A Spitzer-Selected Multi-Wavelength Wide-Area Data Fusion
The Spitzer & HerMES Local Luminosity Function

HERMES
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A) Summary

We present a multi-wavelength **FUV to FIR** catalog of Spitzer-selected sources **(Data Fusion)** over **~60 deg²** observed by the Herschel Multi-tiered Extragalactic Survey **(HerMES)** GT KP

We use this database to determine the **FIR/SMM Local Luminosity Function** based on **Spitzer & HerMES Data**, combining optical and NIR photometry with redshift estimates and **MIPS & SPIRE** observations to optimally identify Spitzer & Herschel sources

We compute the 24, 70, 160, 250, 350, 500 μm as well as the IR bolometric (8-1000 μm) local (0<z<0.4) luminosity function and thus derive important local benchmarks for models of the formation and evolution of infrared galaxies

The Data Fusion and Spitzer/Herschel wide-area observations will soon be enriched by the **VISTA/VIDEO and VST/VOICE datasets** and will thus allow us to investigate infrared galaxies at all redshifts as well as develop concerted plans for their **multi-wavelength follow-up**

B) A Spitzer-Selected Multi-Wavelength Catalog (Data Fusion)

✓ Spitzer has provided almost-optical quality IRAC images complemented by sensitive MIPS observations al longer wavelengths over a number of wide-area extragalactic blank fields

✓ The wealth of **FUV to FIR data** obtained over the years in various fields is often difficult to assemble and merge into a **multi-wavelength catalog with a well-defined selection function**

✓ The Data Fusion is based on **Spitzer public catalogs as well as in-house re-reductions**
 ✓ IRAC and MIPS 7-band catalogs available in all fields matched using SSC's bandmerge
 ✓ **IRAC-1or2 main selection** (3.6 micron or 4.5 micron detection) to ensure reliability

✓ Non-Spitzer catalogs are matched against IRAC-1or2 positions (using nearest-neighbor)
 ✓ **GALEX** NUV & FUV available in all fields
 ✓ **SDSS** ugriz optical available in northern fields (Astro/Photo Calibration)
 ✓ Miscellaneous ugriz **deep optical imaging** available over large portions of all fields
  ✓ SWIRE Phot Follow-Up, INTWFS, NDWFS, CFHTLS etc
 ✓ **2MASS** J,H,Ks shallow NIR imaging available in all fields (Astro Calibration)
 ✓ **UKIDSS** J,K medium-deep NIR imaging available in parts of XMM/LH/EN1
 ✓ **VISTA/VIDEO** will cover ~12 deg² within ES1/XMM/CDFS in ZYJHK
 ✓ **VST/VOICE** will cover ~8 deg² within ES1/CDFS in ugri (m$_{AB}$~26)
 ✓ **Spec-Z** available from SDSS & NED & Recent Literature & SWIRE Spec Follow-Up
 ✓ **Phot-Z** available in SWIRE fields from Rowan-Robinson et al. 2012

✓ A similar approach is being applied to produce a **SERVS IRAC-1or2-selected data fusion** over the ~18 deg² covered by SERVS Spitzer-Warm observations (portions of ES1/XMM/CDFS/LH/EN1), incorporating ongoing Phot & Spec Follow-Up, VISTA/VIDEO & VST/VOICE

# of Sources	IRAC 3.6/4.5	MIPS 24	MIPS 70	MIPS 160	GALEX NUV/FUV	SDSS ugriz	Optical ugriz	2MASS J/H/K	UKIDSS J/K	Area deg²
ES1	390231	61236	2246	961	85039	NA	146537	10904	NA	~7.0
XMM	498027	69629	3823	1702	104344	NA	327024	14794	151565	~8.5
CDFS	462638	97002	4096	1813	101705	NA	177745	12952	NA	~7.5
LH	660682	110516	5548	2417	158981	217005	432490	17139	226838	~11.0
EN1	575524	102406	4652	2133	116180	210571	363949	21210	334955	~9.5
EN2	272412	59378	2331	970	63774	103460	173880	11443	NA	~4.5
Bootes	677522	41969	4325	2825	159218	228757	592136	7007	NA	~8.5
XFLS	107720	16712	2252	322	29208	62437	82576	11682	NA	~4.5

Total # 3,644,756   **Total Area ~ 60 deg²**   **NA = Not Available**

✓ The Data Fusion is a powerful resource to fully sample the **SEDs of infrared sources** and push **Herschel source extraction techniques** in confused SPIRE maps to their limits using e.g. the correspondence between SPIRE 250 μm and MIPS 24 μm (Roseboom et al. 2010)

✓ Combined with **Herschel source extraction techniques** exploiting e.g. the correspondence between SPIRE 250 μm and MIPS 24 μm (Roseboom et al. 2010), the Data Fusion allows us to **fully sample the FUV to SMM SEDs of Herschel sources well below the confusion limit**

✓ **Optical/NIR broad-band color criteria effectively selecting high-redshift galaxy candidates**, Spitzer & Herschel wide-area observations and SED template fitting techniques will enable a detailed **characterization of SMM-bright targets over Southern and Equatorial ALMA fields**

E) Conclusions and Future Work

✓ We produce a Spitzer-Selected Wide-Area Multi-Wavelength (FUV to FIR, including redshift information) Catalog covering Spitzer and Herschel extragalactic survey fields
✓ We provide **useful local (0<z<0.4) benchmarks for FIR/SMM galaxy formation and evolution studies** in the form of MIPS and SPIRE Local Luminosity Function Estimates
✓ The completion of the Herschel mission will yield larger samples and improved SED templates, providing **better IR bolometric luminosity estimates and stronger constraints on models** for galaxy evolution and dust emission from the local to the distant Universe
✓ The Data Fusion and Spitzer/Herschel wide-area observations will allow us to identify and **characterize SMM-bright targets up to high redshifts suitable for ALMA follow-up** and will be expanded using VISTA/VIDEO & VST/VOICE datasets in ideal fields for E-ELT follow-up

C) Data Fusion Properties & Applications

HerMES Fields

MIPS 24 μm FLux Limits

AGN Selection

AGN Selection
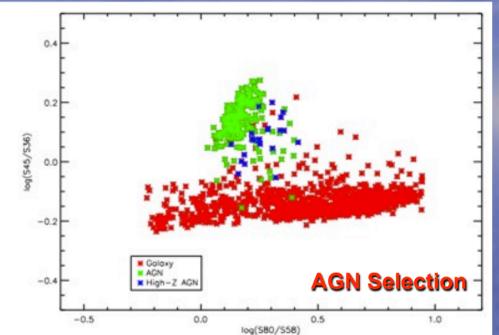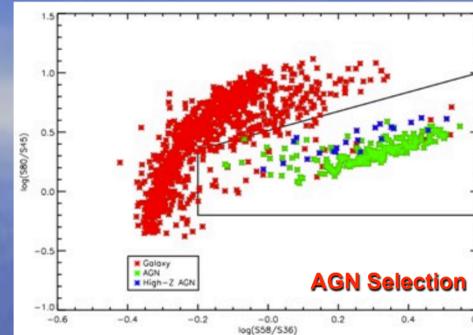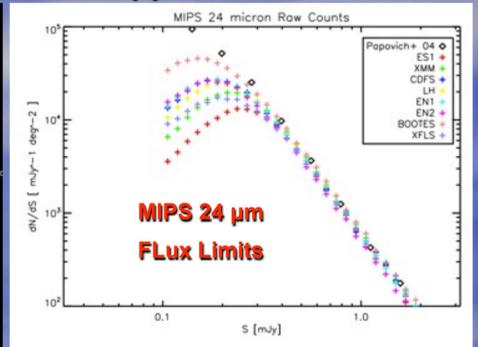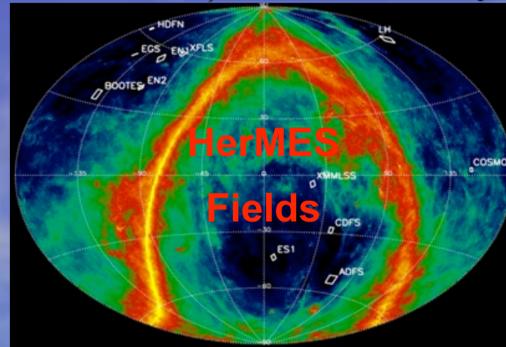
D) MIPS & SPIRE Monochromatic & IR Bolometric LLF

✓ We evaluate the Monochromatic & IR Bolometric LLFs using the 1/V$_{max}$ estimator

✓ We compare our estimates with models and measurements from recent literature

✓ (Poisson) errors are estimated in each field and a weighted mean is then computed

MIPS 70 μm (LH Only)

MIPS 160 μm (LH Only)

COSMOS DATA FUSION

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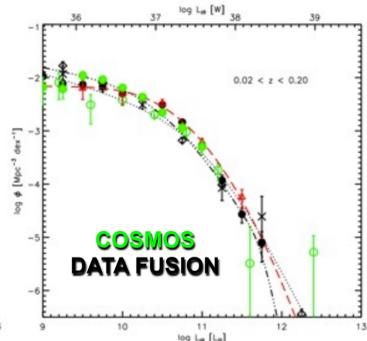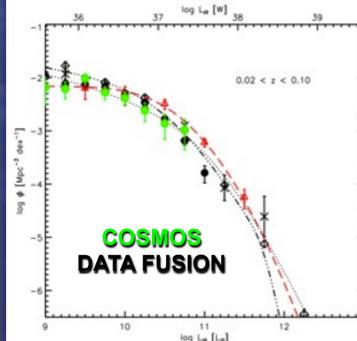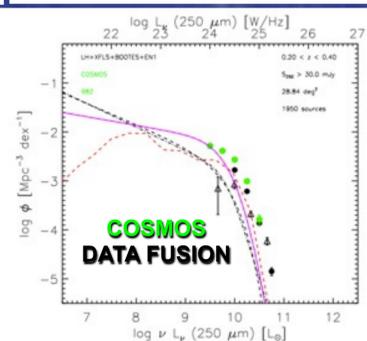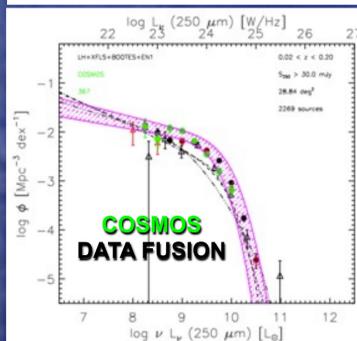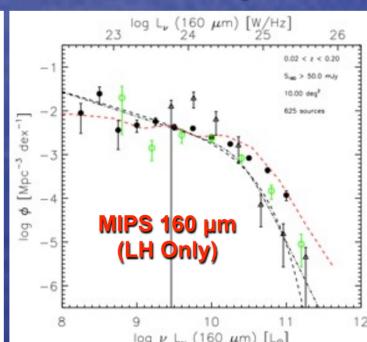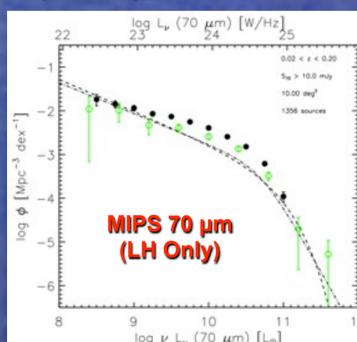
✓ **MIPS-70/160 LLFs**
 ✓ Empty Symbols : Previous Work
 ✓ Filled Symbols : This Work
 ✓ Lines : Various Models for z~0 LFs

✓ **SPIRE-250 LLFs**
 ✓ Empty Symbols : Previous Work
 ✓ Filled Symbols : This Work
 ✓ Magenta Band : MCMC Solution
 ✓ Lines : Various Models for z~0 LFs

✓ **SPIRE-IR-BOL (8-1000 μm) LLFs**
 ✓ Empty Symbols : Previous Work
 ✓ Filled Symbols : This Work
 ✓ Lines : Various Models for z~0 LFs

✓ Combining deep fields such as COSMOS with several Data Fusion shallow fields we can more reliably **probe the FIR/SMM Luminosity Function at both the faint and bright end**

✓ VISTA/VIDEO & VST/VOICE will soon greatly expand from 2 to 15 deg2 the overall size of **Spitzer/Herschel extragalactic survey fields where deep Optical & NIR imaging is available**

✓ This will enable much-improved studies of IR LFs (as well as stellar mass functions and star formation rate functionss) in **fields accessible to ALMA and E-ELT for follow-up**