Herschel PACS/SPIRE data reduction for the HerCULES galaxies: Technical report

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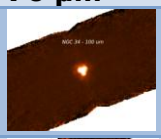
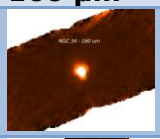
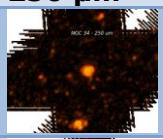
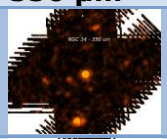
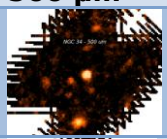
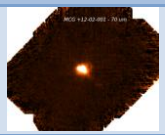
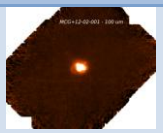
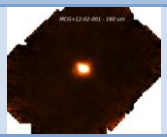
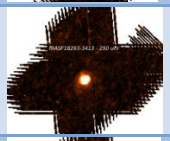
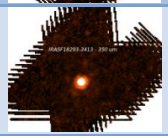
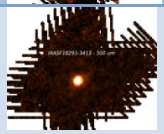
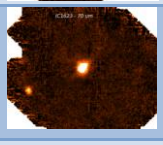
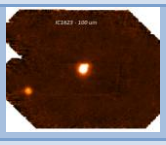
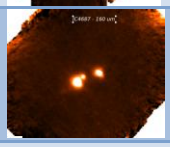
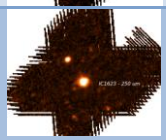
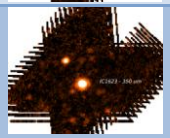
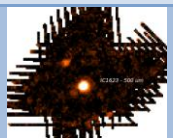
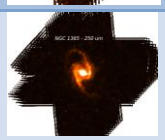
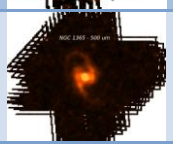
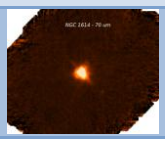
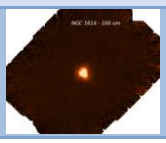
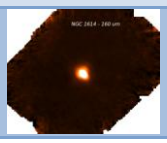
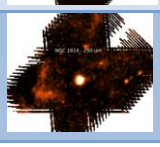
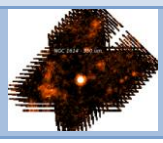
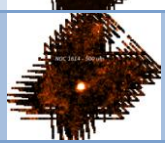
1. Introduction

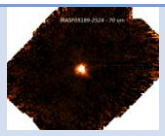
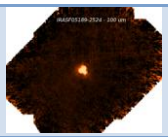
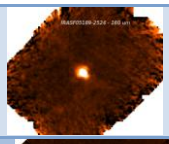
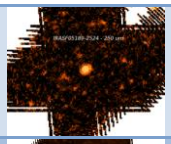
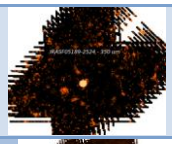
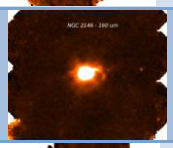
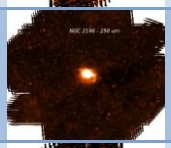
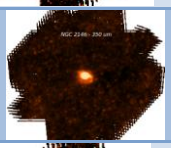
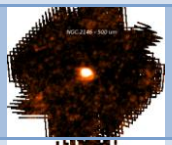
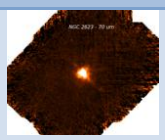
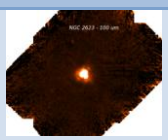
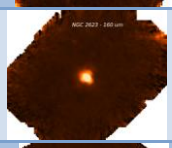
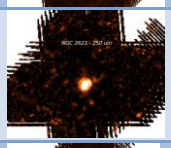
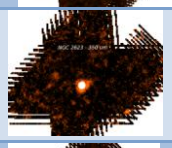
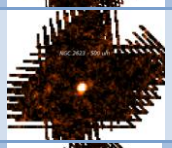
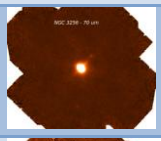
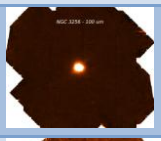
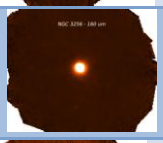
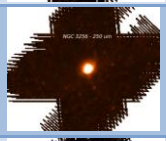
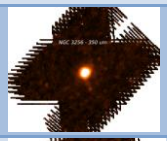
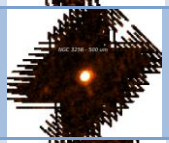
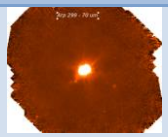
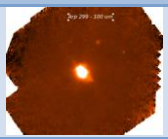
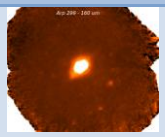
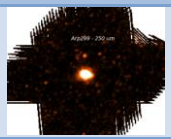
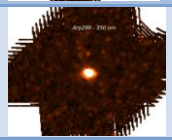
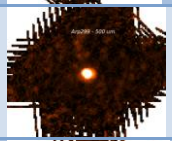
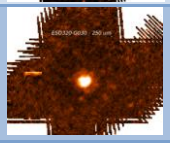
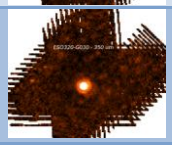
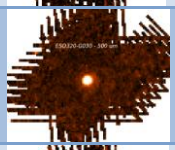
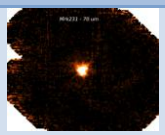
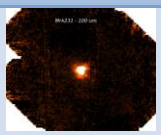
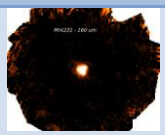
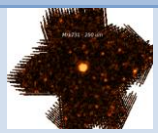
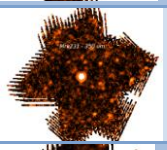
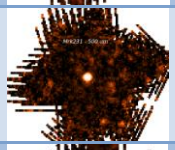
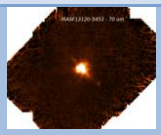
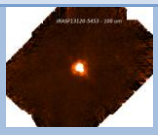
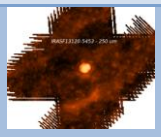
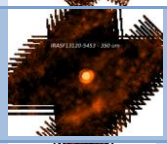
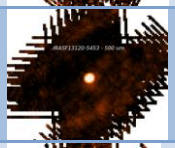
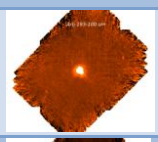
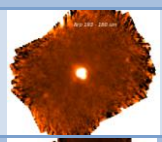
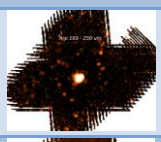
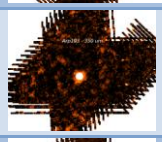
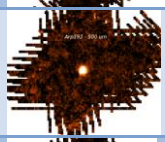
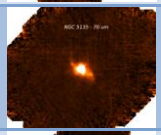
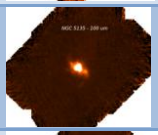
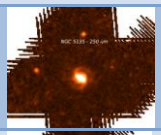
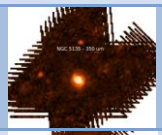
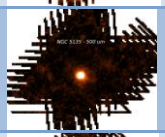
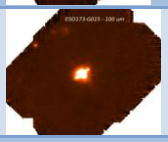
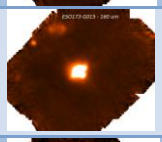
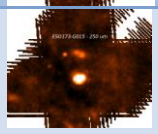
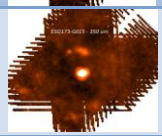
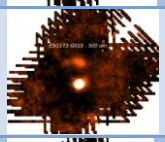
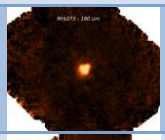
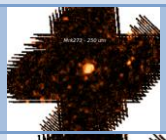
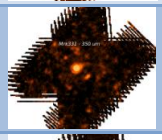
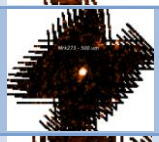
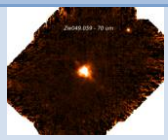
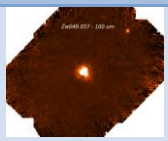
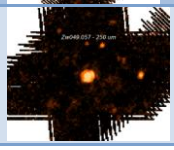
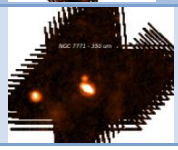
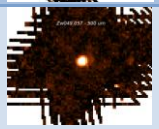
This document describes the delivery of the PACS/SPIRE photometer high level data products of the Herschel Open Time Key Project HerCULES (Herschel Comprehensive (U)LIRG Emission Survey; P.I.: P. van den Werf).

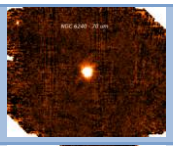
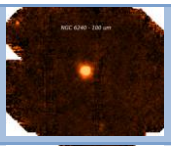
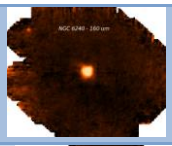
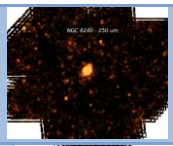
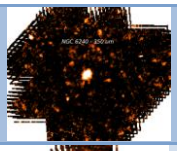
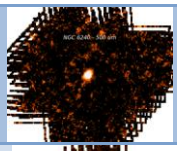
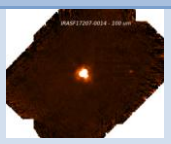
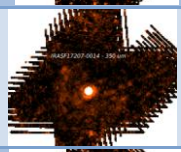
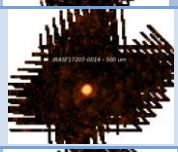
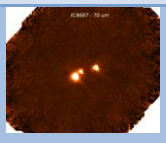
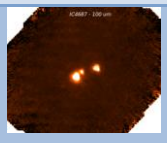
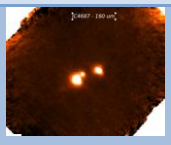
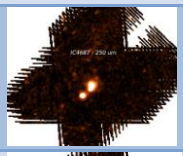
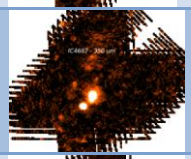
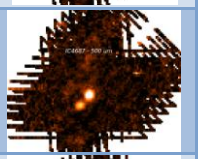
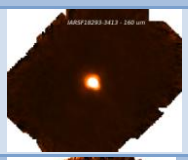
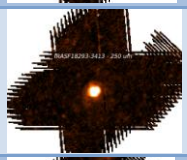
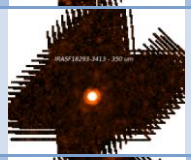
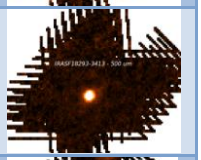
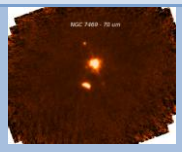
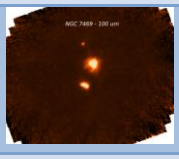
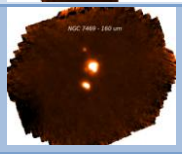
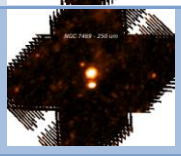
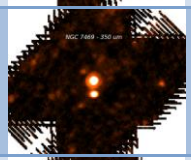
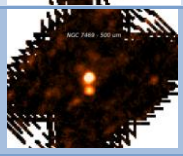
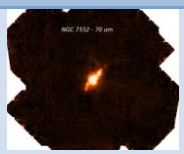
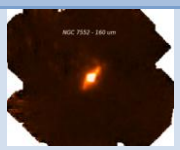
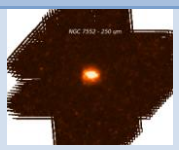
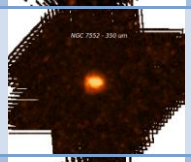
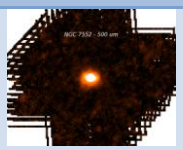
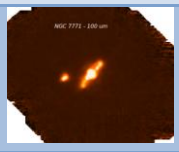
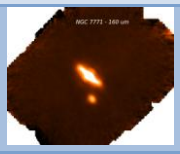
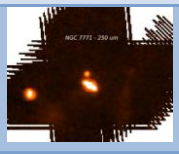
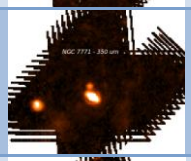
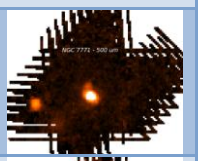
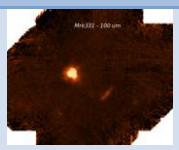
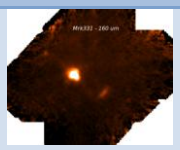
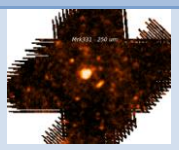
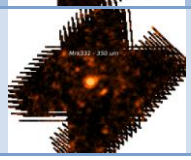
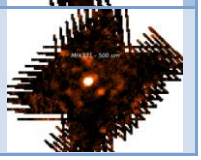
In the framework of HerCULES, we use the PACS (Poglitsch A., et al. 2010, A&A, 518, L2) and SPIRE (Griffin, M.J., et al. 2010, A&A, 518, L3) instruments onboard the ESA Herschel Space Observatory (Pilbratt, G. L., et al. 2010, A&A, 518, L1) to, primarily, investigate the physical conditions of the molecular gas in (U)LIRGs (using SPIRE-FTS and PACS spectrometer) but also analyze their dust far-IR/sub-mm emission by using the PACS and SPIRE imaging capabilities. This technical report describes the data reduction techniques of the PACS and SPIRE imaging of the 26 galaxies that constitute the HerCULES sample.

2. Observations

26 galaxies observed in the HerCULES program were mapped with PACS and SPIRE. The Galaxies and the reduced dataset are presented in the following table:

GALAXY	70 μm	100 μm	160 μm	250 μm	350 μm	500 μm
NGC34						
MCG+12-02-001						
IC1623						
NGC1365						
NGC1614						

IRASF05189-2524						
NGC2146						
NGC2623						
NGC3256						
Arp299						
ESO320-G030						
Mrk231						
IRASF13120-5453						
Arp193						
NGC5135						
ESO173-G015						
Mrk273						
Zw049.057						

NGC6240						
IRASF17207-0014						
IC4687						
IRASF18293-3413						
NGC7469						
NGC7552						
NGC7771						
Mrk331						

3. PACS Data Reduction

PACS data were reduced using HIPE 10.0 in a standard way up to level 1 using custom and well-modified pipeline scripts of HIPE (version 10.0). From level 1 data cubes, the maps were made using the Scanamorphos software (Roussel 2012; http://www2.iap.fr/users/roussel/herschel/). In a first step the HIPE level 1 data cubes were converted to a Scanamorphos compatible format while preserving the Badpixels, Nonscience, Saturation, and Glitchmask masks. From then we converted the cubes to IDL structures. Scanamorphos was run with the /parallel option.

The three maps for each of the PACS bands (70, 100 and 160 μm) are delivered as 5- extension FITS files. For each plane the plate scale is 1.4'', 1.70" and 2.85" at 70, 100 and 160 μm respectively. The 5 planes are:

1. signal map in Jy/pixel,
2. error map in Jy/pixel,
3. total drifts (excluding flux calibration offsets),
4. weight map,
5. signal map weighted to exclude noisy scans.

The absolute flux calibration is about 5%.

4. SPIRE Data Reduction

SPIRE data were reduced using HIPE 10.0 in a standard way up to level 1 using custom and well-modified pipeline scripts of HIPE (version 10.0). Standard detector timeline pipeline was used to remove cosmic rays, flux calibrate the data, and apply temperature drift and response corrections. Scanamorphos was then applied to the data and maps with pixel size of 6'', 10'', and 14'' were created for the 250, 350, and 500 μm data, respectively.

The three maps for each of the SPIRE bands (250, 350, 500 μm) are delivered as single-extension FITS files. The pixel scale of the SPIRE maps is wavelength-dependent: 6'' at 250 μm, 10'' at 350 μm, and 14'' at 500 μm. The flux units are Jy/beam. The reported resolutions are 18.3''x17.0'', 24.7''x23.2'' and 37.0''x33.4'' for the 250, 350 and 500 μm bands respectively while the average beam area is 423, 751 and 1587 arcsec2 for the 250, 350 and 500 μm bands respectively (see Spire Observer's Manual, version 2.4, page 50, Table 5.2). Current flux calibration accuracy is estimated conservatively at ~7%, dominated by the 5% absolute uncertainty in the Neptune model.