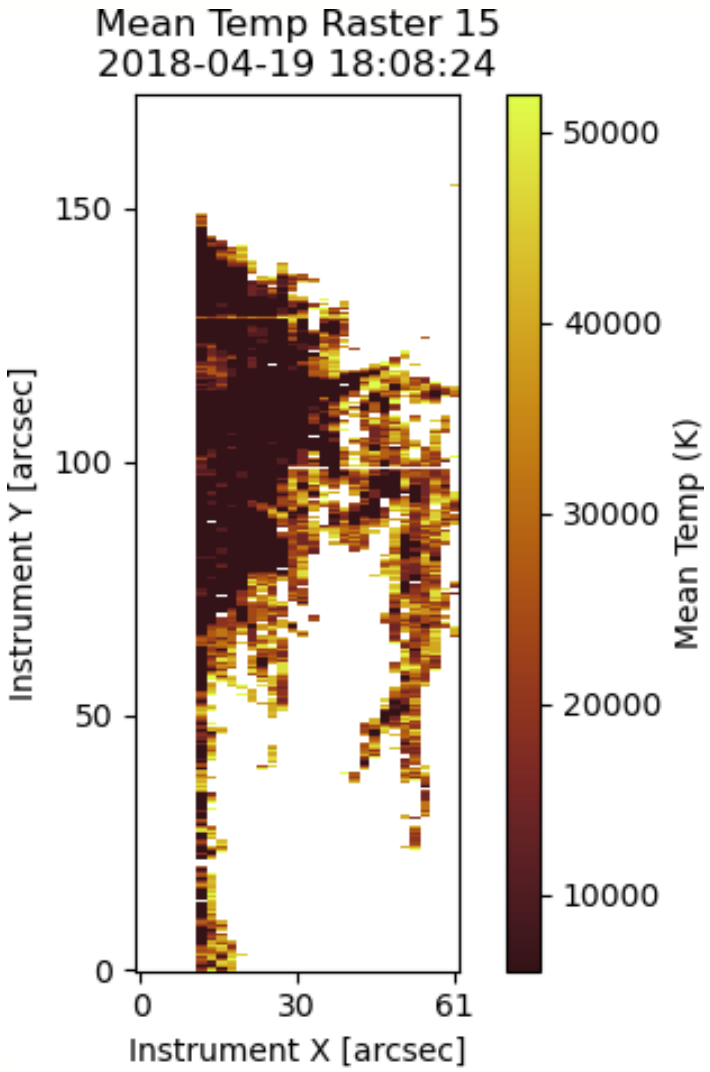

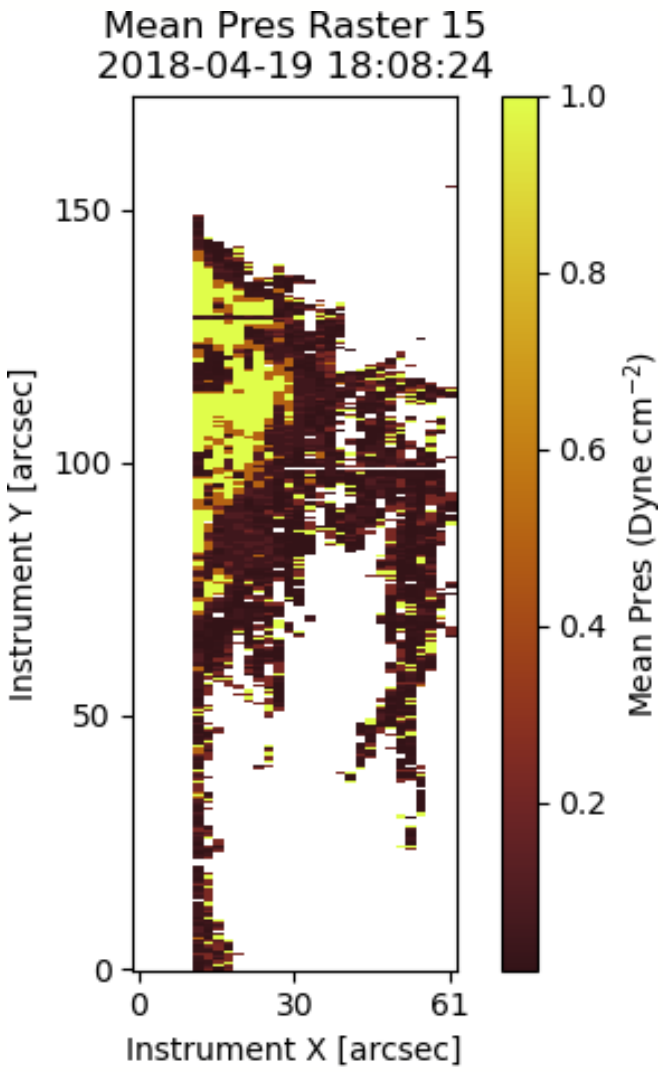

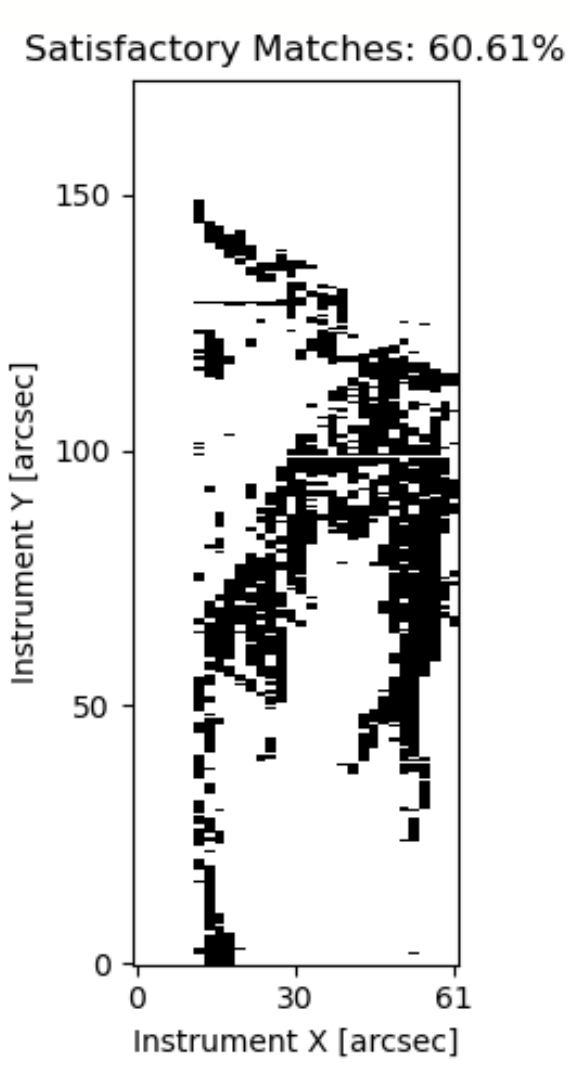

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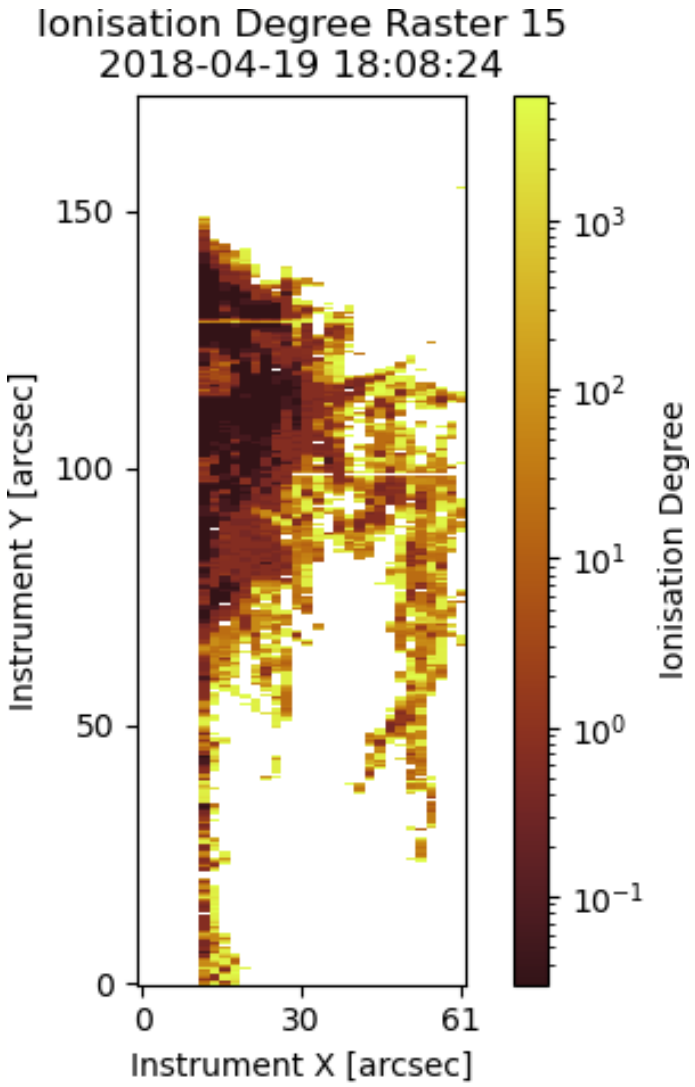
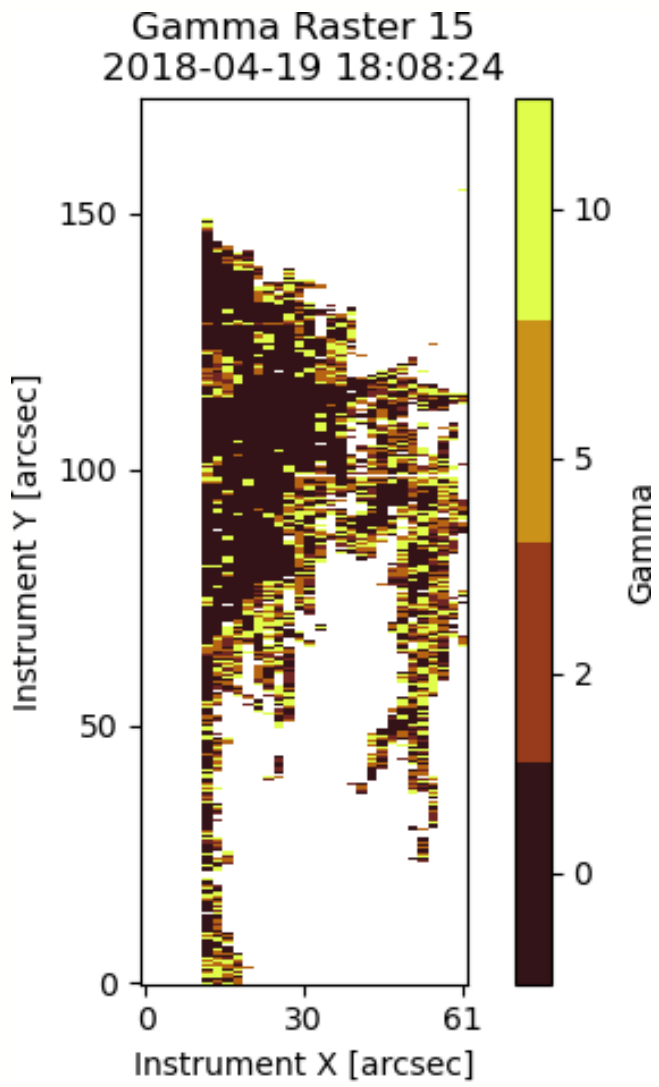
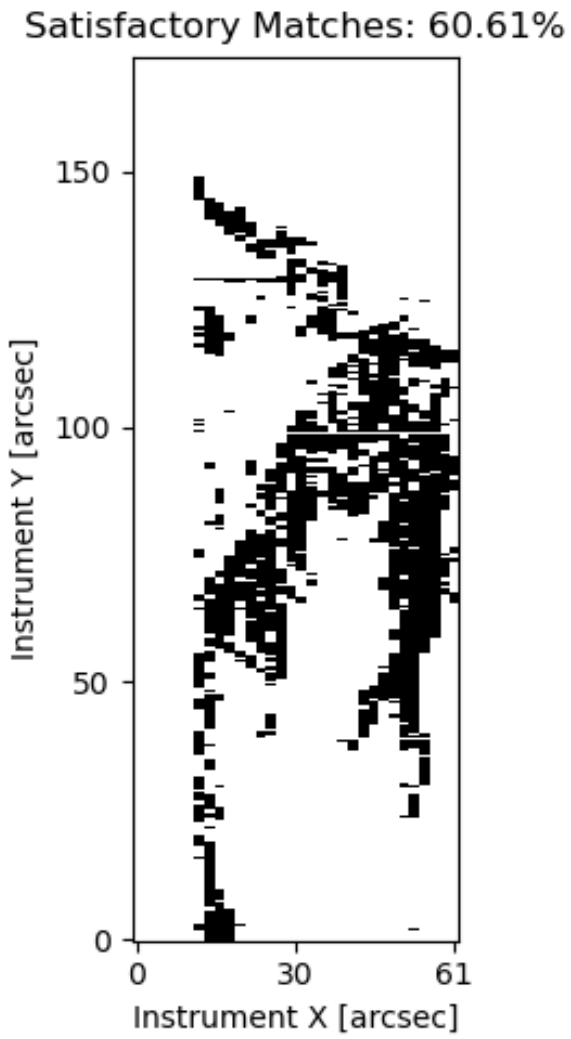
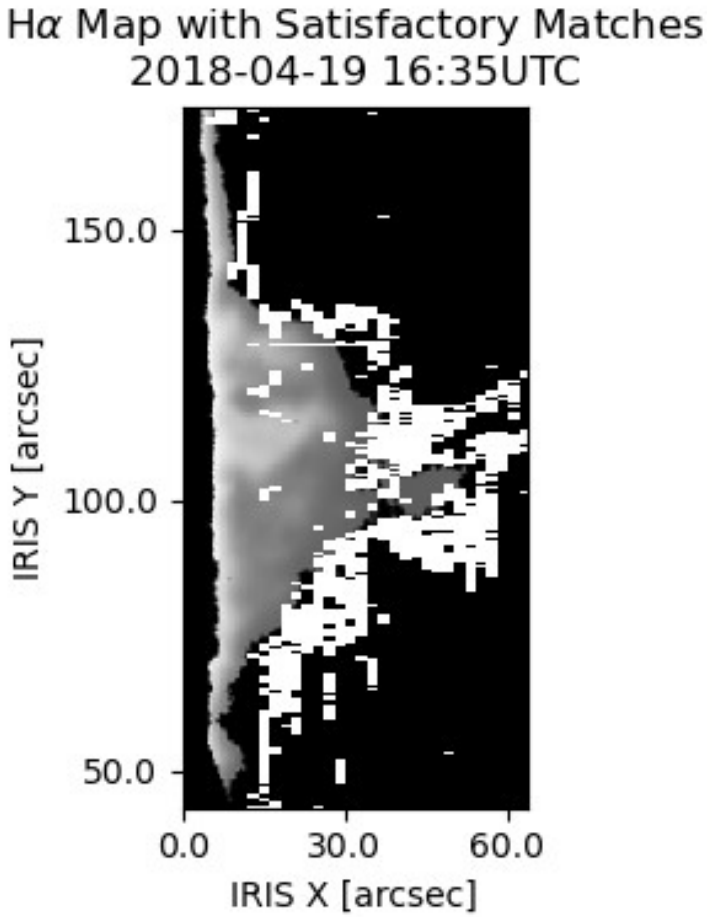






Rolling RMS (rRMS): Results

- We find 35617/72536 (~49%) of the matches are satisfactory.
- Areas where we do not find good matches seems to correlate with where we see Hα emission.
- These areas also tend to have wide line profiles, and some exhibit complex shapes.
  - Caused by non-comoving threads?
- Perhaps an increase in the microturbulent velocity parameter can quantify these unresolved motions?



Conclusions

- The rRMS recovers reliable prominence diagnostics with associated “goodness of fit” through the use of a grid of 1D NLTE models.
- Microturbulent velocity may play a larger role in denser areas.
- Multithread models could assist in the modelling of more complex profiles
- Larger grid of models may also produce better results.

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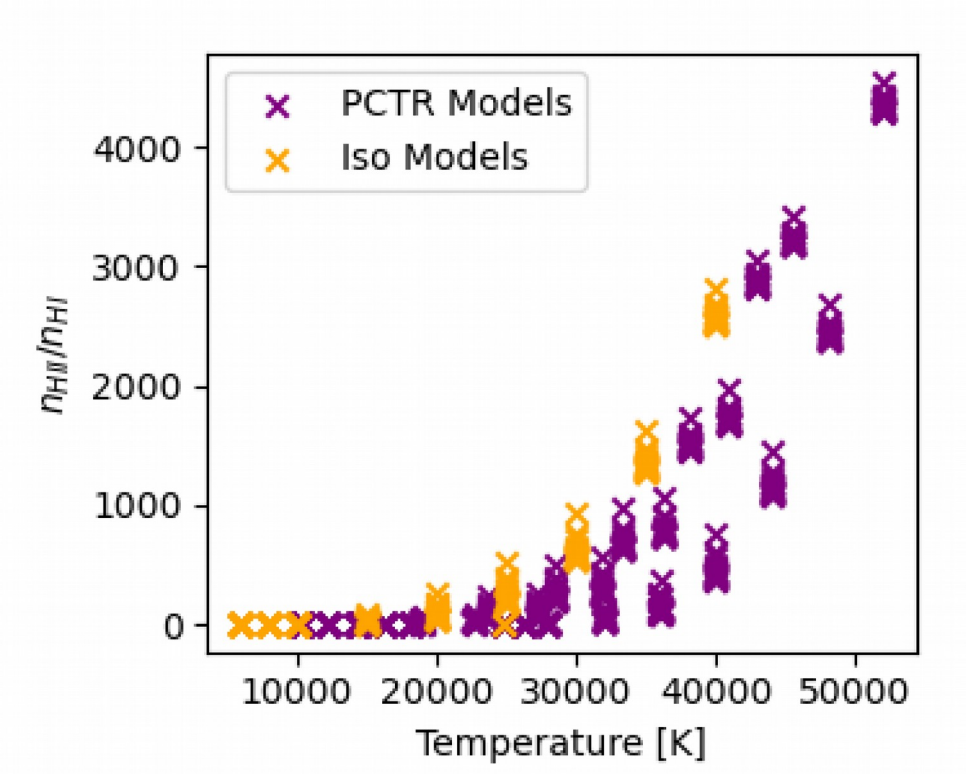
Thank you for listening!

Any questions?

Appendix

$$\mathrm{RMS} = \sqrt{\frac{1}{n}\sum_{n}(\mathrm{data} - \mathrm{model})^2}$$

Appendix


PCTR Models
Iso Models
4000
3000
2000
1000
0
n_{HII}/n_{HI}
10000
20000
30000
40000
50000
Temperature [K]