Companion detections through spectra and ML

Rakesh Nath

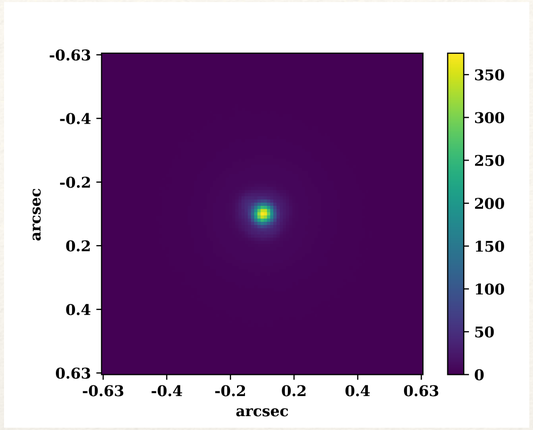
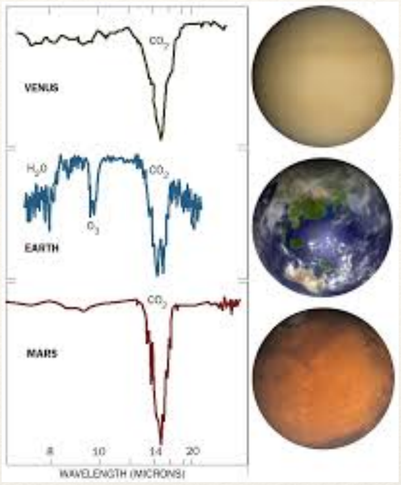
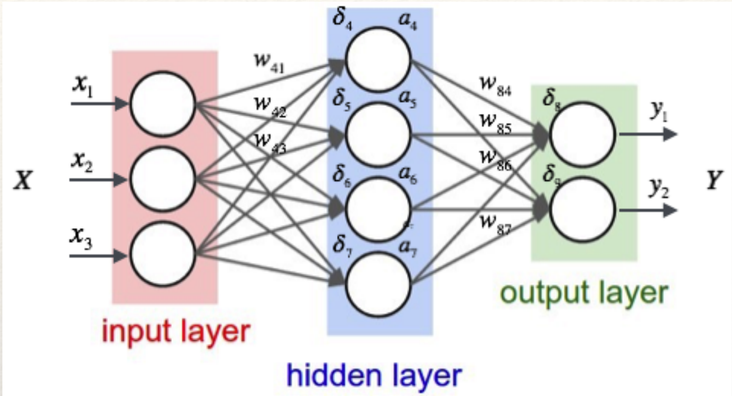


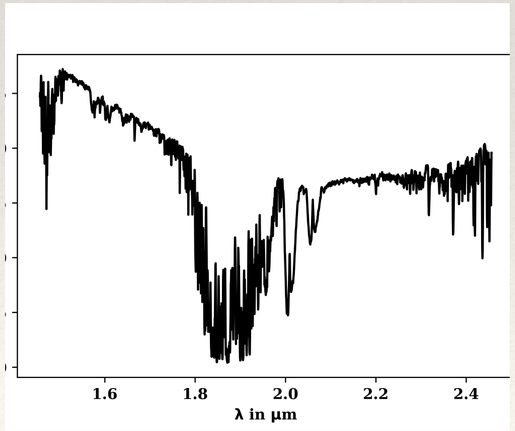
Image (object)

Detailed characterisation



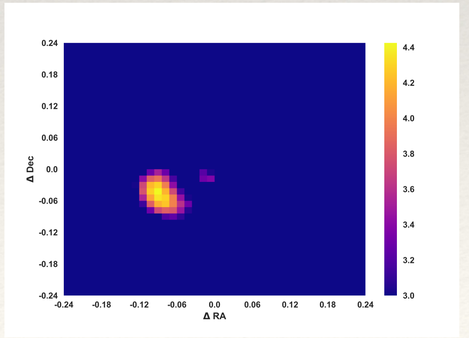


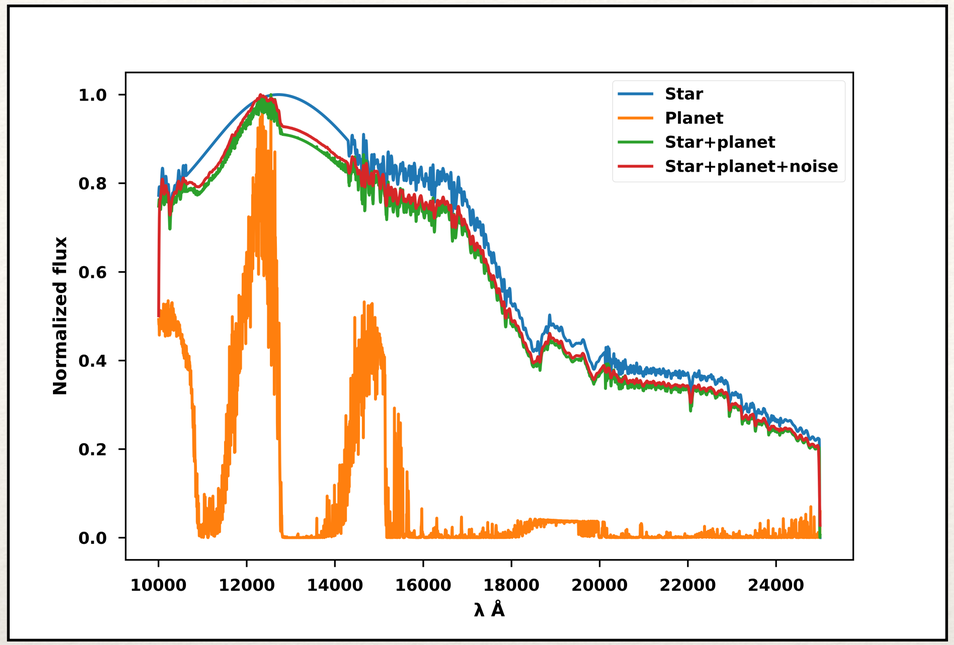
ML blackbox



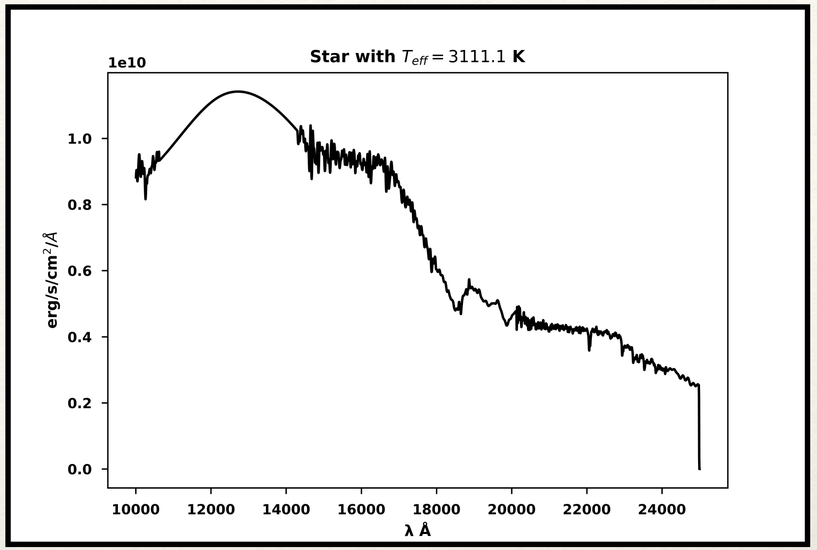
Spectra of every pixel

Probability map





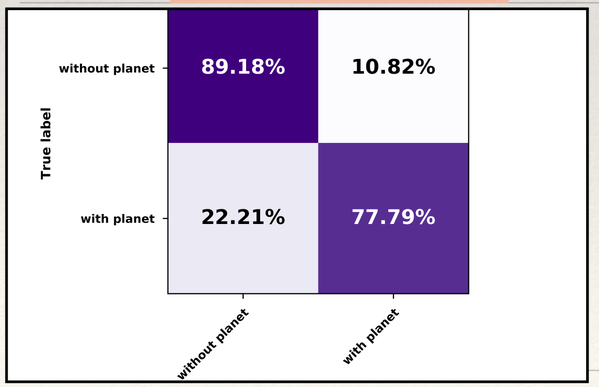
Flux~10^{10}



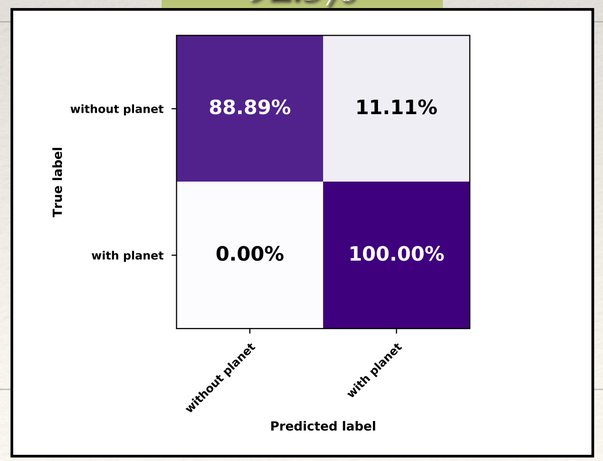
Flux~10^{-8}

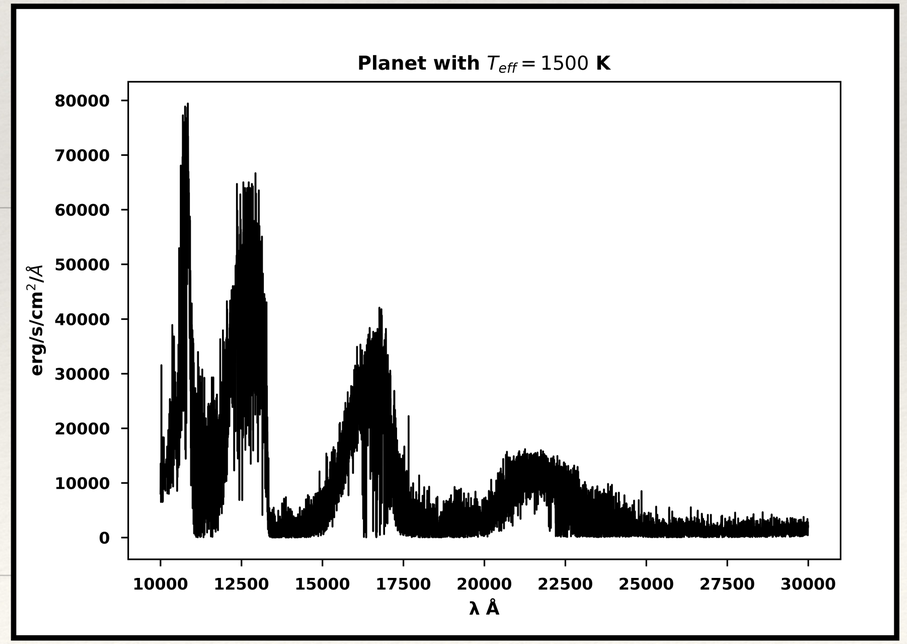
Flux~10^{2}

Cross-correlation 66.6%

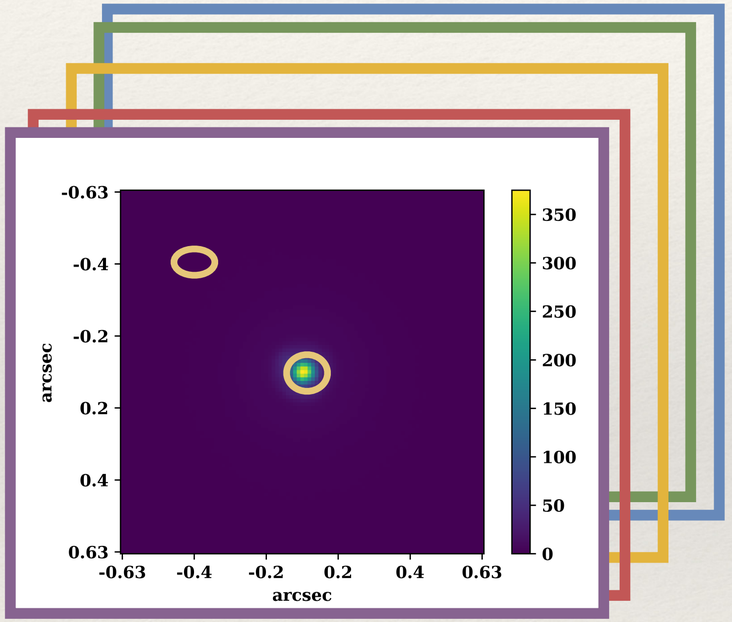


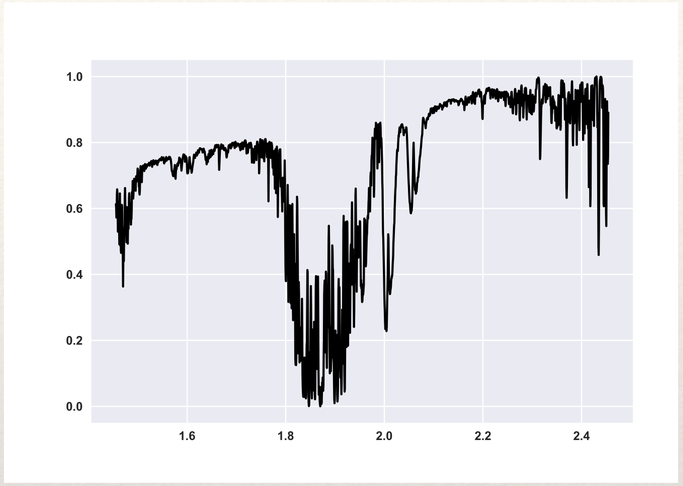
Deep learning 92.3%

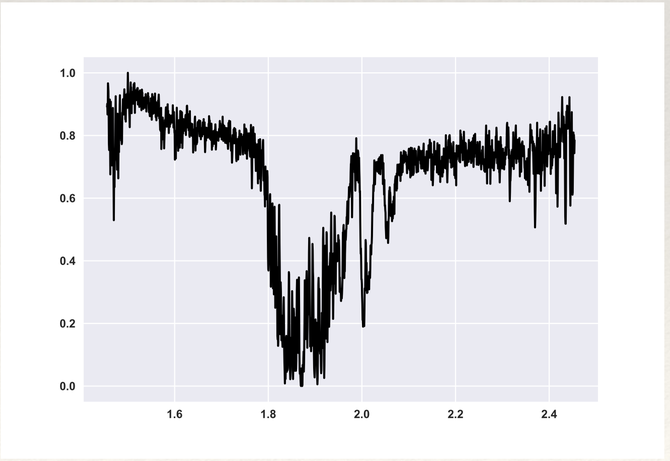


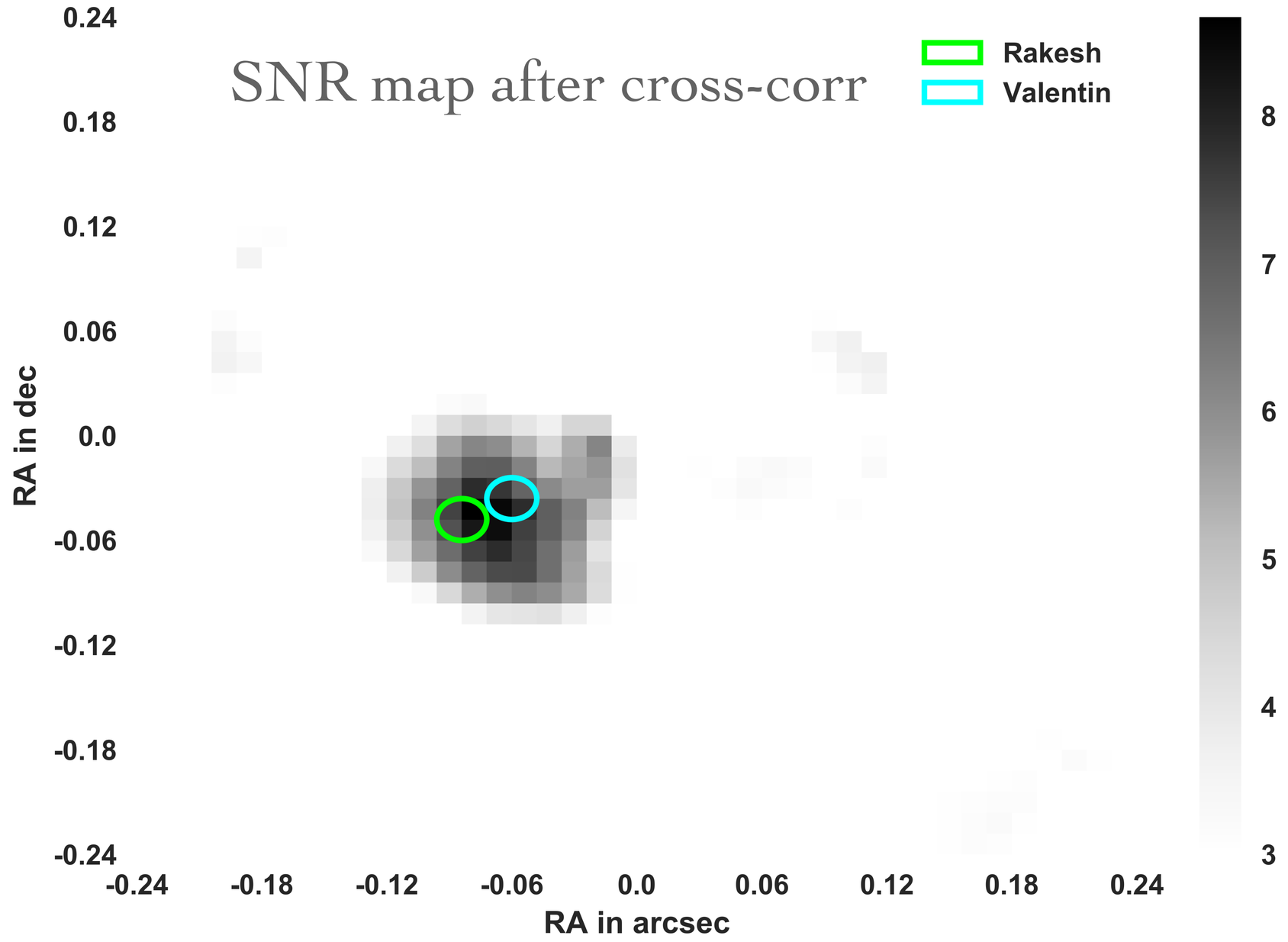


HD142527

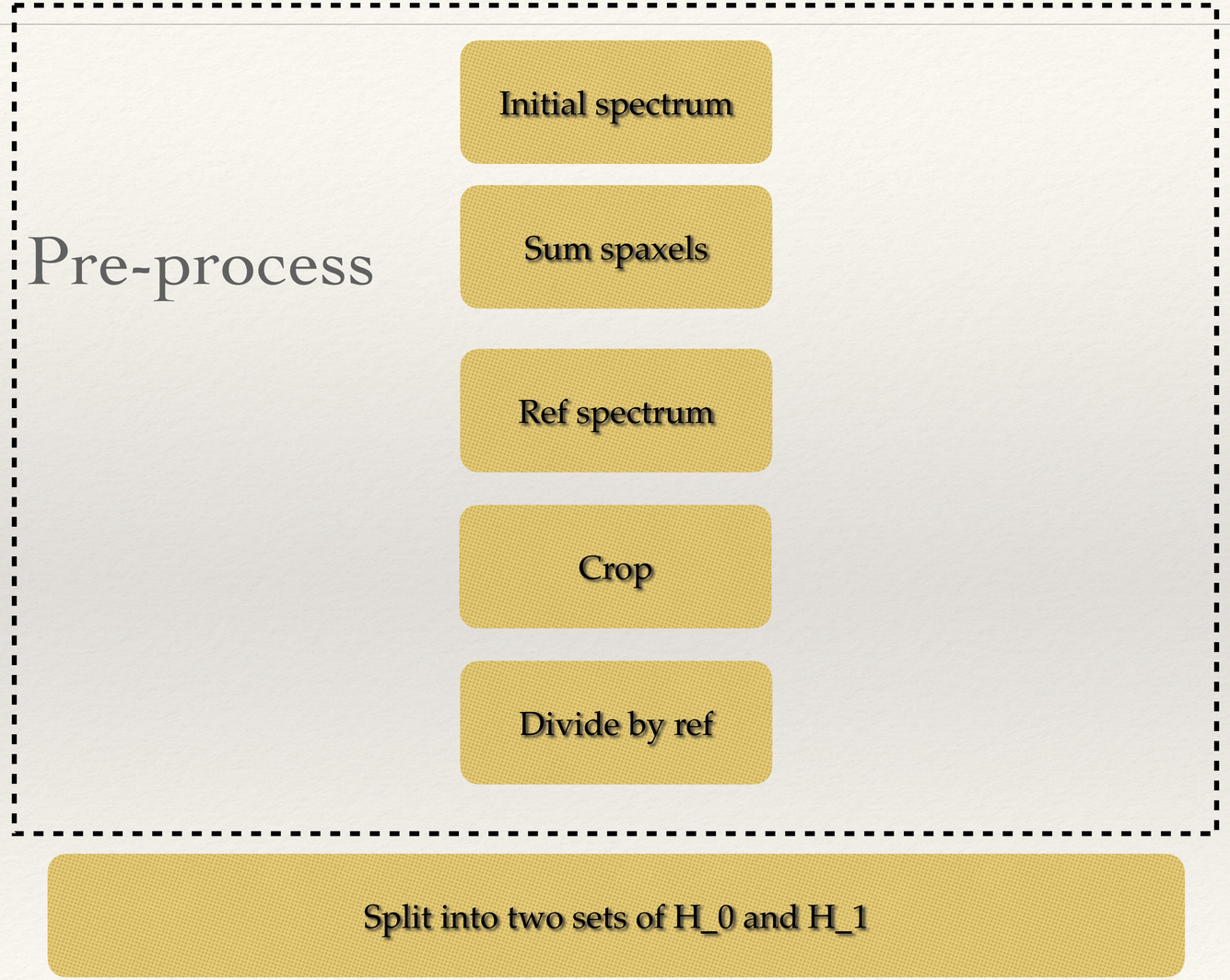

-0.63
-0.4
-0.2
0.2
0.4
0.63
arcsec
-0.63
-0.4
-0.2
0.2
0.4
0.63
arcsec
350
300
250
200
150
100
50
0

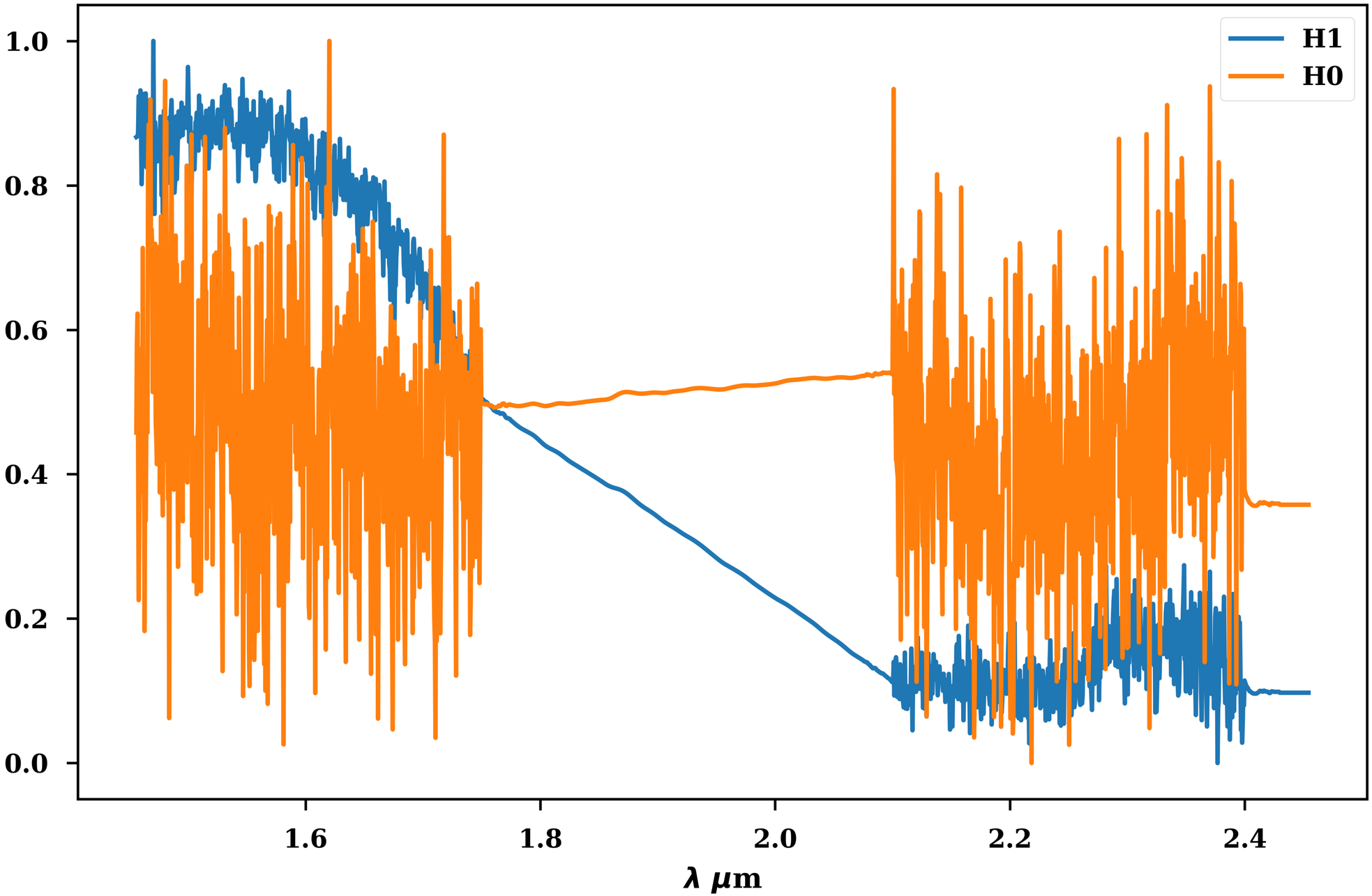

1.0
0.8
0.6
0.4
0.2
0.0
1.6
1.8
2.0
2.2
2.4

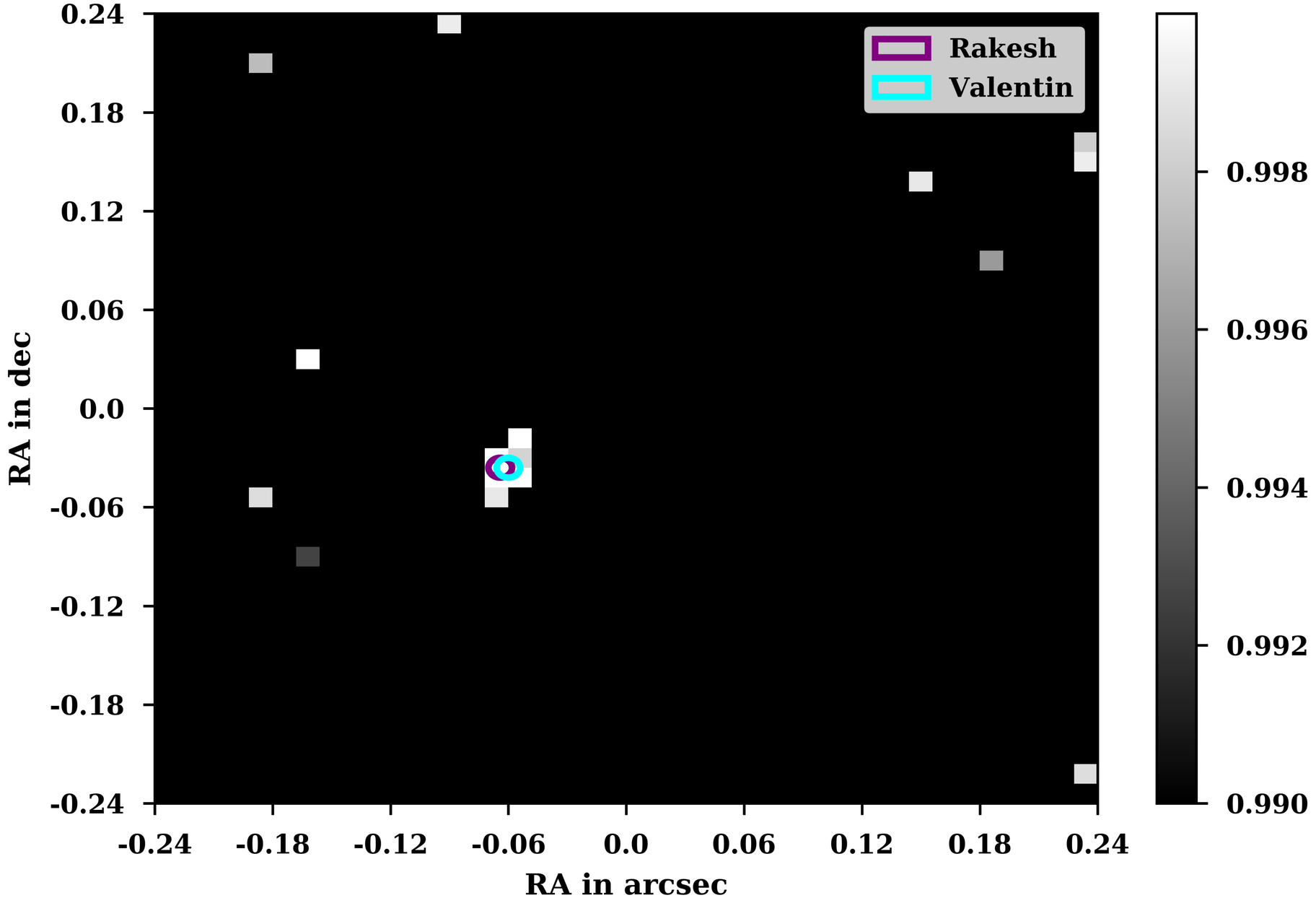

1.0
0.8
0.6
0.4
0.2
0.0
1.6
1.8
2.0
2.2
2.4

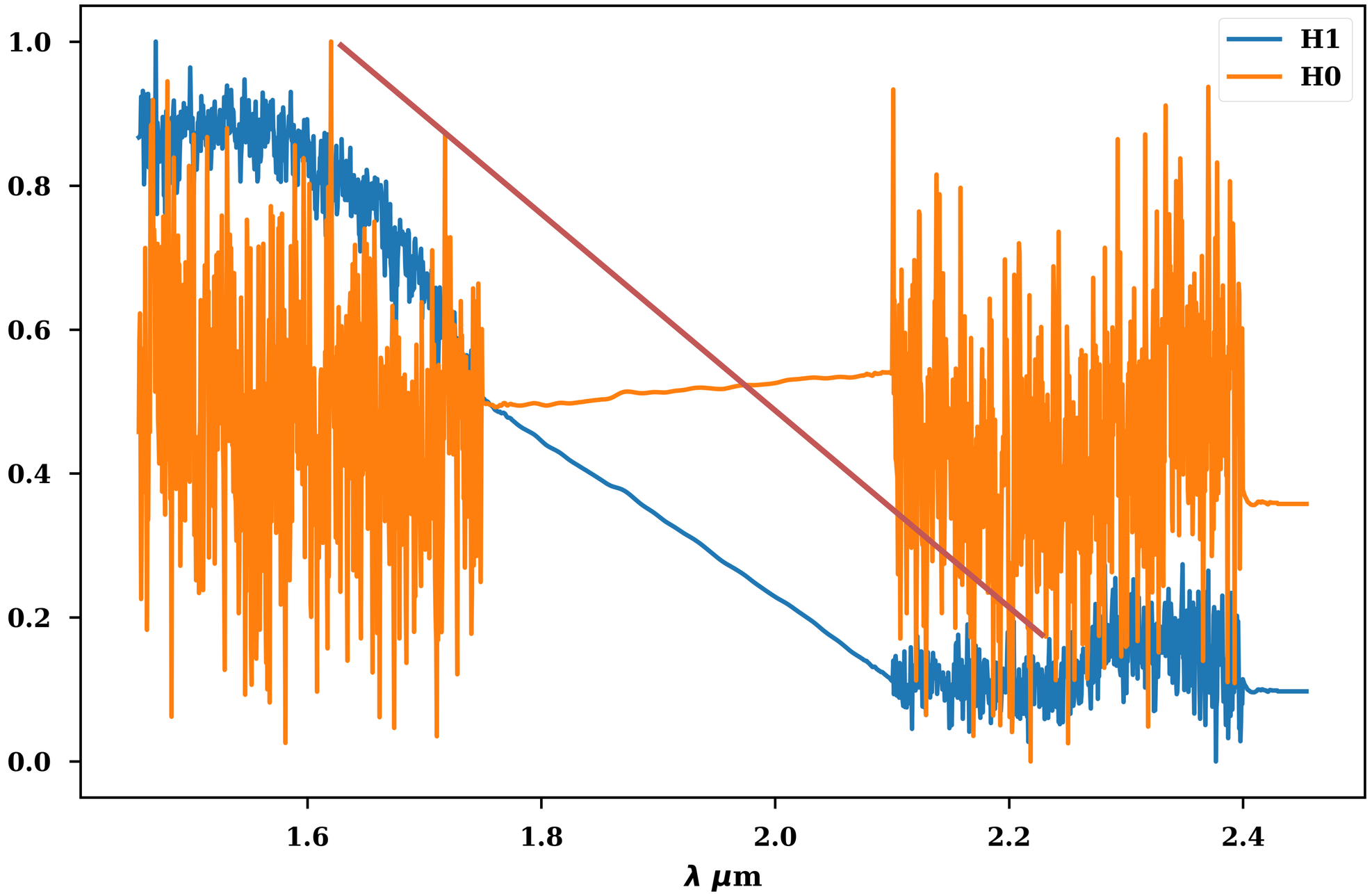

SNR map after cross-corr
Rakesh
Valentin
RA in dec
RA in arcsec
0.24
0.18
0.12
0.06
0.0
-0.06
-0.12
-0.18
-0.24
-0.24
-0.18
-0.12
-0.06
0.0
0.06
0.12
0.18
0.24
8
7
6
5
4
3

ML data preparation

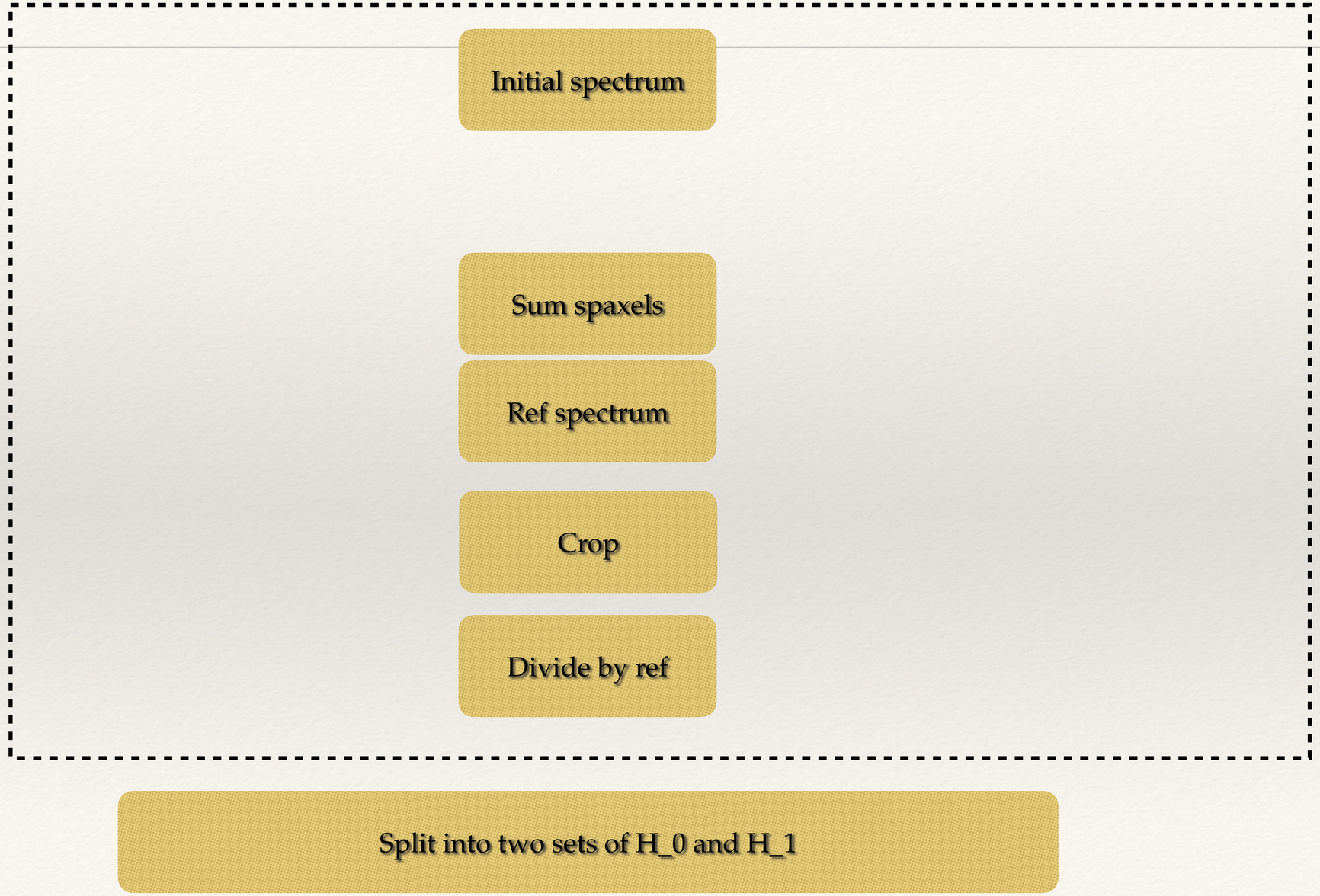


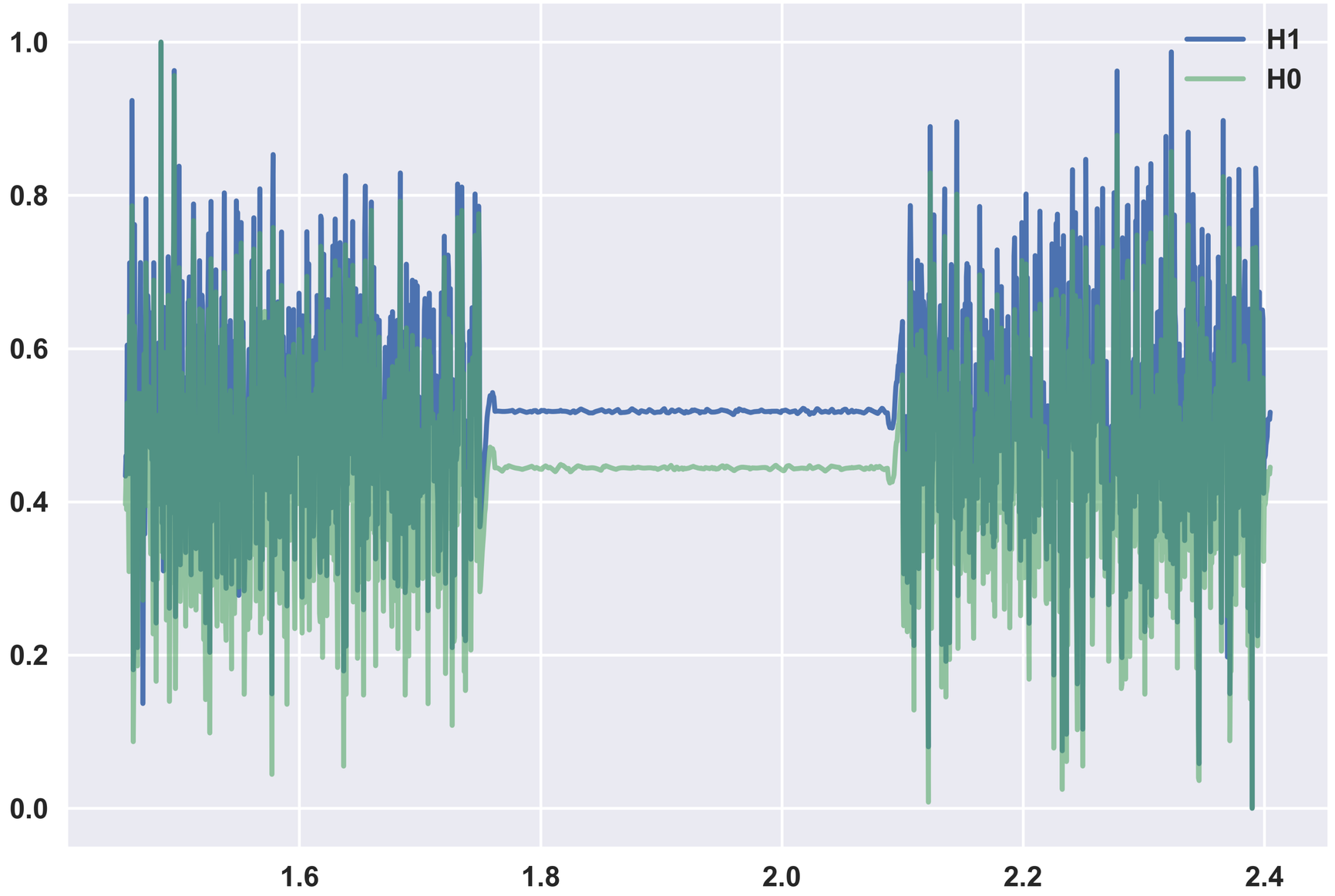

H1
H0
1.0
0.8
0.6
0.4
0.2
0.0
1.6
1.8
2.0
2.2
2.4
λ μm

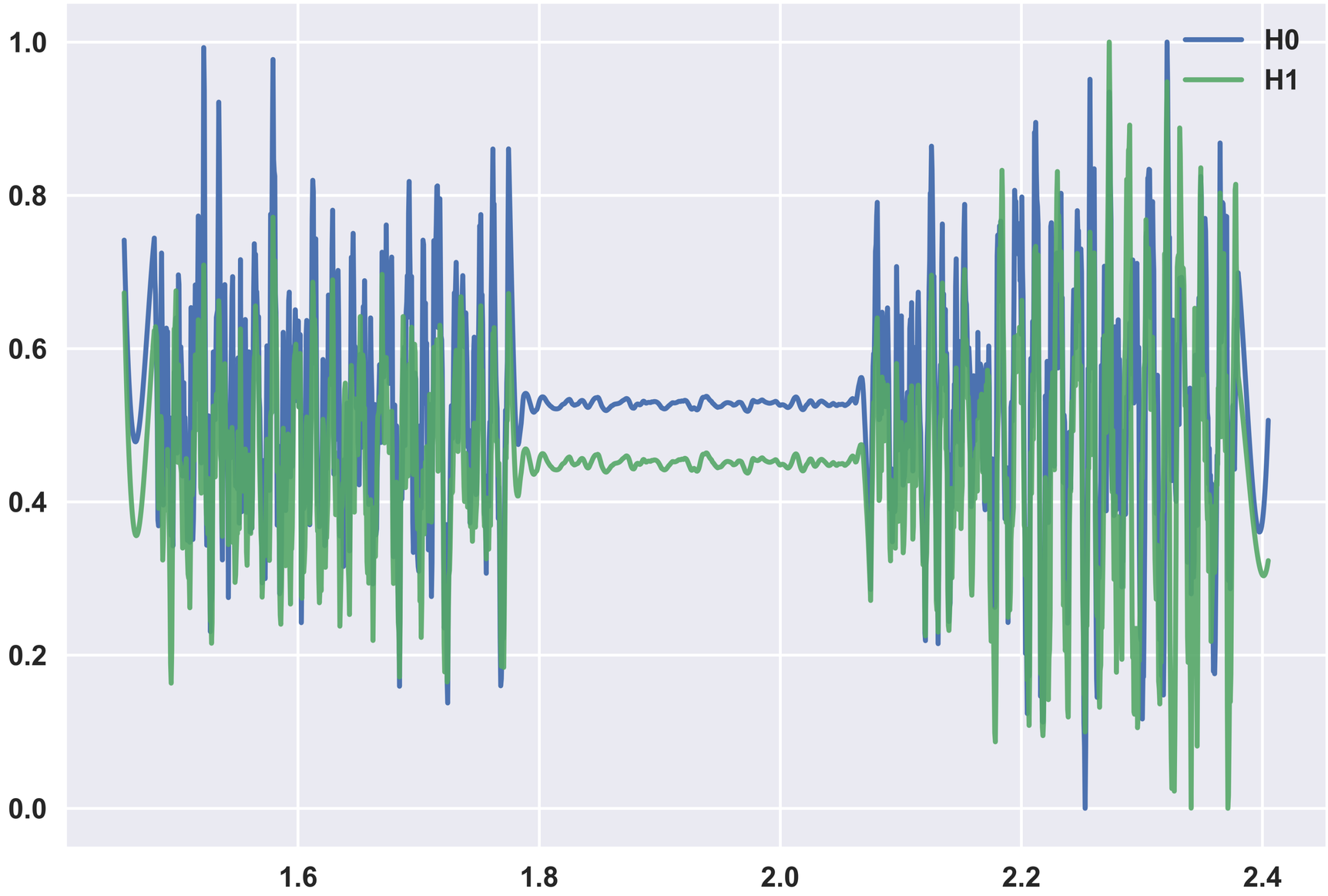

Rakesh
Valentin
0.24
0.18
0.12
0.06
0.0
-0.06
-0.12
-0.18
-0.24
RA in dec
-0.24
-0.18
-0.12
-0.06
0.0
0.06
0.12
0.18
0.24
RA in arcsec
0.998
0.996
0.994
0.992
0.990

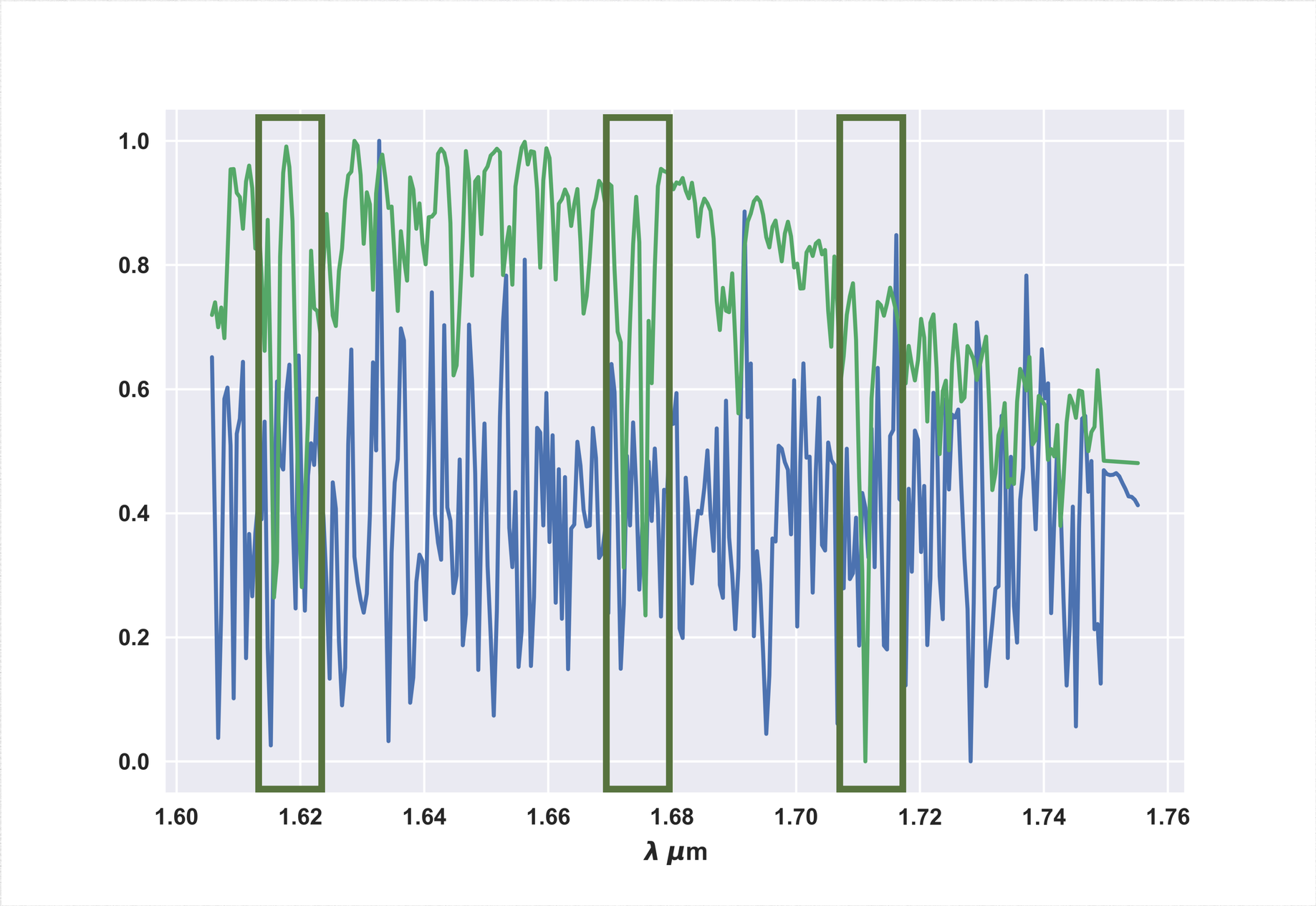

H1
H0
1.0
0.8
0.6
0.4
0.2
0.0
1.6
1.8
2.0
2.2
2.4
λ μm

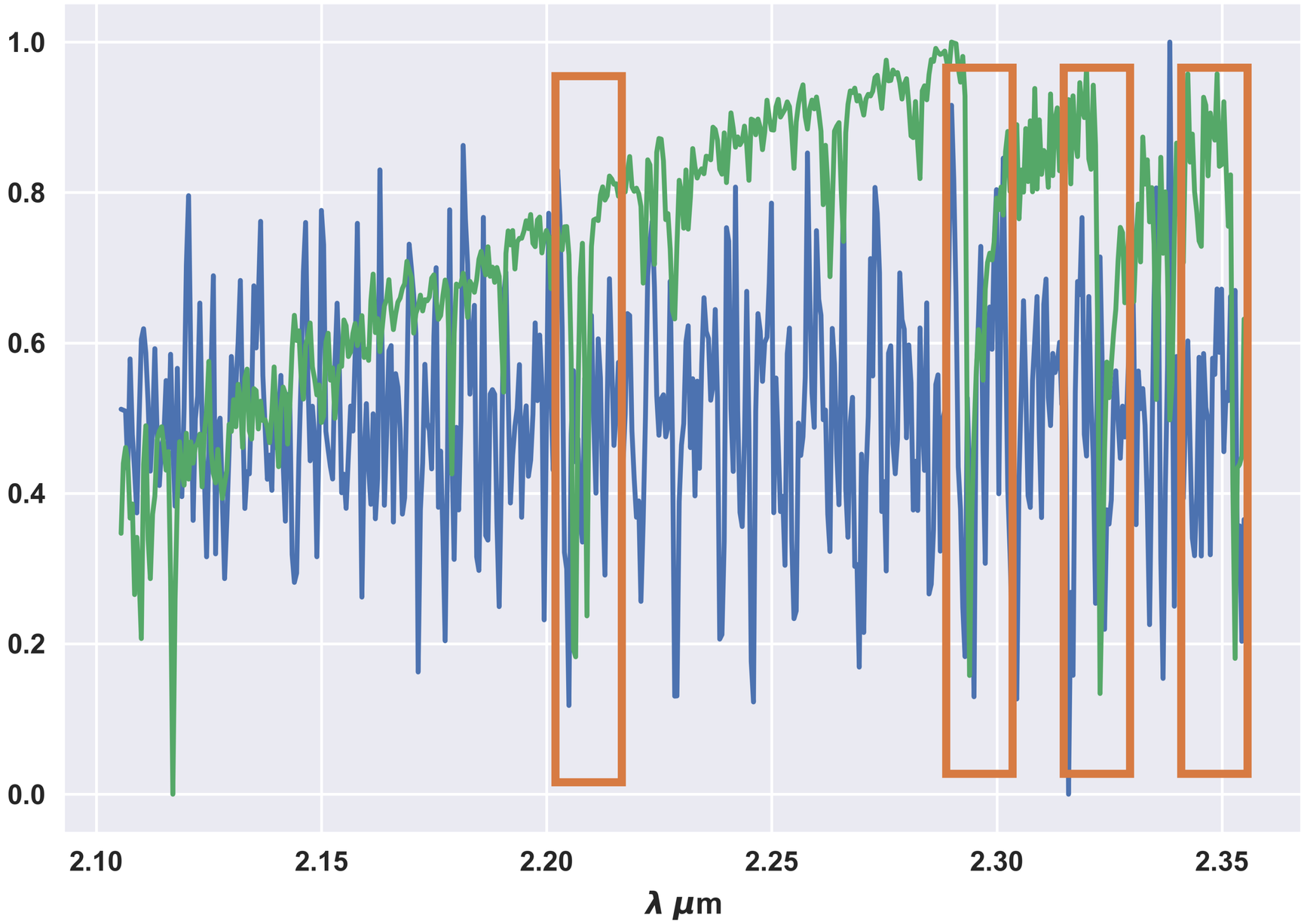
ML data preparation




1.0
0.8
0.6
0.4
0.2
0.0
1.6
1.8
2.0
2.2
2.4
H1
H0


1.0
0.8
0.6
0.4
0.2
0.0
1.6
1.8
2.0
2.2
2.4
H0
H1


1.0
0.8
0.6
0.4
0.2
0.0
1.60
1.62
1.64
1.66
1.68
1.70
1.72
1.74
1.76
λ μm


1.0
0.8
0.6
0.4
0.2
0.0
2.10
2.15
2.20
2.25
2.30
2.35
λ μm

Next steps

- ‘Force’ the network to learn absorption features.
- Create a metric to compare ML and cross-corr
- Compare the ‘sensitivity’ of ML and cross Corr
- Compare ‘specificity’ (fake companions in progress) of ML and cross Corr
- Try this with PDS 70 and potentially explain why it may or may not work.