Brillouin WP 10: Retrieval issues and consequences for ADM-Aeolus

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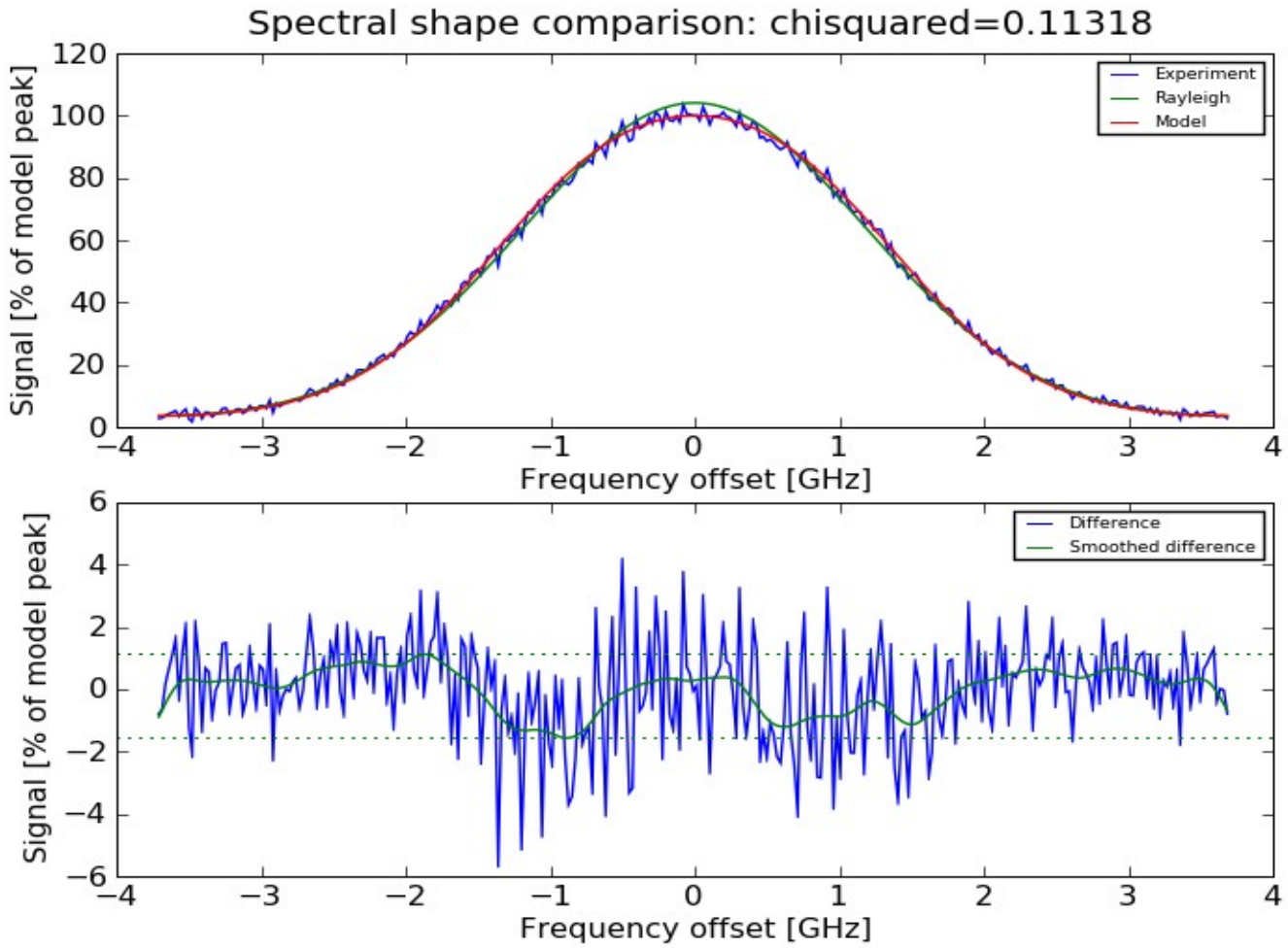
Task WP10:

- Copied from proposal document v.6:
  - Interpretation of experimental data and the novel TENTI description.
  - Describing consequences for retrievals for the ADM-Aeolus wind LIDAR mission
  - Describing consequences for satellite missions in general

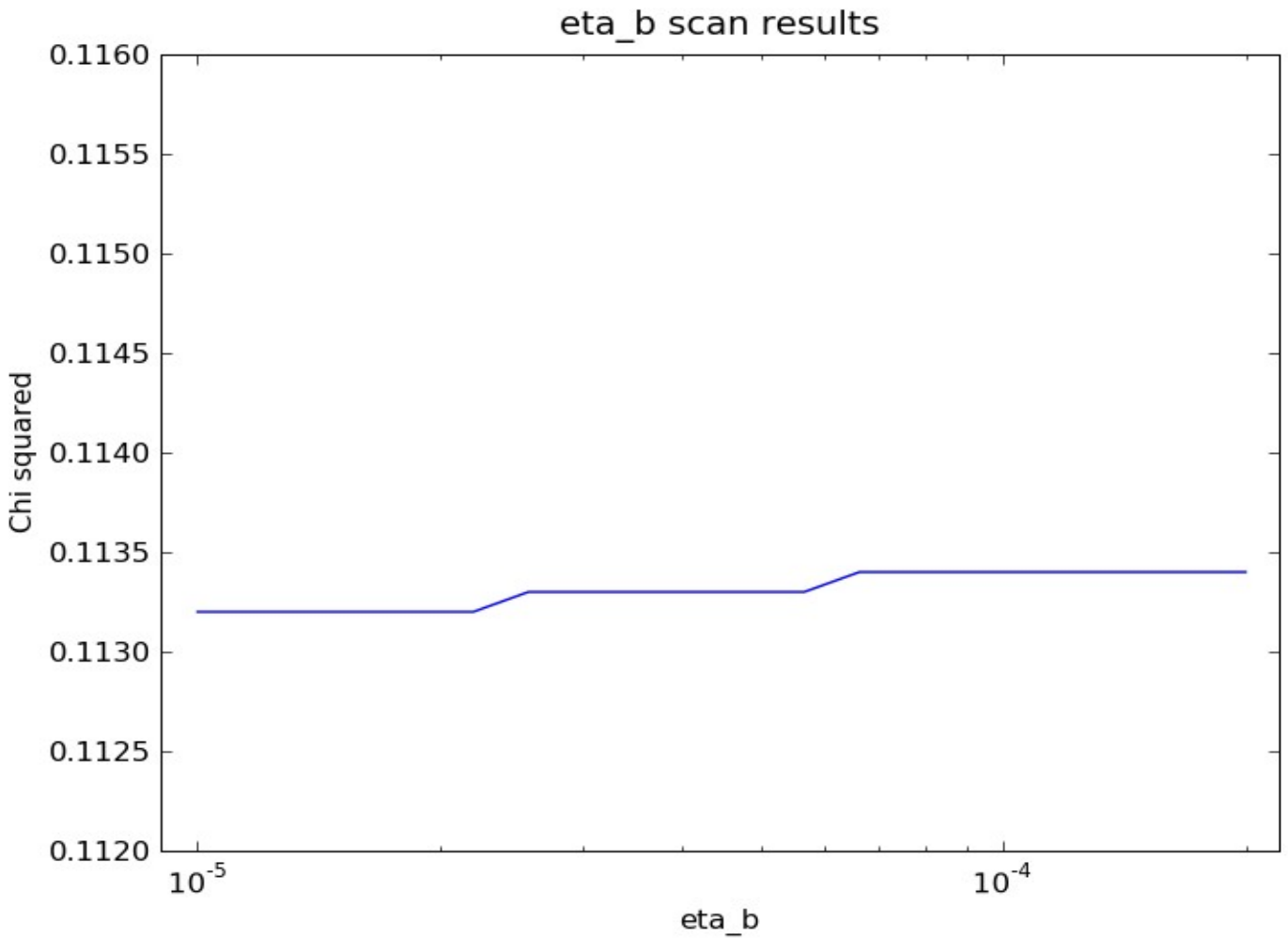
Inputs:

- Calculated spectra (17-Jul)
  - spectra calculated using the rbs program for Air, S6 model, 297 K, and a range of pressures (300 upto 5000 hPa), VU-setup
- Executable program
  - rbs program by Willem
  - (1-Oct. windows version, 6-Oct.linux version)
  - awkward for scripting: sometimes asks to hit return key ....
- Experimental data
  - 1 case: 300 hPa, N2, 297 K (VU)

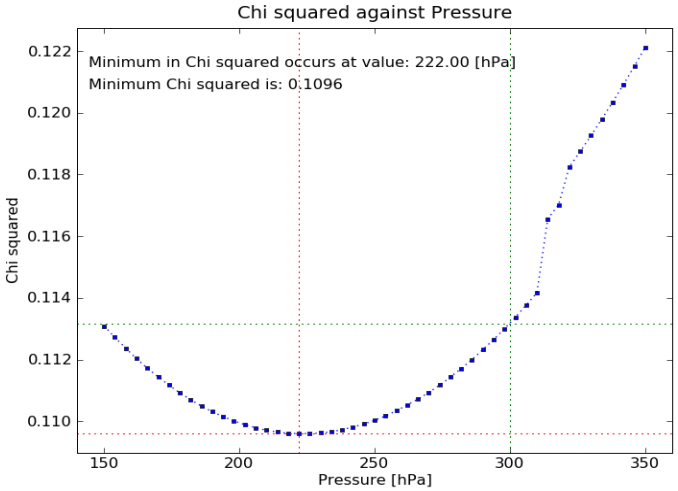
First try: fitting 300 hPa N2 case

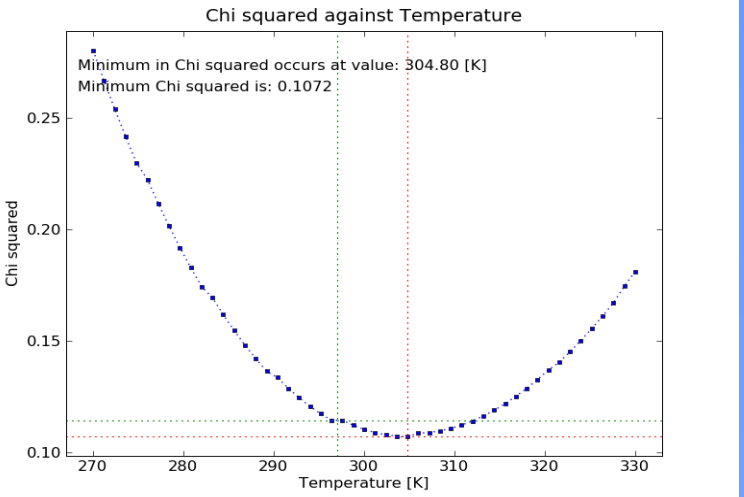


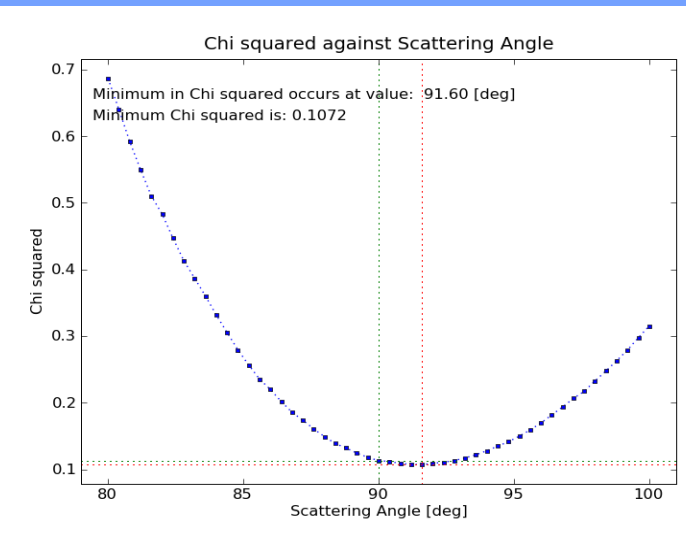
Scanning eta_b for 300 hPa N2 case

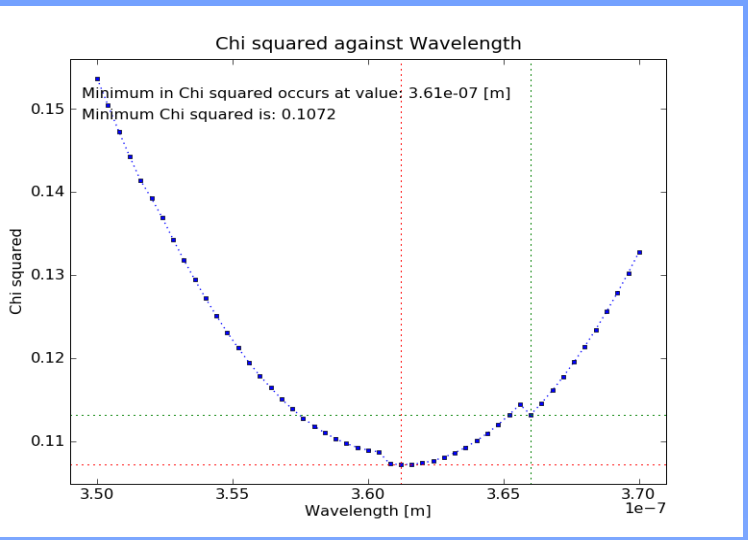


Scanning P,T,angle and wavelength





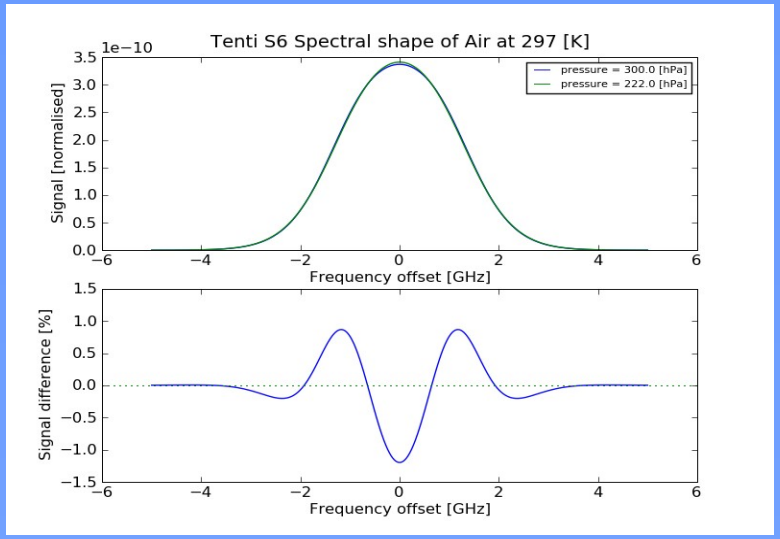


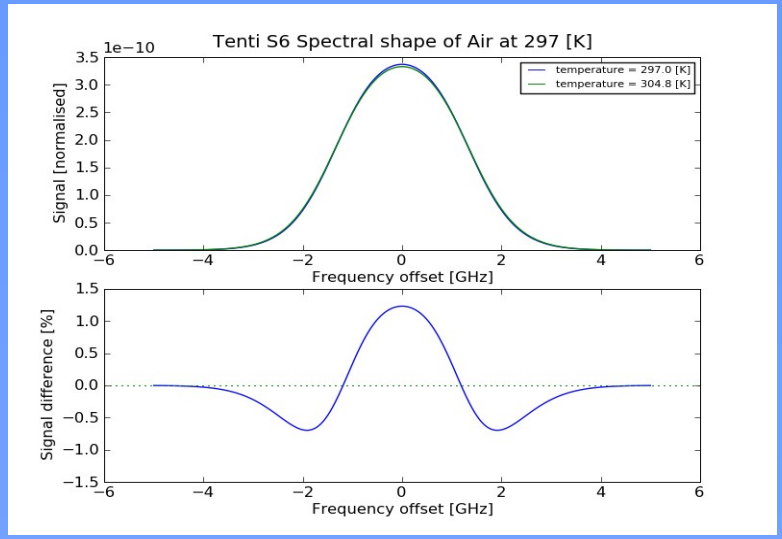


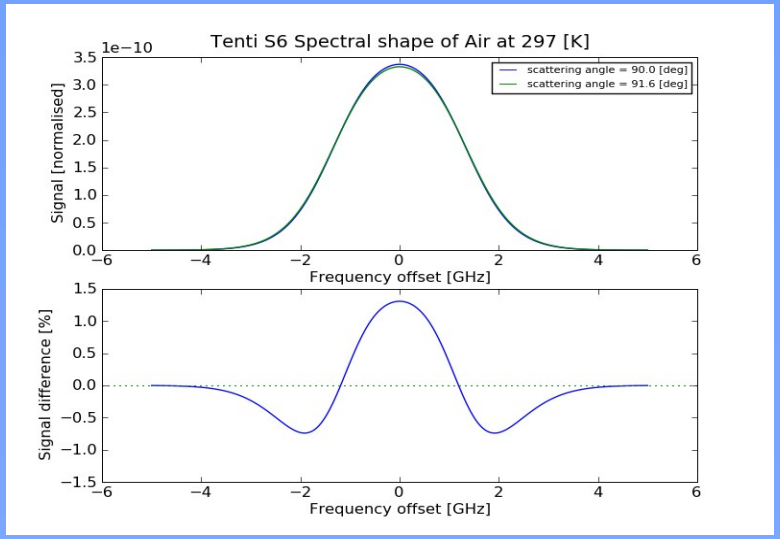
Some observations:

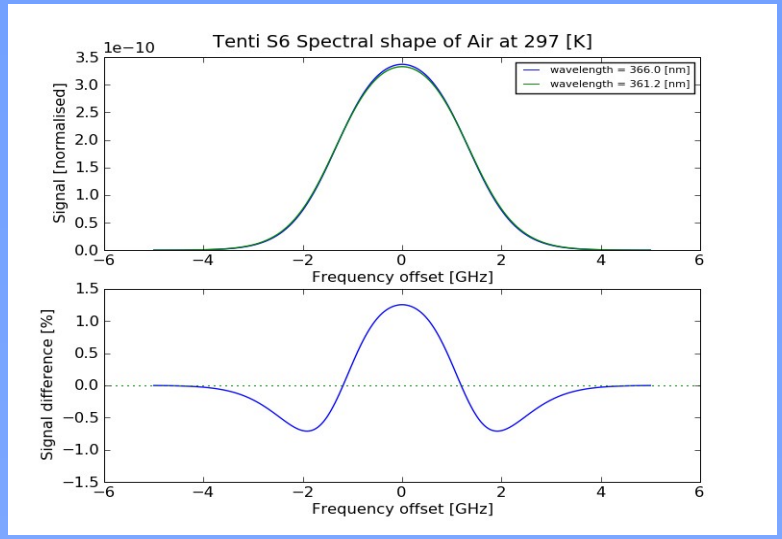
- sensitivity to temperature and scattering angle are largest
- these are also exchangable: both have mainly effect on width of the spectral peak
- wavelength sensitivity is smaller, also acts on width of spectral peak
- pressure sensitivity even smaller, acts on shape of spectral peak
- eta_b sensitivity almost absent (as expected for such a low pressure)

Spectral shapes for 366 nm 90 deg





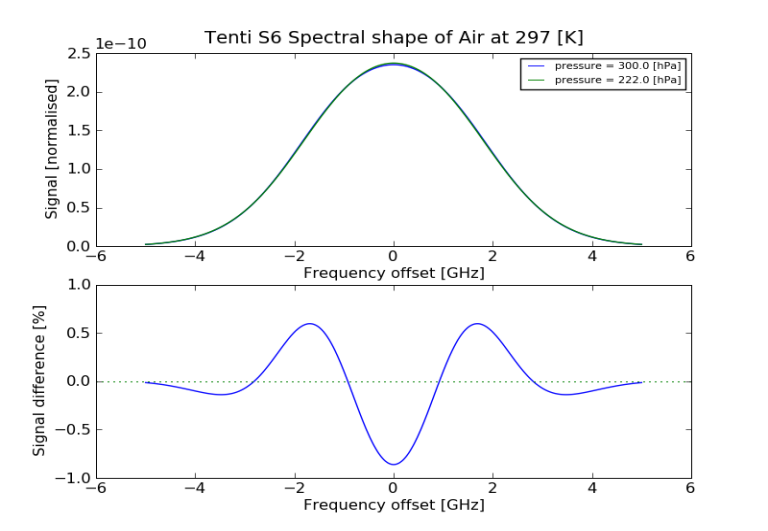


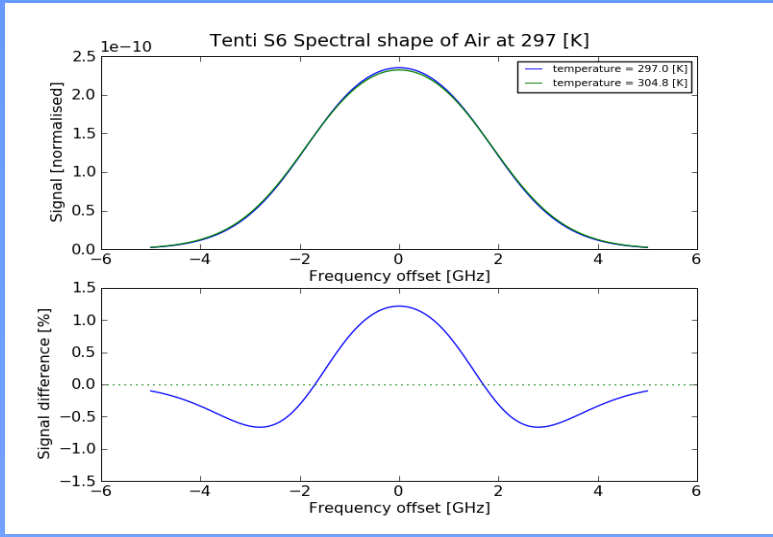


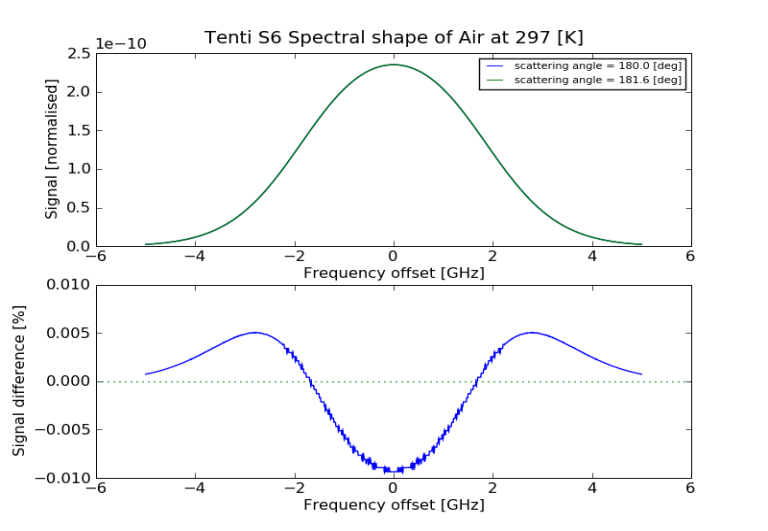
Approach for ADM-Aeolus geometry

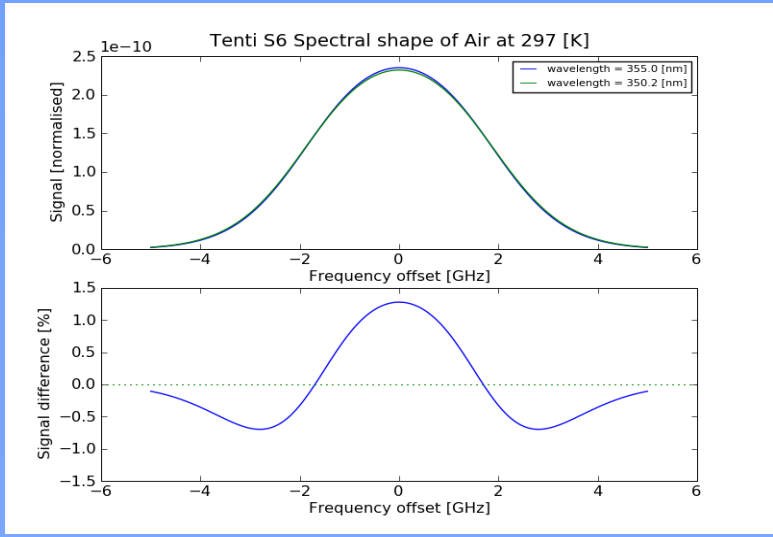
- wavelength 355 vs. 366 [nm]
- scattering angle 180 vs. 90 [deg]
- uncertainty in measurements:
  - based on residuals reported between model and experiment of 1 to 2 %
  - modelled by taking a temperature “error” of 13 [K] which gives a shape difference of 2% for 366 [nm], 90 [deg]
  - gives also for 355 [nm], 180 [deg] a 2% shape difference
- assumption: residual between Tenti model and experiment of 2% may be translated to spectral shape difference between 300 and 500 [hPa]

Spectral shape differences (355 nm)

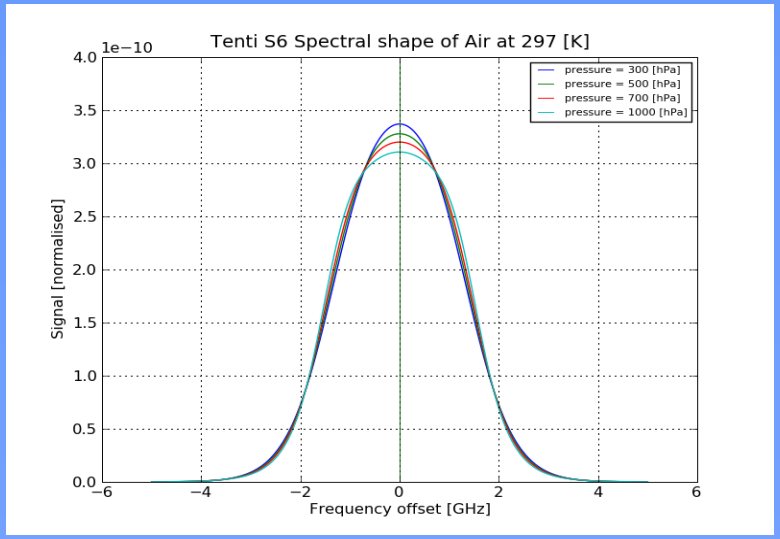


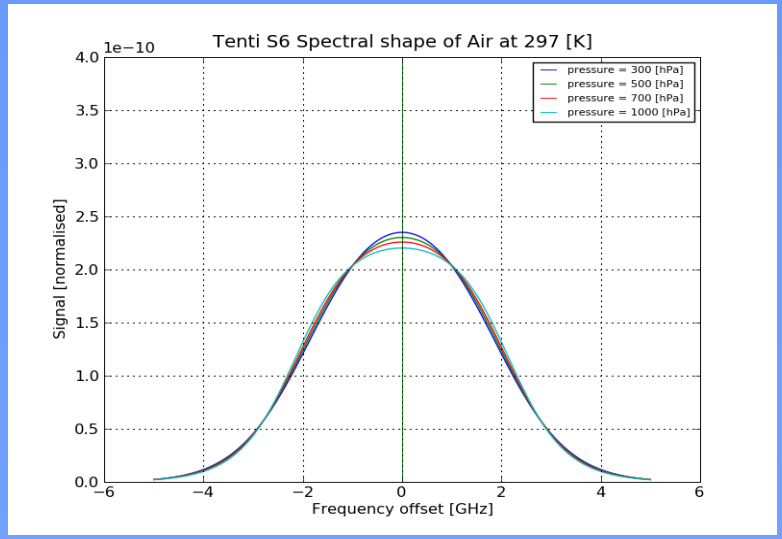


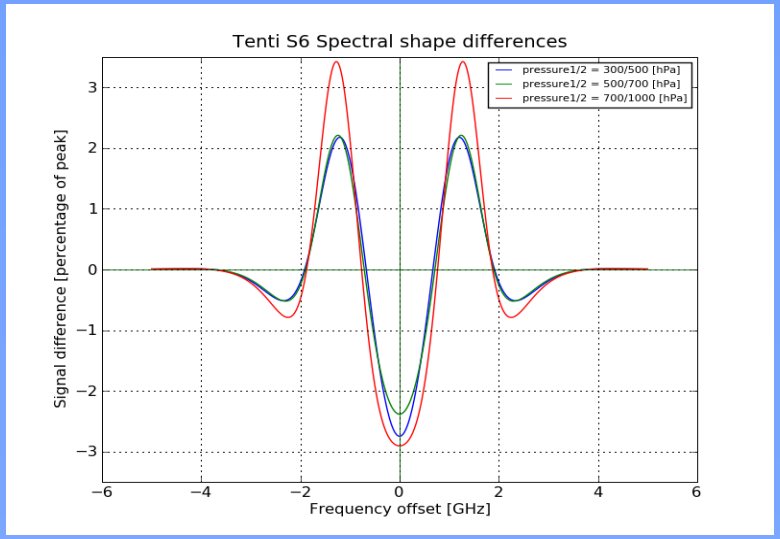


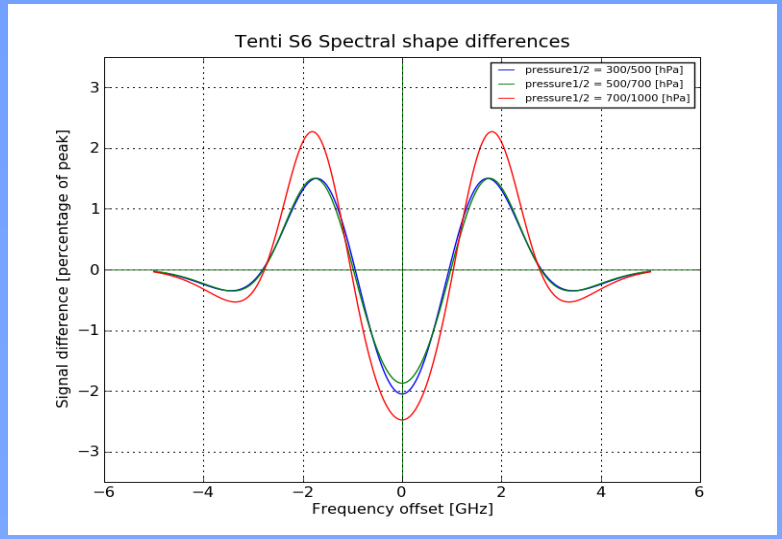


Spectral shapes compared (90/180)



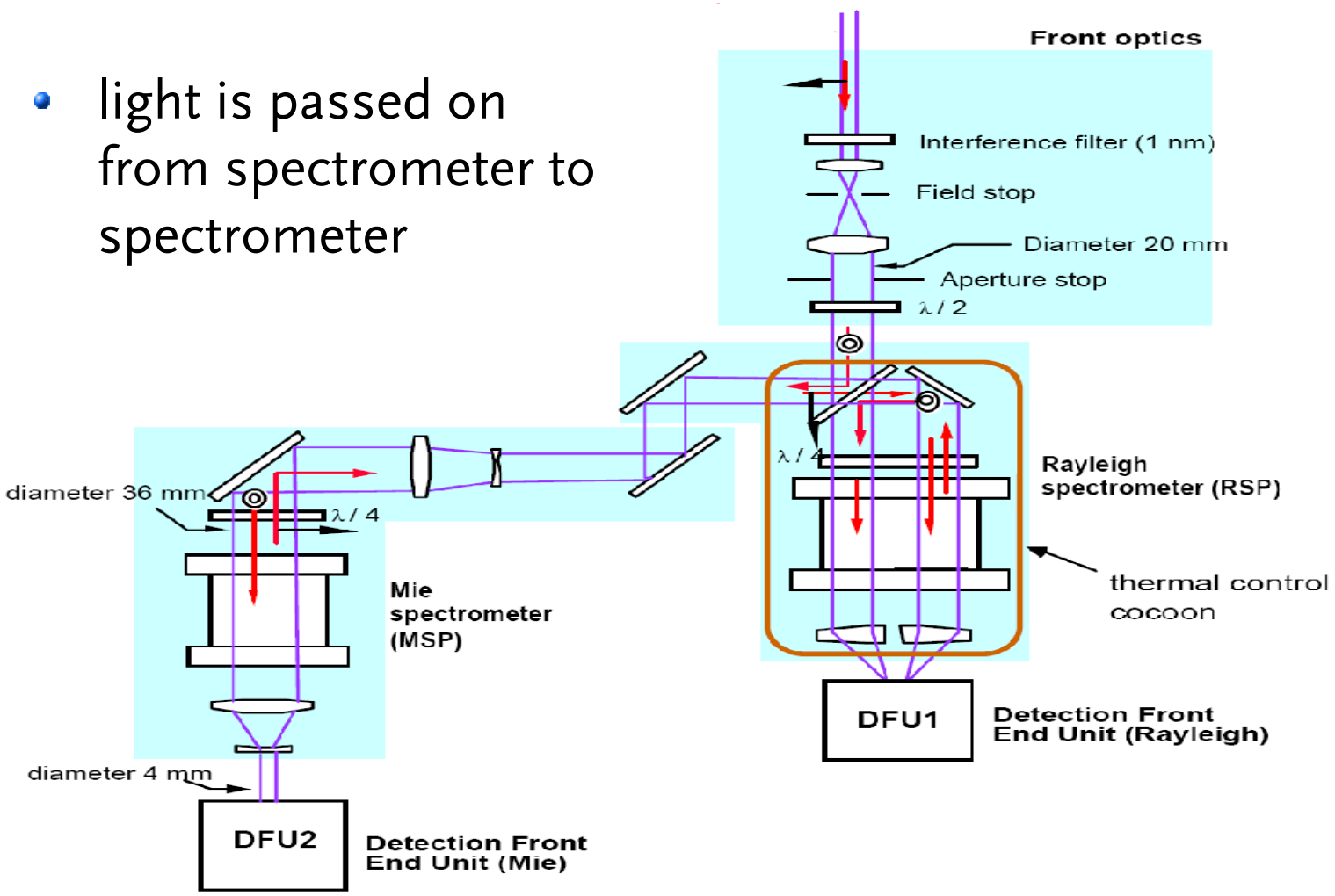




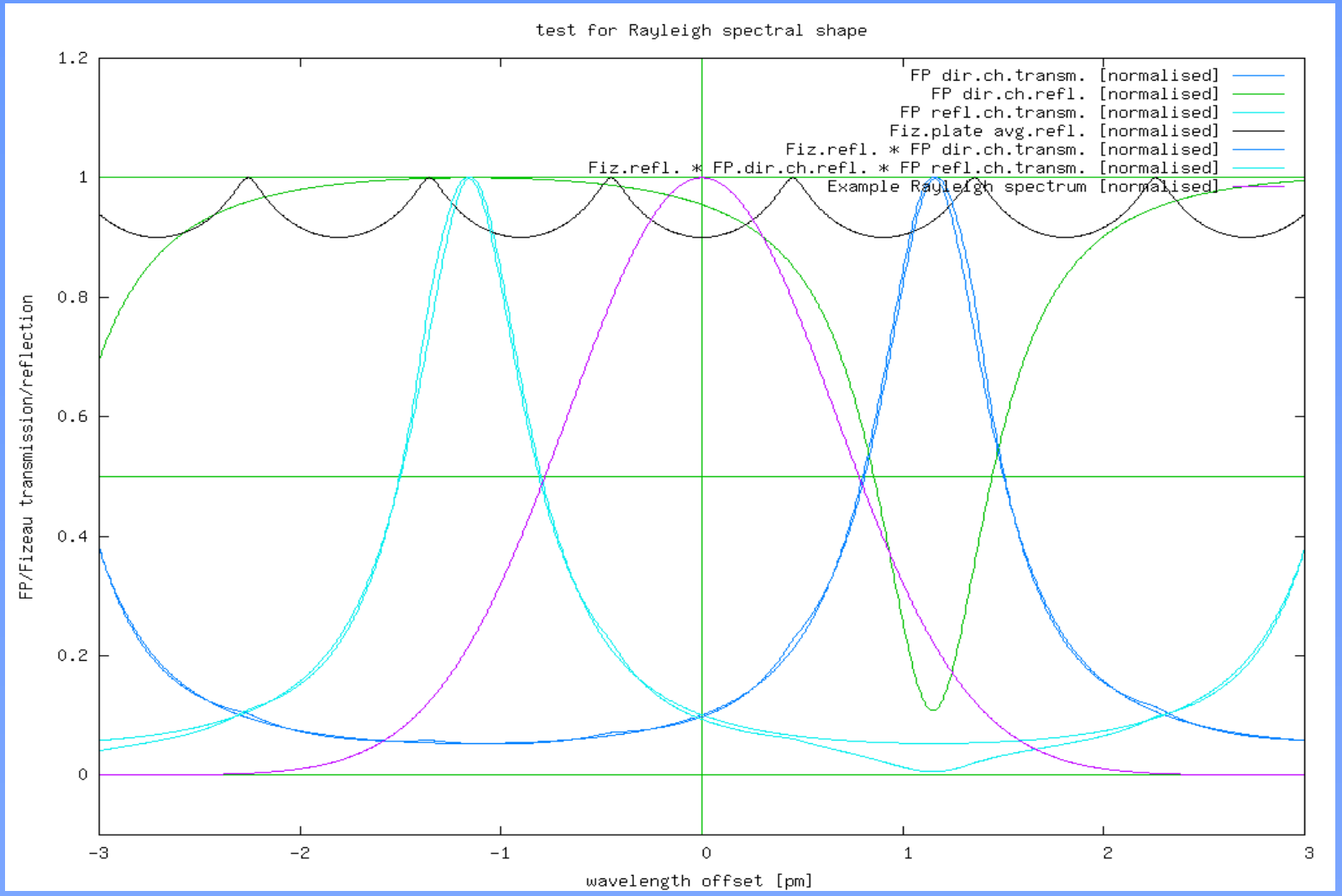


ADM-Aeolus response calculation

- light is passed on from spectrometer to spectrometer

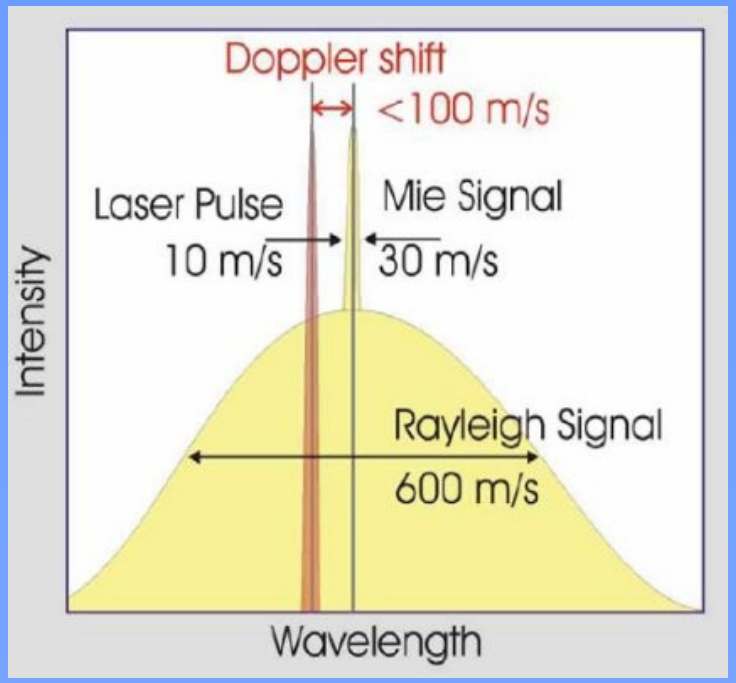


ADM-Aeolus response calculation

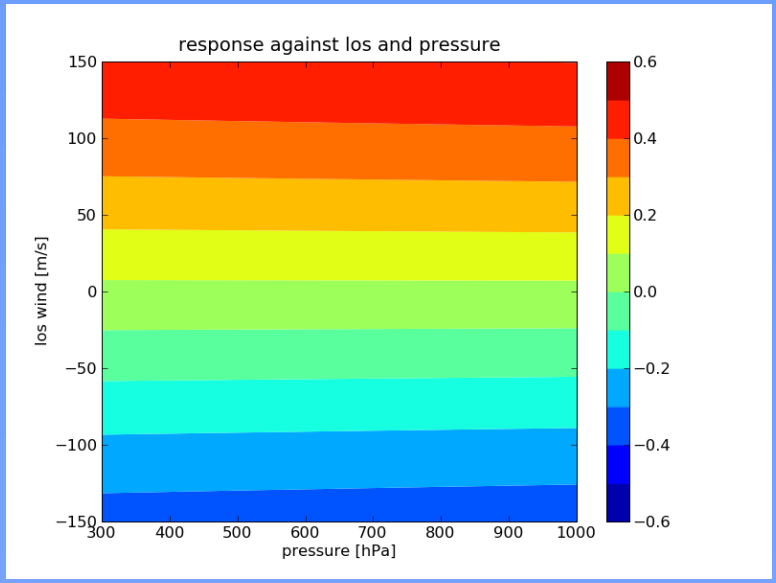


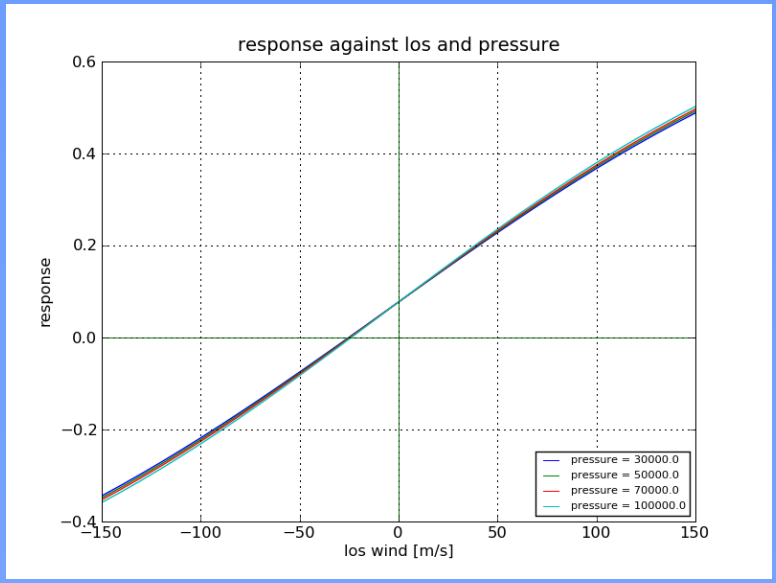
Calculate responses

- Doppler effect shifts the spectrum:
  - $\delta\lambda = \frac{2v_{LOS}\lambda}{c}$
- Response taken to be difference between 2 Fabry-Perot channels:
  - $R = \frac{A-B}{A+B}$



Calculate responses

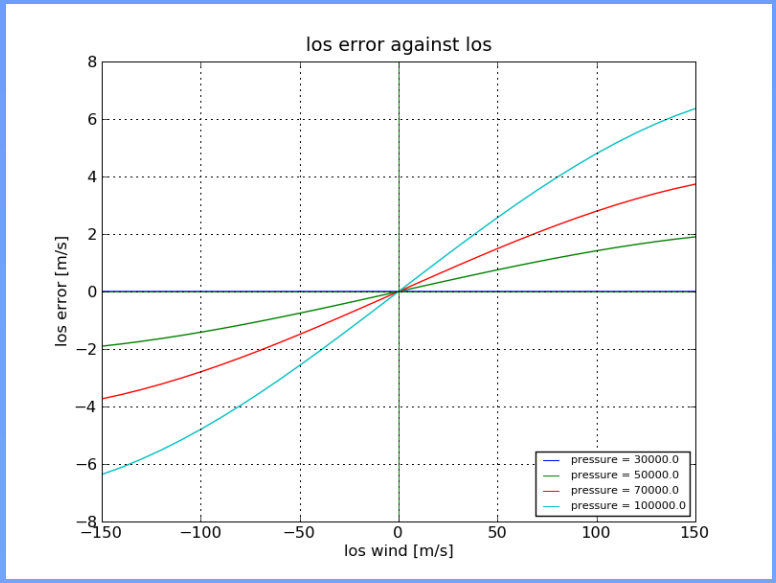


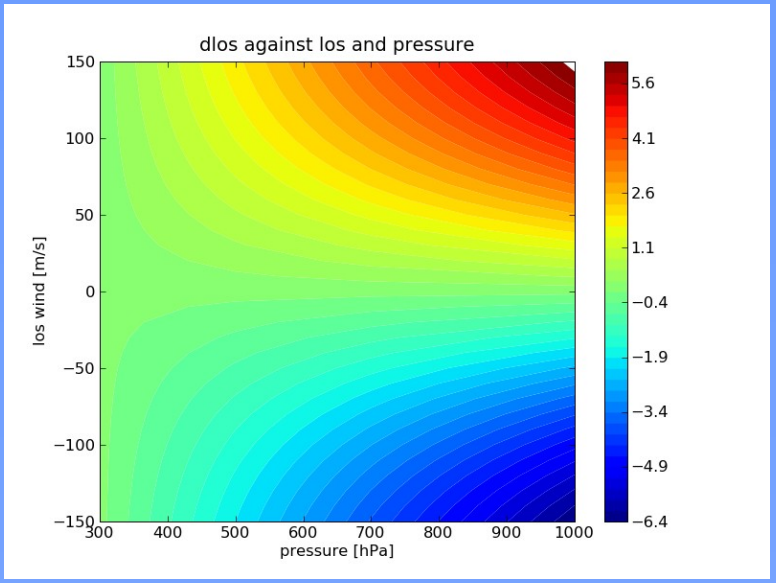


Simplified wind retrieval

- invert relation LOS-wind(Response) to Response(LOS_wind) for 300 hPa
- use this relation to calculate winds for spectra calculated for higher pressures
- difference between input and output wind gives an idea of how a spectral shape change affects the wind result

Calculate responses





Some example wind errors

Input LOS wind [m/s]	wind error [m/s] for retrieval at 500 [hPa]	wind error [m/s] for retrieval at 700 [hPa]	wind error [m/s] for retrieval at 1000 [hPa]
-50	-0.75	-1.49	-2.57
-40	-0.61	-1.20	-2.07
-30	-0.46	-0.91	-1.57
-20	-0.31	-0.61	-1.05
-10	-0.15	-0.30	-0.53
0	0	0	0
10	0.15	0.30	0.53
20	0.31	0.61	1.05
30	0.46	0.91	1.57
40	0.61	1.20	2.07
50	0.75	1.49	2.57

- NOTE: improved results compared to draft TN, due to use of 355 nm 180 deg spectra, in stead of "adapted" 366 m, 90 deg spectra.

Conclusions:

- deviations between measured and predicted spectra in the order of 2% can lead to wind errors of 1 to 2 m/s.
- system requirement is 2 m/s, so this is not negligible.
- the errors will be systematic, which is even more severe
- the errors seem largely proportional to the input LOS windspeed, so could partially be eliminated by calibration by comparing a priori knowledge (from NWP models) with obtained measurements
- Any improvement in the Tenti model that could reduce this effect would be the first path to follow

The end

- questions ?