Spectroscopy data reduction

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April 2019

1 Introduction

- Load the data files
- Plot the bandpass data
- Do bandpass correction on the LCP and RCP data
- Depending on which frequency we are analyzing, pointing offset observations are normally done.
- measure the amplitude at the offset positions
- calculate the pointing correction factor
- do bandpass correction on the On-source observations (repeated if more than one pair of observations)
- Applying pointing correction factor to On-source spectra
- Applying point source sensitivity (PSS) conversion factor for each polarization (You guys worked on the Drift scan observations before). Note that to be accurate a value for the PSS obtained as close a possible to the spectroscopic observation should be used. Another possibility is to determine an average value for the PSS by averaging the PSS value over a long time. For HartRAO we can do this because we have a long-erm monitoring programme which benefits the accuracy.

2 Bandpass

The spectrum produced after the signal passed through a band-pass filter. The drop of the signal on the sides is due to the filter response. The filter acts as a square-law detector, but it is not perfect. As you can see, the noise level for LCP and RCP is different. The noise level of the LCP and RCP is the antenna temperature.

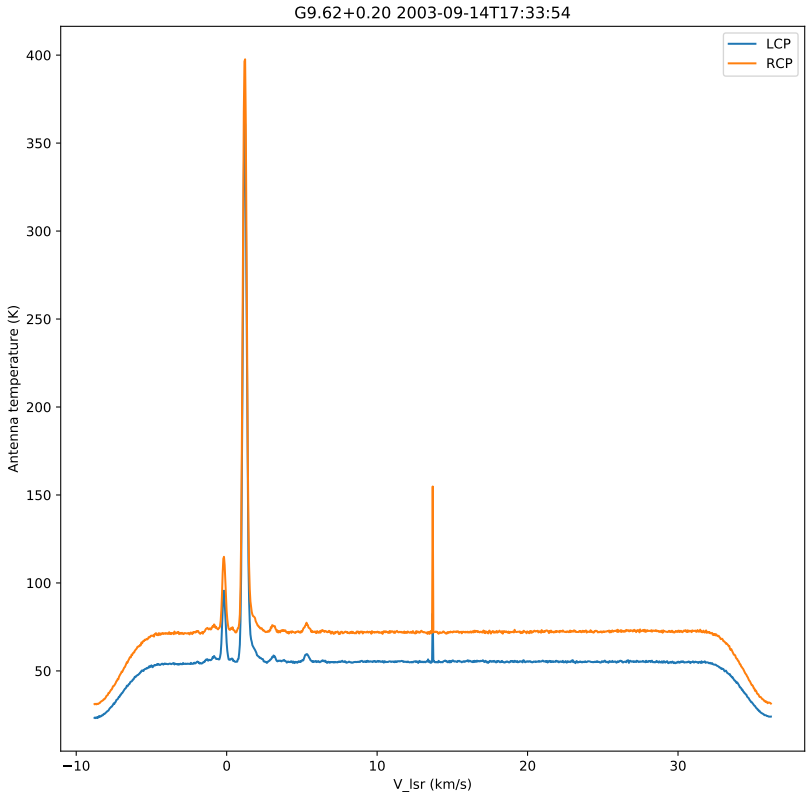

Figure 1: Bandpass of a 1 MHz filter at 6.668 GHz

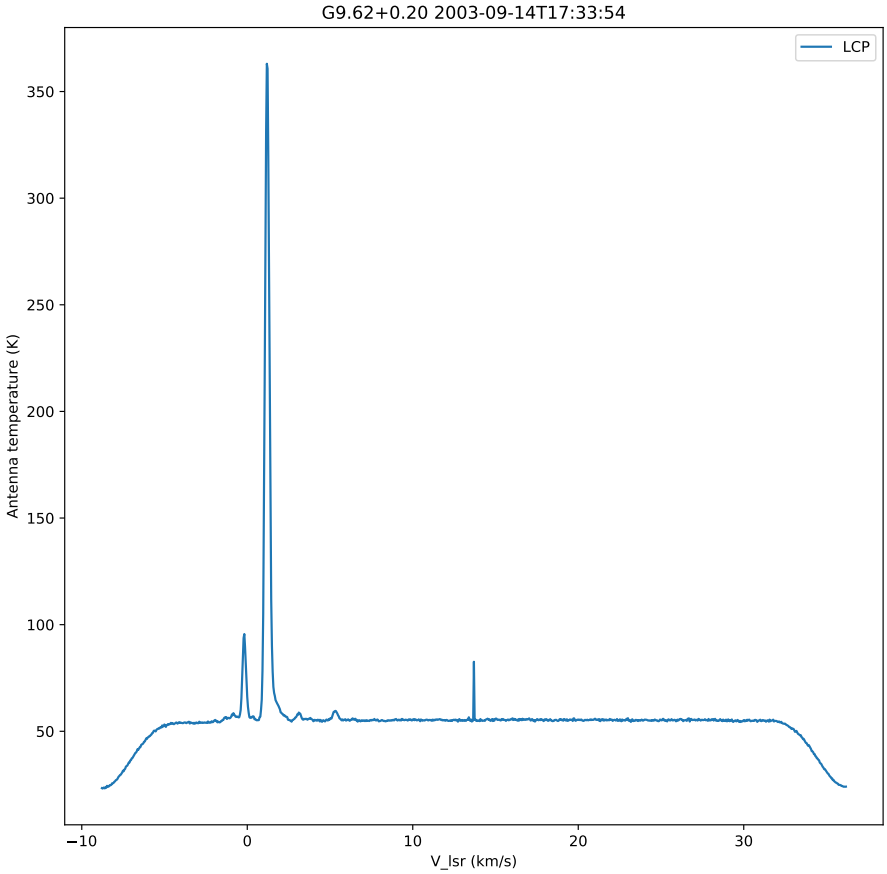

Figure 2: First observation of a frequency switched pair

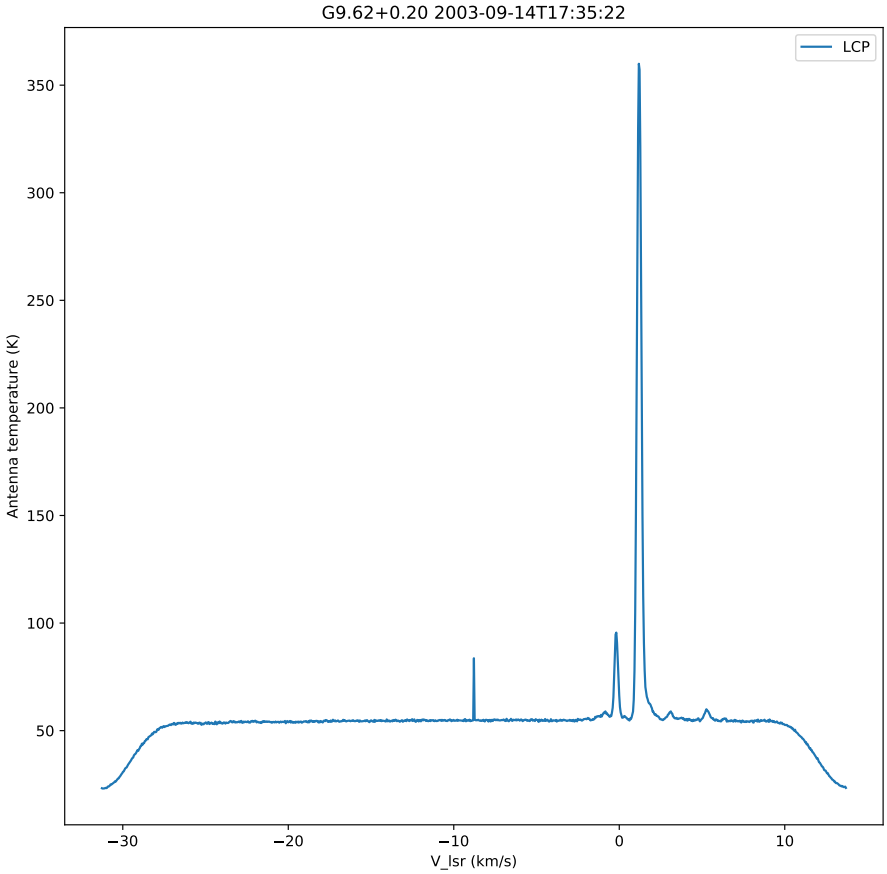

Figure 3: Second observation of a frequency switched pair

3 Averaged bandpass corrections

To do the pointing correction we average the LCP and RCP. This will calculate the average of LCP and RCP and subtract that value from the entire spectrum and pull down the spectrum to zero level.

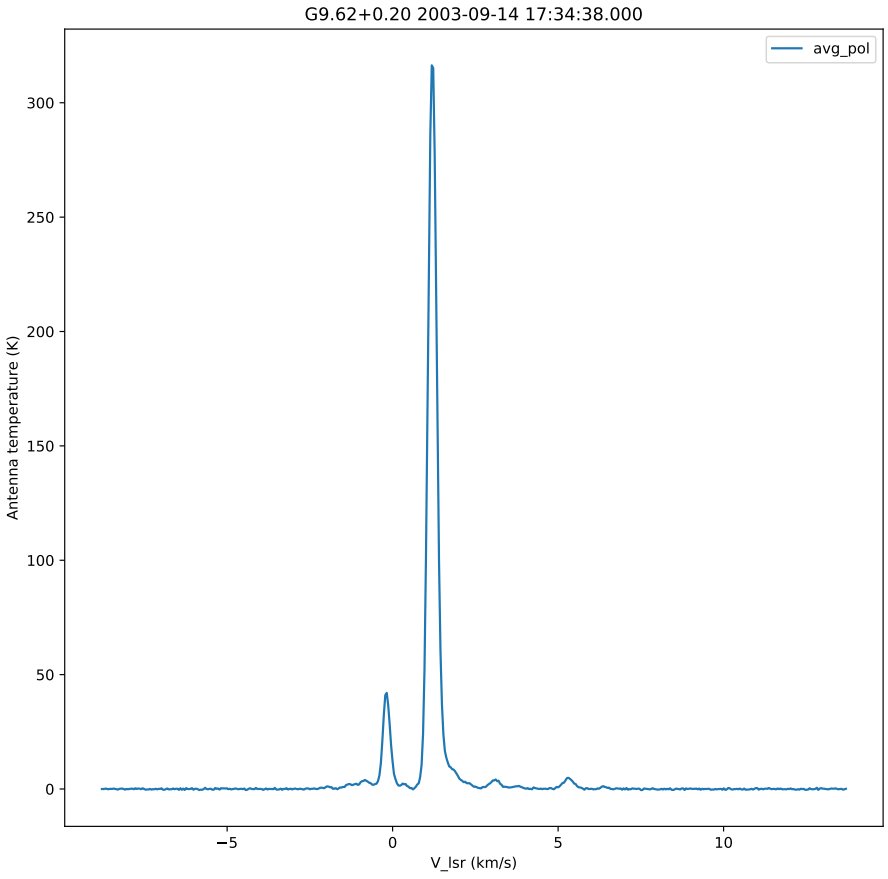

Figure 4: Averaged and bandpass corrected spectrum.

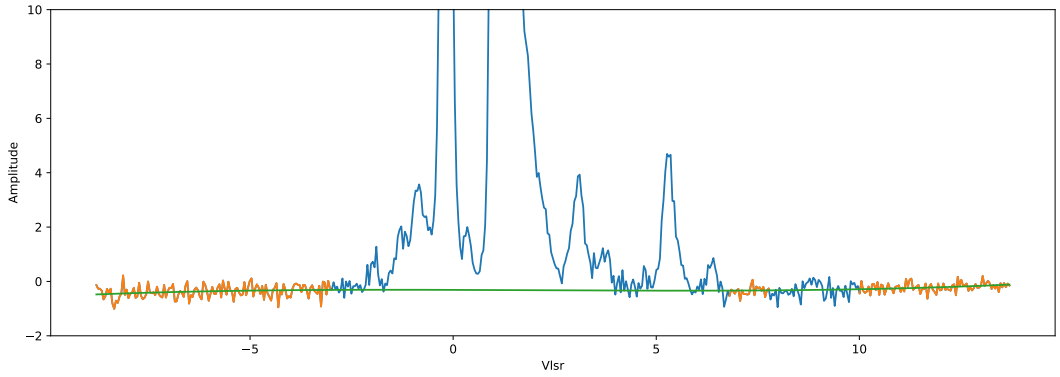

Figure 5: Chosen blocks for the baseline to flatten the baseline if necessary.

4 Pointing observations

Seen the power distribution of the main beam.

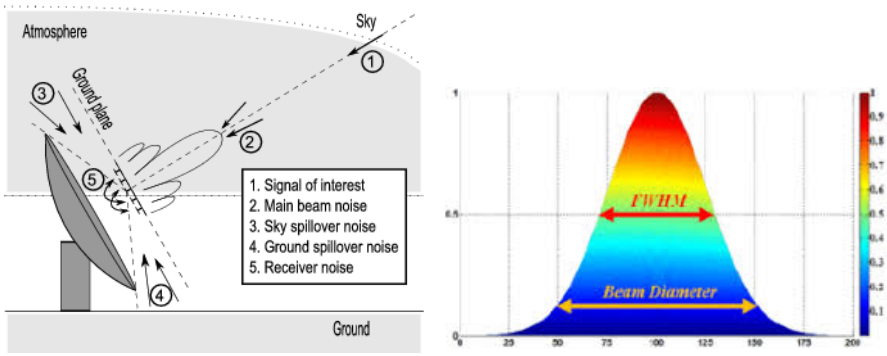

Figure 6: Antenna power distribution.

If we assume that the astronomical source emits spherical symmetrically, the power distribution will be a Gaussian profile in the direction of the observer (in the case the HartRAO telescope). To observe the maximum power from the source, the telescope must be pointed precisely on the source.

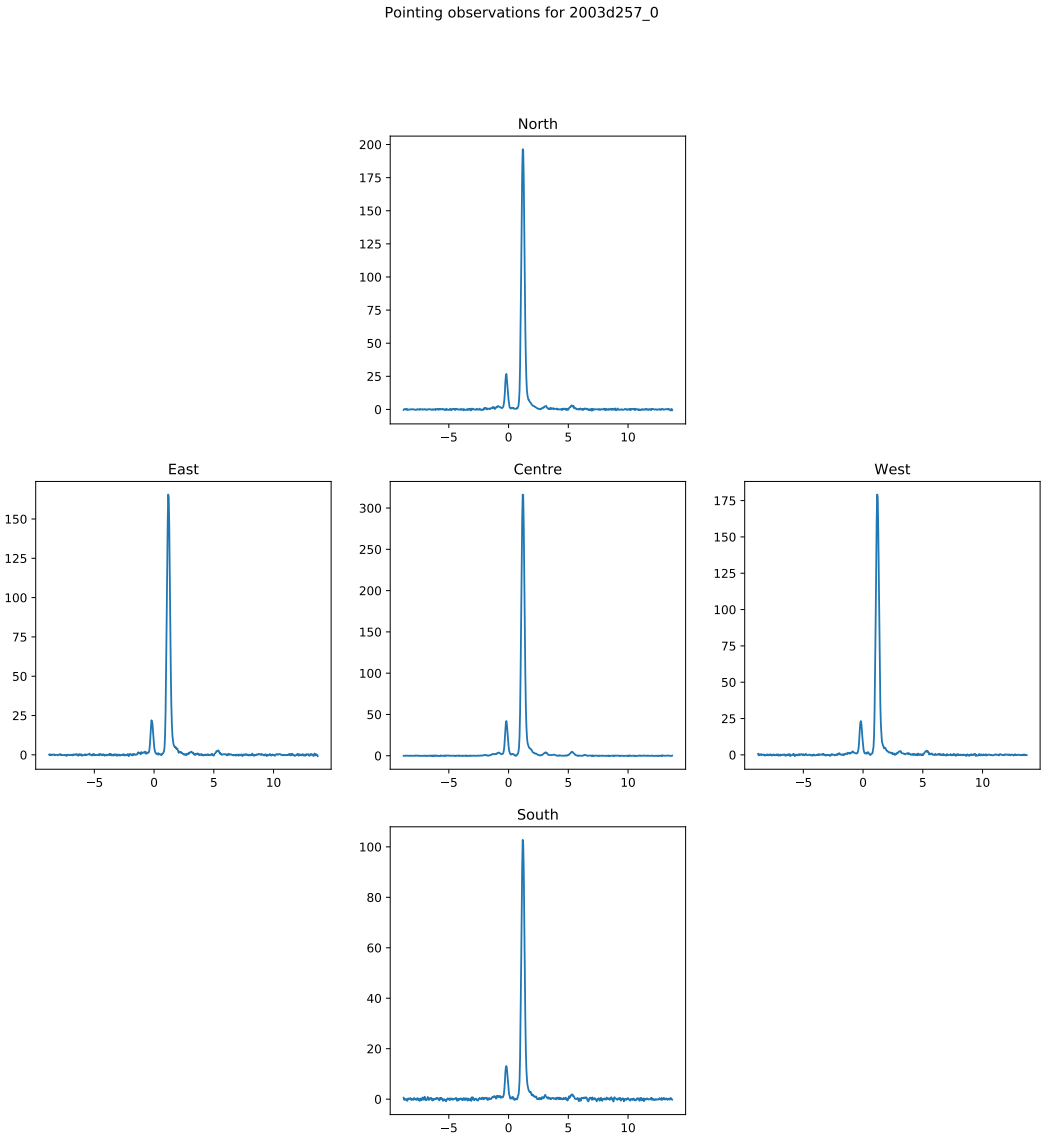

Figure 7: North, South, East, West, and Centre pointing observations.

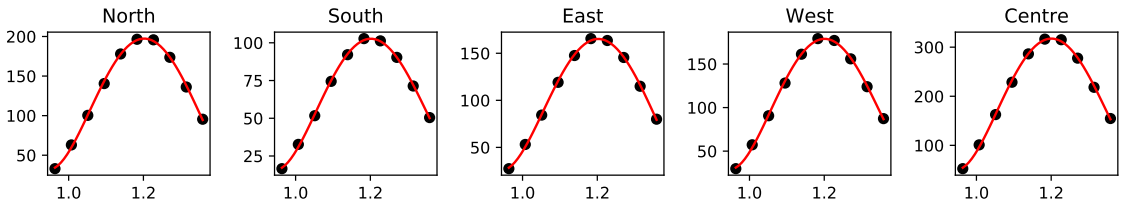

Figure 8: Gaussian fitting to each pointing observation to get the peak flux for each pointing.

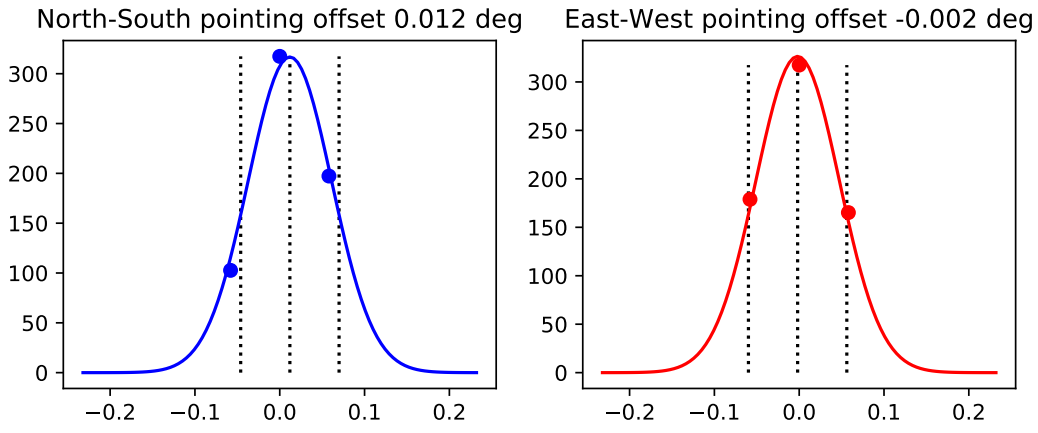

Figure 9: Gaussian fitted to the North-South and East-West pairs to calculate a possible pointing off-set in each of these directions.

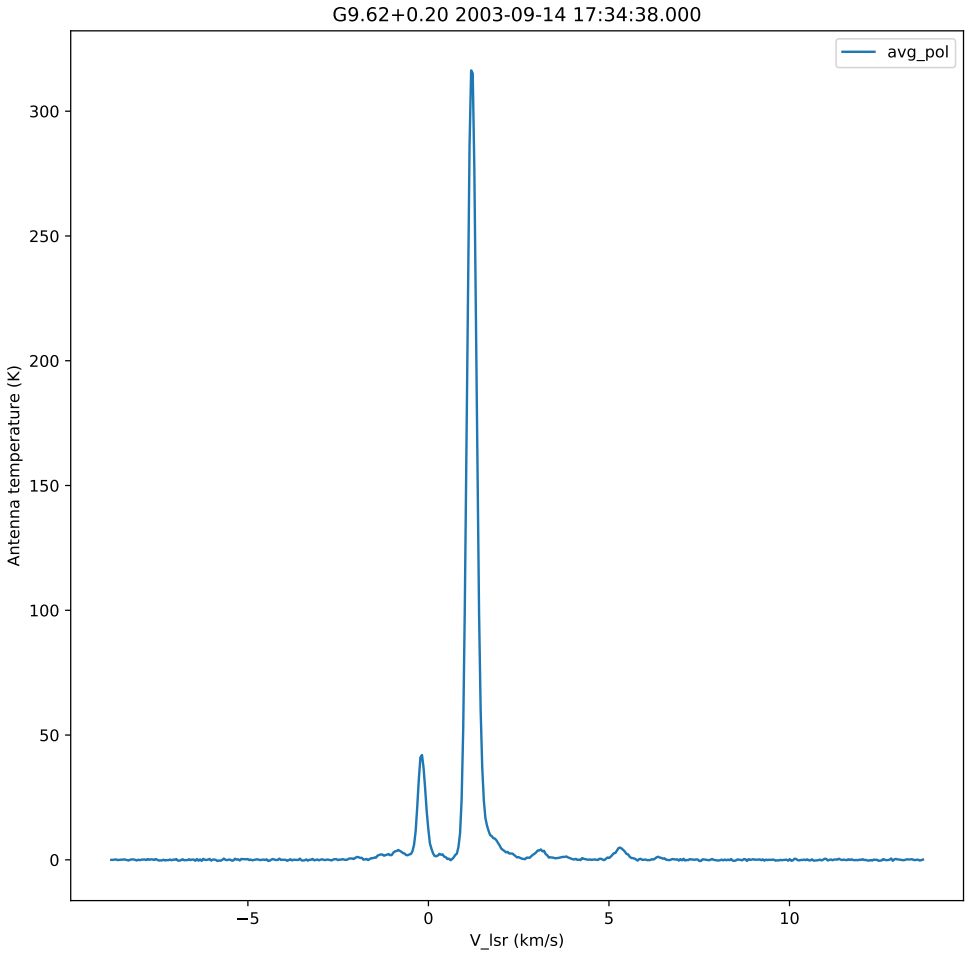

Figure 10: The final spectrum which is corrected for pointing correction factor.

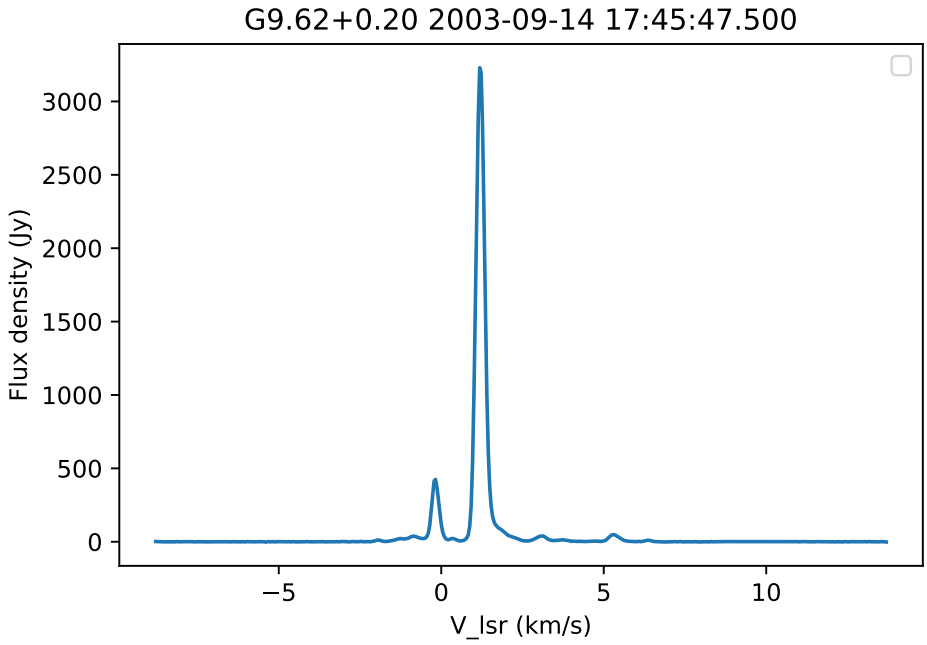

Figure 11: The final spectrum in flux density (Jy) after the spectrum is multiplied by the PSS which was determined from the Drift-scans.