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The Spectrum Toolbox and Spectrum Fitter GUI

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Spectral Analysis

- Spectral arithmetic and manipulation tools are gathered in the *Spectrum Toolbox* (described the Herschel DAG Chap 5). Line fitting can be done using the *Spectrum Fitter* package (Chap 7).
- Both can be accessed from the Tasks View in HIPE, or from the Spectrum Explorer toolbar or right click in the SE spectrum plot.
- The *Spectrum Toolbox* contains tasks for all your favorite operations:
 - **Selection:** extraction (of fragments), flagging
 - **Arithmetics:** add, subtract, multiply, divide by constants or other spectra
 - **Averaging and Statistics.** Includes integrations.
 - **Manipulations:** resampling, smoothing, replacing, gridding, stitching, and folding.
 - **Wavescale conversions:** frequency \Leftrightarrow wavelength \Leftrightarrow wavenumber \Leftrightarrow velocity
 - **Export to ascii.**
- However, not all tasks to manipulate spectra are 'registered' in the toolbox. E.g., *convertK2Jy* is a HIFI specific tool for K \rightarrow Jy.





Spectrum Fitter (GUI)

- The **SFG** provides tools for fitting lines and continua/baselines with various profiles and polynomials.
- As many components to each as you wish.
- Different fitter engines available, default is Levenberg-Marquardt (most robust).
- Works on one spectrum at a time...
- But fit parameters can be applied as starting approximations to other spectra, or an entire spectral cube.
- Can be used with exo-Herschel spectra, as long as they are formatted to one of SimpleSpectrum, Spectrum1d, Spectrum2d, the SPIRE and HIFI extensions of these (e.g. WbsSpectrumDataset from an HTP), SpectralSimpleCube and the PACS extension of this.





HIFI Demo (Schuyler)

- We will use a HIFI Point observation of $\text{H}_2\text{O } 1_{01} - 1_{10}$ 557 GHz in emission + absorption. In this observation the line is in the lower sideband.
 1. Load the data, open in SE, navigate to the Level 2 spectrum.
 2. Convert GHz \rightarrow km/s with the Spectrum Toolbox.
 1. Why? Saved fit parameters are more flexibly applied to other lines in the source at similar velocities.
 2. Also, the integrated line fluxes are properly expressed in $\text{K} * \text{km/s}$ (not $\text{K} * \text{GHz}$).
 3. Fit the continuum and line profile separately.
 4. Save the best-fit parameters.
 - Export models and fit parameter tables into either or both ascii and a “context” that can be saved to a pool, with contents that can be exported to FITS.
- If time, we show how to apply a set of stored models to an entire spectral cube, CO 10-9 1551 GHz in emission.
 5. Crop the cube, and convert to velocity.
 6. Fit one “pixel” spectrum with the SFG.
 7. Apply the fit parameters as starting guesses to the rest of the cube.





Question to presenters

- We have general intro then HIFI + SPIRE + PACS fitting examples. Do we need all 3? Main difference is use of the Sinc profile for SPIRE.
- What about the hands-on session after Nanyao's "Combining Spectra" demo? For fitting practice there is not much scripting, mostly interactive with the GUI.

