DATA REDUCTION FOR HEVICS PUBLIC DATA RELEASE OF 2 SCAN DATA

THE HEVICS DATA REDUCTION TEAM

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The data consists of two orthogonal scans of each of the four HeViCS fields (see www.hevics.org) in each of the five wavebands (100, 160, 250, 350 and 500μm).

PACS 100 and 160μm

We have produced PACS maps at 100 and 160 μm using HIPE version 7.1.0 for both map making (simple projection, `photProject`) and data pre-processing. Maps with the naive projection algorithm were obtained, following the approach described by Ibar et al. (2010), in two steps: for each scan, we made a first map from the standard data reduction pipeline. In these maps, the $1/f$ noise was corrected by applying a high-pass filter with a length of 20 and 40 frames for the green and red map, respectively, and deglitching was performed by means of the sigma-clipping standard algorithm (`IIndLevelDeglitchTask` task in HIPE, with $\sigma = 3$). On these preliminary maps, we used SExtractor to perform a rough source extraction, producing a segmentation map to be used to mask the extended, bright sources, in order to both avoid over-subtraction due to the high-pass filtering, and to better tune the deglitching. The flux threshold was set to 2.5σ (`DETECT_THRESH` parameter), and the minimum number of pixels above the threshold, for a source to be detected, was set to 48 and 24 for the green and red channel, respectively (`DETECT_MINAREA` parameter). In order to minimize the high-pass filtering over-subtraction, the masks obtained in this way were enlarged, by adding 4 and 2 pixels to the detected sources, for green and red maps, respectively.

In a second step, the data were reduced again. The `photMMTDeglitching` task was applied before the high-pass filtering (`scales=2,nsigma=5`), with the bright sources being masked to avoid the typical "over-deglitching" of their brightest parts. Then, high-pass filtering was run, having the bright sources masked, with a filter length of 10 and 20 frames for green and red, respectively, and having set the `interpolateMaskedValues` parameter to `True`, to ensure that, in the case where the length of the mask for a given source is higher than that of the high-pass filter, no flux is removed (PACS Data Reduction Guide, version 7).

After this, the second-level deglitching task was run, first only on the sources (the `nsigma` parameter was set to 3) and then again on the whole map (with the `nsigma` parameter set to 7, in this case), to get rid of glitches possibly not detected by the MMT task. At this point the nominal and orthogonal scans were joined, and the map was produced with the `photProject` task.

Calibration files supplied with HIPE version 7.1.0, were used (see ICC report: PACS Photometer - Point-Source Flux Calibration (April, 12, 2011), by T. Müller et al).

The FWHM has a slight dependence on the Scan Orientation Angle. For fast speed parallel mode, it is about 6.9"x13.0" in the green band, and about 11.0"x14.0" for the red (see PACS photometer point spread function (November 2010), by D. Lutz). We use the detector's nominal pixel size of 3.2"/pxl and 6.4"/pxl for green and red, respectively.

SPIRE 250, 350 and 500μm

The SPIRE data were processed up to Level-1 as provided by the SPIRE Instrument Control Centre (ICC). This Jython script was run in HIPE (build number 4.0.1367), In terms of the SPIRE scan map pipeline up to Level-1, this was very similar to the Herschel Common Science System/Standard Product Generation v5 since we aready had patched the new parts of v5 into our old v4. So we used the flux calibration product of v5 where the SPIRE calibration is based on Neptune data and have applied the ICC factor of 1.0067 to the PMW maps giving us the equivalent of the latest v7 calibration. In addition we ran concurrentGlitchDeglitcher removing the effect of often low level, but frequent glitches appearing in all bolometers of an array at the same time.

The difference to the standard pipeline was that we used the sigmaKappaDeglitcher instead of the ICC-default waveletDeglitcher. Furthermore, we did not run the default temperatureDriftCorrection and the residual, median baseline subtraction. Instead we use a custom method called BriGAdE (M. W. L. Smith et al. in prep) to remove the temperature drift and bring all bolometers to the same level (equivalent to baseline removal). For every bolometer in each array BriGAdE fits the thermistor timeline to the bolometer signal timeline assuming a linear relationship to find the baseline to subtract (a similar process is presented in Pascale et al. 2010). The timeline fitting is applied to the whole observation (including turnaround data) except for samples with signal from bright sources, un-identified glitches or mask flags from the pipeline that would remove the sample from the final map. These are automatically masked from the fitting process to prevent biasing of the fit. If both thermistors contain 'jumps' (an artefact where there is a sudden DC offset in the time-lines) these are either corrected or switched to the slightly less sensitive Dark Pixels of the individual array. For the 250 and 500um arrays, where we have two functional thermistors, we used the thermistor providing the best fit to each bolometer. The 350um array has only one functioning thermistor, and so instead of a second thermistor we attempt the same process with a Dark Pixel. We have found this method improves the baseline subtraction significantly especially in cases where there are strong temperature variations during the observation.

Both scans were then combined to make our final maps using the naive mapper provided in the standard pipeline. The FWHM of the SPIRE beams are 18.1", 25.2", and 36.9" with pixel sizes of 6", 8", and 12" at 250, 350, and 500um, respectively.