The 3rd JCMT Large Program

11/Feb/2020
Presented by Aran Lyo

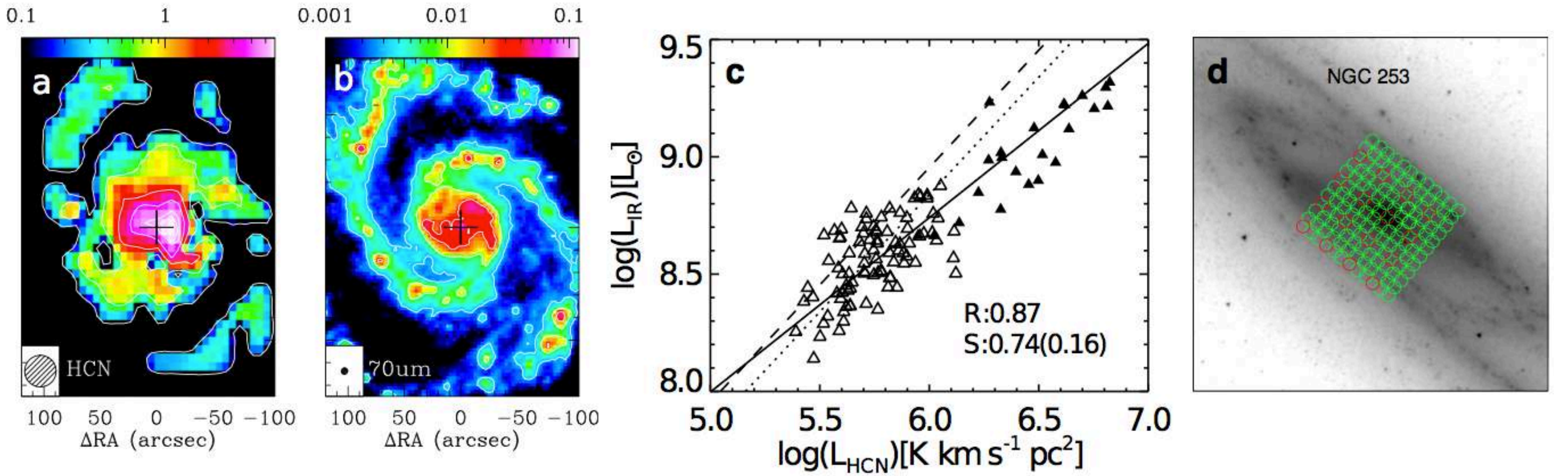
- Observational period : Feb/2020 ~ Jan/2023
- Allocated time : 4,800 hrs
- Accepted proposals: 13

Open Enrollment to programs approved for time during the 20A Call for Large Programs is open now and will close March 13th 2020
(https://www.surveygizmo.com/s3/5363747/JCMT-20A-Large-Program-Open-Enrollment)

6. Mapping the Dense Molecular Gas in the Strongest Star-forming Galaxies (MALATANG)

(PI: Yu Gao, Purple Mountain Observatory/China)

- **Aim**: to expand our MALATANG program to construct the largest and deepest HCN(4-3) and HCO^+(4-3) maps in a complete infrared (IR) flux-limited sample of 23 brightest IR galaxies plus 5 additional IR-bright galaxies in the EMPIRE survey (IRAM30m HCN(1-0) and HCO^+(1-0).

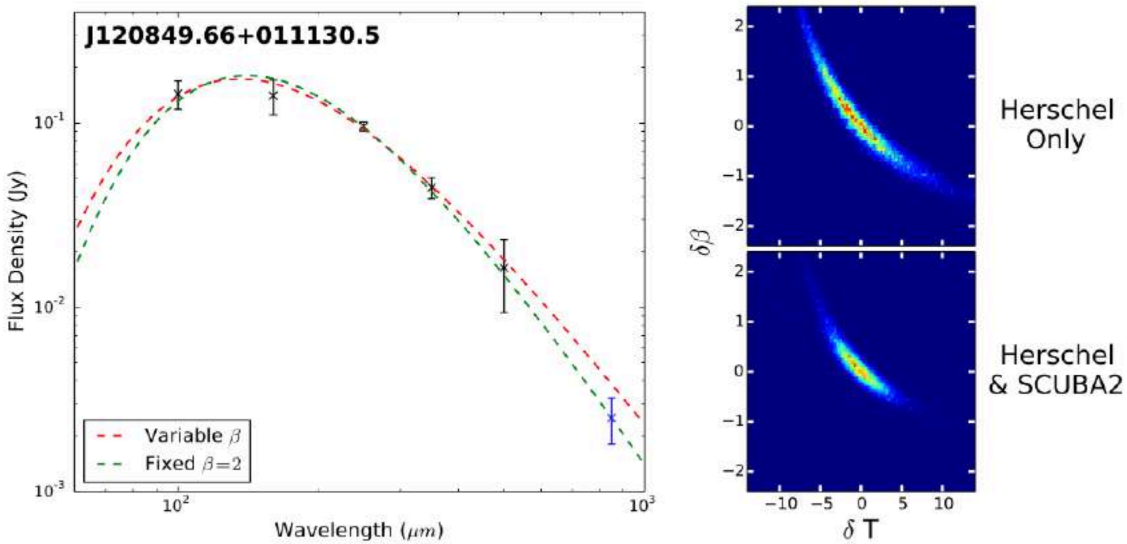


(a) Moment 0 map of the HCN J= 1 – 0 emission towards M 51. (b) Herschel/PACS 70 µm image tracing the IR dust continuum. (c) The resolved L_{IR} – $L'_{HCNJ=1-0}$relation observed towards M 51, with each symbol representing a region ~1 kpc in size. The solid and dashed lines show the best log-linear fits to the nuclear (filled triangles) and disk (open triangles) regions combined and to the disk regions only, respectively. The combined correlation is seen to be shallower than the galaxy-integrated linear relation observed by Gao & Solomon (2004) (illustrated by the dashed line). (d) Schematic of a HARP-B jiggle mode observations of a MALATANG target (NGC 253)

7. JINGLE at the edge: the ISM of starbursts and green valley galaxies

(PI : Chris Wilson, Canada)

- **Aim:** to systematically study the cold ISM of galaxies in the local Universe; gas and dust mass measurements of 200 local galaxies which predominantly reside on the main sequence of star-forming galaxies (previously) → to extend 69 starburst and green valley galaxies



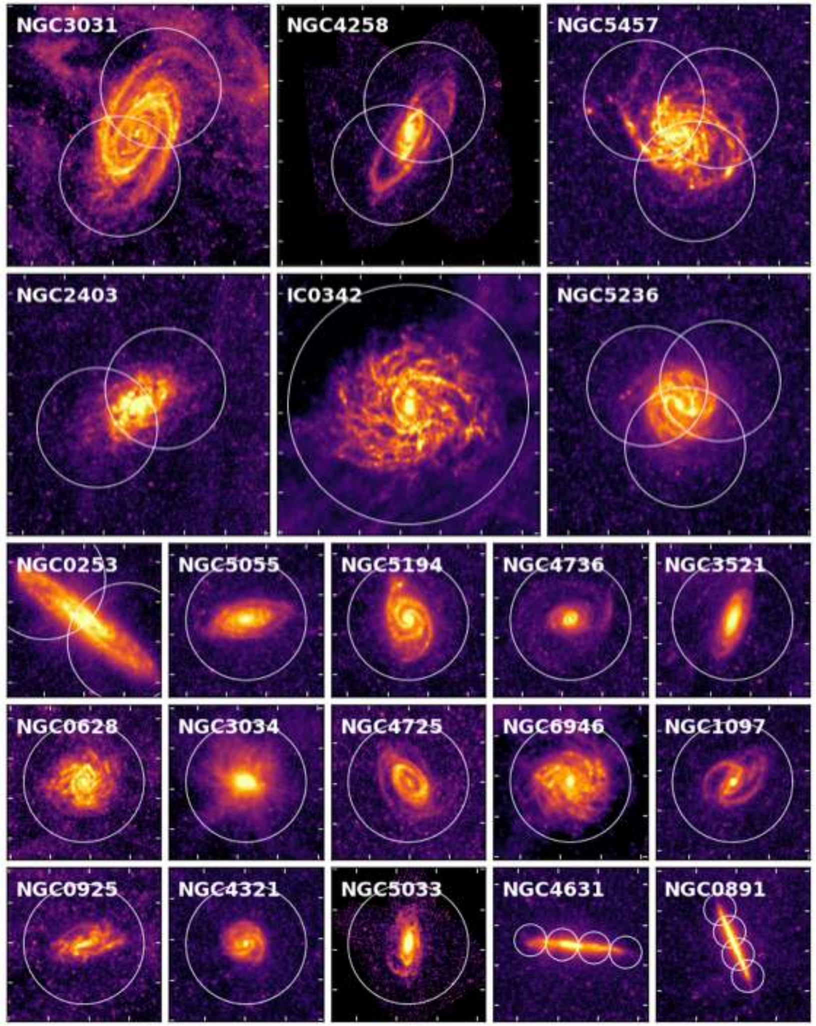
H-ATLAS photometry of J120849.66+011130.5 (black points), with modified- blackbody models with different β overlaid: β = 1.5 (red dashed line) and β = 2.0 (green dashed line). Clearly, the Herschel data alone cannot distinguish between the two scenarios, but the addition of a data point at 850μm does (e.g. the blue data point is a predicted 850μm SCUBA-2 flux for β = 2). Right: Surface density plots showing the uncertainties in both β and T_{dust} for Monte-Carlo simulations of Herschel data only (top) and Herschel+SCUBA-2 data (bottom). *The uncertainties on β and T_{dust} are drastically reduced with the addition of the SCUBA-2 850μm datum*

8. DOWSING: Dust Observations With Scuba-2 In Nearby Galaxies (PI: Matthew Smith)

- Aim: to investigate dust, the ISM and star formation across a wide range of environments both within and between galaxies

→ With a resolution of approximately 100-250 parsecs, we will be able to study our sample with five times better resolution than studies based on just *Herschel* data

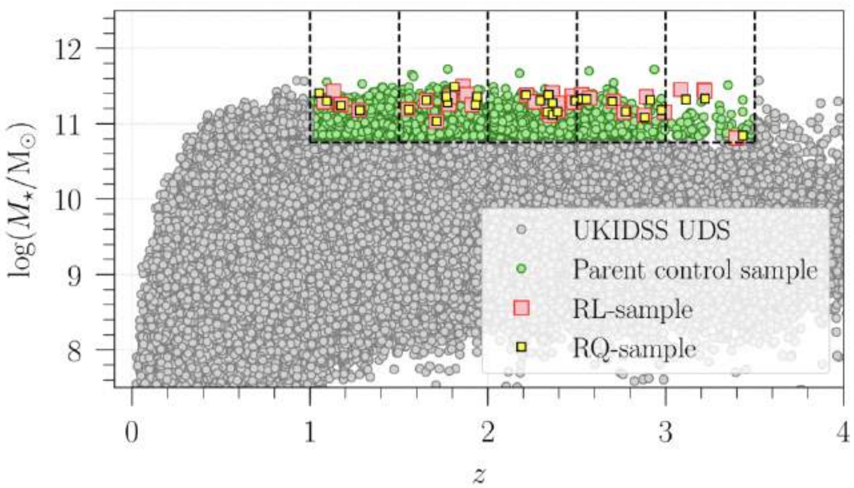
- Targets: nearby 21 galaxies that have large angular sizes on the sky at 450 & 850um

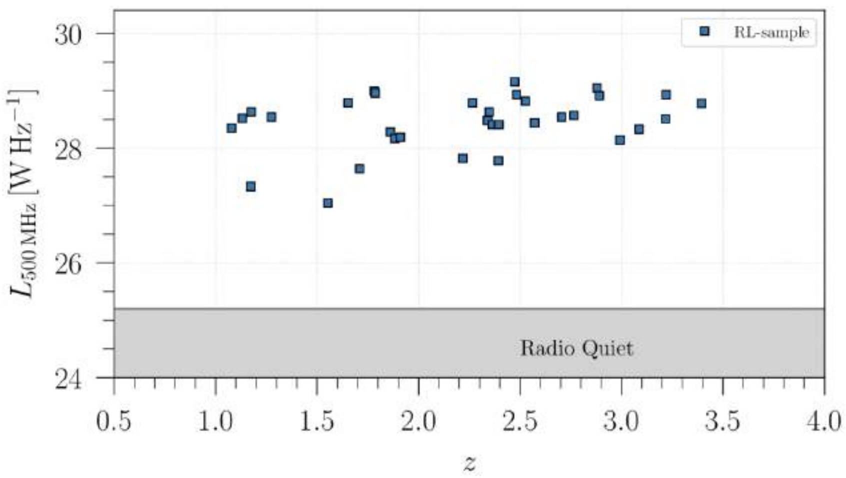


The Herschel-SPIRE 250µm images for the sample of 21 galaxies in the DOWSING proposal.

9. RAGERS: The RAdio Galaxy Environment Reference Survey (PI: Thomas Greve, UK)

- **Aim:** to investigate the existence of systematic differences in the over-densities of dusty galaxies around radio-loud vs radio-quiet galaxies → AGN feedback ?
- **Method:** to map the over-densities of dusty galaxies within the Mpc-scale environments of a sample 33 powerful radio galaxies uniformly distributed across the redshift range $1 < z < 3.5$ and mass range $M_\star \geq 10^{10.7}\ M_\odot$





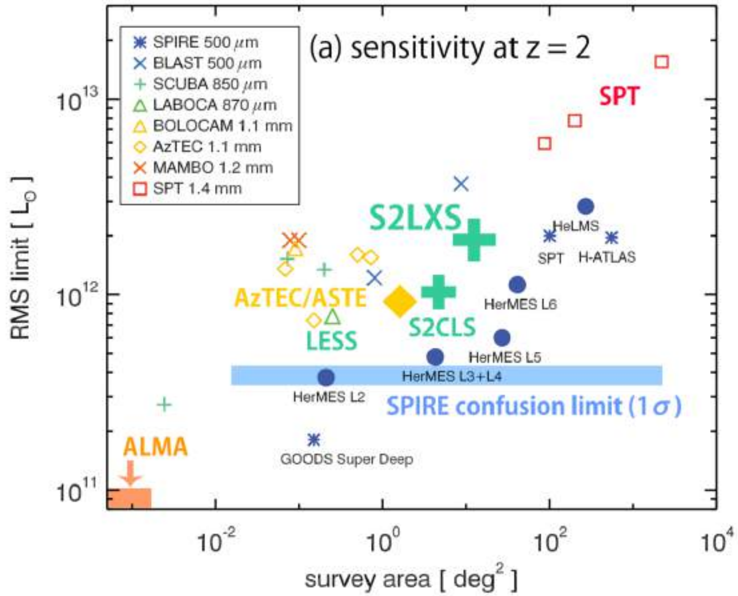
The M⋆ − z plane for the 33 RL-galaxies (large pink squares) and 33 RQ-galaxies (yellow squares) targeted by RAGERS.

10. NEPSC2: The SCUBA-2 850um Survey in the North Ecliptic Pole **(will be presented by Prof Shim)**

11. S2LXS: SCUBA-2 Large eXtragalactic Survey (PI: Jim Geach, UK)

- **Aim:** to reveal the cosmological evolution of dust enrichment, obscured star-formation, black hole growth and the link between environment and star formation out to the epoch of reionization ← directly detect 370 S_850>8 mJy point sources.

- **Method:** map 10 square degrees of extragalactic sky at 850µm to a depth of 2 mJy/beam, covering XMM-LSS & E-COSMOS



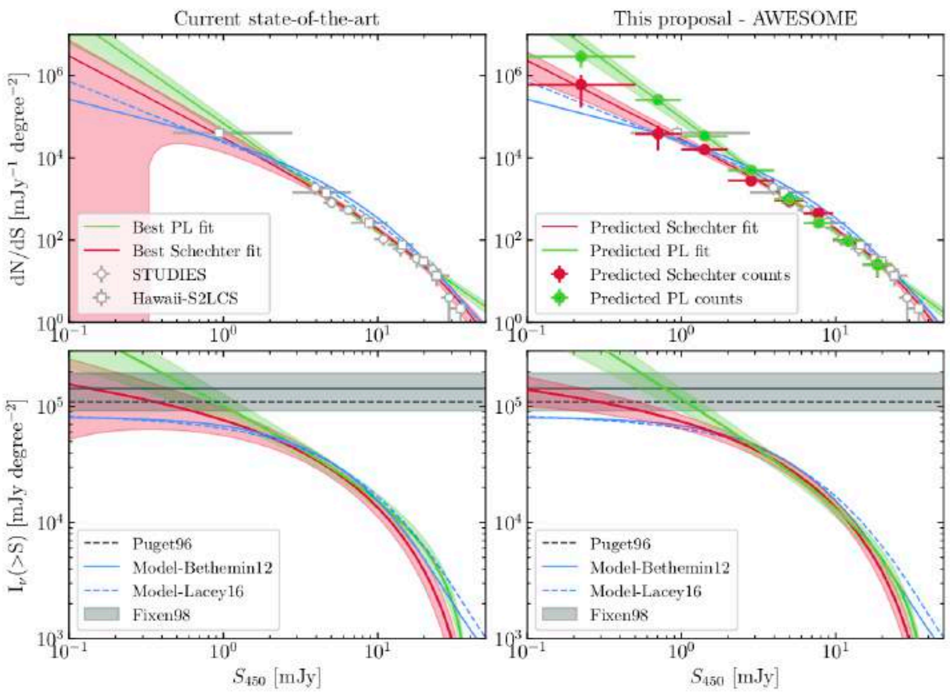
A comparison of survey depth and area for a range of submm/mm surveys, indicating how S2LXS fills a niche, detecting ULIRG-class galaxies at z~2 over 10 square degrees, directly complementing S2CLS.

12. AWESOME: A Well-Deep EAO Survey Observing Most Of The EBL

(PI: Chian-Chou Chen, ASIAA/Taiwan)

- ***Aim:*** *obtain new determination of CIB at 450 micron with a precision that is ~35% better than that measured by COBE*

- **Method:** to observe a sample of carefully selected massive lensing clusters, which will allow us to integrate the images down to a noise level of 0.8-0.9 mJy/beam at 450 micron. The ultimate objective is to construct number counts down to 0.1 mJy level so below the 450 micron confusion limit by roughly an order of magnitude, by exploiting the power of gravitational lensing.

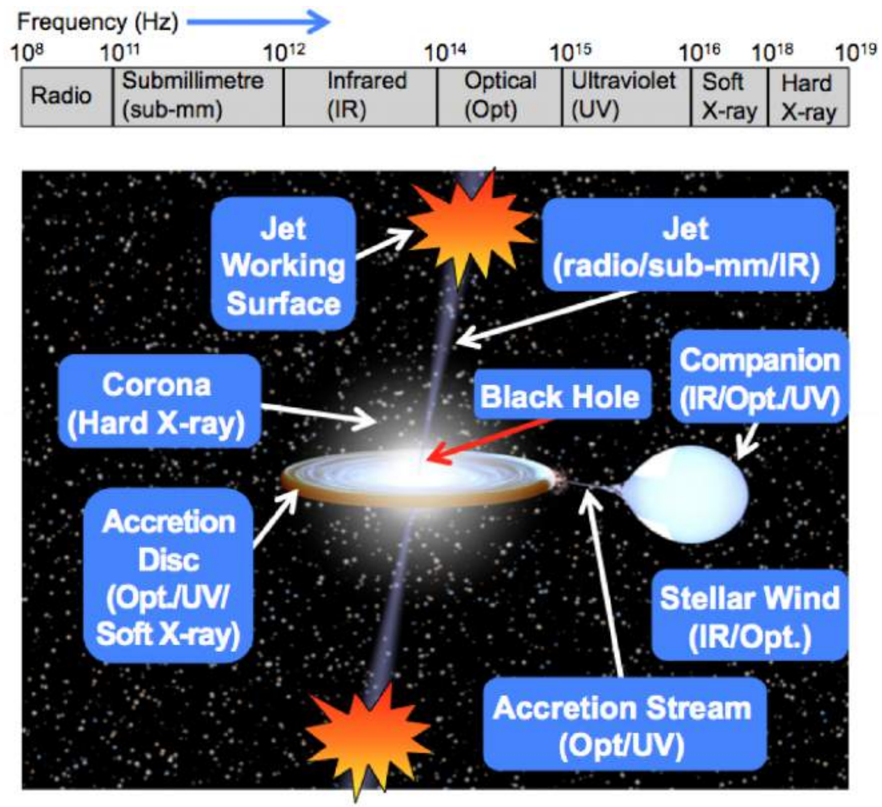


13. PITCH-BLACK – PolarIzation and Timing CHaracteristics in BLACK hole jets

(PI: Alex Tetarenko, EAO)

- **Aim:** to characterize jet properties and how they evolve.

→ Determining in what circumstances jets arise as a by-product of accretion, and quantifying how much power they inject into the surrounding medium, are problems of broad astrophysical importance (e.g., jet feedback can affect other astrophysical processes, such as star formation and galaxy evolution)

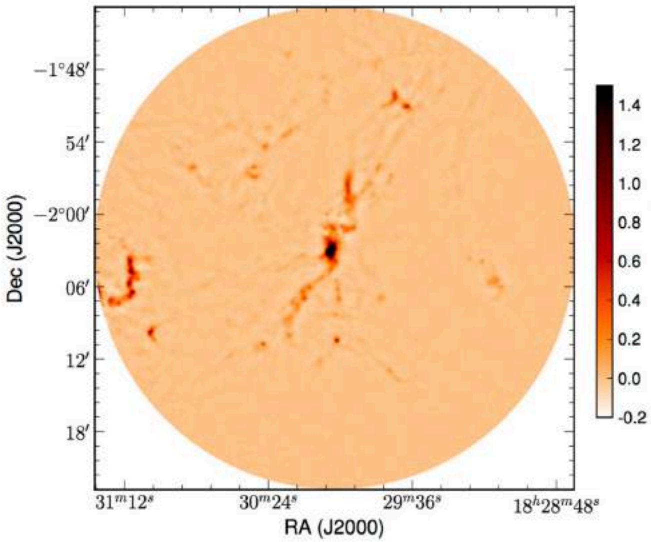


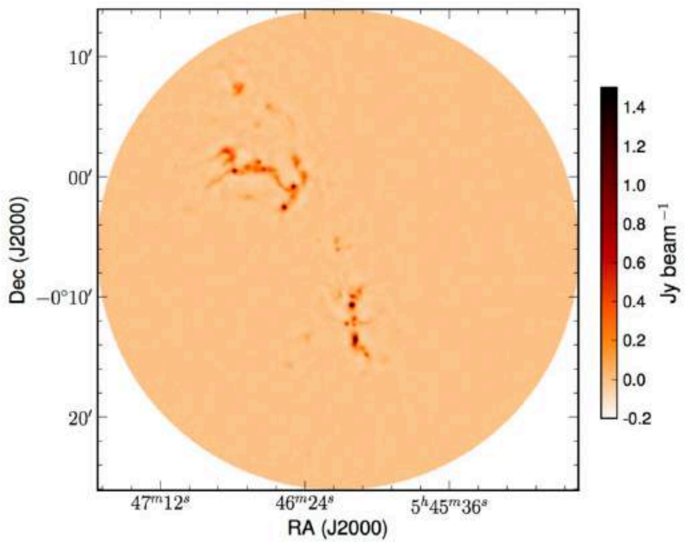
- **Method:** SCUBA-2/POL-2 observations of 6 outbursting BHXBs over the next 3 years.

1. A Transient search for variable protostars (PI: Gregory Herczeg, KIAA/China)

- **Aim: How do stars gain their mass ?**
- **Method:** long-term JCMT/SCUBA2 monitoring program of star forming regions
- 2.5% relative precision in flux calibration at 850 microns

- **Targets:** NGC 1333, IC 348, Orion A OMC2/3, NGC 2024, NGC 2068, Ophiucus, Serpens Main, Serpens South, **M17, DR 21a, DR 21b, DR 21c, M17sw, S255**

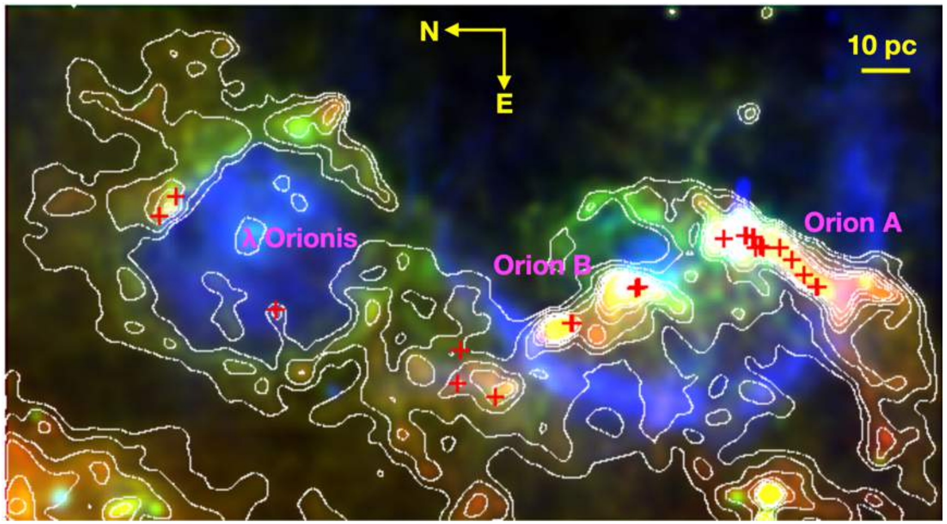




2. SPACE: Submilimeter Polarization and Astro-Chemistry in Earliest star formation

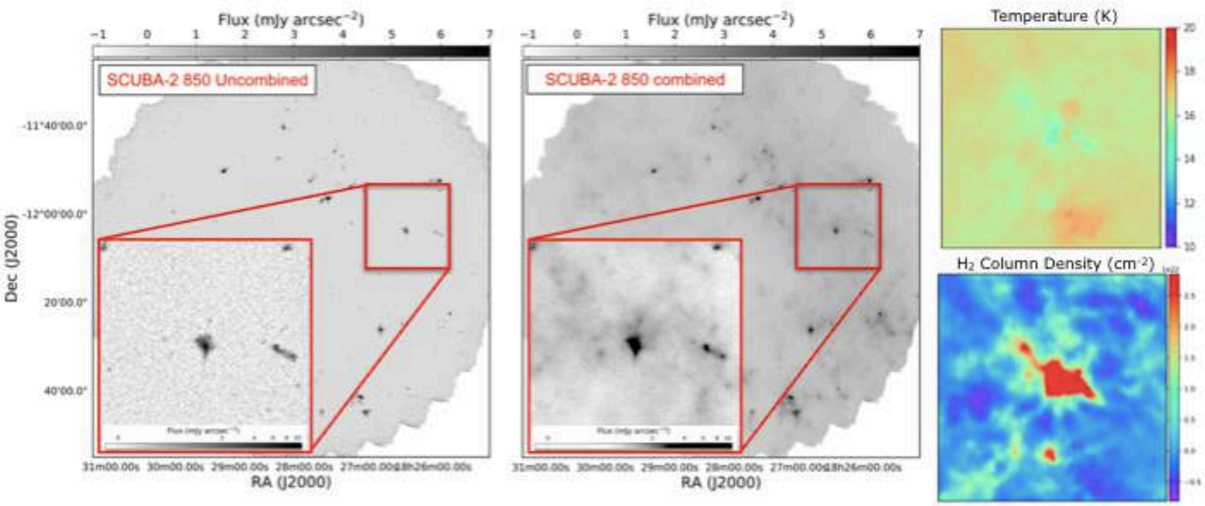
(PI: Tie Liu, SHAO/China)

- **Aim:** to probe magnetic fields inside filaments and around dense cores; to investigate the gravitational stability of cores by considering all support mechanisms from thermal, turbulent, and magnetic pressures; to investigate the grain alignment efficiency and dust grain properties in dense cores; to pioneer cold cloud chemistry by 3D chemical modeling and constrain grain properties; to study the correlations between protostellar outflows and magnetic fields and assess the impact of outflows to the measurements of magnetic fields in the filaments and cores.
- **Method:** dust polarization (SCUBA2+POL-2) and molecular line (N_2D^+) mappings toward a well-selected sample of 65 densest cloud cores (in 24 fields) in the filamentary Orion Giant Molecular Cloud (GMC).



3. ALOHA IRDCs: A Lei of the Habitat and Assembly of Infrared Dark Clouds (PI: Di Li, NAOC/China)

- **Aim:** to study the initial conditions of the Galactic massive star formation
- **Method:** 2mJy/beam at 850 um survey + *Spitzer* absorption, *Herschel*, and *Planck* absorption through our own multi-band dust imaging combination and analysis tool J-COMB



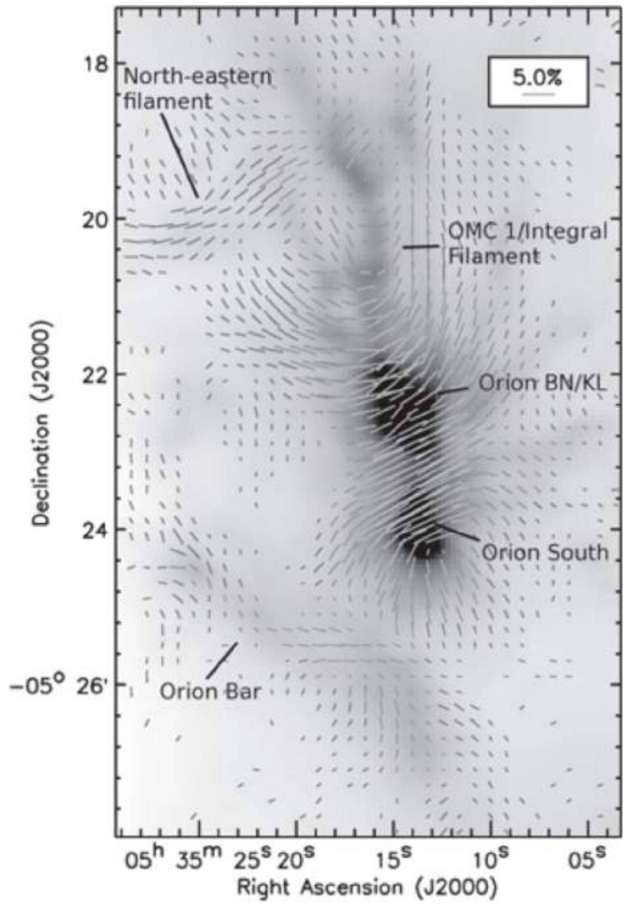
The comparison of uncombined and combined JCMT 850µm images of one IRDC (SDC19.376-0.034) obtained through JPS. The significant extended structures missed out from SCUBA-2 image from JPS alone can be recovered properly with our own innovative J-COMB multi-band analysis tool with sufficient intensity dynamic range while preserving spatial resolution, both of which are crucial for studying gas assembly.

4. BISTRO: B-fields In STar-forming Region Observations

(PI: D. Ward-Thompson, UK)

- **Aim:** to explore two new dimensions: the 'evolutionary axis' of star formation parameter space, by targeting some starless, pre-stellar and proto-stellar regions at various evolutionary stages, and the 'size-scale' axis by probing different distance objects at the same angular resolution (hence different physical size resolution), at distances from ~100pc to ~10kpc, including regions around the Galactic Centre.

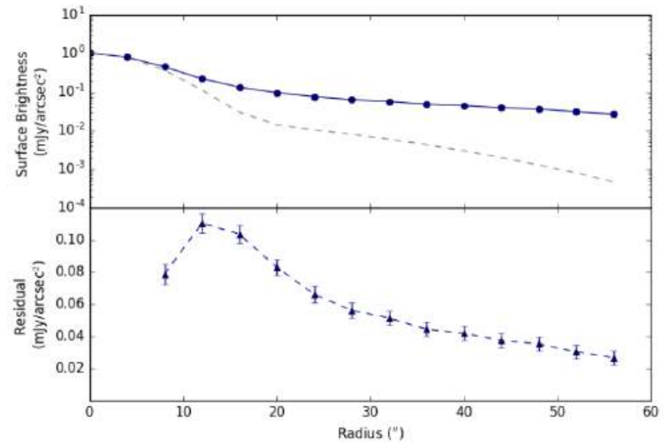
- **Method:** SCUBA-2+ POL-2, polarization mapping at 450 & 850um within cold dense cores and filaments on scales of ~1000 AU in nearby star-forming regions
- **Targets:** L1544, L1498, L43, L1517B, FeSt_1-457, G192.16 , G35.2N, G240.31, I18360, W51, M17, G28.34+0.06, Sgr_B2, G0.253+0.016, Clouds_e/f, 20km/s_cloud



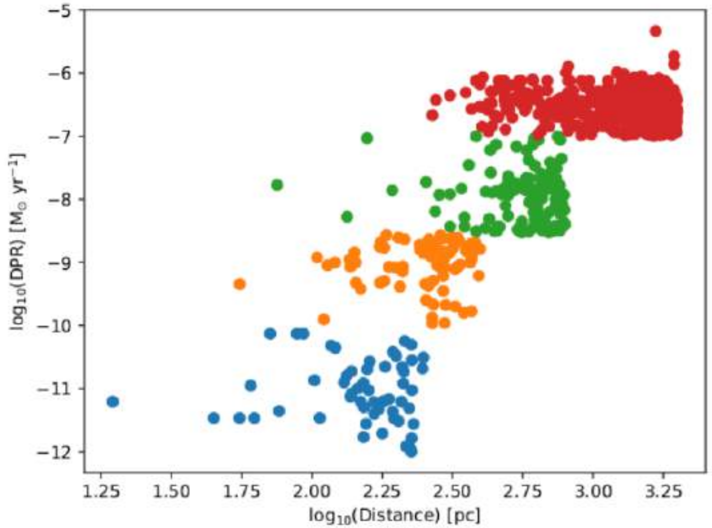
The first results from BISTRO: Polarisation map of Orion A – the integral filament – see Ward-Thompson et al., 2017, ApJ, 542, 66.

5. The Nearby Evolved Star Survey (NESS) (PI: Peter Scicluna, ASIAA/Taiwan)

- Aim: (1) why winds of AGB stars initially start to become dusty, (2) how the properties of the wind vary as the star evolves and why unexpectedly large jumps in mass-loss rate appear during the AGB phase, and (3) how mass loss varies among stars of differing stellar types, in ways not previously possible.
- Method: 850um continuum (mass loss); $^{12}CO(2-1)$, $^{13}CO(2-1)$, $^{12}CO(3-2)$, $^{13}CO(3-2)$ (gas outflow & $^{13}C/^{12}C$)



Radial profile of W Aql derived from SCUBA-2 850μm observations (Dharmawardena et al., in prep).The lower panel shows the residual after subtracting a point-source profile (the SCUBA-2 beam, Dempsey et al 2013) from the observed profile. The resulting profile corresponds to a lower limit on the extended component of the sub-mm emission.



Distance vs dust production rate (DPR) for the NESS sample. Each colour corresponds to a different sub-sample in mass-loss rate.