

Proposal ID: 08_0038
PI name: David A. Neufeld
PI email: neufeld@jhu.edu

Data processing liaison: Helmut Wiesemeyer
Email: hwiese@mpifr.de

Bonn, 27 October 2021

Dear David,

The attached file `Cycle9_GR_OT_08_0038_DNeufeld.class` contains the processing steps to create the level 3b and level 4 data products (.great files), including:

- Atmospheric transmission correction: Water vapor columns were determined from free fits to the atmospheric emission in the respective sub-arrays (pixels grouped together) by means of an atmospheric model¹ further specifying the opacity due to dry species. In order to minimize the impact of gain drifts, the atmospheric emission used as input was derived from those measurements immediately following regular calibrations on loads at ambient and cold temperature.
- The obtained spectra are on T_A^* scale (RJ-equivalent forward beam brightness temperatures) and were converted to the T_{mb} scale by means of coupling efficiencies measured on Jupiter and Mars,
- subsequently, spectral baselines were removed, in form of polynomial or (occasionally in 4G1) wavelet fits of up to fourth order.
- For the 4GREAT bands and the central LFA and HFA pixels, the continuum level was added back to the spectra, so as to ensure the correct line-to-continuum ratio (appending `_LFA0` and `_HFA0`, respectively, to the source names). The continuum fluxes were derived from dedicated double-sideband calibrations otherwise using the same water vapor columns and dry opacities as above.
- For a given spectral line, spectra from equivalent positions were averaged with $1/\sigma_{rms}^2$ weighting (where σ_{rms} refers to the noise across the residual baseline).
- Data files and plots for the array footprints are presented, as above after baseline removal and averaging under $1/\sigma_{rms}^2$ weighting, yet without assigning a continuum.

As a matter of fact, the frequent saturation (at target velocity) of the absorptions in the OH $^2\Pi_{3/2}$, [OI] $\lambda 63\mu m$ and (occasionally) [ClI] lines is compatible with these continuum levels (within the noise level), with few exceptions arising from baseline uncertainties in the relevant velocity intervals.

For the targets towards which the NH₂ ground state line at 952.6 GHz was detected in the OH⁺ tunings (4G2), the bandpass retained for the final spectrum was enlarged so as to display both lines. However, the NH₂ line, arising from the image band, blends with a telluric ozone feature. Towards I16060, the CH₃OH $v_t = 0 - 2, 4(2,2) - 3(1,3)$ and H¹³CO⁺ J = 7 - 6 lines were also detected (in the signal respectively image band), along with the ArH⁺/p-H₂O⁺ setup.

¹ S. Paine, The AM atmospheric model, SMA Technical Memo #152 v11, DOI 10.5281/zenodo.3406483

In spectra where the narrow (~1 km/s wide) mesospheric [OI] λ 63 μ is within the velocity interval of the astronomical OI absorption or emission, the affected spectral channels are masked.

Further comments can be found in the aforementioned data reduction script.

We recommend the use of a recent version of the CLASS software (Jul 17 or later) which is part of the GILDAS software package (<http://www.iram.fr/IRAMFR/GILDAS>).

If you have any questions please do not hesitate to contact me.

Best regards,

Helmut

(Helmut Wiesemeyer, GREAT liaison)