Preparing For The Landing

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This is an abstract Complete this summary at the end of the paper

I. INTRODUCTION

To be added if evaluation includes this part

II. THEORY

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III. METHOD

To be added if evaluation includes this part

IV. RESULTS

A. Spectral Analysis of the Atmosphere

Gas	Wavelength (nm)	Min. Flux	Temperature (K)	Doppler Shift (nm)
O_2	632	0.90	150.0	8.96e-03
O_2	690	0.87	450.0	1.24e-02
O_2	760	0.93	450.0	1.58e-02
H_2O	720	0.95	150.0	2.27e-02
H_2O	820	0.91	189.2	1.48e-02
H_2O	940	0.87	424.4	7.55e-03
CO_2	1400	0.90	450.0	2.70e-02
CO_2	1600	0.93	250.0	5.56e-02
CH_4	1660	0.90	150.0	6.57e-03
CH_4	2200	0.90	450.0	4.36e-02
CO	2340	0.97	216.7	2.74e-02
N_2O	2870	0.97	183.3	3.32e-02

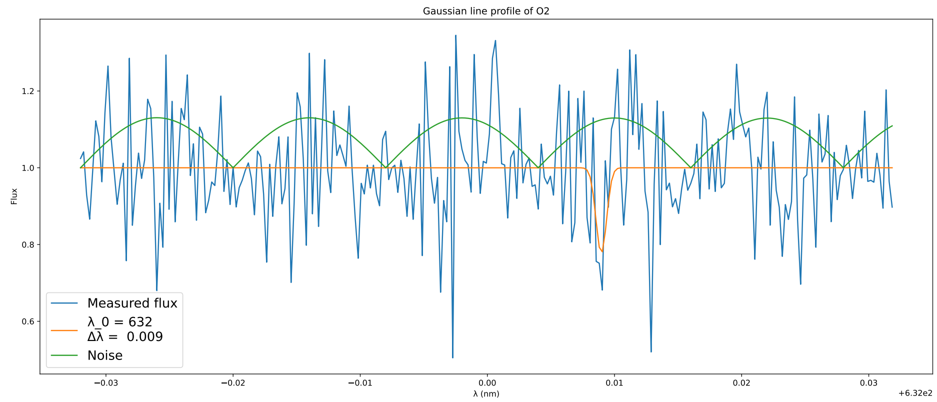

Figure 1. Flux Data and Spectral Line Analysis

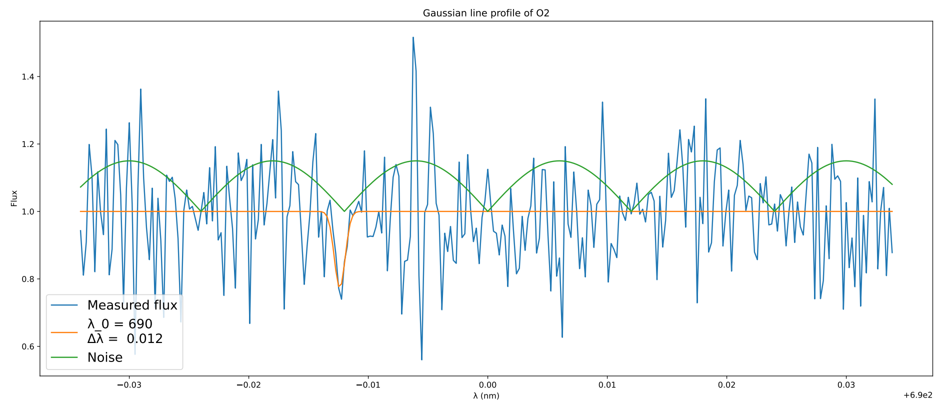

Figure 2. Flux Data and Spectral Line Analysis

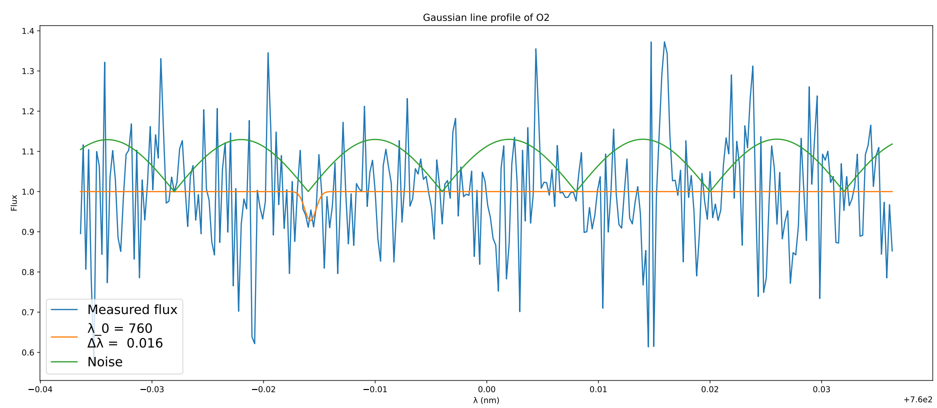

Figure 3. Flux Data and Spectral Line Analysis

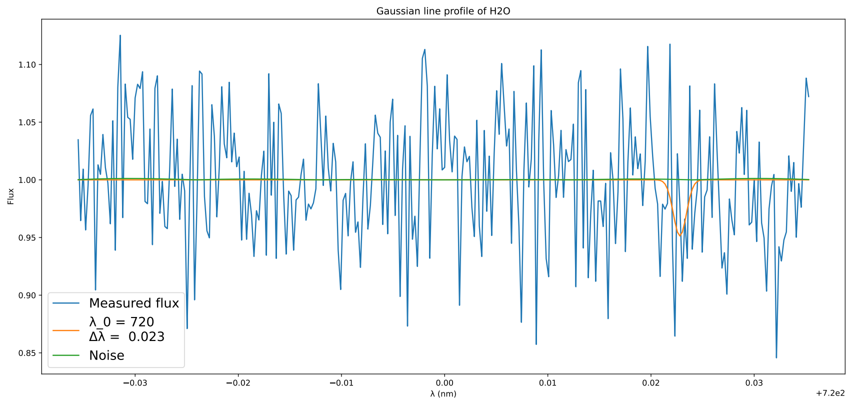

Figure 4. Flux Data and Spectral Line Analysis

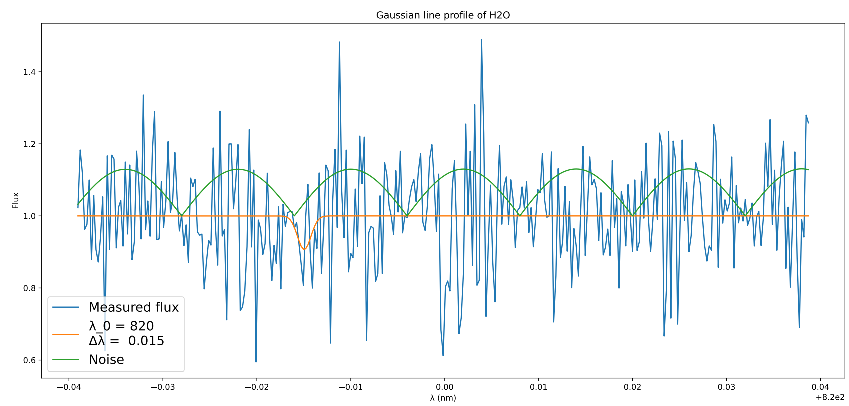

Figure 5. Flux Data and Spectral Line Analysis

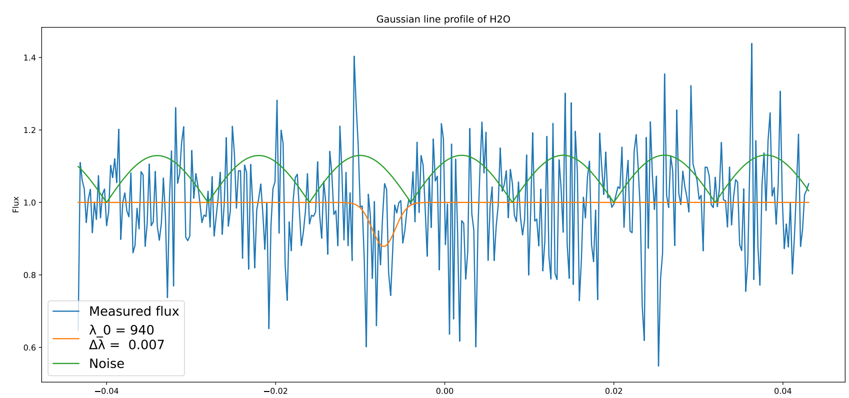

Figure 6. Flux Data and Spectral Line Analysis

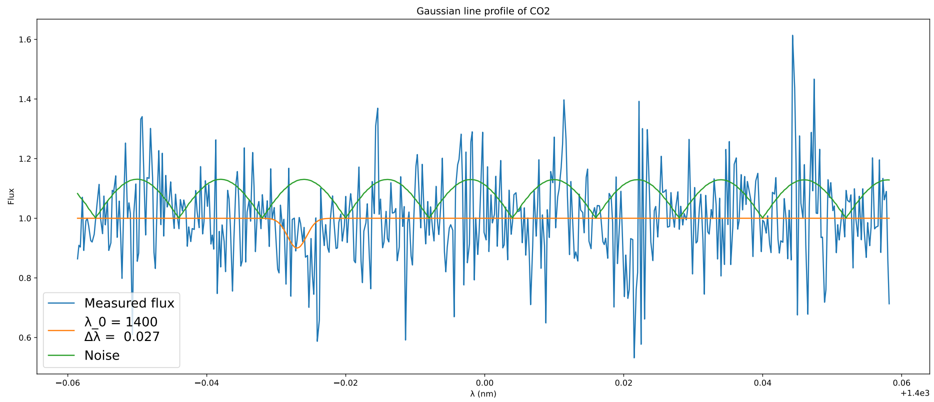

Figure 7. Flux Data and Spectral Line Analysis

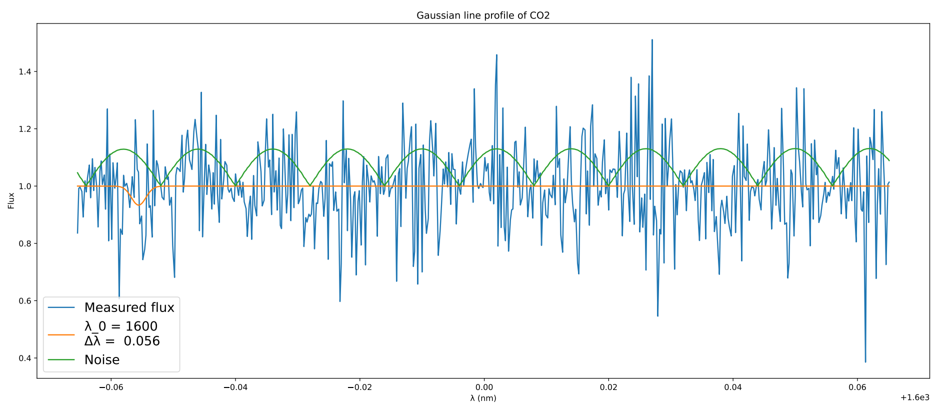

Figure 8. Flux Data and Spectral Line Analysis

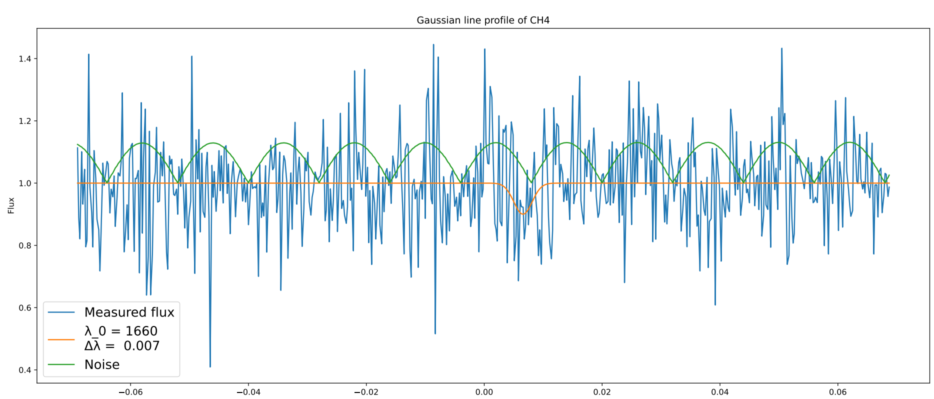

Figure 9. Flux Data and Spectral Line Analysis

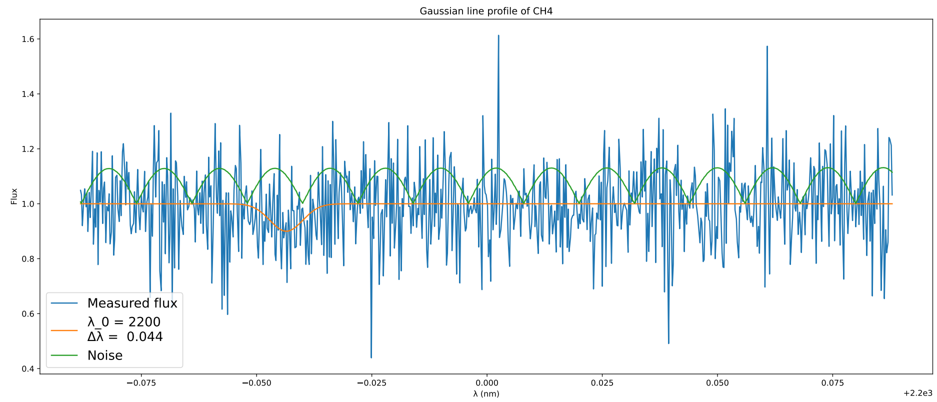

Figure 10. Flux Data and Spectral Line Analysis

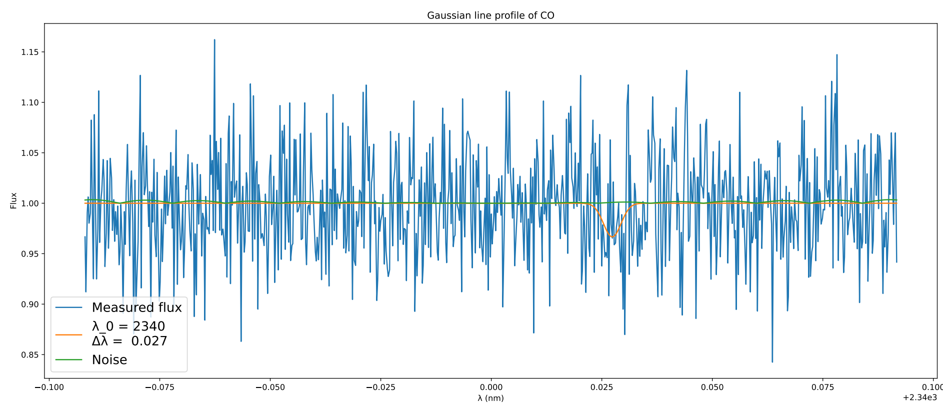

Figure 11. Flux Data and Spectral Line Analysis

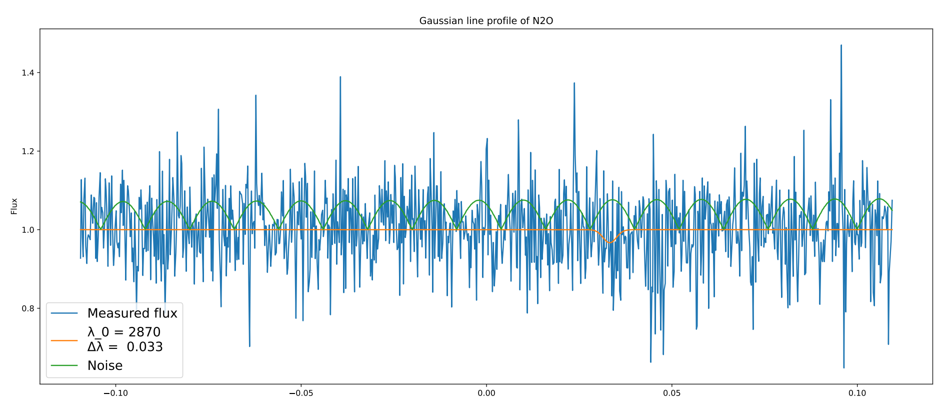

Figure 12. Flux Data and Spectral Line Analysis

Depicted in Figure 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12 are the Gaussian line profile of possible gases contained in the target planets atmosphere. Table IV A depicts much of the same information in addition to the temperature.

On top of the plots we have added the noise from our data. The noise have values in the range of 0.05 to 0.15, but For the sake of visualization we have added 0.95 as to lay the noise on top of the other data to make it easier to see its effect.

B. Model of Planet Atmosphere

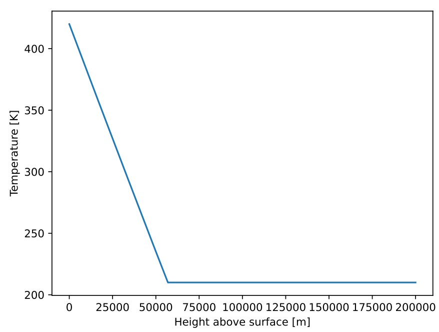

Figure 13. Our model of the temperature as a function of meters above the surface

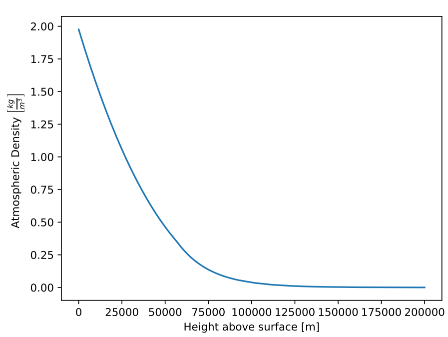

Figure 14. Our model of the atmospheric density as a function of meters above the surface

V. DISCUSSION

A. Spectral Line Analysis

To filter out spectral lines which were flukes we used a multitude of criteria.

- Temperature of different spectral lines in one gas
- Variation in the analysis with different levels of accuracy
- Doppler shift
- Amount of flux
- How good a fit the calculated line is in comparison to measurements

Of a real spectral line we expect the lines to have about the same temperature. This was not the case for either O_2, H_2O, CO_2 and CH_4. We therefore doubt them being possible gases in the atmosphere.

When running our analysis we could choose whatever accuracy we wanted. As our accuracy got higher a lot of our results changed temperature drastically. This was to our advantage as it most likely meant the spectral line was a fluke. Using this as a criteria we can could be even more secure in our choice to doubt O_2, H_2O and CH_4. The temperature of CO and N_2O converged towards 217 K and 183 K respectivly as seen in table IV A.

The Doppler shift is quite inconsistent in most cases. We clearly observe this in CO_2, H_2O and CH_4 in which we observe the absolute shift being around 2 times as much for CO_2, 2-3 times as much for H_2O and 7 times as much for CH_4. In all other cases their are either just one line per gas or consistent results. O_2 had very consistent results.

The flux was on the higher end of what we expected ($0.7 \rightarrow 1$). Only a single line of O_2 and H_2O broke through 0.90. We expect to see a lower flux for real spectral lines. The most likely candidates so far being N_2O and CO both had a very high flux of 0.97 which makes it more uncertain they are real.

When looking into which spectral lines fit the measured data the most we also need to take the noise into account. The more noise, the higher the likelihood of fluctuations looking like spectral lines. We will focus on the parts of the graphs where the noise is relatively low and seemingly bounces of the Gaussian line distribution.

O_2

The first spectral line of O_2 at 632 nm 1 is not too far off the peak of the noise and has a big fluctuations all around. This seems to most likely be a fluke.

The second spectral line of O_2 at 690 nm 2 is very close to a local minima point. Comparing this to every other local minima of the noise we see our line profile gives a good match with the lowest fluctuations of all the local minimums. This seems to be a real line

The third spectral line of O_2 at 760 nm 3 is also very close to a local minima and our line profile seems like a good fit here as well. Out of all the local minima points this also seems like the most likely to contain a true line.

Just looking at the graphs we observe oxygen giving us two seemingly good fits.

H_2O

All the line profiles of H_2O seen in 4, 5 and 6 Are surrounded by a lot of data not matching our line profile, and do not seem like good fits.

CO_2

The first spectral line of CO_2 seen in 7 is close to a local maxima of noise so we can not say with certainty wether or not this is a true line or just a fluke.

The second spectral line of CO_2 seen in 8 is located very close to a local minima of noise which gives us confidence in its validity, but our curve is not the best fit for the measured data.

When taking both graphs into account it seems likely that none of the spectral lines of CO_2 are real.

CH_4

The first spectral line of CH_4 seen in 9 is not too far off a local minima of noise, but there are a lot of measured flux above our line profile, which may point to it not being a real line after all. Our graph does not fit the measured data very well either.

The second spectral line of CH_4 seen in 10 is located in between a local minima and maxima and follows the measured data quite nicely. Its the only local minima with a dip in flux over a wide range. This might be a sign the line is real.

Judging by its graphs its very hard to say weather or not the graphs actually represent real lines.

CO

The spectral line of CO seen in 11 is surrounded by a bit different data. In this case, the noise was relatively small in comparison with the measured data. This means the noise will have less an effect on the flux. When the flux varies this much with such small amounts of noise its not very likely this is a real line. Our line profile does not match too well with the measured data either.

N_2O

The spectral line of N_2O seen in 12 is located right under a local maxima which makes it more likely the measured dip in flux is a result of chance and noisy data. Looking at the rest of the graph there seems to be no dip of significance around any of the local minima.

VI. CONCLUSION

A. Atmosphere composition

Judging by temperature, Doppler shift and variation in analysis it seems CO and N_2O is the only viable options. These two have the most consistent and almost equal temperature.

Judging by the flux, CO and N_2O are the worst option. On the other hand, O_2 and CH_4 rises as the best options.

Judging by how good a fit our model is, we observe O_2 being the best fit by far.

To conclude the discussion of results as seen in V A, there is no clear candidate which checks all the boxes. We choose to consider how well a fit our model is in addition to the flux the most important factors as that is based in actual data and not our just our own calculations. The line profile seen in 2 and 3 matches a lot closer than the one seen in 1. As the temperature of the first two are equal (450 K) which also matches earlier estimates made in Jannik: Refferer til temp estimat i del 3 of the planets temperature, we will assume they are real lines. The atmosphere is therefore 100 % O_2 with a mean molecular weight μ of

$$\mu = \frac{2 \cdot 15.9994 \cdot 1.66 \cdot 10^{-27}}{1.00794 \cdot 1.66 \cdot 10^{-27}} = 31.75.$$

VII. APPENDIX

ACKNOWLEDGMENTS

REFERENCES