ESO Phase 3 Data Release Description

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"These data products are generated by the APEX Science Operations Team, which consists of astronomers and telescope operators.
The APEX-SciOps Phase 3 collection is a project that starts from public observations and, by applying a standard calibration process, delivers science ready APEX data to the community via the ESO Archive.
The data files conform to the ESO Science Data Products Standard, and in particular to the specifications for APEX data."

Abstract

APEX observation of project 092.F-9305(A), Boomerang Nebula, the coldest place in the Universe (Sahai & Nyman 1997) were conducted during the second semester of 2013 using the Large APEX Bolometer Camera (LABOCA). The object is a pre-planetary nebula that shows a unique high speed wind and mass expansion features that reflect into lower temperatures in the Universe even colder than the Cosmic Microwave Background radiation. The atmospheric window of 870µm, where LABOCA operates, provides the opportunity to study the dust around the envelope and the grain size distribution. The source was clearly detected at a signal to noise level of 46.

Overview of the Observations

Observation at 870µm were carried out on three observing dates, accumulating in total 6.6h of telescope time, including overheads. The precipitable water vapor (PWV) fluctuated between poor and excellent weather.

- Obs. 2013 Aug. 21, *PWV = 1.0mm – 1.5mm*
- Obs. 2013 Aug. 22, *PWV = 1.0mm – 1.2mm*
- Obs. 2013 Nov. 21, *PWV = 0.3mm.*

The required observing time as predicted by the LABOCA observing time calculator was 3.6h (2.2h on source), assuming 1.0mm PWV, but in view of the unstable weather during the first two observing dates, to the project was given 2h extra under more stable and excellent pwv (2013 Nov. 21).

The Boomerang Nebula was scanned with an angular resolution of 18.6 arcseconds using the Spiral Raster observing pattern, a uniform mapping. The reference pixel used is number 52 of the array, and the spiral pattern was defined by a start radius of 18”, and radial velocity of 2.25”/s.

The object is clearly detected and is fully covered by the observing pattern. The continuum detection has dimension in the map field of around 2.0 arcmin^2 as is shown in the next figure.

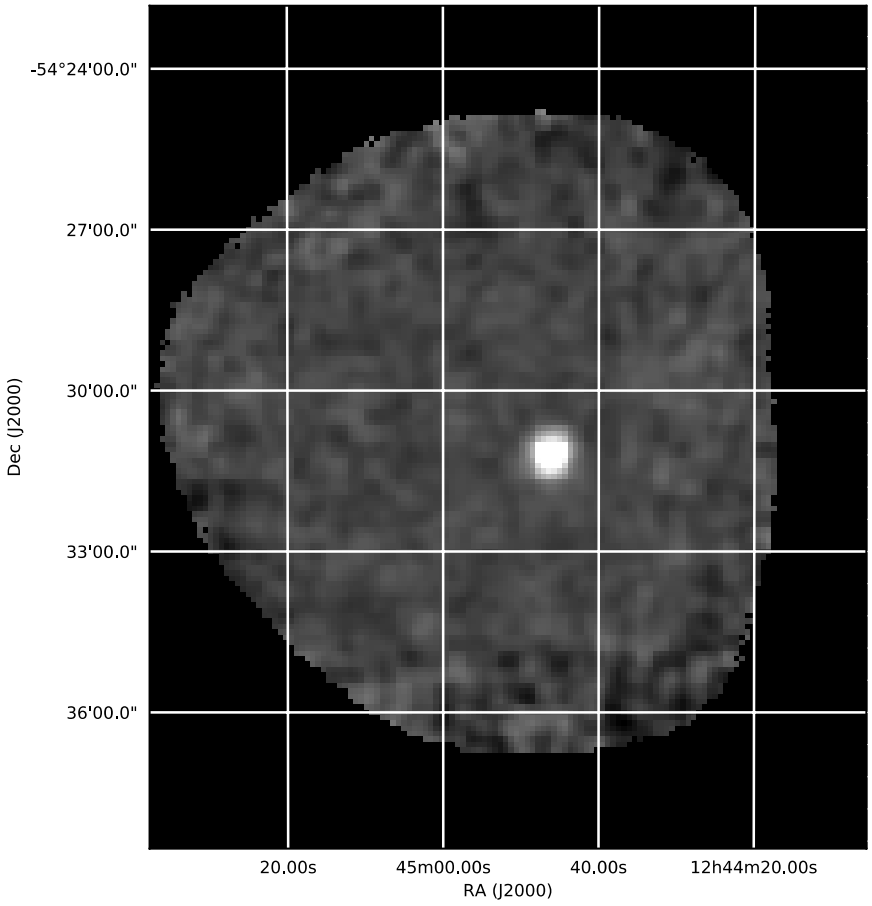

Figure 1. Boomerang Nebula in a continuum detection at 870µm. Equatorial coordinates.

Release Content

The total exposure time collected for the program during the days of 2013 August 21+22, and 2013 Nov. 21 is 5.1h on source. Using the APEX facility software reduction Bolometer Data Analysis (BoA; Schuller et al. 2012 SPIE 8452T, 10), data were combined and calibrated achieving in the object central position the continuum peak of 162.2 +/- 3.5 mJy/beam.

Source	R.A. [J2000]	Dec. [J2000]	Intensity (mJy/beam)	RMS (mJy/beam)	S/N
Boomerang	12:44:45.99	-54:31:13.5	162.213	3.488	46.50

Table 1. Summary of data result.

In this release, the Root Mean Square and Signal to Noise maps are included as associated files to the Intensity map.

Release Notes

Data Reduction and Calibration

APEX regular observations includes calibration of the atmosphere emission (skydip: opacities as a function of time), and primary and secondary calibrators in order to correct for pointing and focus every 1-2 hours.

The science data reduction is handled with BoA, and the final map is obtained after applying standard data reduction process. This includes flagging of bad channels, flagging excessive telescope speed and acceleration, and removing median sky noise from data using as reference the gain of bolometer 52. In addition, correction for atmospheric opacities are derived by interpolation of skydips, and Tau_model outcomes to scale the measured calibrators peak flux. We interpolated the opacities and flux calibration factors from the discrete set published on the official APEX calibration pages LABOCA Zenith opacities & LABOCA Calibrators, web pages.

Data Quality

In total 23 continuum scan were combined. This represents the 59% of the total integration time. Data from the first date of observations (2013 August 2) were discarded during the reduction, as it was affected by errors caused by too low scanning speed. This loss is not harmful for the combined map as these data also had the highest PWV, and hence the lowest atmospheric transparency.

The BoA package returns a result FITS file that contains three images: intensity, coverage and weight, all of them with the same size map. Specifically, the weight is computed and stored for each pixel as $1/rms^2$, *the inverse of the square of the rms of a single channel* . For convenience reasons, the map used on this data product is the homogeneous RMS map and the coverage map is discarded.

Previous Releases

No previous release to report.

Data Format

Files Types

Data product contents three Fits files, the intensity file *Boomerang_FLUX.fits*, the *Boomerang_RMS.fits* that provides the noise information and *Boomerang_S2N.fits* with the Signal to Noise ratio.

Acknowledgements

Any publication making use of this data, whether obtained from the ESO archive or via third parties, must include the following acknowledgment:

- "Based on data products created from observations collected from Atacama Pathfinder EXperiment (APEX), collaboration between Max Planck Institud für Radioastronomie (MPIfR), Onsala Space Observatory (OSO), and the European Southern Observatory (ESO) under ESO programme 092.F-9305(A)."

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