Possible Open Time Extragalactic Programmes

based mainly on the

Extragalactic Herschel Open Time (Extra-HOT) Consortium

Alberto Franceschini

Padova University

Extra-Hot Constitution

- The aim is to coordinate the formulation of a number of extragalactic key programmes for submission in response to the Herschel Open-Time call for proposals. We hope to provide an environment in which large proposals can be successful. We aim to optimise the scientific effectiveness of the HSO by pooling resources in the planning, preparation, execution and analysis of observing programmes.
- PLANNING: We will ensure that surveys address a wide variety of science goals and are carried out in areas of wide community interest. We will bring a wide variety of theoretical expertise to the optimising of observing plans and use our instrumental expertise to optimise observing modes.
- PREPARATION: We will ensure that the required preparatory data is in place.
- EXECUTION: We will pool resources and expertise in data processing and validation.
- ANALYSIS: We will provide theoretical and observational expertise for rapid exploitation of the Herschel data.
- A secondary goal of this consortium is to provide a common political voice to EU and national funding agencies.

Leiden October 2005 Meeting Introduction (by S. Eales)

- Founding of the EXTRA-HOT consortium in September 2005 as a vehicle (a) for planning Herschel open-time key projects, (b) pooling resources in the planning, preparation and execution of observing programmes.
- Announcement of Opportunity for open-time key projects will be February 2007. Deadline will be six months later.
- A key project is >100 hours
- Total mission length approximately 3 years. OT will be 2/3 of this.
- EXTRA-HOT is currently open to all astronomers.
- EXTRA-HOT is **not** the only route by which large open-time proposals will be submitted.
- EXTRA-HOT proposals will only be successful if they are better than proposals from outside the consortium.

Aims and Objectives of the Meeting

- To define some proto-proposals that meet the science aims of as many members of EXTRA-HOT as possible.
- To generate a plan for how these proto-proposals can be transformed into successful OT proposals.
- To ensure that EXTRA-HOT members not at this meeting are kept as fully involved as possible.

Presenter	*Title*
Steve Eales	*Introduction*
Seb Oliver	*Herschel SPIRE GT Program*
Cedric Lacey	*Predictions for surveys with HERSCHEL from a CDM model of galaxy evolution*
Steve Eales	*Herschel Observations of SCUBA2 Legacy Surveys*
Eelco van Kampen	*Galaxy formation and large-scale structure: What do we want to know?*
Dave Clements	*A Herschel Survey of High z AGN*
Jonathan Davies	*Low Level Cold Dust Emission*
Dave Clements	*Planck & Herschel*
Denis Burgarella	*When UV meets IR*
C. Kramer	*A HIFI Key Programme on Nearby Galaxies*
C. Gruppioni	*A deep Herschel survey in SWIRE-S1*
A. Franceschini	*A far-IR multiwavelength study of the COSMOS field*

Galaxy formation and large-scale structure:

What do we want to know ?

Eelco van Kampen, Institute for Astrophysics, Innsbruck

with Jim Dunlop, John Peacock, Will Percival,

Galaxy formation: what do we want to learn from Herschel ?

- The basic stuff: luminosity function, colours, redshift distribution in the 6 passbands
- Environment: clusters vs. filaments vs. field
- Dust mass versus:
  - star formation rate
  - stellar mass (old, young)
  - cold gas mass (clouds, disk)
- What drives (dust-enshrouded) starbursts at z~1 ?
  - mergers (minor/major)
  - interacting galaxies
  - interaction with clusters (their ICM)
- Pairs of dusty (star-bursting ?) galaxies

Large-scale structure: what do we want to learn from Herschel ?

- The basic stuff: clustering, power spectrum, biasing
- Clustering evolution of sub-mm sources:

  SPIRE 250 micron (z~1-2) and SCUBA-2 850 micron (z~2-3) have the same angular resolution with similar corresponding physical sizes, but at different redshifts

  → link up with the JCMT legacy survey

  This should not really work for PACS at 175 micron and SCUBA-2 at 450 micron

Issues:

- total sample size
- minimum field size
- resolution: resolving ‘close’ pairs

Herschel Observations of SCUBA2 Legacy Surveys

- SCUBA-2 is the new submillimetre camera which will be installed on the JCMT in 2006.
- A large fraction of the observing time on SCUBA-2 has already been allocated to Legacy surveys

Extragalactic SCUBA-2 Surveys

Two-year plan:

- 850-micron map of 20 square degrees down to a 10-sigma limit of 7 mJy (FWHM = 14 arcsec) - Survey 1
- 450-micron map of 0.6 square degrees down to a 10-sigma limit of 5 mJy (FWHM = 7 arcsec - Survey 2
- 850-micron map of same 0.6 square degrees down to a 10-sigma limit of 1.5 mJy (Survey 2)

Science Goals

- Large-scale structure of the submm sky (Survey 1)
- Resolving the submm background at short submm (Survey 2)
- Search for extreme clusters (Survey 1)
- Search for Sunyaev-Zeldovich signals from high-z clusters (Survey 1)
- Evolution of the luminosity function (Surveys 1 and 2)
- Cosmic star-formation history (Surveys 1 and 2)

The missing link – the importance of Herschel

- Survey 1 will not provide dust temperatures, and thus bolometric luminosities will be very uncertain (remember, L_{bol} is proportional to dust temperature to the fifth power.
- 95% of SCUBA-2 sources will lie at z>1, so SCUBA-2 will not tell us much about the evolution of dusty galaxies during the last eight billion years.

Herschel follow-up (S. Serjeant)

- More timely for Herschel than Planck ERCSC; astrometry much better
- Possibility of data analysis synergies with SCUBA-2
- PACS and SPIRE photometry 75-500μm
  - probe the peak of the SEDs, get bolometric luminosities, dust masses, better photo-z
  - exposure times of ~ a few min per source
- SPIRE FTS/HIFI spectroscopy
  - Best possibility of "blind" redshift determination of sub-mm galaxies should be with SASSy: could try e.g. [CII] (though deficient in local ULIRGs). Other (non-HSO) redshift survey programmes will also be in progress.
  - Aim is to use atomic line species (e.g. C^+, O^{++}, N^+) and molecules (e.g. OH, H_2O) to probe SFR, density and temperature of ISM, radiation field, etc, constrained by reference to photoionisation and PDR models
  - Key diagnostics: atomic fine structure lines (CII, OI, OIII etc) and molecular lines (OH, H_2O etc). Also, for brightest sources, SIII (33μm) and OI (63μm) may be detectable with PACS spectrometer.
  - R=20 SPIRE FTS spectrum: approx. 1 hour per source

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Herschel follow-up of SCUBA-2 and ASTRO-F All-Sky Surveys

Mark Thompson (University of Hertfordshire) • Stephen Serjeant (University of Kent) • Harold Butner (JAC) • Antonio Chrysostomou (University of Hertfordshire) • Dave Clements (Imperial College London) • Jim Collett (University of Hertfordshire) • Kristen Coppin (UBC) • Iain Coulson (JAC) • Bill Dent (UKATC) • Frossie Economou (JAC) • Nye Evans (Keele University) • Per Friberg (JAC) • Gary Fuller (University of Manchester) • Andy Gibb (UBC) • Jane Greaves (University of St Andrews) • Jennifer Hatchell (University of Exeter) • Wayne Holland (UKATC) • Mike Hudson (University of Waterloo) • Andrew Jaffe (Imperial College London) • Tim Jenness (JAC) • Hugh Jones (University of Hertfordshire) • Johan Knapen (University of Hertfordshire) • Jamie Leech (JAC) • Bob Mar
(HIA/NRC Canada) • Toby Moore (Liverpool John Moores University) • A
(Cardiff University) • Michele Pestalozzi (University of Hertfordshire) • Ak
of Cambridge) • Douglas Scott (UBC) • Russell Shipman (SRON/Kapteyn
London) • Ludovic Van Waerbeke (UBC) • Serena Viti (University College L
(University of Kent/Open University/RAL) • Jan Wouterloot (JAC) • Ming

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SASSy: SCUBA-2 All-Sky Survey

- Response to call for JCMT legacy surveys: awarded 1500 hours over five years from semester 2007A
- 5σ 150mJy at 850μm, triple scanning redundancy
  - can use fainter limit (e.g. 3σ 90mJy) for known objects
- Three phases
  - Pilot phase: two 10 degree wide strips
    - P2P strip NEP - Galactic Pole - Galactic Plane
    - galactic plane strip
  - ALMA sky -30?δ?+40
  - "All" sky -30?δ?+70 (extended JCMT operations)
- Rapid data release to JCMT (then wider?) community - emulate the spirit of the IRAS mission

Herschel follow-up

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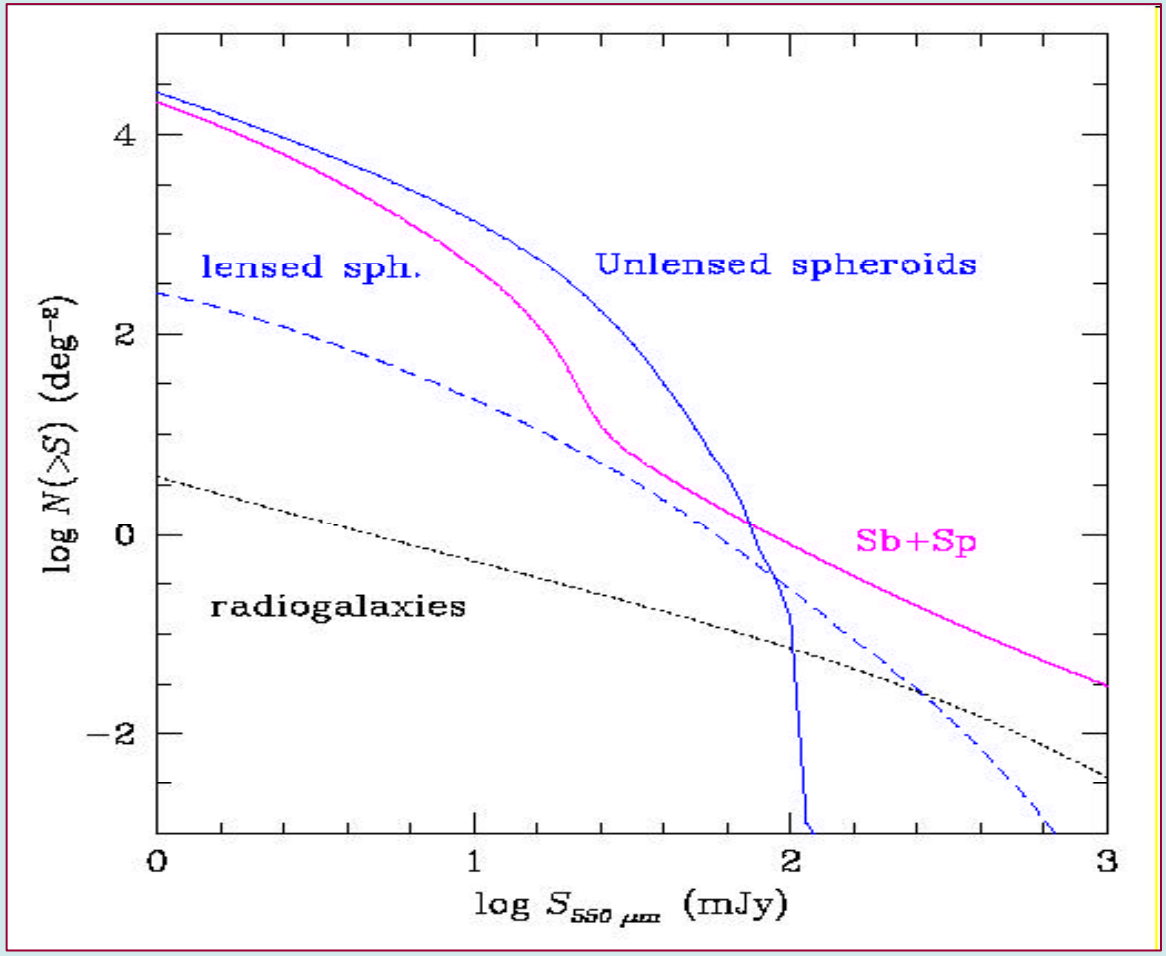
A shallow wide-area survey with Herschel SPIRE

(De Zotti)



200 sq.deg. in 3 SPIRE channels to S(500μm) ? 100mJy

- **Strong lensing survey**
- **High-z clustering**
- **Rare objects**
- **Planck foregrounds**

Predicted integral source counts per square degree at 550 μm. The solid line sinking down at 100mJy and the dashed line show the counts of unlensed and strongly lensed proto-spheroidal galaxies, respectively (Granato et al. 2004). The other solid line gives the sum of counts of starburst and spiral galaxies, the radio galaxies (mostly blazars). The effect of lensing on populations other than proto-spheroidal galaxies has been neglected.

Planck and Herschel

(Dave Clements)

- Planck will be launched at the same time as Herschel
- Goal is CMB observations
- But will at the same time produce all-sky survey at 9 frequencies:
  - 30, 44, 70, 100, 143, 217, 353, 545, 857 GHz
- Will produce maps and point source catalogs in all these

Planck and Herschel Synergy

- Planck can provide sources for followup by Herschel
  - Eg. luminous high z galaxies, outbursting BL Lacs or galactic mini-quasars
- Herschel can provide higher resolution complementary images to aid Planck data analysis
  - Eg. component separation

Planck Data Release Policy

- The Early Release Compact Source Catalog
  - Based on first Planck all-sky coverage
  - Due out 22 months after launch
  - Will not be as deep, accurate or reliable as final catalog
- Full survey complete 22 months after launch
  - 1 year for ‘final’ processing, 1 year proprietary
  - Final catalog to public 46 months after launch

Planck Related Projects for Herschel

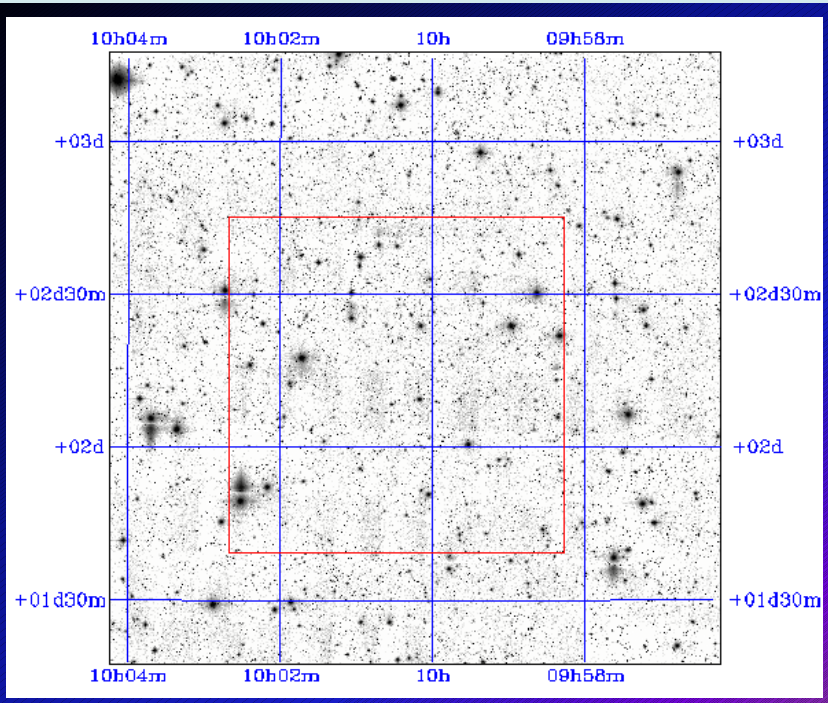
- Followup of candidate high z sources
  - Select by colour from ERCSC possibly using additional databases (eg. IRAS)
  - Get extra photometry, better astrometry, possibly spectroscopy with Herschel
- Observing submm bright AGN with Herschel - BL Lac, GPS, non-thermal
  - Sources found or confirmed by Planck
- TOO of AGN detected with Planck quick alert system
  - Special software to search Planck timelines for outbursting sources

H-COSMOS:
A FAR-INFRARED MULTIWAVELENGTH SURVEY IN THE COSMOS FIELD

[Proposed as Key Project for the Herschel Open Time]

Current proponents: A. Franceschini et al.

- COSMOS is an HST Treasury project to survey a 2 square degrees equatorial field with the ACS HST camera.
- It is the largest survey that HST has ever undertaken, utilizing 10% (640 orbits) of the HST observing time over the course of 2 years.
- The project also incorporates major committments from other observatories around the world, including the VLA radiotelescope, ESO's VLT in Chile, ESA's XMM X-ray observatory, the Spitzer Space Telescope, and Japan 8m Subaru telescope in Hawaii.
- The COSMOS collaboration involves ~100 astronomers n a dozen countries.
- http://www.astro.caltech.edu/~cosmos/index.html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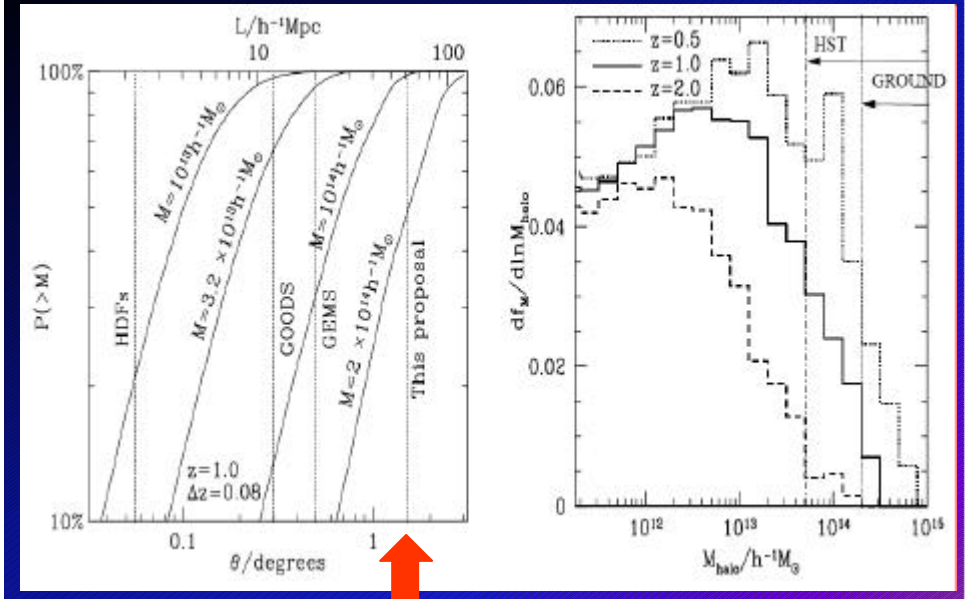
10h02m
10h
09h58m
+03d
+02d30m
+02d
+01d30m


L/h⁻¹Mpc
10
100
100%
10%
P(>M)
M=10¹³h⁻¹M⊙
M=3.2×10¹³h⁻¹M⊙
M=10¹⁴h⁻¹M⊙
M=2×10¹⁴h⁻¹M⊙
HDFs
GOODS
GEMS
This proposal
z=1.0
Δz=0.08
0.1
1
θ/degrees
z=0.5
z=1.0
z=2.0
HST
GROUND
0.06
0.04
0.02
0
dfM/dlnMhalo
10¹²
10¹³
10¹⁴
10¹⁵
Mhalo/h⁻¹M⊙

COSMOS

Available multiwavelength data in the COSMOS field

- from space:
  - Herschel PACS, SPIRE Guaranteed-Time 110, 170, 250, 350, 500 μm
  - Spitzer IRAC 3.6, 4.5, 5.6, 8 μm
  - Spitzer MIPS 24, 70, 160 μm
  - HST/ACS I-band
  - GALEX far-UV, near-UV
  - XMM 1.5 Msec

- ground based:
  - Subaru SCam B,V,r',i',z'
  - NOAO K-band
  - UKIRT J,H band
  - VLA 20 cm
  - IRAM 1.2mm, LABOCA/APEX 850 μm
  - VISTA z,Y,J,H,K
  - VIMOS/VLT optical spectroscopy for more than 50000 galaxies/AGNs.

Table 3: Multi-λ COSMOS Data

Data	Bands, λ, Res.	AB mag 5σ pt. src	status	Investigators/Time
Spitzer-MIPS	160,70,24μm	0.15 mJy(5σ)	P	Sanders *et al.*
Spitzer-IRAC	8,6,4.5,3μm	11,9,3,2 μJy(5σ)	P	Sanders *et al.*
HST-ACS	814I	27	C/U	C12-13 581 o
HST-ACS	475g	27	C	C12 9 o
HST-ACS	475g	27	P	C14-15 590 o
HST-NIC3	160W	22.9(5% area)	C/U	C12-13 590 o
HST-NIC3	160W	22.9(5% area)	P	C14-15 590 o
HST-WFPC2	300W	25.4	C	C12-13 590 o
HST-WFPC2	450W	26.4	P	C14-15 590 o
Subaru-SCam	B, V, r ,i, z	27 -26	C	Taniguchi *et al.* 10 n
Subaru-SCam	7 IB filters	26	U	Taniguchi *et al.* 8 n, Scoville 3 n
Subaru-SCam	NB816	25	U	Taniguchi *et al.* 8n
CFHT-Megacam	u *	27	C	Sanders *et al.* 24 hr
CFHT-Megacam	u,i*	26	C	LeFevre *et al.* 12 hr
CFHT-LS	u-z	-	U	Deep LS Survey
NOAO	K_s	21	C/U	Mobasher *et al.* 18 n
CFHT	K	23 (9×9_)	U	Sanders *et al.* 3n
UH-88	J	21	C/U	Sanders *et al.* 10 n
GALEX	FUV,NUV	26.1,25.8	C	Schminovich *et al.* 200 ks
XMM-EPIC	0.5 – 10 keV	10^{-15} cgs	C/U	Hasinger *et al.* 1.4 Ms
CXO	0.5 – 7 keV	pointed	F	Elvis *et al.*
VLT-VIMOS sp.	(R=200)	#=3000 (I_{AB} <23)	C	Kneib *et al.* 20 hr
VLT-VIMOS sp.	(R=200,600)	#=45000 (I_{AB} <25, z≥ 0.8)	U	Lilly *et al.* 540 hr
Mag.-IMAX sp.	(R=3000)	#=2000	U	Impey, McCarthy, Elvis 12 n
Keck/GEMINI sp.	(R=5,000)	#=4000 (I<24)	U/F	Team Members
IRAM-30m	1.2 mm	1 mJy (20×20_)	U	Bertoldi *et al.* 94 hr
CSO-Bolocam	1.1 mm	3 mJy	U	Blain *et al.* 40 n
JCMT-SCUBA2	450,850μm	??, ??	F	Legacy Trinational Survey
VLA-A	20cm	24μJy(1σ)	C	Schinnerer *et al.* 10 hr
VLA-A/C	20cm	8μJy(1σ)	C/U	Schinnerer *et al.* 265 hr
SZA(full field)	9 mm	S-Z to 2 × $10^{14}M$	U	Carlstrom *et al.* 2 mth

Status: C → completed; U → underway (done or scheduled time); F → future proposal; P → this proposal

Table 1: Expected Numbers of Objects in COSMOS 2-deg^2 Field

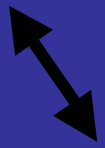
Class	#	IAB (10σ))	IRAC-4.5um	MIPS-24um	Reference
All objects	1.9×10^6	< 27	3×10^5	30,000	COSMOS-Subaru
XMM-AGN	3400	27	3000	3000	based on Lockman Hole
XMM-clusters	~120	5×10^{-17} cgs	~120	~100 ?	COSMOS XMM
strong lens systems	60–80	–	60–80 ?	?	Fassnacht *et al.* 2004
VIMOS Gal.w/ Spectra	$\sim5\times10^4$	I≤25	$\sim5\times10^4$	$\sim10^4$	COSMOS-VIMOS, Kneib *et al.*
Optically-selected QSOs	600(100)	24(21)	600	150	Croom *et al.* 2001
Optically-selected z > 4 QSOs	50	25	50	>10	Cristiani *et al.* 2004
ULIRGs	3,000	26	3,000	3,000	Smail *et al.* 2002
ExtremelyRedObjects	25,000	25	20,000	>3,000 ?	Daddi *et al.* 2000, Smith 2002
LymanBreakGalaxies (z≤2)	65,000	25.5	40,000	>1,000	Steidel *et al.* 2004
LymanBreakGalaxies (z~3)	10,000	25.5	>7,000	>500 ?	Shapley *et al.* 2001
Red high-*z* Galaxies (z > 2)	10,000	25.5	>3,000	1,000	Labb´e *et al.* 2003
L,T Dwarfs	300(<200 pc)	28(4σ)	300	50	Burgasser *et al.* 2002
Asteroids	~180		~180	?	Meadows *et al.* 2004
KuiperBeltObjects	100-250	27	100-250	>50	Jewitt (private comm.)

... but size large enough for a fantastic sampling of even very rare source populations ...

see recent first set of papers released on astro/ph

H-COSMOS Survey Alternatives (cnt.)
(the inner 1 sq. degree)

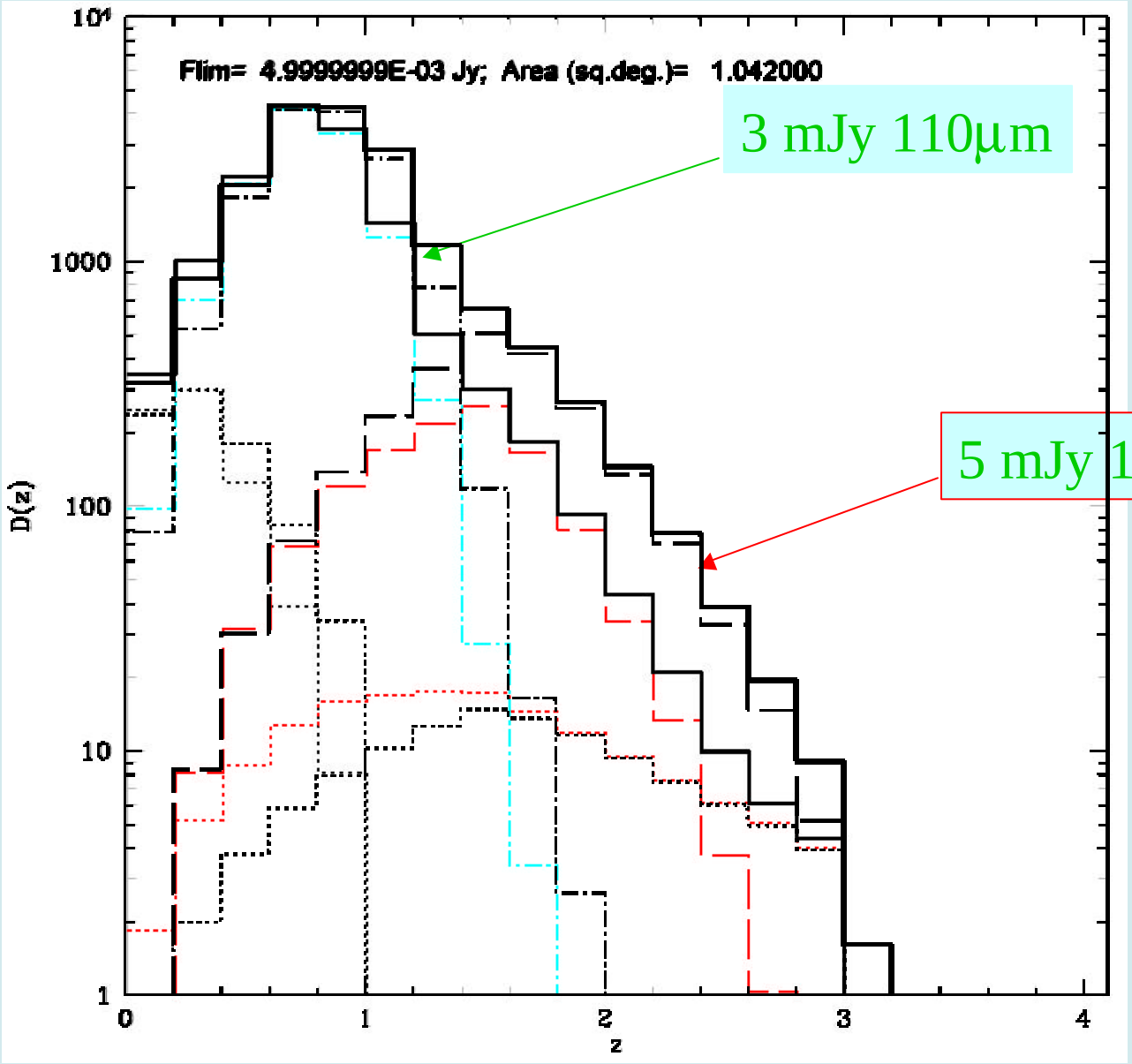
Name	PACS Time	SPIRE Time	Total Time	70	110	170	250	350	500
-	hr	hr		mJy	mJy	mJy	mJy	mJy	mJy
H-COSMOS-1	500	150	575	**6.0**	3.3	3.5	8.0	9.7	11.



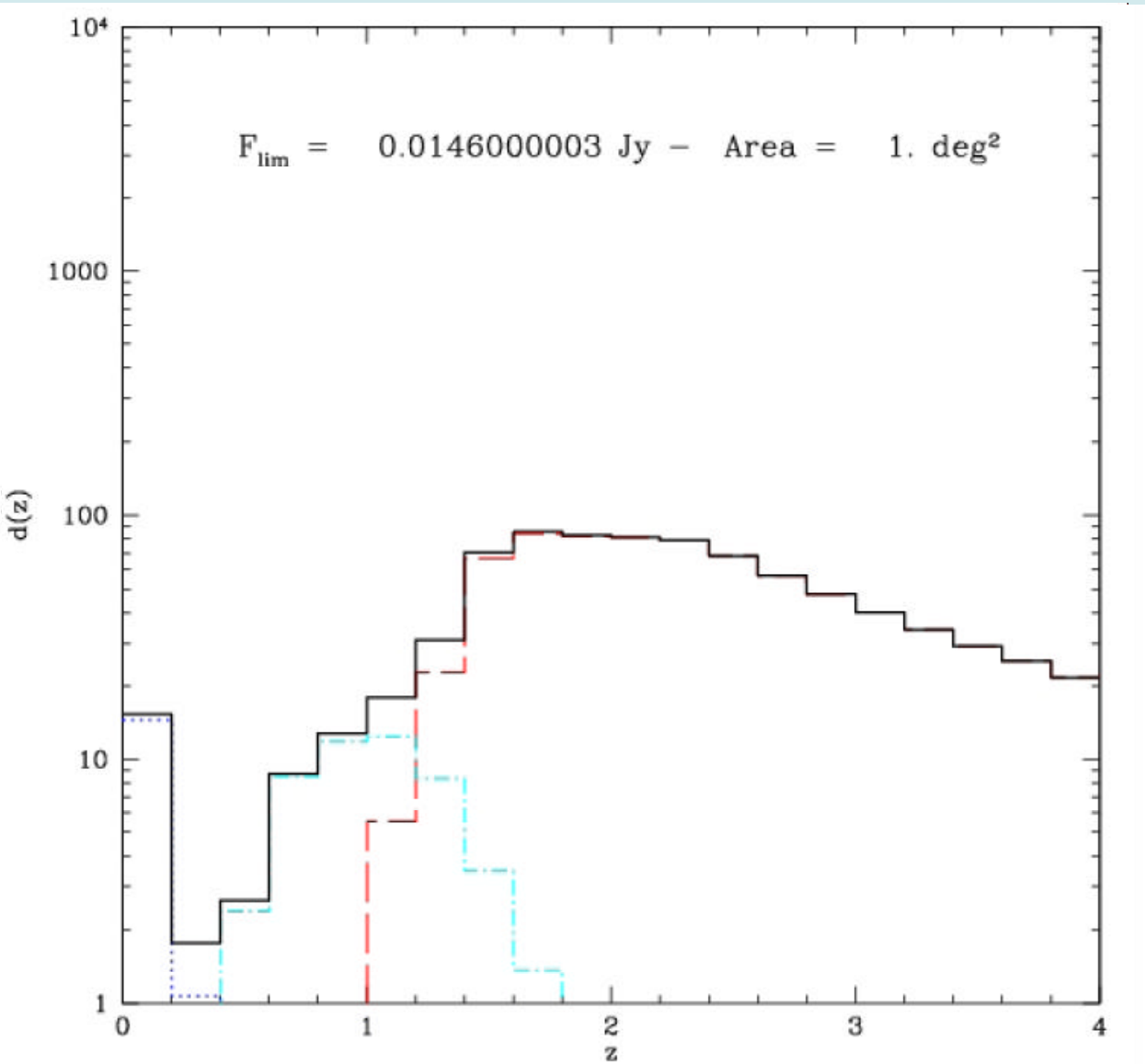
H-COSMOS-1: 500 all PACS 110 μm
H-COSMOS-2: 500 all PACS 70 μm
H-COSMOS-3: 500 PACS 70 + 500 PACS 110 μm
H-COSMOS-4: 1000 all PACS 70 μm

Time - PACS SPIRE H-COSMOS (Spitzer Depths)

Predicted z-distributions for flux-limited samples



z-distributions for SPIRE observations



500 micron - in - out - jpg - eps - pdf

Galaxy clusters

What for ?

- use as lenses to find high-z sources (GT)
- Sunyaev-Zeldovich effect
- cluster dust (in the ICM)
- cluster galaxies
- infalling galaxies
- merging clusters

Eelco van Kampen

Galaxy clusters

Michael Balogh

Large sample of matched clusters at z~0.5 and z~1 (or higher ?)

Main science goal: evolution of dusty star formation in dense environments

Two issues: - cluster selection

Mass selection would be ideal (RCS sample ?)

X-ray selection ?

- number density

- The present aim is to survey 30 clusters, ten each at z=0.4, 0.8 and 1.2 with the aim of investigating the cosmic evolution of infall/star formation in rich environments.
- This programme would complement the GT cluster programme, which is aimed at lensing.
- The cluster sample should be selected to have the highest masses. Ideally this would be done using the new SZ surveys, but in practice it would probably have to be done using a mixture of optical samples (EDISCs/RCS) and X-ray surveys (XMM serendiptiy survey).
- This working group may propose a Spitzer programme in February aimed at obtaining 24-micron observations of a preliminary sample.

A Herschel Survey of High z AGN

Dave Clements Imperial College
Kate Isaak Cardiff University
Bernhard Schulz IPAC
Alain Omont IAP
Et al…

How to study the Universe

- Two ways to examine the distant universe
  - Blind surveys
  - Targeted pointings at known high z objects
- Pros and cons
  - Targeted surveys are potentially biased
    - Need to control bias, and understand relationship of the objects targeted to the broader population
  - Blind surveys have substantial problems for followup
    - May know there's something there, but redshift, nature, connection to broader population can be difficult to assess

What can we learn from AGN?

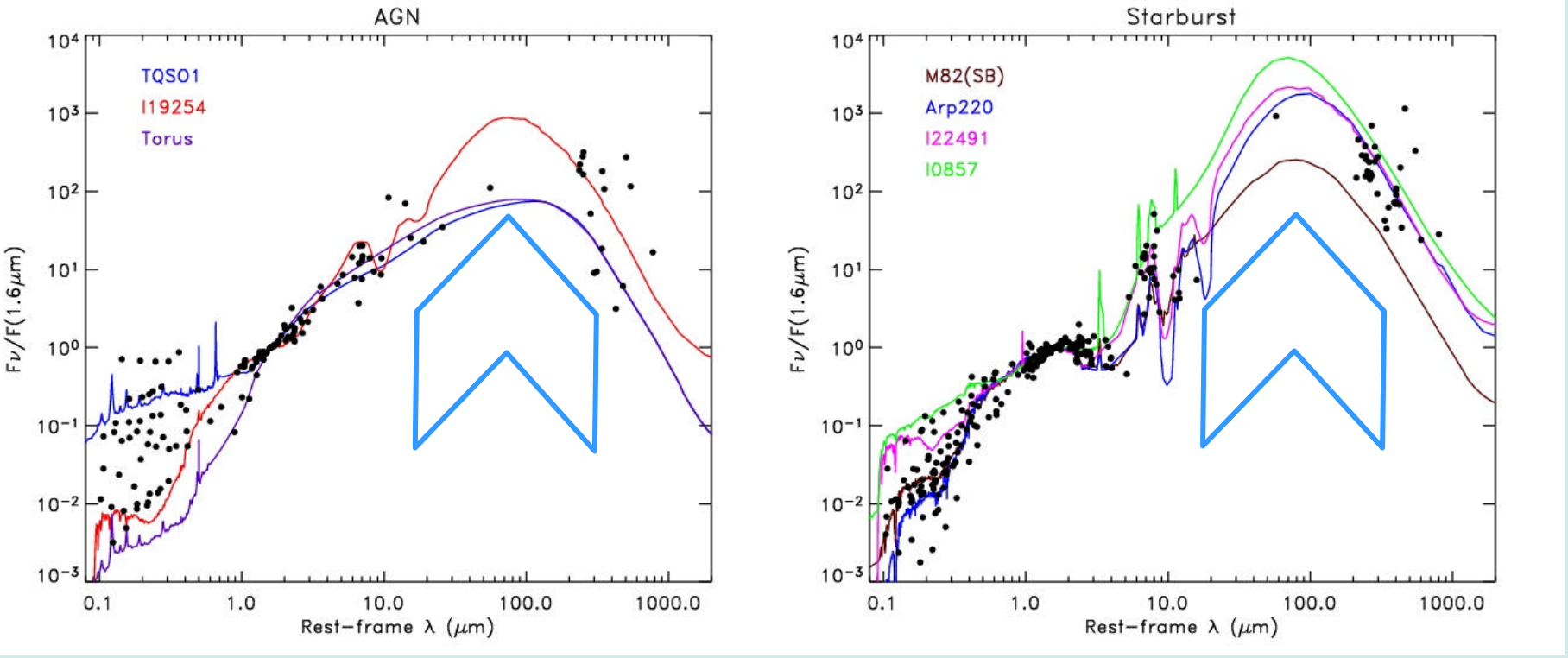
- Studies of individual objects
  - SEDs, individual content and history, role of star formation…
- Studies of well-defined samples over large redshft range
  - Population statistics and evolution
  - Connection to other populations
- Studies of local environments
  - Clustering, size of DM clumps, broader role in evolution
- NB Even the largest 'large area survey' will be too small to include enough AGN to say anything about their population and evolution

Why Herschel?

- Submm studies to date have been successful, and shown that dust plays a significant role in AGN
- BUT cannot determine bolometric luminosity, dust temperatre, mass, properties, role of hot AGN-heated dust
- Need shorter wavelength Herschel channels to do this
  - Cannot be done from ground

An obvious scientific case for cosmological surveys with Herschel

- Exploring a new territory for cosmology
- Observations needed to **measure** bolometric luminosities of cosmic sources at high-z
- Essential for determining SFR's, BH accretion rates, etc.
- To identify the most active "cosmic sites" at any redshifts



(Rowan-Robinson et al. 2005; Polletta et al. 2006)

Science Goals

- Star formation & dust content as a function of z in AGN
  - Need range of redshifts
- Star formation & Dust as function of AGN type
  - Need range of types, luminosities etc.
- Triggered star formation and environment
- Need large enough samples to be statistically valid

Sensitivities Needed

- 10-20mJy sensitivity in PACS and SPIRE bands will be fine
  - Ultimate sensitivity set by confusion limit
  - Individual integration times quite short (10-15 mins)
- Map ~4'x4' region (SPIRE jiggle map) for imaging targets to similar snesitivity
- 127 hours total needed

The Proposal

- Obtain PACS/SPIRE photometry for a consistent sample of AGN
  - Probe range of redshifts, (2, 4, >5) to examine evolution
  - Probe range of luminosity
  - Range of quasar type (optically selected, BAL, x-ray selected)
  - 25 in each class (175 for photmetric part)
- Image 9 in each class for environment study (63 total)

Proto-Proposal:
A HIFI Open-Time Key Programme on Nearby Galaxies

C. Kramer, KOSMA, Universität zu Köln
with
R. Güsten, F. Israel, S. Lord, P. van der Werf,
et al.

complementary to HIFI Guaranteed Time Key Program on
Physical and Chemical Conditions of the ISM in Galactic Nuclei
by R.Güsten et al.

Herschel-HIFI:
Heterodyne Instrument for Far-Infrared Spectroscopy

480 – 1920 GHz (625 – 158 micron)

- At 480 GHz the beam is 42"; at 1910 GHz 13"
- T_{sys}(SSB) = 200-500K (480-1250 GHz);
- T_{sys}(SSB) = 1600K in Band 6
- Bandwidth is up to 4 GHz;
- Resolution of 135-270-539-1100 kHz

[CII] @ 1.9 THz
[NII] @ 1.4 THz
[CI] @ 0.49 THz, 0.81 Thz
13CII, 13CI
CO @ 5-4, 6-5, ..., 15-14, ...
H_2O
OH
...

PACS: [OI], [OIII], [NII], ...
Competition with PACS in
HIFI band 6: 1.5-1.9 THz

Coordination also with
SPIRE

HIFI allows to obtain the full velocity information which is crucial to understanding the physics

The Interplay of Star Formation and the ISM in Galaxies

Properties and history of the various components of galaxies:

- Circum-nuclear regions (AGN, starburst, ...)
- Spiral arms (Inner- & Outer regions, Z)
- Bars
- Tidal bridges/tails
- Inter-arm regions/Spurs
- Halo (Z)

What are the physical properties of each component ?

- The ISM and its phases

- The gas energy balance

Regulating star-formation

The Interplay of Star Formation and the ISM in Galaxies

Properties and history of the various components of galaxies

What are the physical properties of each component ?

- The ISM and its phases

- The gas energy balance

Pending:

Coordination with PACS-OT teams,
SCUBA2/HARP-B legacy programs,
SINGS-Team, etc.

Low Level Cold Dust Emission

Jonathan Davies, Maarteen Baas and Steve Eales

Dust 'leaking' out of the disc of NGC891 (Howk and Savage 1997). Radiation pressure driven dust loss is discussed in Davies et al. 1998.

It is not difficult to believe that dust may reside at large distances from the disc.

Understanding the total dust content and spatial distribution of dust is an essential part of many models:

1. Dust may act as a tracer of a much more substantial cold molecular component, that could help explain the missing mass problem (Valentijn, 1990, Valentijn and van der Werf, 1999, Lequeux et al. 1993, Gerhard and Silk 1996).
2. Influence on the many determinations of the star formation history of the Universe (Madau et al., 1996).
3. May even affect our view of the distant Universe.

The Observations

For SPIRE position the 4'x8' detector with the longer side along the major axis from the centre outwards in both directions giving 28 resolution elements across the galaxy even at the longest wavelength.

This will correspond to about twice the optical radius. From our ISO observations we need to reach about 10 mJ per beam which at 3 sigma should take about 1 hour.

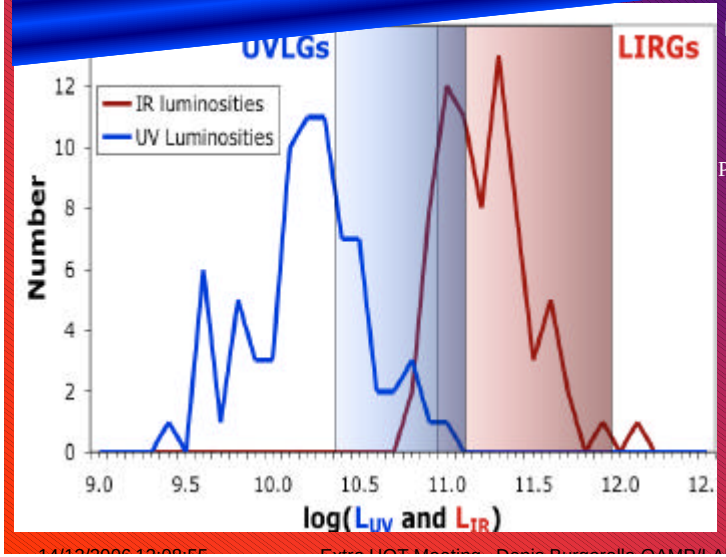
Thus we require about 34 hours on source with SPIRE. We suspect that a similar amount of time will be required with PACS.

When UV meets IR

- UV & IR are two facets of Star Formation
- Cosmologically speaking, looking at the IR side is better that looking at the UV side (Fig 1).
- However, to understand galaxies and their Star Formation History, it is better to also possess the UV side.
- Furthermore, the amount of information harvested from the rest-frame UV side has always been larger (e.g. deeper spectroscopy, higher angular resolution: Fig 2).
- Finally, it is possible that most high redshift objects have a UV side and an IR side (e.g. the same are seen on both sides and UV luminous Galaxies are also Luminous IR Galaxies: Fig 3)

Denis Burgarella

Part of UVLGs (LBGs) are LIRGs



Burgarella et al. (2005, A&A submitted) & preliminary report @ astro-ph/0509388

Part of the LBGs at z ≈ 1 detected with SPITZER (24 µm so far) are LIRGs (from 24 µm)

Fig 3

back

Proto - Proposal (or Section of)

Higher level science objective: better understand the formation and the evolution of galaxies by a multi-wavelength approach:

- **Study the Star Formation rate of two samples selected in rest-frame Ultraviolet (GALEX, 10-m class telescopes, HST) and in rest-frame Infrared (Herschel) and sum them up to get the total Star Formation.**
- **Make use of additional information in the optical to build UV-to-FIR Spectral Energy Distributions (SEDs) and, by a comparison with models/templates, determine their Star Formation History.**
- **Make us of 10-m classe telescopes and HST to estimate their morphology / dynamics / abundances**

Targets: Deep imaging of already observed fields (usual ones such as CDFS, ELAIS, etc.) to detect individual galaxies up to the highest redshifts

Wavelength Regime: rest-frame IR (dust emission)

Open Time Programmes

1. **PACS/SPIRE Deep Survey of the COSMOS / CDFS / ELAIS S1 Field(s)**
   - **Deepen the PACS/SPIRE surveys to the confusion limit**
   - **Comprehensive investigation of galaxy evolution at z < 1.5**
   - **Coordinator: E. Bell, MPIA**

2. **SPIRE (+ PACS ?) Survey of SCUBA-2/LABOCA Legacy Survey Fields**
   - **Complement the GT confusion-limited SPIRE survey**
   - **Comprehensive investigation of star-formation/AGN activity as a function of environment and redshift**
   - **Coordinator: E. Bell, MPIA**

3. **Large-Area Shallow Survey**
   - **Few x 100 sq. deg. to ~ 100 mJy 5s**
   - **Strongly lensed sources (halo mass function, dark energy)**
   - **High-z clustering**
   - **Rare objects**
   - **Planck foregrounds**
   - **Coordinator: G. de Zotti, Padova**

Open Time Programmes

4. **High-redshift AGNs**
   - **Sample of AGN over a wide range of luminosity in a narrow redshift slice at z = 1**
   - **Coordinator: M. Jarvis, Oxford**

5. **High-Mass Cluster Survey**
   - **Survey 30 high-mass clusters; z = 0.4 - 1.2**
   - **Evolution of infall/star formation in rich environments.**
   - **Coordinator: E. Van Kampen, Innsbruck**

6. **Herschel Survey of Local-Universe Activity (HERLOGA)**
   - **AGNs vs. Starbursts as tracers for high-z FIR galaxy formation and evolution**
   - **ULIRG power sources**

   Coordinator: L. Spinoglio, INAF-IFSI, Roma

Open Time Programmes

8. **Follow-up of Astro-F/SCUBA-2 Sources**
   - **Coordinator: S. Serjeant, Kent**
9. **SPIRE/FTS Surveys of the high-z Universe**
   - **Coordinator: D. Rigopoulou, Oxford**
10. **Extended dust around nearby galaxies and intracluster dust**
   - **Coordinator: J. Davies, Cardiff**
11. **Dust in Ellipticals**
   - **Coordinator: M. Stickel, MPIA**
12. **HIFI Programme on Nearby Galaxies**
   - **Coordinator: C. Kramer, Cologne**

Next EXTRA-HOT meeting in connection with the February 20-21 ESTEC Meeting on the Herschel OT Key Programs

Extra-HOT main web page:

http://astronomy.sussex.ac.uk/~sjo/extrahot/

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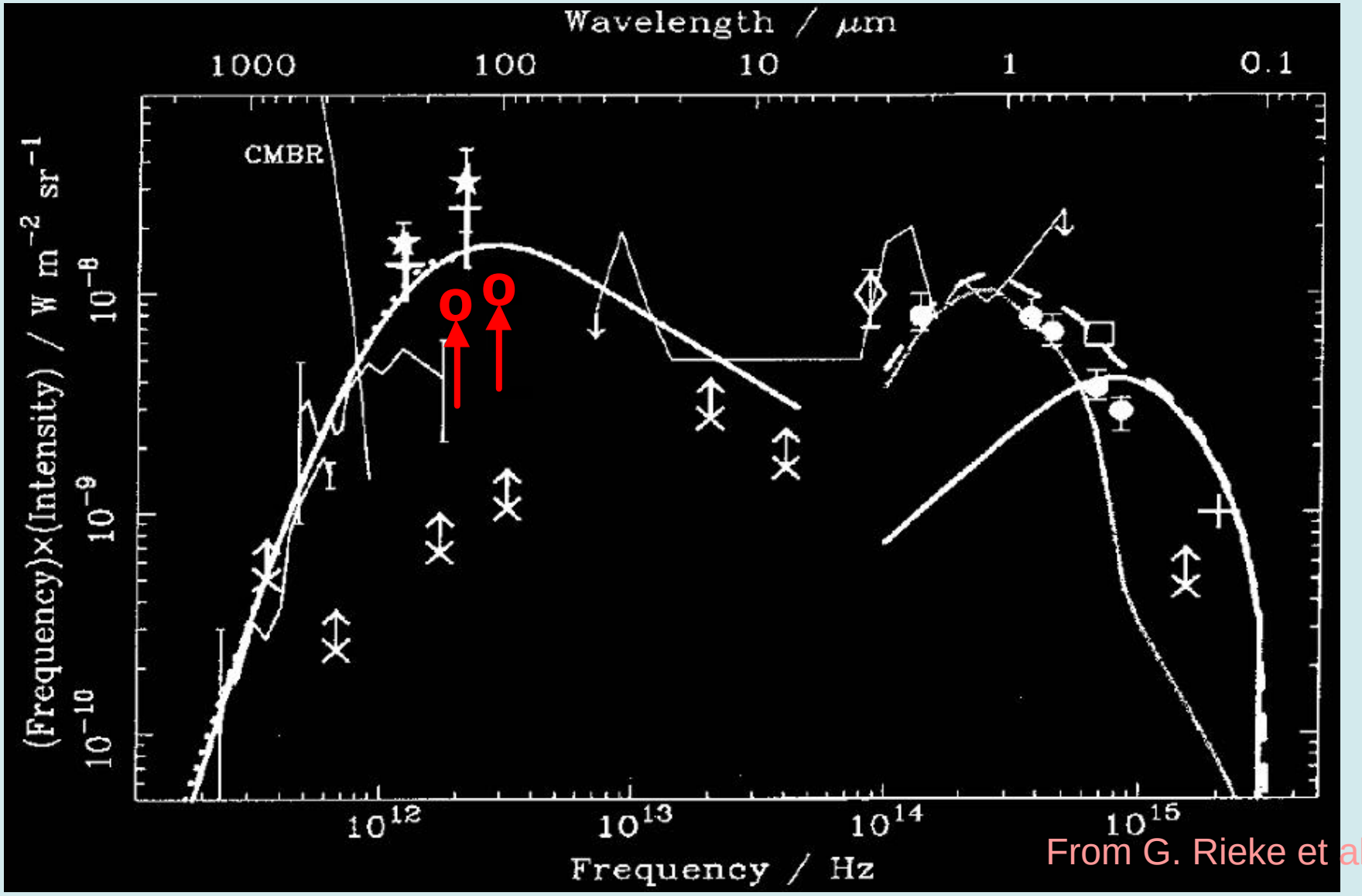

From G. Rieke et al.

Resolving the strongest extragalactic astrophysical background (60% to S_{170}=4 mJy, 70% to S_{110}=4 mJy)