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DOCUMENT

HIFI Beams as Ancillary Data Products: Release notes

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1 INTRODUCTION

This Ancillary Data Product archive contains the information about the HIFI beam patterns, based on observations in-flight on Mars, and an optical model representative of the Herschel telescope, including obscuration, truncation, and measured wave-front errors. The corresponding files provide the most accurate representation of the optical coupling of the HIFI detector beams to the sky.

2 DESCRIPTION OF THE ANCILLARY DATA PRODUCTS

2.1 Scope and method for the product generation

The details on the generation of the HIFI beam pattern files is best described in the official HIFI beam release note document released in 2014 together with the corresponding files. This note can be found on the Herschel Science Centre web pages – see http://herschel.esac.esa.int/twiki/pub/Public/HifiDocsEditableTable/HifiBeamReleaseNote_Sep2014.pdf. For the convenience of users, this document is actually also contained in the Ancillary Data Product archive containing the beam files themselves (see next Section).

Further details can also be found in the PhD thesis manuscript of Dr. W. Jellema – see <http://www.rug.nl/research/portal/en/publications/optical-design-and-performance-verification-of-herschelhifi%2824e22068-b3ba-45d9-b72b-503e951b193f%29.html>.

2.2 Content of the Ancillary Data Product

2.2.1 Deliverable format and structure

The beam models are provided for each of the 14 HIFI mixers (7 mixer bands in 2 polarisations), and at two spot frequencies for each mixer band (called “a” and “b” in the following). In total, the Ancillary Data Product archive contains 28 files named HIFI_Beam_<band><pol><freqspot>.fits.gz, where <band> is the mixer band (between 1 and 7), <pol> is either H or V, and <freqspot> is a or b. Each of those files is about 27 Mb (compressed) in size. Within each of them, the following extensions are present:

- **PrimaryImage:** the 2-D beam pattern, given as 2705 x 2705 pixel arrays. The spatial resolution of the beam models scatters around 18 points per Half Power Beam Width

(HPBW), covering a square spatial range from roughly -75 to $+75$ HPBW. Figure 1 illustrates such a pattern for two extreme frequency spots of the HIFI range

- **Azimuthally averaged beam profile:** the azimuthal average of the above 2-D beam patterns, offering a 1-D beam profile. Examples of such profiles are illustrated in Figure 2
- **Encircled Energy Fraction (EEF):** the encircled energy fraction encompassed by the beam as a function of the radial distance from the beam centre. Examples of such profiles are illustrated in Figure 3

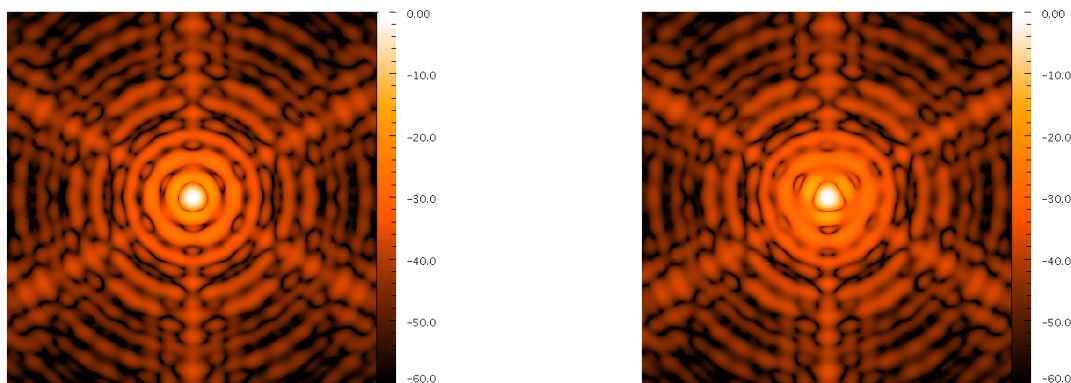


Figure 1: Two sample beam shapes: band 1 in polarization H at 520.5 GHz; band 7 in polarisation H at 1847.5 GHz (files `HIFI_Beam_1Ha.fits` and `HIFI_Beam_7Vb.fits`, respectively). The beam intensity is color-coded (in dB), normalized to unity (0 dB) at the centre. We show here the central 541 pixels out of 2705, i.e., the complete beam models are larger than what’s depicted here

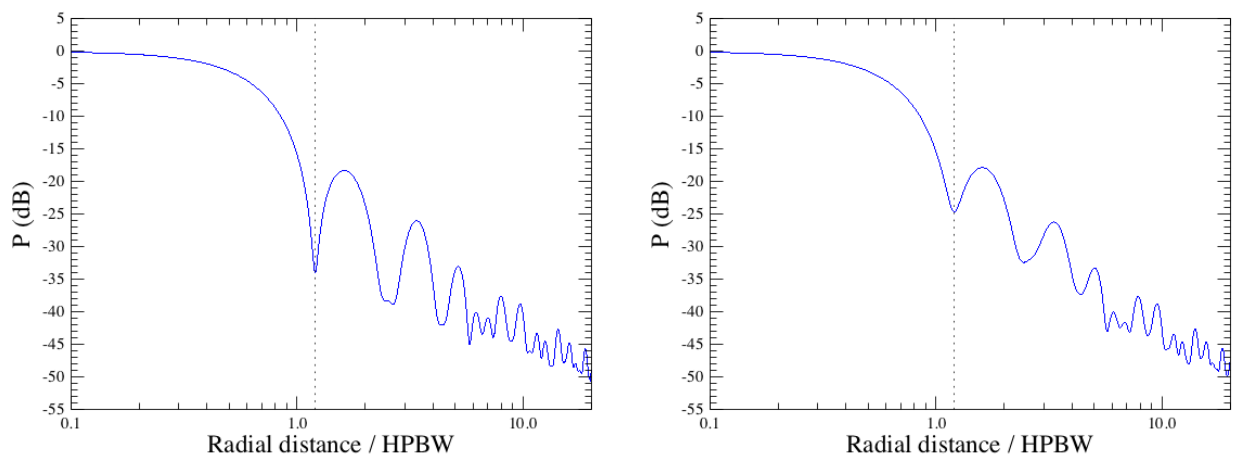


Figure 2: 1-D azimuthally-averaged beam profiles for the same band and frequencies as Fig. 1

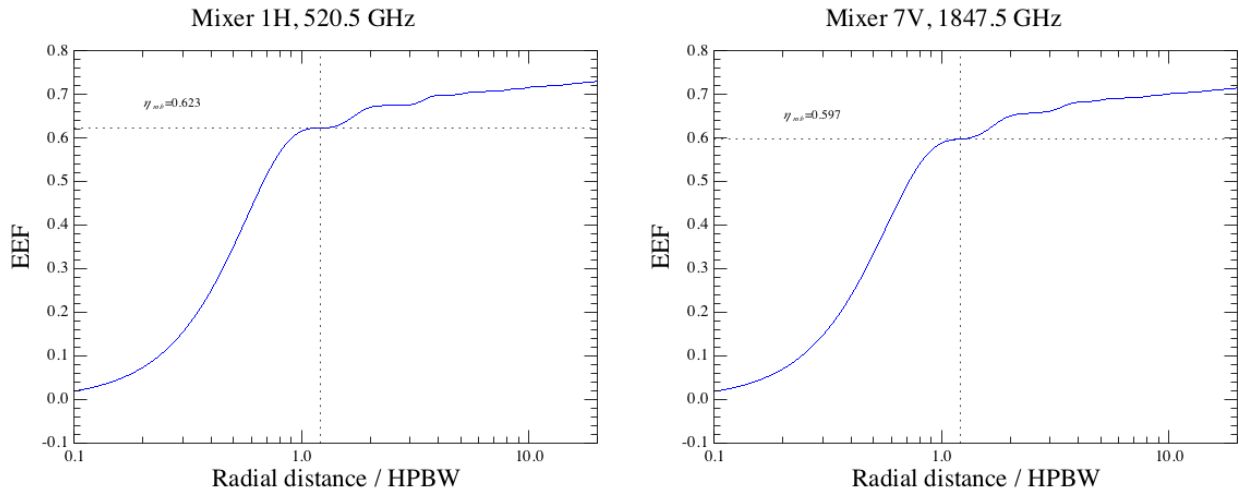


Figure 3: Encircled Energy Fraction profiles for the same band and frequencies as Fig. 1

The Ancillary Data Product archive also contains the following files:

- `HifiBeamReleaseNote_Sep2014.pdf`: the original HIFI beam release note from Sept. 2014, giving all details about the beam derivation and associated assumptions
- `getHifiBeam.py`: a Jython code which can be used in e.g. HIPE to read the FITS files provided herewith. Beams are rescaled to the frequency of interest (parameter frequency being in GHz) and rotated from focal-plane coordinates to an Equatorial frame (centred at 0,0), taking account of the position angle of the observation.

2.2.2 HIFI Beam Files Data Product queries in the HSA

Like any other Ancillary Data Product archives served by the HSA, the trend analysis data products are provided as a single compressed archive from the Ancillary Data Product query menu. This archive contains all the gzipped FITS files mentioned above and amounts to 760 Mb in total size.

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