First results from PACS deep surveys

Dieter Lutz, for the PACS Evolutionary Probe (PEP) team

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The deepest Herschel-PACS blank fields taken to date

PEP GOODS-N 30h
100+160µm during
Science demonstration phase
~300 sources

PEP GOODS-S 113+113h
70+100+160µm
~800 sources
From MIPS to PACS

GOODS-S MIPS 160μm
FIDEL team
From MIPS to PACS

GOODS-S PACS 160µm
PEP team
From MIPS to PACS

GOODS-S MIPS 160µm
FIDEL team
GOODS-S PACS 160µm
PEP team

preliminary
Ability to cover large fields (COSMOS 2sq.deg.)
PEP fields

- PEP is the major Herschel 100/160µm extragalactic survey of key multiwavelength fields
- +10 lensing galaxy clusters
- Coordinated with Hermes for SPIRE coverage
- Hermes and Atlas extend to wider+shallower PACS coverage
- GOODS-Herschel will go deeper on (parts of) GOODS fields
- Herschel lensing survey substantially extends the number of lensing clusters

<table>
<thead>
<tr>
<th>Field</th>
<th>Area</th>
<th>Total Exp. [hours]</th>
</tr>
</thead>
<tbody>
<tr>
<td>COSMOS</td>
<td>85'x85'</td>
<td>213</td>
</tr>
<tr>
<td>Lockman Hole</td>
<td>24'x24'</td>
<td>35</td>
</tr>
<tr>
<td>E-CDFS</td>
<td>30'x30'</td>
<td>35</td>
</tr>
<tr>
<td>Groth Strip</td>
<td>67'x10'</td>
<td>35</td>
</tr>
<tr>
<td>GOODS-S</td>
<td>10'x15'</td>
<td>113</td>
</tr>
<tr>
<td>GOODS-N</td>
<td>10'x15'</td>
<td>30</td>
</tr>
</tbody>
</table>
Resolving the Cosmic Infrared Background with PACS

Lagache et al. 2005 ARAA

Altieri et al. 2010 Abell 2218 lensed counts

Berta et al. 2010 (talk on Thursday)
The need for far-IR calorimetric star formation rates

- Our community has been relying almost exclusively on extrapolation from the optical and mid-infrared as the avenue towards studying galaxy evolution and star formation rates.
- We know this extrapolation is pretty good.
- **But how good?**

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**From 24µm**

**From rest frame UV**

**From submm/radio**
Extrapolation from 24$\mu$m to 100$\mu$m (B. Magnelli)
PACS 100$\mu$m
The star formation rates of typical $z \sim 2$ star forming galaxies

- BzK star-forming galaxies in GOODS-N, $K_{AB} < 22$, $z=1.5-2.5$
- Far-infrared luminosity from 160$\mu$m flux, redshift, Chary & Elbaz 2001 SED

Nordon et al. 2010

Elbaz et al. 2010 (next talk)
Z~2: Extrapolation from 24µm overpredicts FIR

- Star formation rates based on 24µm, z, and Chary/Elbaz SED family **overpredict the calorimetric FIR by factors 4-7.5 at this redshift**

- Similar behaviour of X-ray AGN and other galaxies

- **Obscured AGN and/or changing SED shape/PAH strength?** Setting in of the effect at z=1.5 favours the latter, to be continued…

Nordon et al. 2010 (poster)
Z~2: Extrapolation from rest frame UV slightly overpredicts FIR


Overprediction by factor ~2

Modest modification to extinction law needed?

Extrapolation from rest frame UV

Nordon et al. 2010 (poster)
Towards reconciling observed and theoretical star formation rates

Dave 08

Daddi+ 07

Perez-Gonzalez+08
Extrapolation from submm/radio assuming radio/FIR correlation

Very high IR luminosities of SMGs as estimated from submm/radio via local radio-FIR relation are substantiated by Herschel data.

.. Previous selection effects on dust temperature can now be largely avoided.

Magnelli et al. 2010 (talk on Thursday)
The co-evolution of AGN and star formation

Models of merging galaxies (Hopkins+06)

BzK-15504 z~2.38 rotating disk with central AGN (Genzel+08)
FIR has best contrast between host star formation and intrinsic AGN SED (QSO SEDs from Netzer+07)

FIR detection rate 21% for X-ray AGN

No trend with obscuration (but only few $L_{X}>10^{44}$ in sample)

Shao et al. 2010 (poster)
Two modes of AGN / host coevolution: Merger vs. secular

Increase with $z$ of SFR in massive galaxies

$L_{SF} \propto L_{AGN}^{0.8}$ (Netzer09)

Shao et al. 2010 (poster)
Direct far-infrared luminosity functions

Gruppioni et al. 2010 (poster)
FIR-based determinations of the specific star formation rate

Rodighiero et al. 2010 (talk on Thursday)
Stacked far-infrared detection / SED constraints for Lyman Break Galaxies

Magdis et al. 2010 (Poster)
Surprisingly large dust masses of submillimeter galaxies

Santini et al. 2010

... more dust than expected for gas phase metallicity
Thank you!

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Lockman Hole