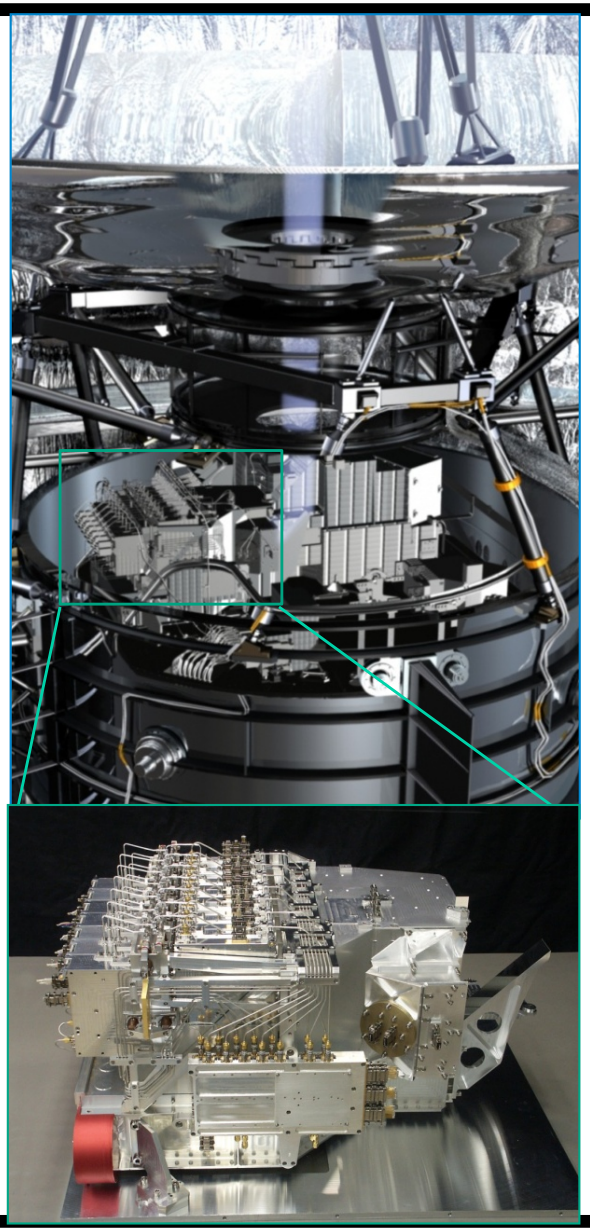


HIFI pipeline overview:
What's done at levels 1, 2, and 2.5?

Carolyn McCoey (University of Waterloo)

David Teyssier (ESAC)

Pat Morris, Adwin Boogert, Colin Borys (NHSC)

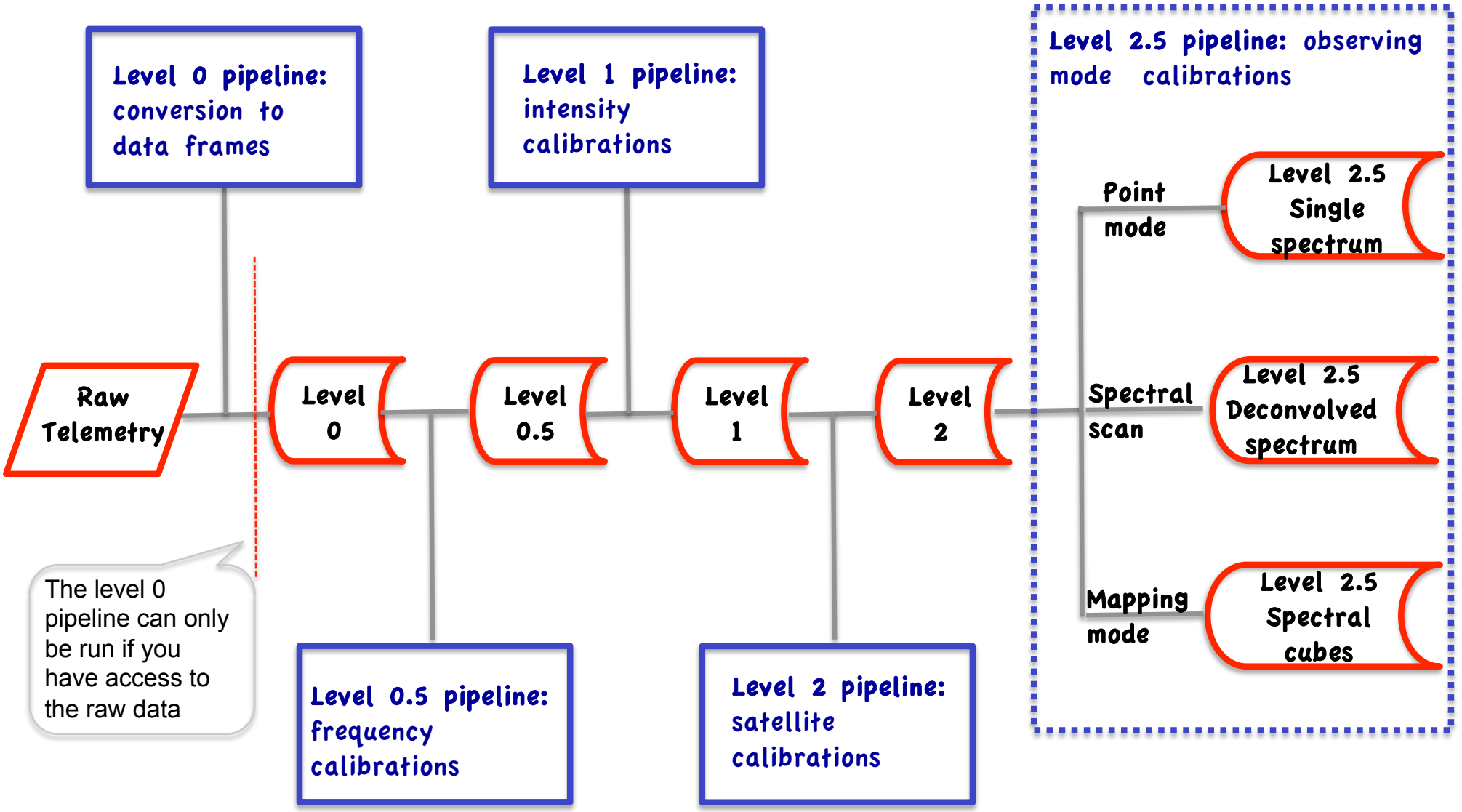
Emmanuel Caux, IRAP (ex-CESR)

Thanks – Frank Helmich, HIFI PI, and the HIFI Consortium

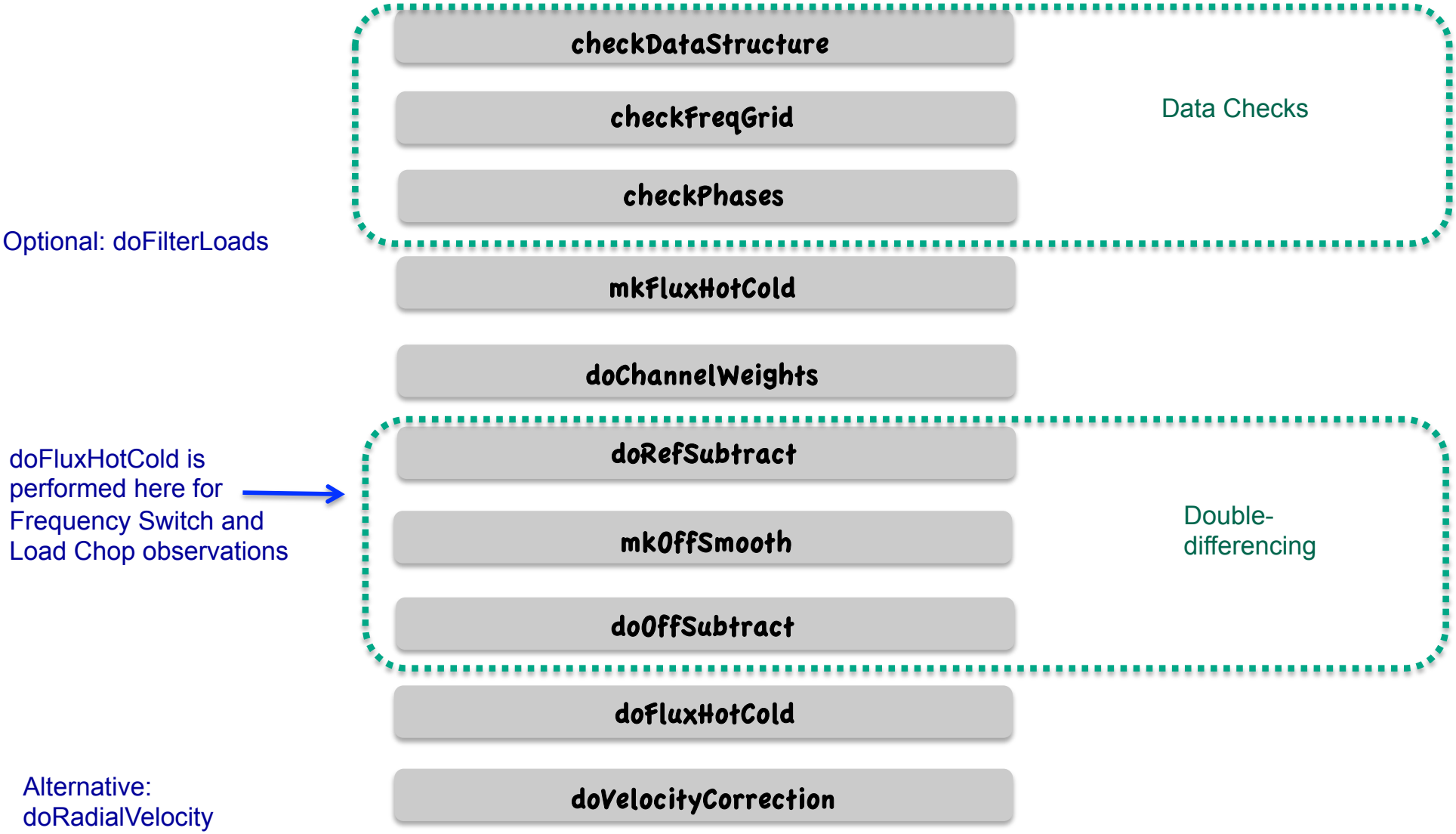
Pipeline Concept

- All HIFI data processed before made available in HSA
- In HIPE you are provided with the same pipeline
- The processing of HIFI observations is similar to ground-based heterodyne telescopes, e.g CSO, JCMT, IRAM, KOSMA…
- One pipeline for **all** HIFI observing modes
- The pipeline is customizable

Overall Pipeline Structure



Level 1 Pipeline



‘Scratches’ in some frequency switch and load chop observations seen in WBS-V data.

Applying the intensity calibration before the reference position is smoothed and subtracted removes the ‘scratches’ and also improves baseline noise level

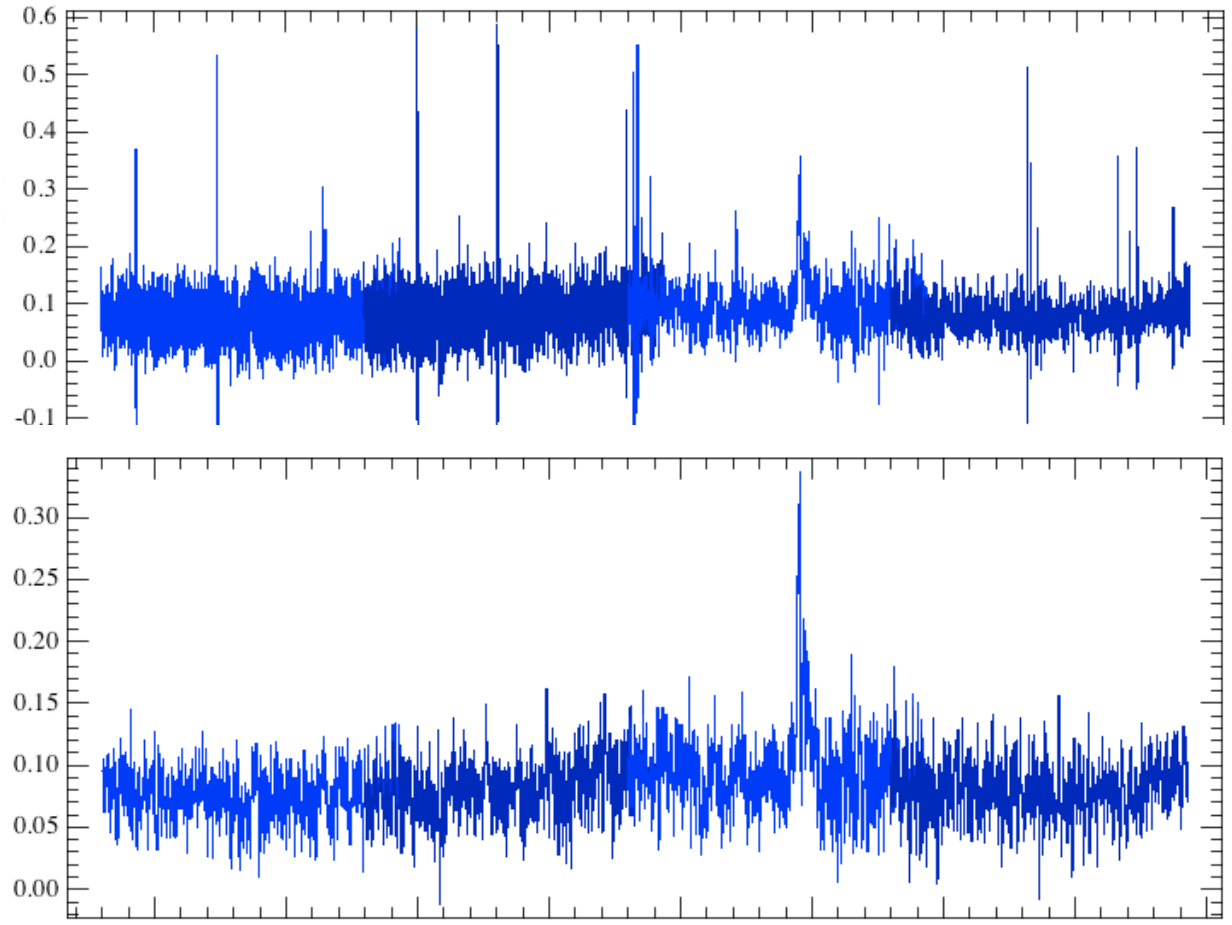


Illustration of level 1 pipeline steps

- **Reference and OFF subtraction: eg. for DBS observations**

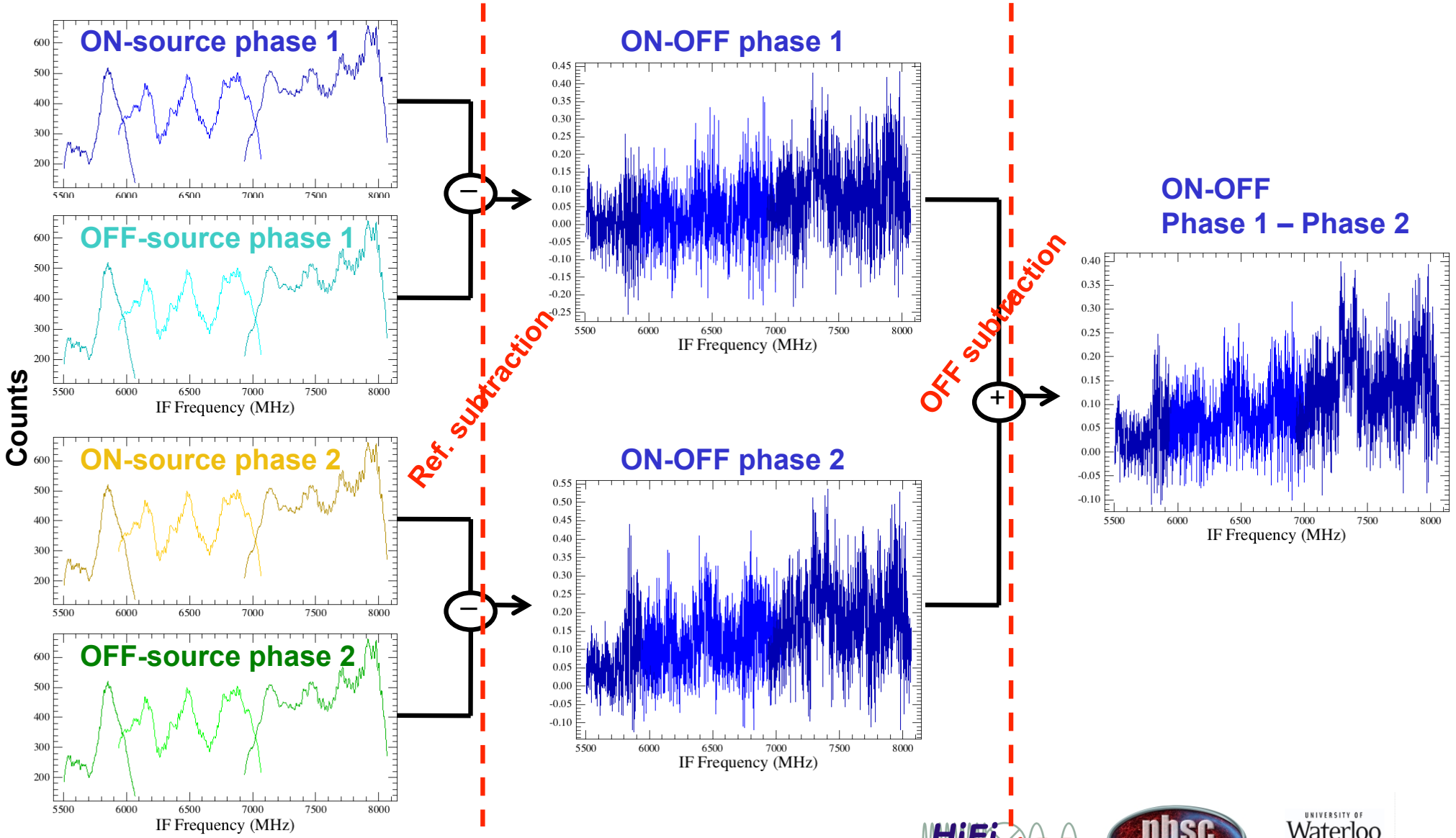
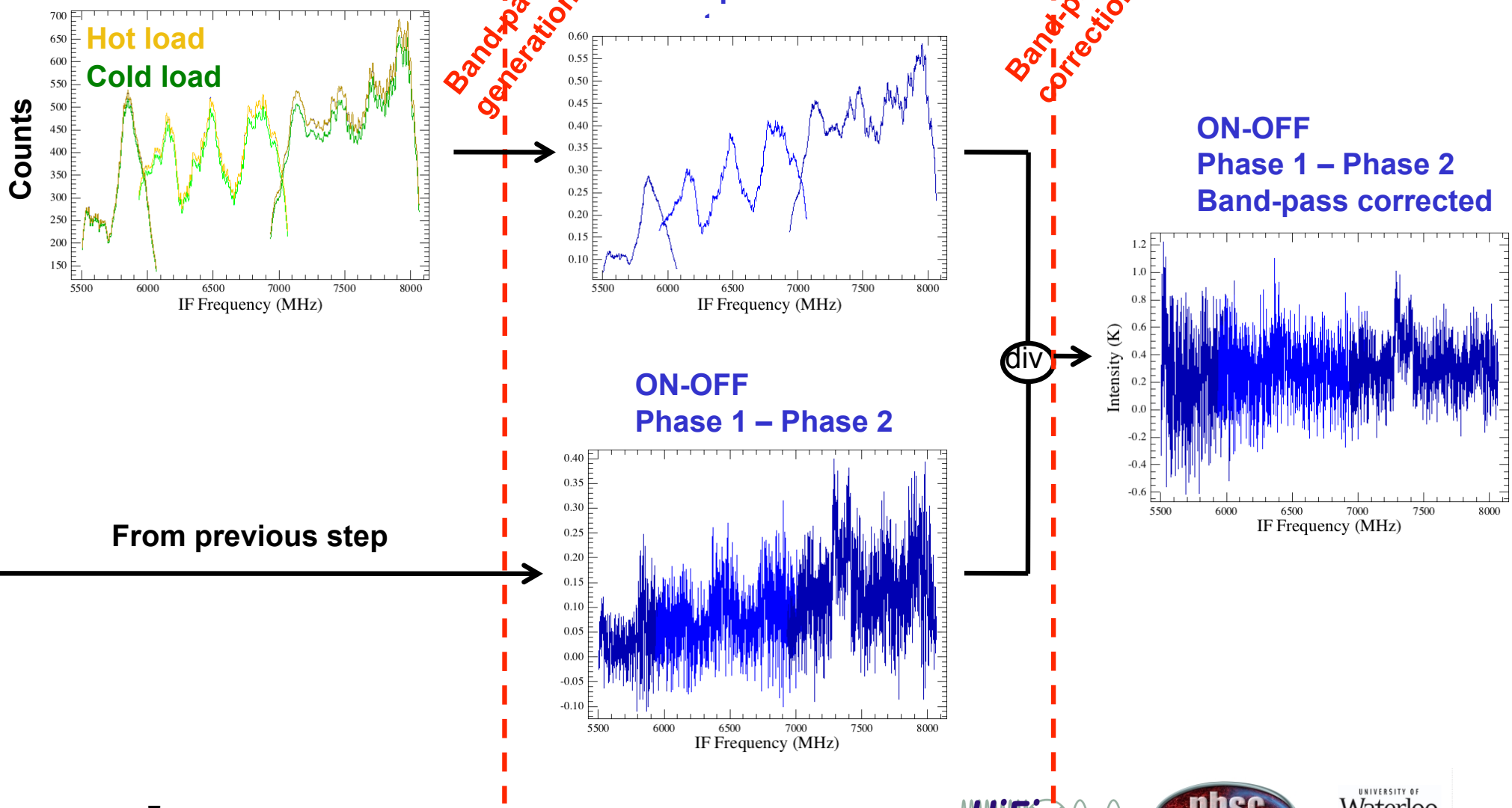


Illustration of level 1 pipeline steps

- **Bandpass calibration: eg. for DBS observations**



Level 2 Pipeline

Alternative:
doMainBeamTemp

Not done for OTF maps

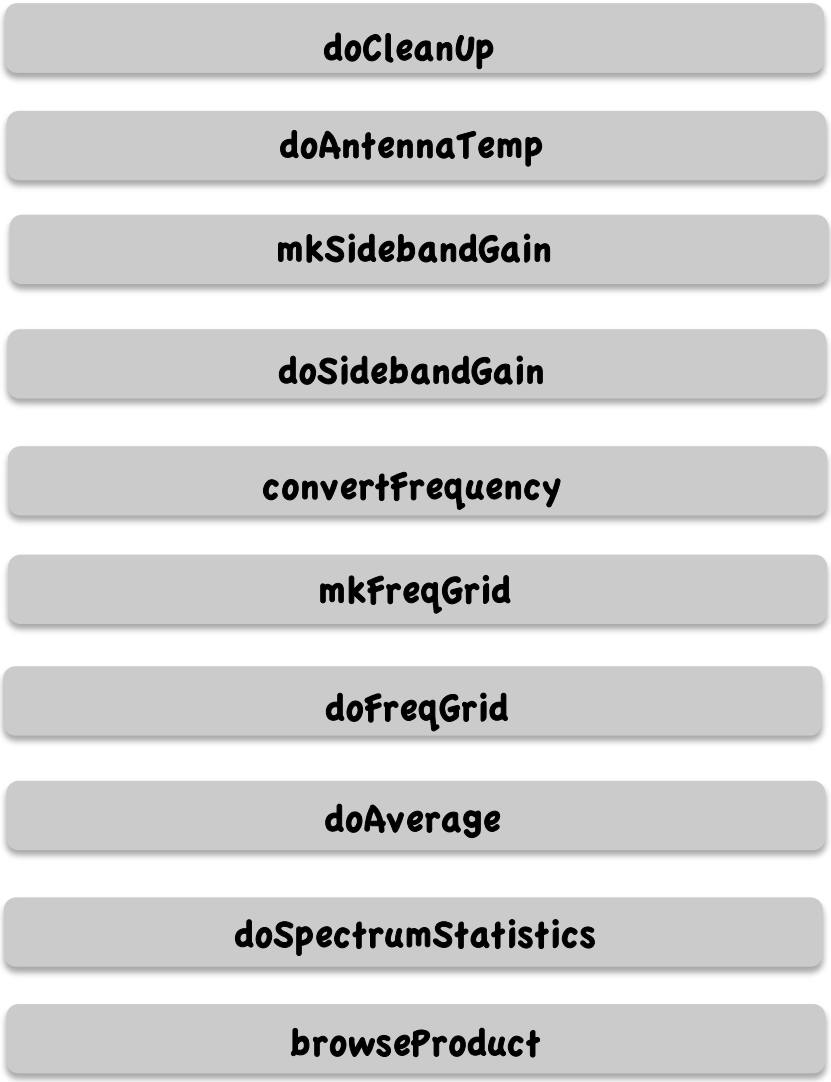
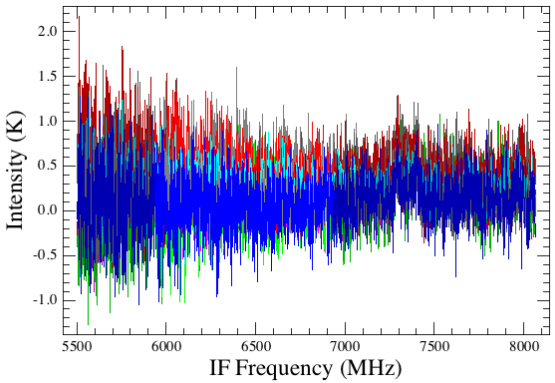


Illustration of level 2 pipeline steps

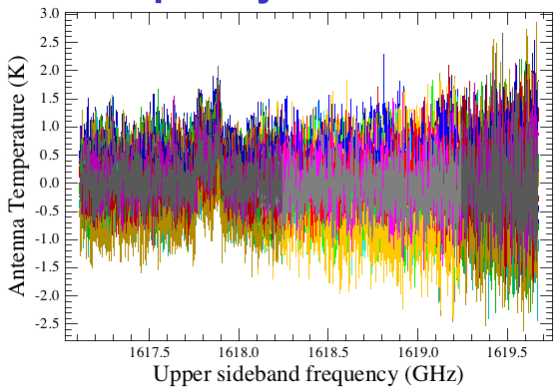
- **Side-band calibration and average**

Collection of all ON-OFF

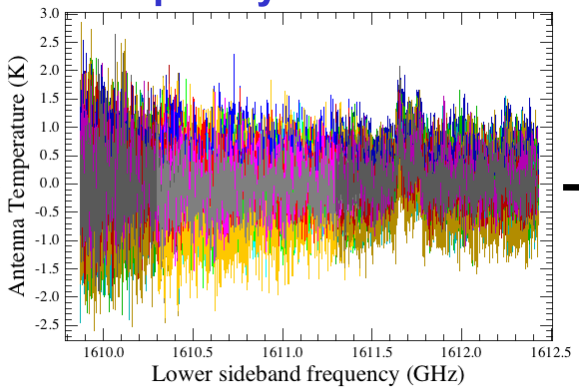


Side-band calibration

All spectra in USB frequency scale

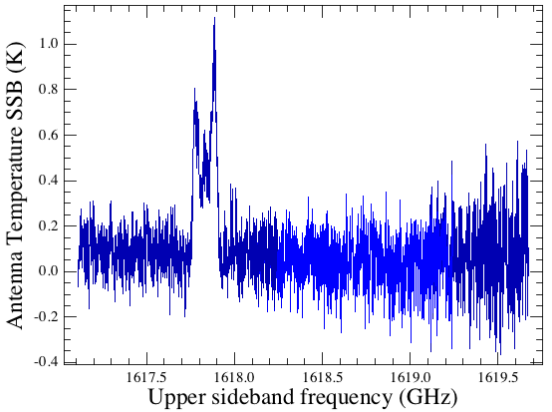


All spectra in LSB frequency scale

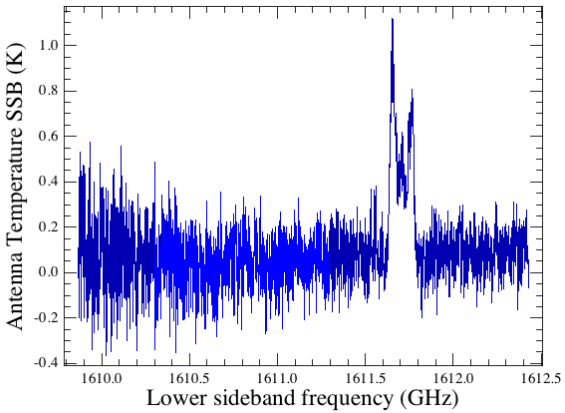


Average all SSB spectra

Level2 USB



Level2 LSB



Wavelength scales in HIFI data

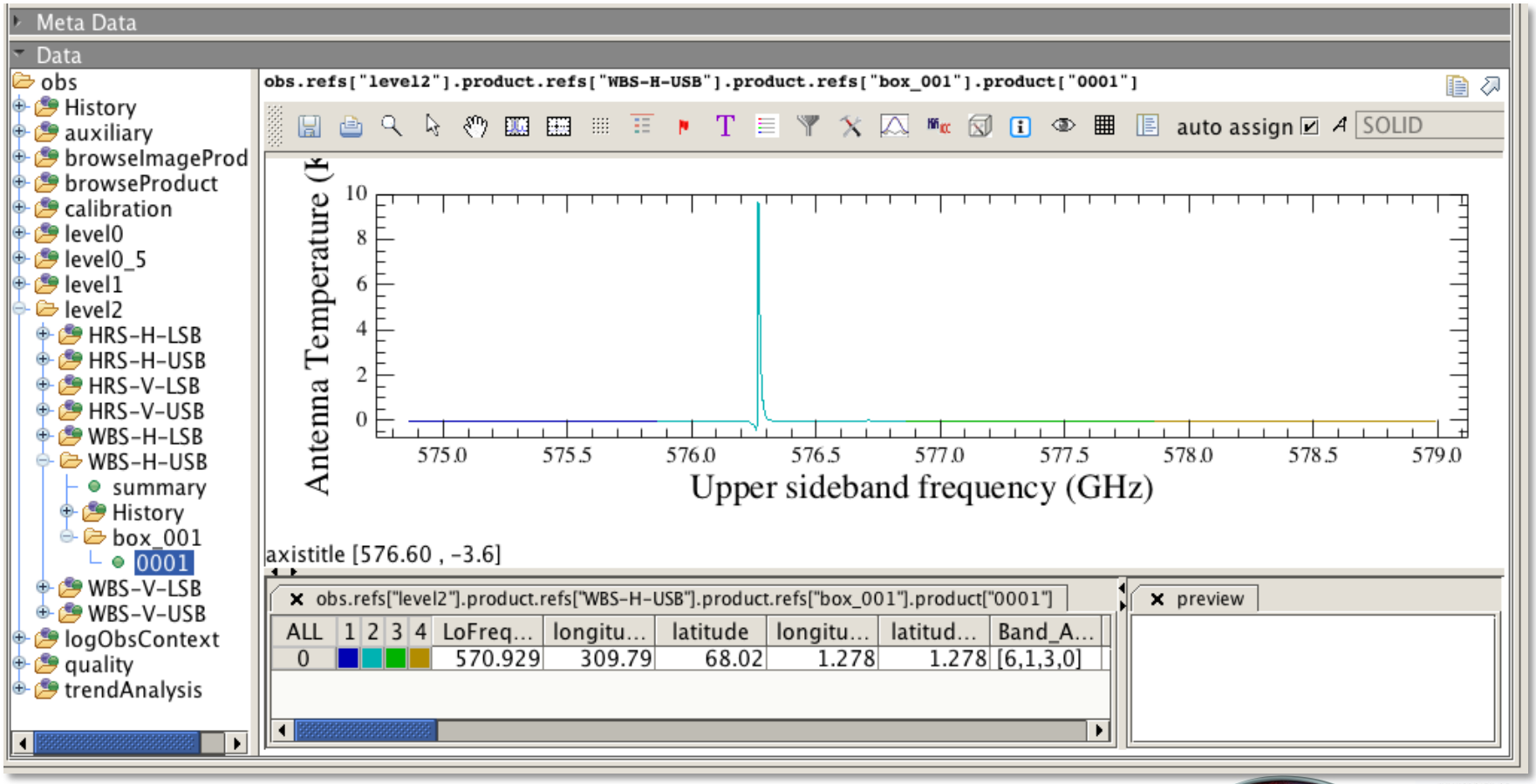
- **From channel number to IF frequencies**
  - *The assignment of channel number to IF frequency is performed in the spectrometer-specific branch of the pipeline (between level 0 and level 0.5)*
- **Space-craft radial velocity**
  - *The correction of the space-craft velocity along the source line-of-sight is done in the level 1 pipeline*
  - *For fixed target, it brings the frequency scale in the LSR*
  - *For moving targets, it brings the frequency scale in the frame of the target*
- **USB/LSB scales**
  - *The level 2 pipeline creates two products: a USB and an LSB spectra*
  - *The two products are not only mirror spectra of one another wrt the LO frequency – intensity calibration can vary in either side-band*
- **Velocity scales**
  - *No pipeline product is given in velocity scale*
  - *Conversion to velocity scale can be done by you in the spectrum toolbox*

Level 2.5 pipeline

- Observing mode specific
- Is a combination of data taken in observation to form final products

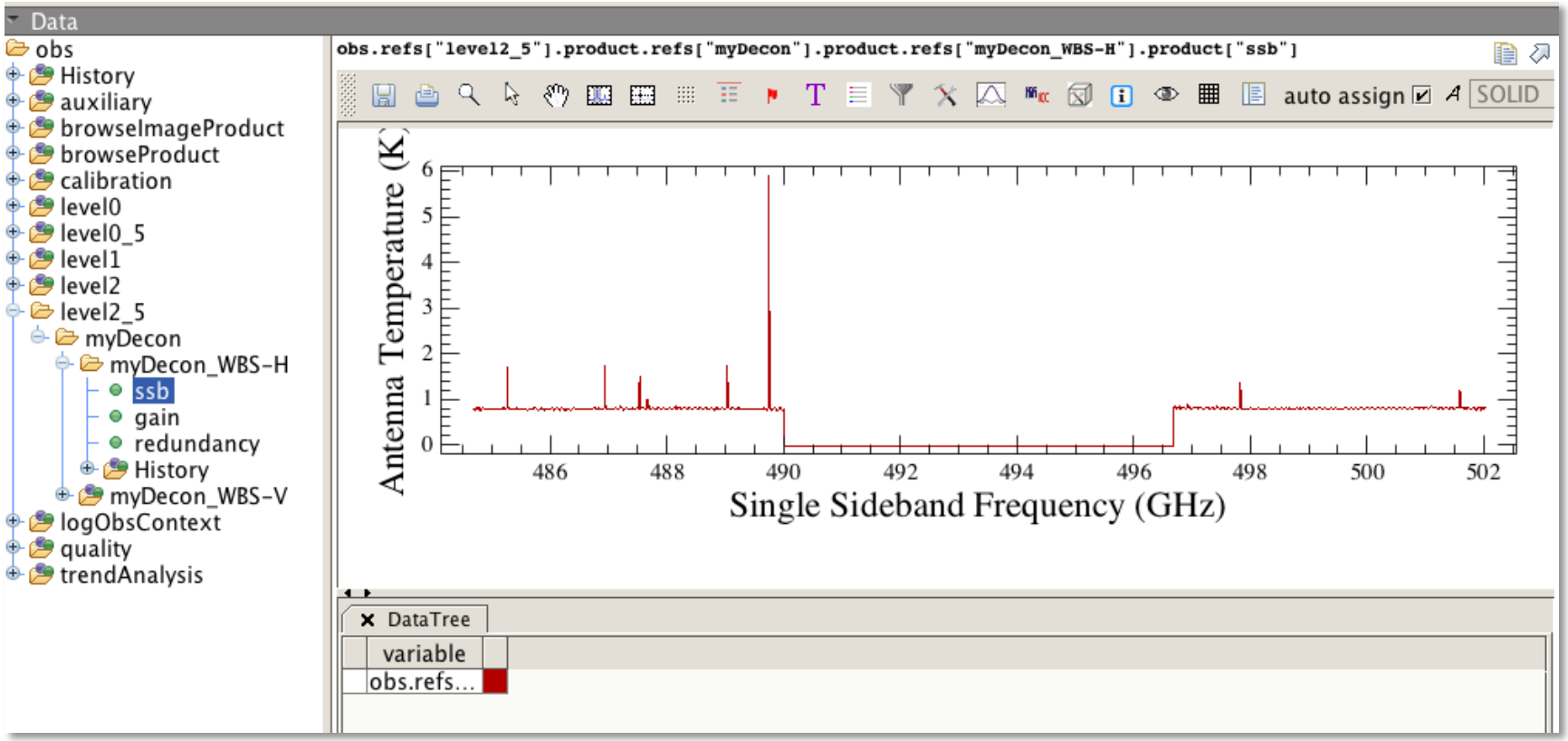
– Point Mode:

- Nothing done, the final products are level 2 spectra, one for each spectrometer, polarisation and sideband



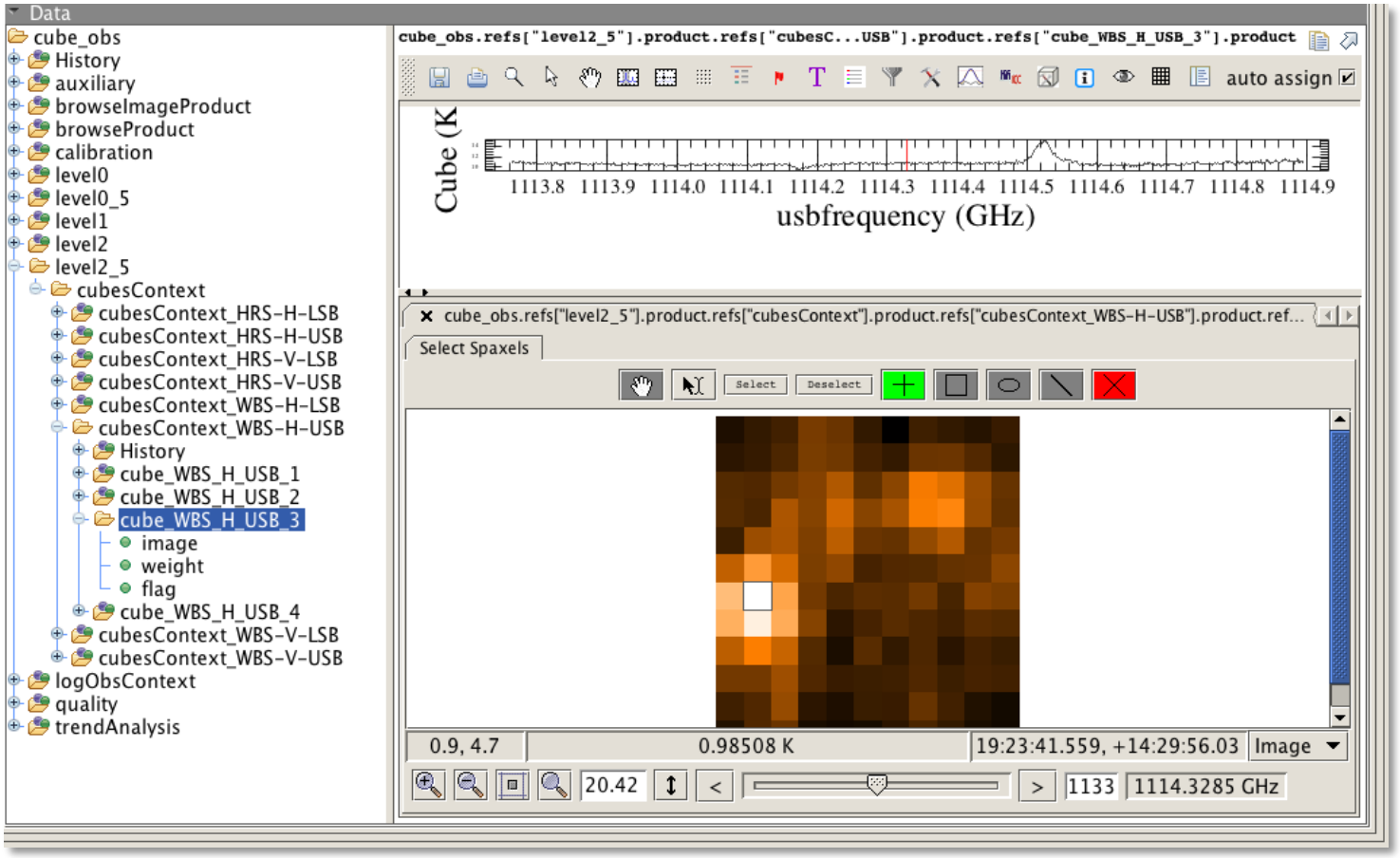
– Spectral Scans:

- deconvolved to give Single Sideband Solution for the H and V polarisations (more tomorrow)



– Mapping Observations

- Mapping observations are gridded to produce spectral cubes for each spectrometer, polarisation and sideband (more tomorrow)



Documentation

- "What was done to my data", in the HIFI Data Reduction Guide. Summary of the pipeline steps
- "Running the HIFI pipeline", in the HIFI Data Reduction Guide. Description of how to use the pipeline, update calibration and customise the pipeline.
- HIFI Pipeline Specification document. Detailed description of each pipeline step including the assumptions, mathematics/algorithms and changes to data

Questions?