

The Herschel ATLAS

Steve Eales on behalf of the H-ATLAS team

- Largest Open Time Key Project (600 hours)
- A survey of 550 square degrees of the sky, four times larger than all other Herschel extragalactic surveys combined
- Five bands: 110,170,250,350 and 500 microns, with 5σ limit at 250 μm of 45 mJy





The fields

- Southern fields: 2dF, VISTA (VIKING), VST (KIDS), DES
- Equatorial fields: 2dF, SDSS, GAMA, VISTA (VIKING), UKIDSS, VST (KIDS), GALEX, GMRT
- Northern fields: SDSS, LOFAR, UKIDSS
- We predict 35,000 sources will already have redshifts, including 90% of those at z<0.1, and in the GAMA fields 90% at z<0.3







H-ATLAS Science Programme A

Far-IR/submm version of the Sloan photometric survey.

We aim to measure the dust content and dust obscured star formation in ≈30,000 galaxies in the nearby (z<0.3) universe.

How does star formation depend on environment?
How does dust mass depend on galaxy type and environment
How much evolution has there been in the last three billion years?





Programme B – High-Resolution Observations of Planck Sources

We will survey one eightieth of the sky in two of the same bands as Planck

• empirical test of Planck pointsource extraction (positions, fluxes etc.)

 high-resolution observations of Planck point sources

• a clean 'SZ' sample of high-redshift clusters

• joint Herschel-Planck study of highlatitude dust



BOLOCAM image at 1.1 mm of Abell 1835, showing the SZ effect and two dusty galaxies



Programme C: Lensing

• Existing lensing samples typically contain ≈10 sources

• Models suggest that 500 μm is the golden spot for finding lensed systems, and that the ATLAS should contain several hundred lenses.

• Possible projects: (i) investigations of the cosmic evolution of darkmatter halos, (ii) a study of submm sources well below the Herschel confusion limit, (iii) measurement of cosmological parameters.



Blue – nearby galaxies; green – blazars; red – unlensed high-z galaxies; dashed red – lensed high-z galaxies



• Programme D: studies of high-z AGN (e.g. stacking analysis on 10,000 SDSS quasars)

- Programme E: evolution and clustering of submillimetre galaxies
- Programme F: study of prestellar cores and protostars at high latitude



When we look at high latitude, the dust is close!



IRAS map at 100 µm of 10x10 deg² around the SGP



Science Demonstration Observations

- Herschel observed a 4x4 deg² region of one of our fields on the celestial equator on 22 November 2009 in parallel mode
- SPIRE data reduction fairly complete
- PACS data reduction less advanced

Hard-Core SPIRE Data Reduction

- New temperature correction module designed by Enzo Pascale (low-pass filter of temperature time streams, fifth-order polynomial fit to temperature time streams and then normalize and subtract from detector time streams).
- At 250 and 350 µm, no correlation between noise of different bolometers and 1/f knee is at a scale of ≈ 5.5 deg
- At 500 µm, some correlation between bolometers, and 1/f knee is at a scale of 1.7 deg
- High-pass the time streams at the 1/f knee for each array



4 x 4 deg² 250 μm

Hspot noise estimates in the three bands: 9.1, 12.4 and 10.5 mJy

Measured noise: 9.4, 7.6 and 10.6 mJy



First PACS Images



PACS at 160 microns



- Current estimates of the noise are 30 mJy (1 sigma) at 110 µm and 46 mJy (1 sigma) at 170 µm.
- Hspot estimates: 13.4 mJy and 18.9 mJy
- Estimates of the point spread function from stacking suggest that the beam has not been smeared by fast-scanning
- Watch this space!







Source Extraction and Identifications

- We are currently trying five source-extraction packages, including two (MADX and the Matrix Filter Multi-Frequency Method) designed to operate at several frequencies simultaneously
- Counterparts are currently being found by a Bayesian method that uses both the positions and spectral energy distributions of the potential counterparts



How Well Will We Do? Programme A

- MADX finds 14900 sources detected at >5 σ , including 5053 detected at >5 σ at 250 µm, 7178 at 350 µm and 479 at 500 µm
- Predicted total for survey is 521,000
- Predicted total at z < 0.3

 (assuming redshift distribution is the same as models) is 80,000





Programme B





Programme C: Are the Bright 500-µm Sources Lensed

- There are eight SDP sources with flux at 500 µm above 100 mJy
- Two are galaxies at z<0.1
- One is a blazar









 But five are either unlensed high-z galaxies or lensed high-z galaxies









Programme 5: AGN

 Two blazars detected, including one which is one of the 200 brightest gamma-ray sources in the sky





Programme F: Galactic Science



- If 'blob' is galactic, it is likely to be at a distance of less than 1 kpc.
- We estimate that its mass (gas plus dust) is less than 1 solar mass.
- Possible isolated prestellar core



Conclusions

- SPIRE survey is reaching our target noise limits
- PACS survey is a factor of 2-3 above the required sensitivity
- We are detecting 2-3 more sources than we expected
- The current 9-hour limit on AORS is a major problem for our maps of the SGP and NGP
- Other than that, are no major obstacles for any of the six H-ATLAS science programmes.



Ten Years in Submm Astronomy



1998: SCUBA observations of the HDF – five sources after 20 nights



2009: Herschel – 15000 sources after 16 hours