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DOCUMENT

HIFI System Noise Temperature Data Products: Release notes

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Reference	HERSCHEL-HSC-DOC-2113
Issue	1
Revision	0
Date of Issue	13 May 2016
Status	For release
Document Type	Release note
Distribution	HSC, SAT



APPROVAL

Title HIFI System Noise Temperature Data Products: Release notes	
Issue 1	Revision 0
Authors D. Teyssier	Date 13 May 2016
Approved by: P. Garcia-Lario	Date

CHANGE LOG

Reason for change	Draft Issue	Revision	Date
First version of document	1	0	13 May 2016



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1 INTRODUCTION

This Ancillary Data Product archive contains information about the System Noise Temperature (thereafter T_{sys}) characteristics of the HIFI instrument. In particular, detailed spectra of T_{sys} vs Intermediate Frequency are given for a fine granularity grid of Local Oscillator tuning frequencies. The System Noise Temperature data products are particularly relevant to the instrument experts or engineers interested in inspecting in great details the performance of HIFI as a heterodyne detector.

2 DESCRIPTION OF THE ANCILLARY DATA PRODUCTS

2.1 Scope and method for the product generation

Like all heterodyne detectors, the HIFI sensitivity is measured in terms of System Noise Temperature, or T_{sys} , in units of Kelvin. This temperature is assessed through the contrast of detector counts measured on two internal black body sources (so-called *Y-factor*) – higher ratio between those two indicates lower T_{sys} and therefore better sensitivity (see also Section 5.1 of the HIFI handbook – <http://www.cosmos.esa.int/web/herschel/legacy-documentation-hifi>). To first order, the T_{sys} is provided as a single scalar number applicable to a given tuning of the Local Oscillator source (LO). In practice, however, the T_{sys} is a spectral function of the Intermediate Frequency (IF) and its detailed profile versus frequency contains important information about the overall system performance.

Because measurements of the respective internal hot and cold loads of HIFI are an intrinsic part of any observing sequence with HIFI, the T_{sys} spectra can be formed at any tuning performed by the instrument, and is actually stored in the Calibration Context of any HIFI observation (see also Section 3.3 of the HIFI Data Reduction Guide – http://herschel.esac.esa.int/hcss-doc-15.0/load/hifi_um/html/hum_tour_cal.html). A relatively exhaustive collection of T_{sys} information can be therefore extracted from the tunings performed over full band spectral scans executed in the course of the mission.

2.2 Content of the Ancillary Data Product

2.2.1 Deliverable format and structure

The System Noise Temperature information is provided in a global gzipped tarball called `HIFI_TSYS_DataProducts.tar.gz` (total compressed size is 538 Mb). This tarball is

composed of the following:

- A directory `General1` contains information on the T_{sys} as a scalar figure in function of the LO tuning frequency (in GHz). The table `HIFI_TSYS_TABLE.csv` gathers median T_{sys} values measured in spectra collected on a grid of typically 1 GHz steps. The content of this spreadsheet is illustrated in 7 PDF plots (`Tsys-x.pdf`, with x 1 to 7) summarizing the T_{sys} behavior with LO frequency for each mixer band, and each polarization. Figure 1 illustrates one of those plots in band 1 – see caption for further details.
- 14 directories named after the HIFI LO bands (1a, 1b, ..., 7b) are then provided with detailed T_{sys} vs IF spectra on a grid of LO frequency corresponding to that of the tunings performed in Spectral Scans ran on the respective LO bands. In each directory, a collection of plots and FITS files are given:
 - `TSYS_WBS-<pol>_<band>_LOF_<lof>GHz.fits.gz` contain the T_{sys} vs IF spectra at LO frequency `<lof>` and for band `<band>`, measured in the polarization `<pol>` of the WBS. Note that for bands 1a and 5a, two periods apply. They are distinguished as “1a_BEFORE_OD474”/”1a_AFTER_OD474” and “5a_BEFORE_OD642”/”5a_AFTER_OD642”, referring to the Operational Day (OD) when the instrument setting change did result in noticeable changes in the T_{sys} behavior.
 - `TSYS_<band>_LOF_<lof>GHz.png` display the respective WBS-H and WBS-V (in black and blue resp.) T_{sys} spectra contained in the above FITS files. Figure 2 illustrates such a plot at one LO frequency tuning in band 1a.

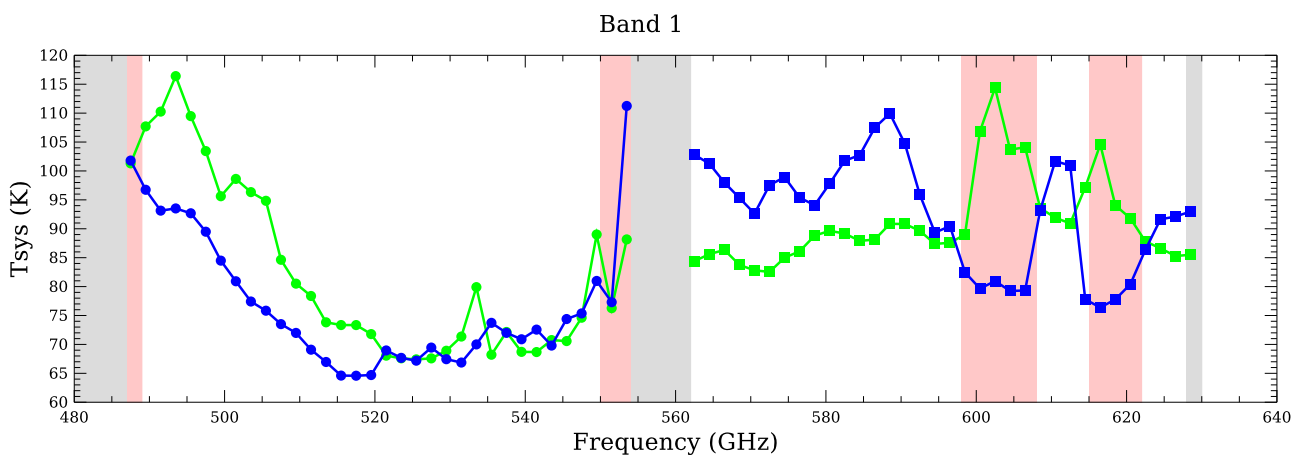


Figure 1: Median T_{sys} as function of the LO frequency for HIFI band 1. The green lines show the H polarisation, while the blue ones apply the V polarisation. Circle symbols are for the "a" bands and square symbols for the "b" bands. Grey areas indicate areas where the LO cannot pumped the mixer at all, while pink areas show the LO-deficient areas.

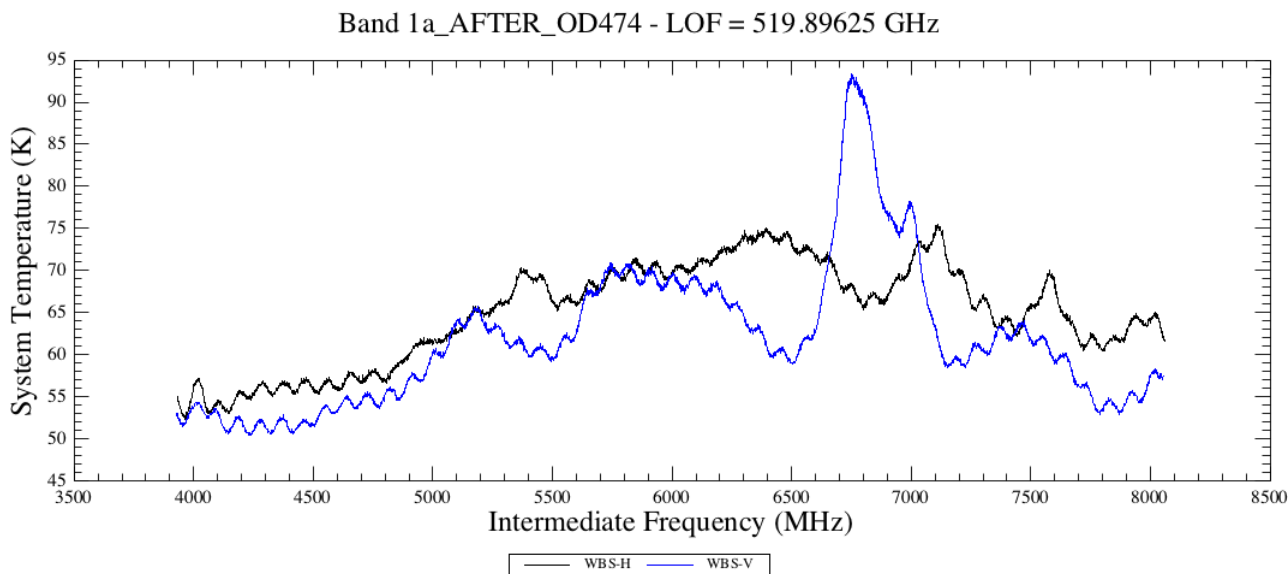


Figure 2: Example of T_{sys} spectra on the Intermediate Frequency scale for a given tuning of band 1a. The WBS-H and WBS-V data are displayed in black and blue respectively

2.2.2 Trend Analysis Data Product queries in the HSA

Like any other Ancillary Data Product archives served by the HSA, the System Noise Temperature data products are provided as a single compressed archive from the Ancillary Data Product query menu. This archive contains all the files mentioned above.

Alternatively, the products can also be fetched from the Herschel Science Centre portal – see <http://www.cosmos.esa.int/web/herschel/ancillary-data-products>.

Finally, because the T_{sys} spectra are part of the overall Calibration Context, they can also be fetched by downloading the full Calibration Context, using the “Retrieve Products” menu of the HSA.