HCSS HIFI
Deconvolution Tool Demo

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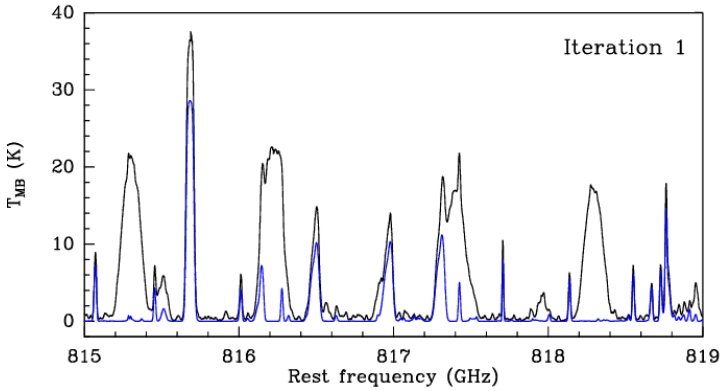

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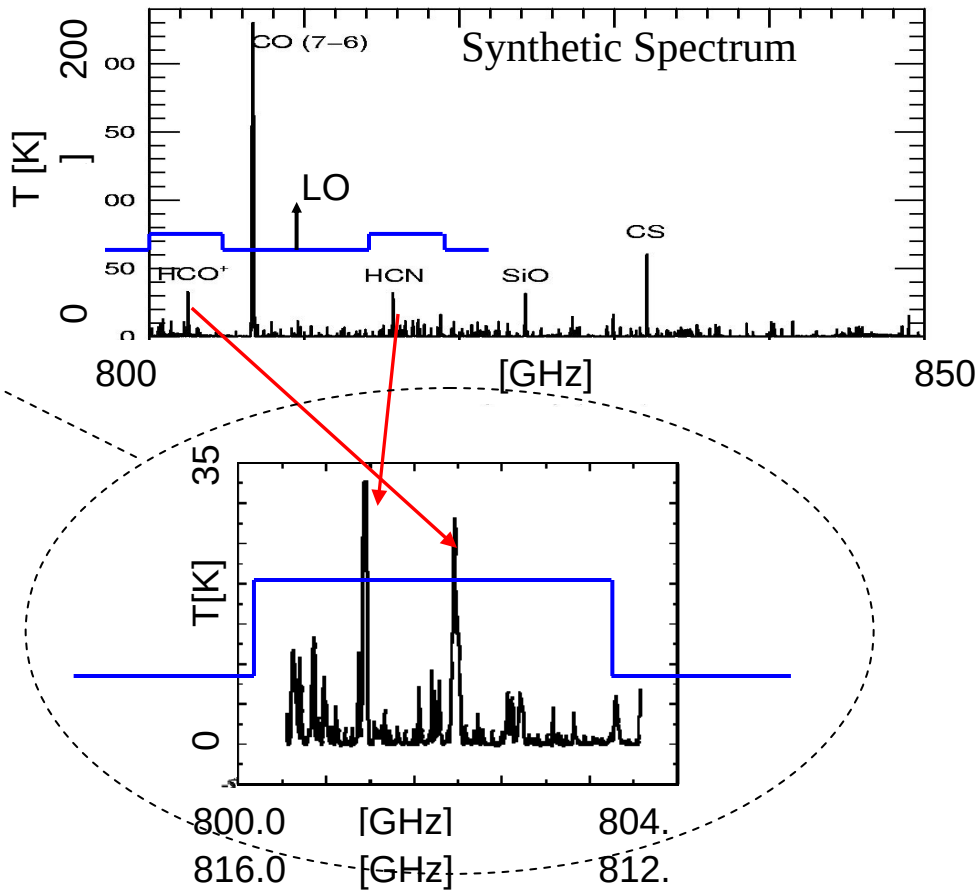
Deconvolution Tool Demo
Intro - The Problem

HIFI Deconvolution tool:
deconvolves HIFI's native dual sideband observations; a crucial processing need for spectral surveys.

Every spectrum taken with HIFI contains the upper and lower sideband data folded together.

In regions rich with lines, the user needs a way to sort this out.

Additionally, the upper and lower sidebands may have different gains.



Double sideband spectrum

Deconvolution Demo - The Solution

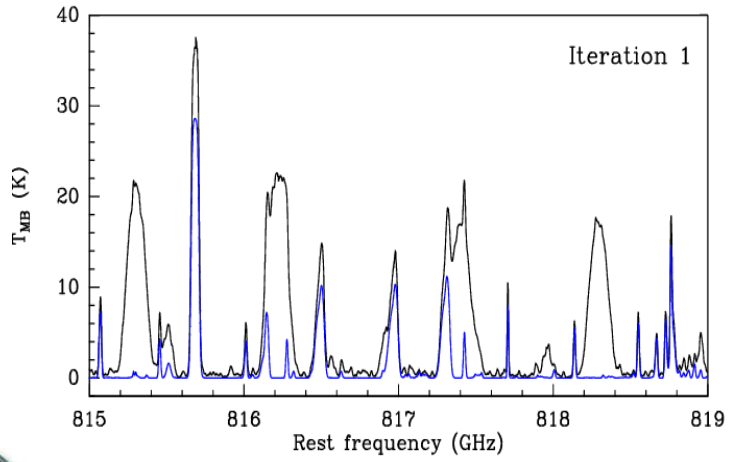
With a series of LO settings, the double sidebands are marched across the band, providing a sufficient number of over-lapping "confused" observed double sideband spectra to constrain the single sideband result - I.e., the source's true spectrum

An iterative chi-square minimization method (the Conjugate Gradient Method) finds the best single sideband solution.

CGM minimizes chi-square of the DSB observed & modelled residuals using knowledge of the chi-square gradients.

Successfully used on CSO surveys, gas cell data, & HIFI Data Simulator products.

Before and After Deconvolution:



Deconvolution Demo Considerations

The algorithm solves the LSB & USB sideband channel values and also the gains at each LO setting in a 2-step process: 1) fit SSB solution, 2) fit gains and SSB solution together.

Implementation in XCLASS was the prototype (Schilke and Comito) & subsequent improvements by Delforge and Comito.

Implementation was done in pure Fortran (Lord) and HCSS JAVA (Xie and Lord) with a Jython pre-processor added by Borys

Pre-processor removes spurs, and resamples the data to a grid.

Currently the HCSS and XCLASS versions are tested successfully on HIFI ILT gas cell data, & HIFI Data Simulator products.

Deconvolution - Status and Improvement Details

Items Complete:

- Conjugate Gradient Method available in HCSS for all users
- HCSS JAVA HIFI Deconvolution Package – up and running
- Interfaced and End-to-End tested with HCSS HIFI Simulator
- Preprocessing HTPs into JAVA code (Resampling, Upper, Lower Freqs)
- Integrated w/HIPE – run with scripts or GUI – viewing with spectrum explorer

Additional features In Development:

- Include Frequency Switching Spectral Survey Deconvolutions
- Channel-by-channel weights (from Cal) included in the JAVA Software
- Improved HIPE GUI with DSB Display Capabilities, DSP products, RMS vs. iteration number, SSB viewing
- Ghost detection and ghost prevention tools

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Sideband Deconvolution
HCSS Decon & XCLASS Decon

Mostly in synch - but some development differences

Comparison of HCSS and XCLASS Development

	HCSS/HIFI Deconvolution	Comment	XCLASS Deconvolution	Comment
Freq. Switch	In progress	Coded, not tested	Implemented	Tested
Channel Weights	In progress	Coded, not tested	Unimplemented	Future work
Polynomial Gain Fits	On Hold		Prototype	Not yet Working

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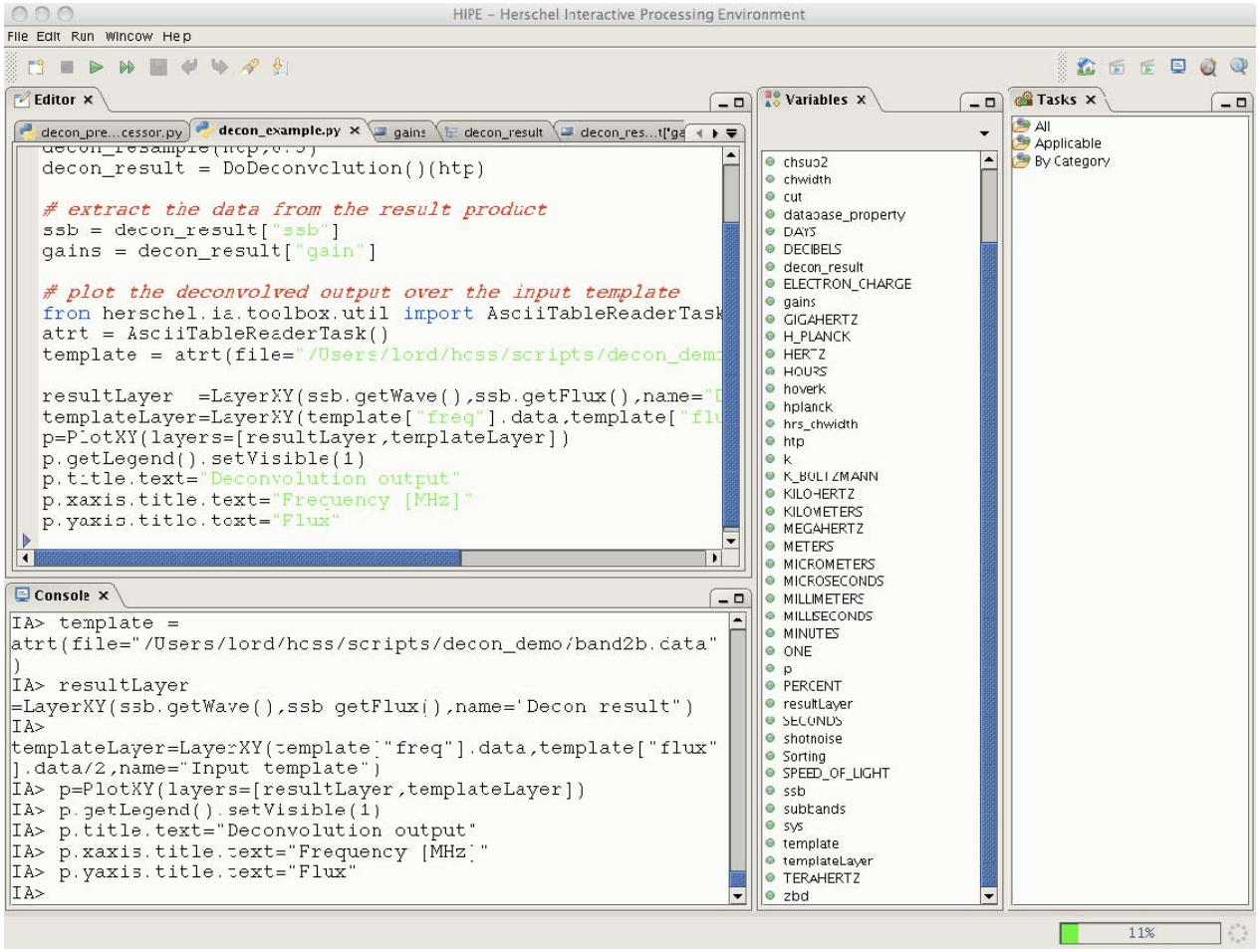
Demo Results

- Line results accurate in sideband placement and frequency
- Gain results _very_ good…
- Line amplitudes undershoot currently due to coupling factors present in simulator but not pipeline: eta_mb

Screen shot of Decon/HIPE



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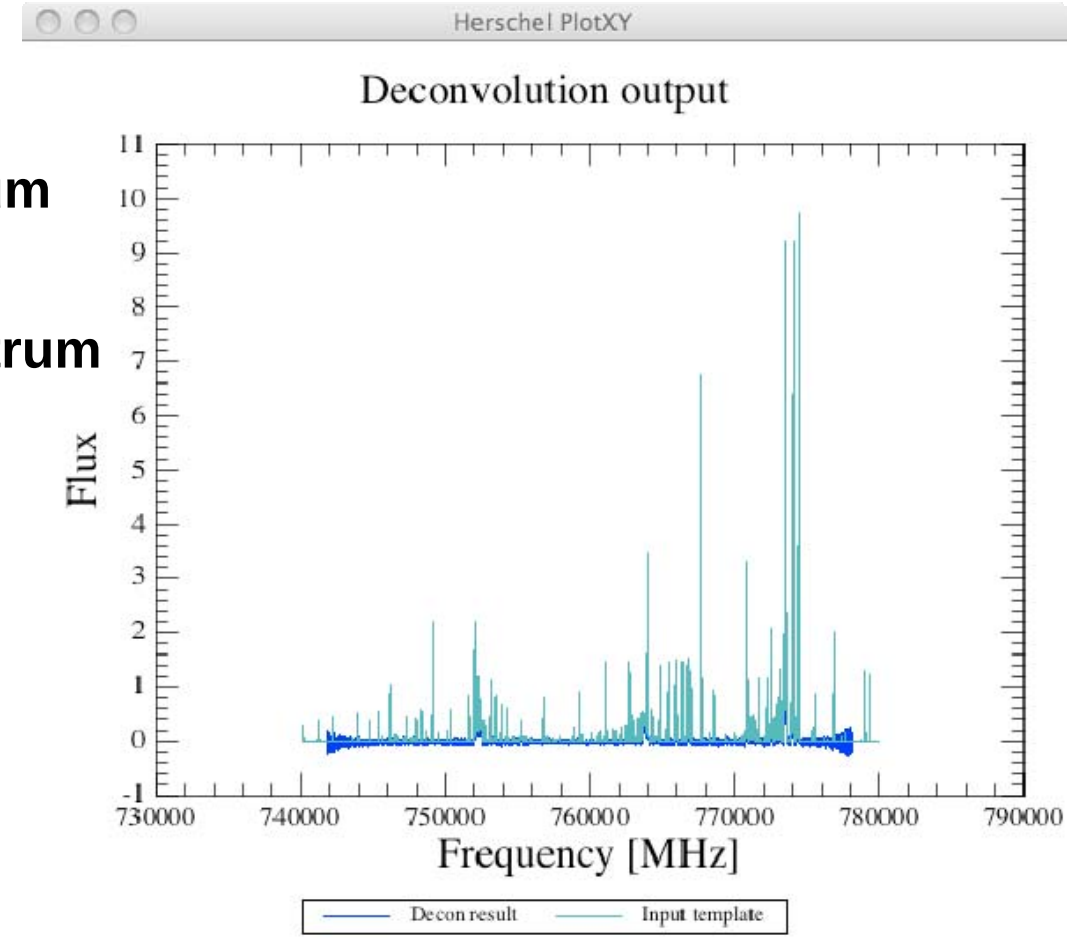
Results

Input spectrum Green

Output Spectrum Blue



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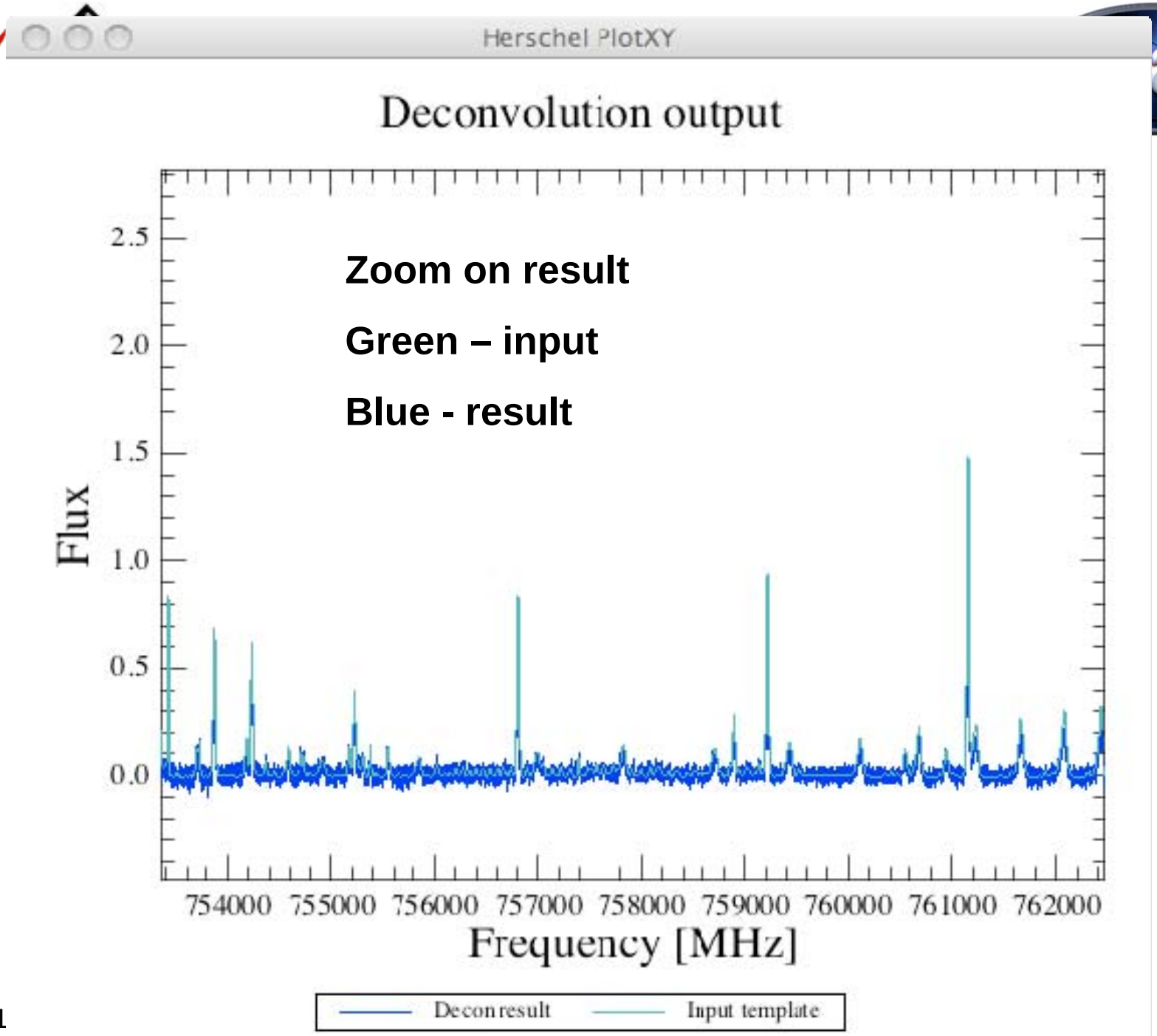
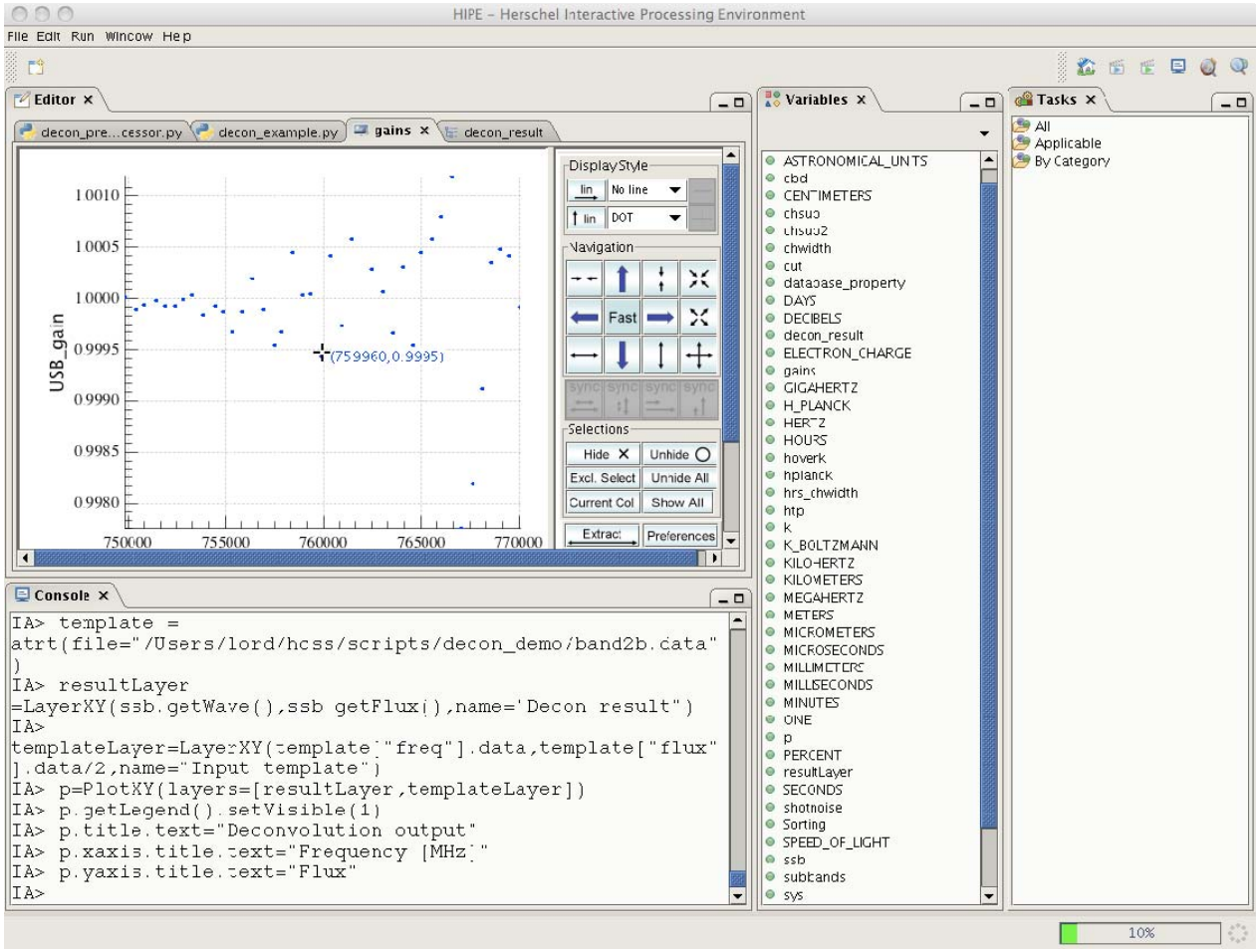

Herschel PlotXY
Deconvolution output
Zoom on result
Green – input
Blue - result
Flux
2.5
2.0
1.5
1.0
0.5
0.0
754000
755000
756000
757000
758000
759000
760000
761000
762000
Frequency [MHz]
Decon result
Input template

Result – Gains for scans



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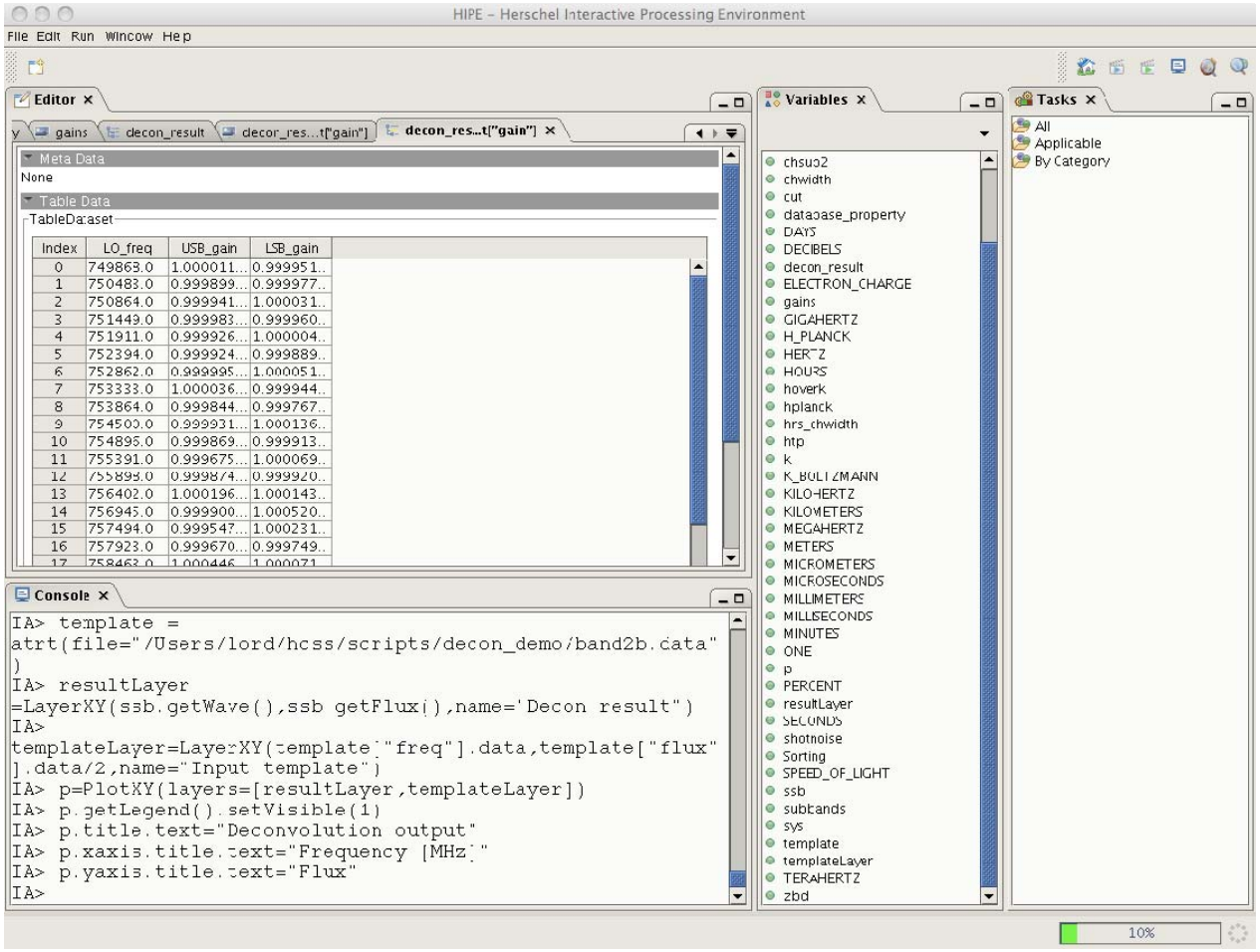
Result – Gains Printed



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