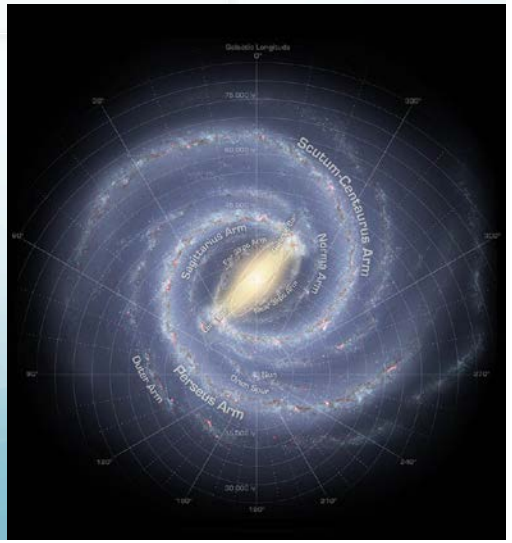
JCMT and the Galaxy

Michael Burton
UNSW

With many, many thanks to
Derek Ward-Thompson (UK), Woojin Kwon (Korea) and Yu Gao (China)
and their colleagues

THE UNIVERSITY OF NEW SOUTH WALES



Observations of Dust reveal:

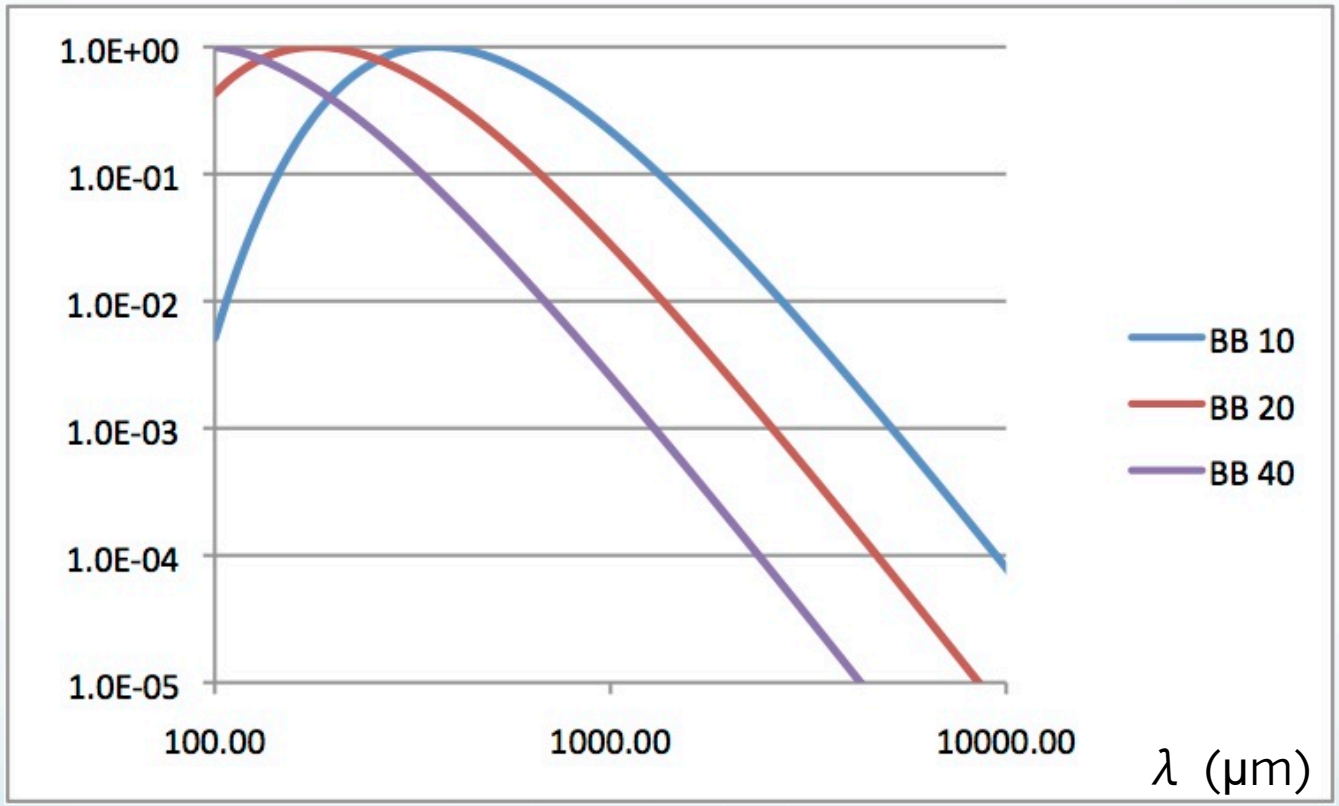
- Temperature
- Column Density

  and if you can determine the distance (molecules) then

- Luminosity
- Mass

Temperature and Luminosity

Flux
νB_ν

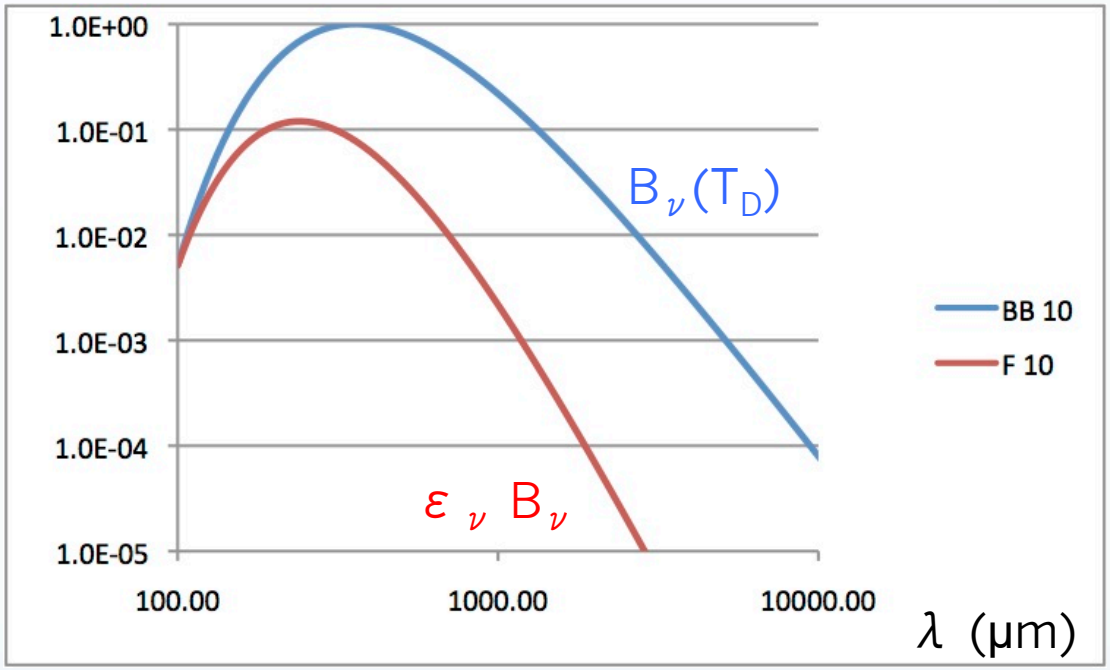


$\lambda_{Peak} T$ = constant ➔ Temperature

Area under curve ➔ Luminosity

Column Density and Mass

Flux
νB_ν

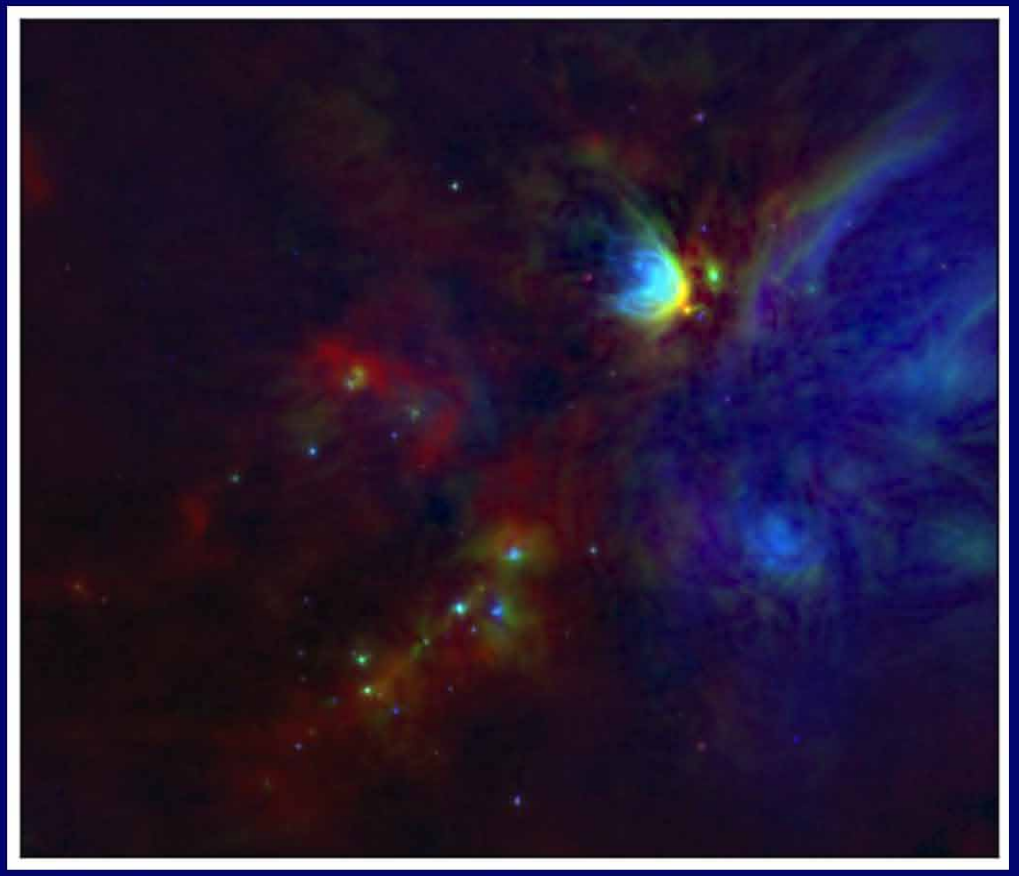


Dust properties β ➔ $\varepsilon = 1 - e^{-\tau} \sim \tau \sim \tau_0 (\nu / \nu_0)^\beta$

Column Density $N = F_\nu / \kappa_\nu B_\nu(T)$

Mass $M = N \, \Omega D^2$

Current and future directions in star formation research with the JCMT



Pattle et al, 2015
MN 450 1094

Derek Ward-Thompson,
University of Central Lancashire

JCMT splinter meeting at International Astronomical Union: 2015 August 6th

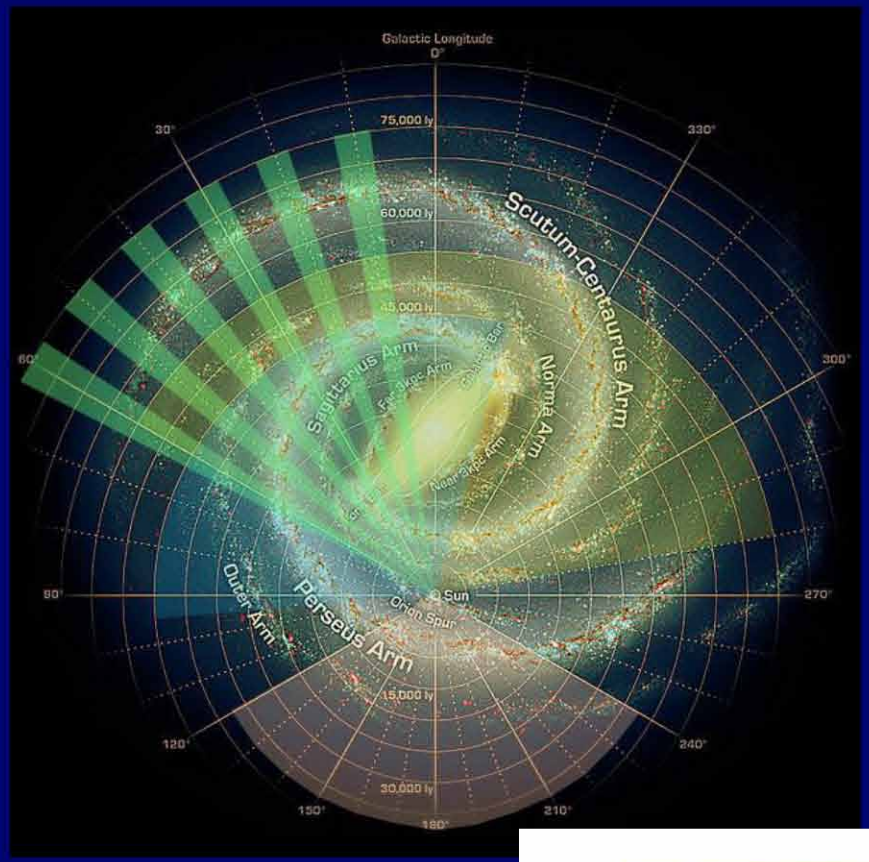
Galactic Splinter Discussions – Possible Projects 1

Ongoing business: Complete Galactic Plane with SCUBA2 – mass, high-mass star formation (~2000 hours)

Follow-up business: Galactic Plane in CO – kinematics, structure (~2500 hours)

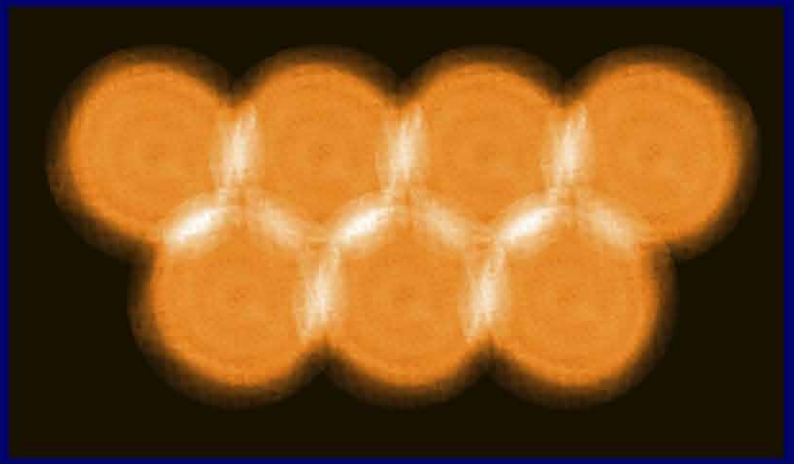
JCMT Plane Survey (JPS)

450 hours of legacy survey time in band 3
Map regularly spaced sections of the inner Galaxy
$10° < l < 65°$; $|b| < 1°$

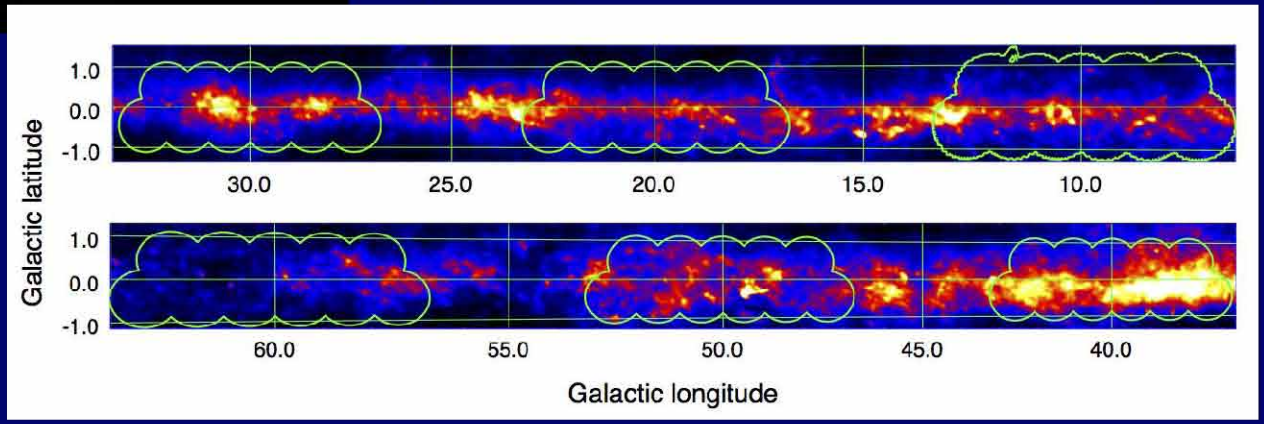


Right: The JPS patch regions superimposed on the Planck dust map

4.5° x 1.7° patches at l =10°, 20°… 60°
target rms 10mJy/beam at 850μm

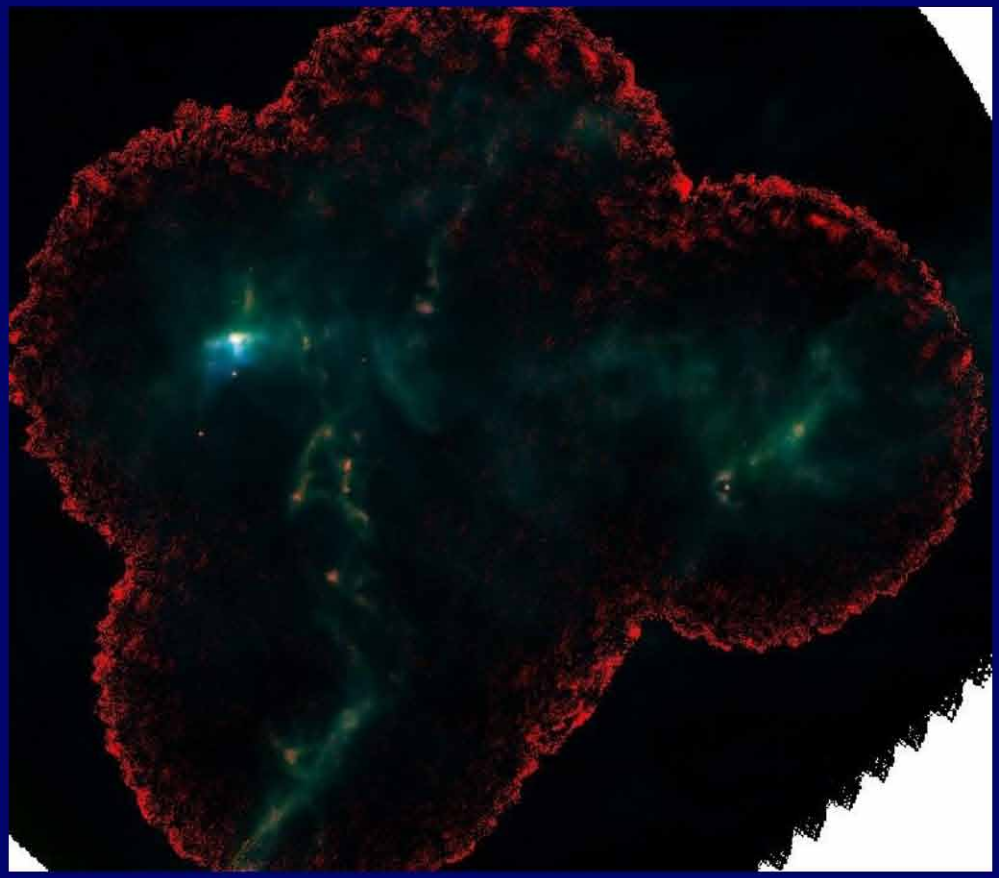


Above: Triangular grid pattern of 1-degree pongs tiles; approx 8 repeats of each tile to reach target 10 mJy/beam



L1495 in SCUBA2 & Herschel

Red – 850um
Green – 500um
Blue – 250um

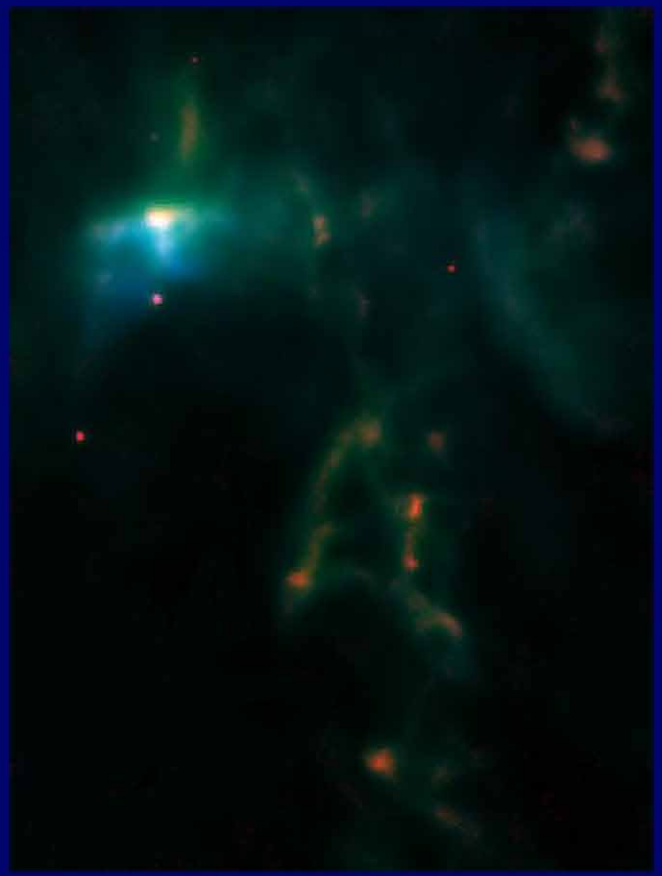


Ward-Thompson
et al 2015 in prep

L1495 central region

Red – 850um
Green – 500um
Blue – 250um

Note the red cores



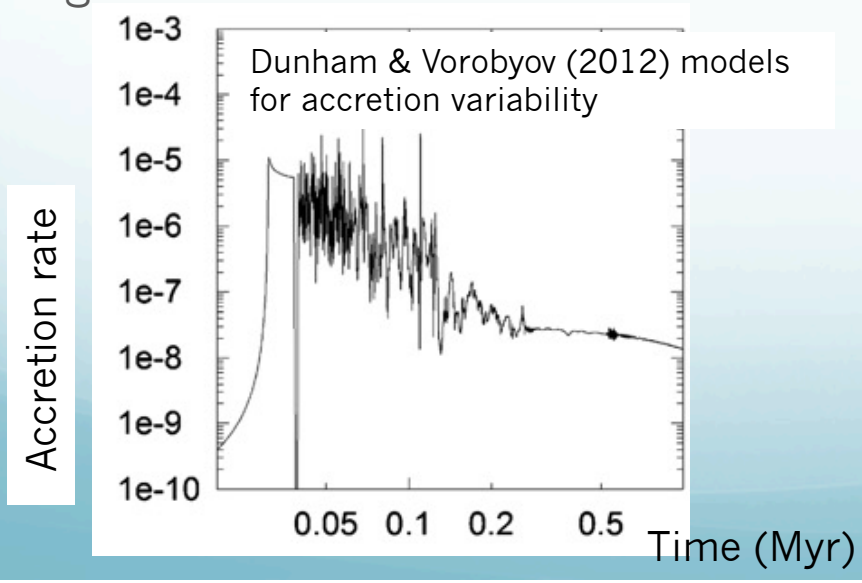
Ward-Thompson et al 2015
in prep

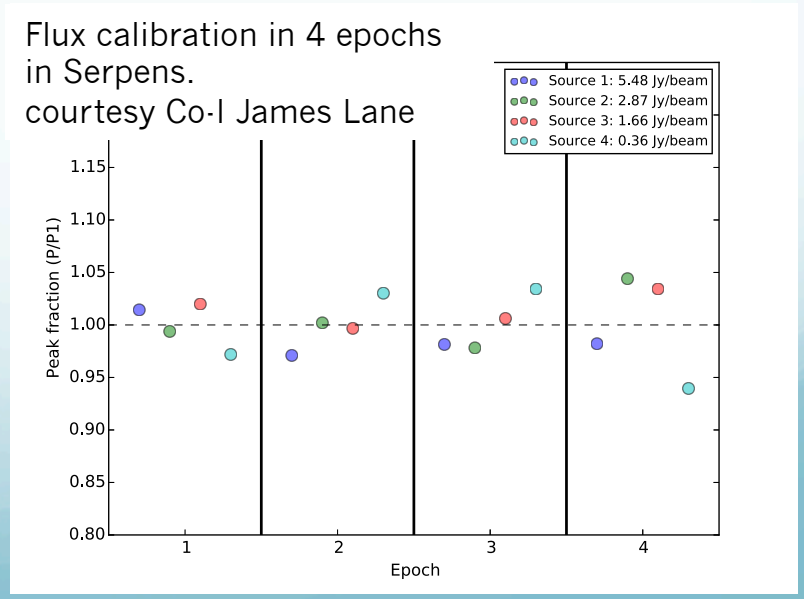
How does a star gain its mass? A JCMT/SCUBA2 Transient Search to Measure Protostellar Variability

Gregory J. Herczeg (PKU), Doug Johnstone (NRC), and many others

- Protostellar luminosity is generated by accretion energy
- Luminosity problem: protostars are too faint
- Possible solution: accretion variability with large, episodic bursts

PILOT SCIENCE/RESULTS: obtain images to evaluate self-calibration accuracy; can achieve 3% rms if multiple bright sources are in the same image





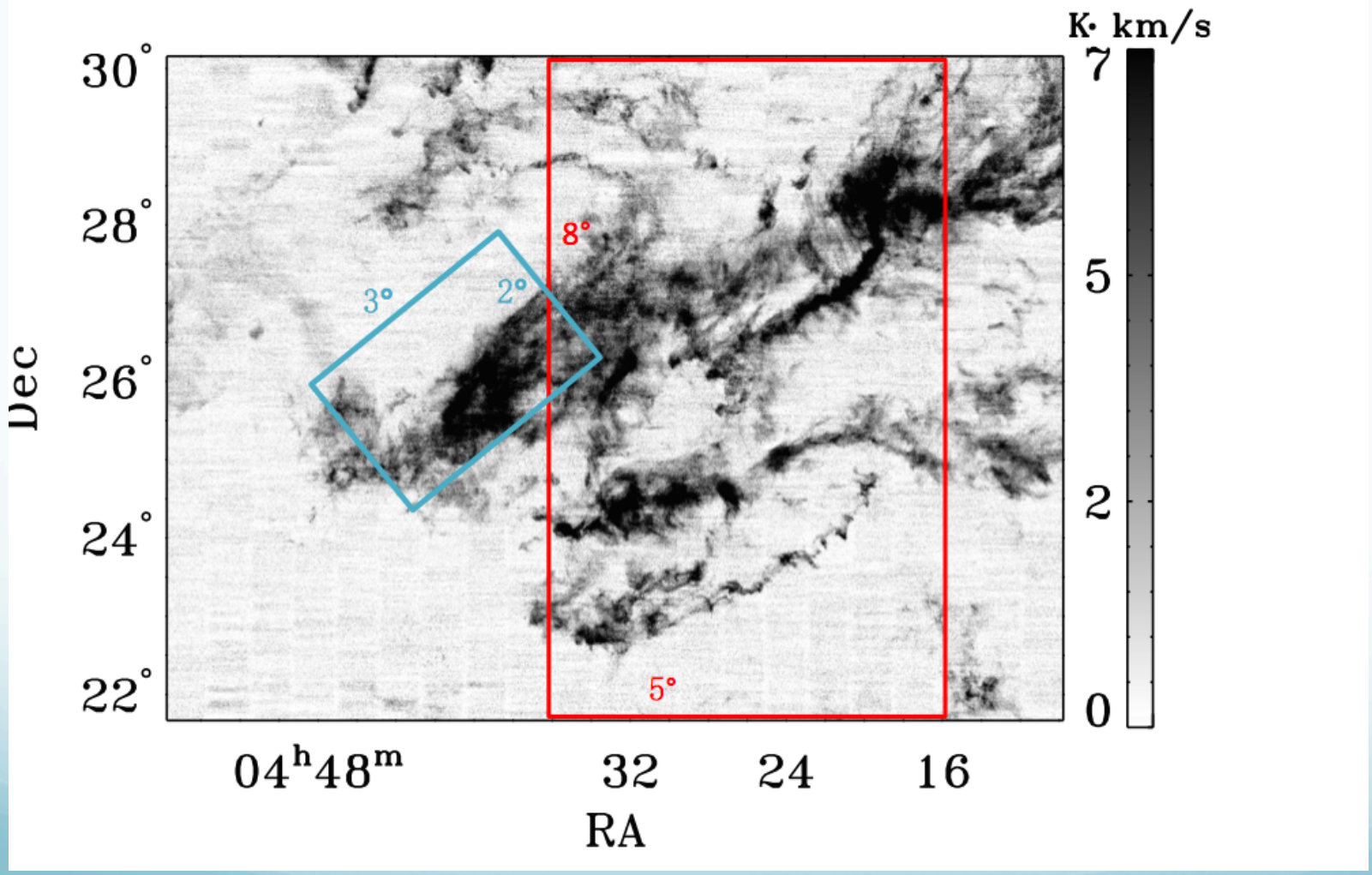
Galactic Splinter Discussions – Possible Projects 2

New: HARP survey of nearby and spiral-arm clouds in CO and higher density tracers – gas kinematics, mass assembly in star formation, virial estimates, role of turbulence in star formation

New: HARP survey of high-latitude clouds – molecular cloud formation, atomic-molecular transition, isolated star formation

JCMT LEGACY SURVEY PROPOSAL:

HARP Observation of Taurus gas and Stellar-Feedback(HOTS)



Proposed observation regions in the LEGACY SURVEY—HOTS

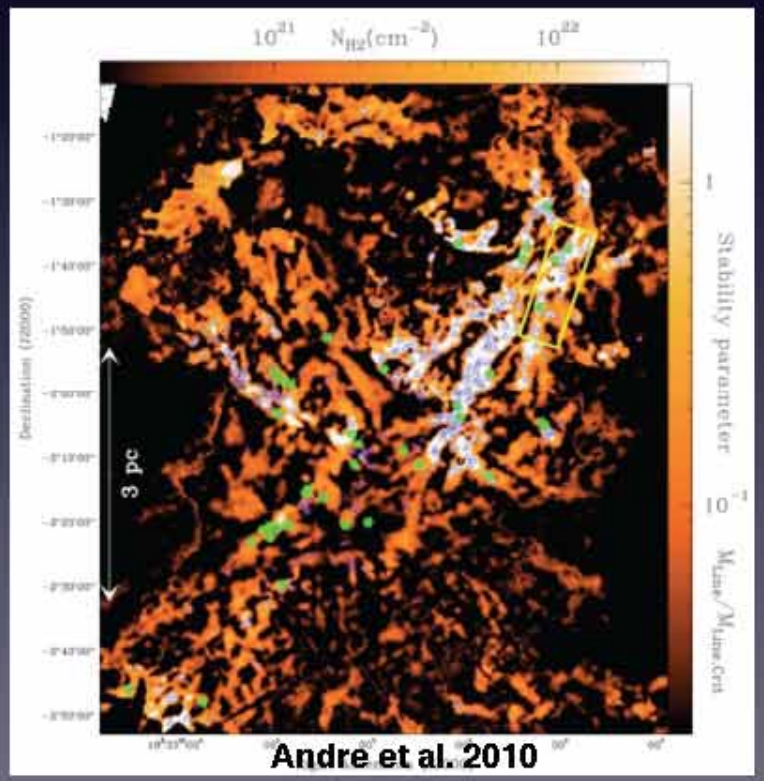
Kinematics of Filamentary Structures

PI: Eun Jung Chung

- Aquila Rift molecular complex
  northern part
  4′×16′ portion

- Tracers
  CO, ^{13}CO, C^{18}O
  HCO$^+$, H^{13}CO$^+$

- Proposed: 28 hours (HARP)
  Achieved: 10.5 hours (37%)



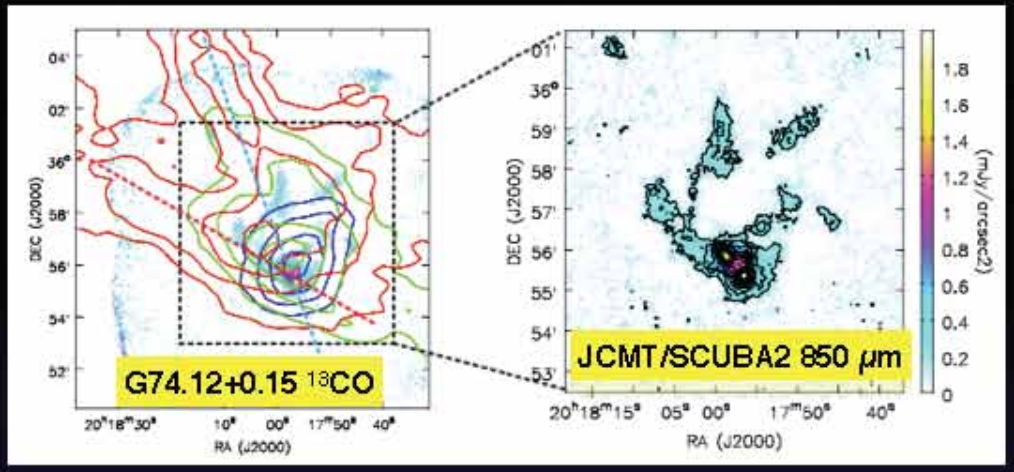
Andre et al. 2010

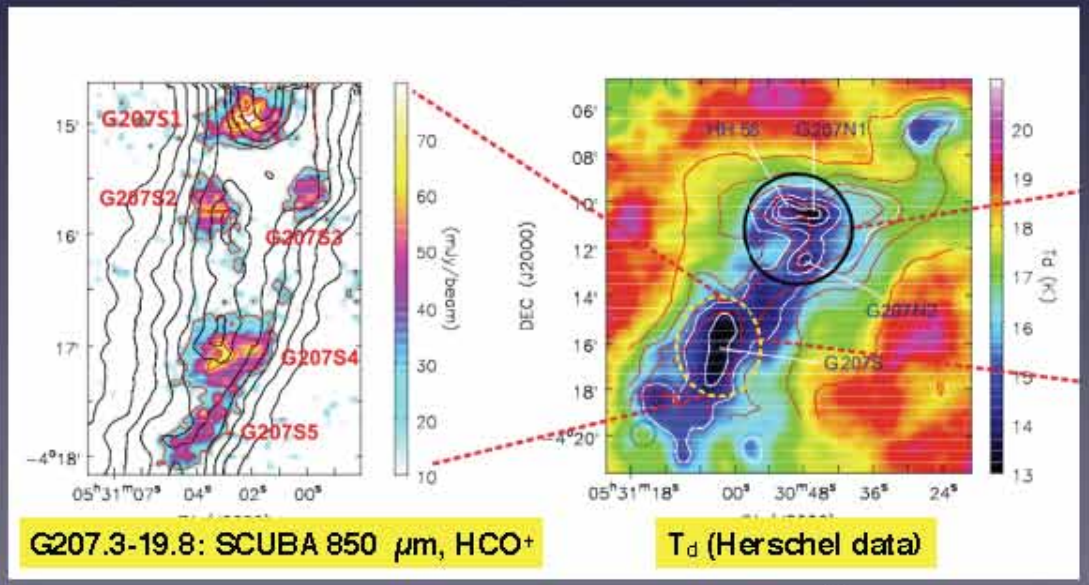
Planck Galactic Cold Clumps

PI: Tie Liu

- Physical properties of PGCCs
- Proposed: 30 hours (SCUBA2 @ 850 μm)
  Achieved: 13.3 hours (44%)

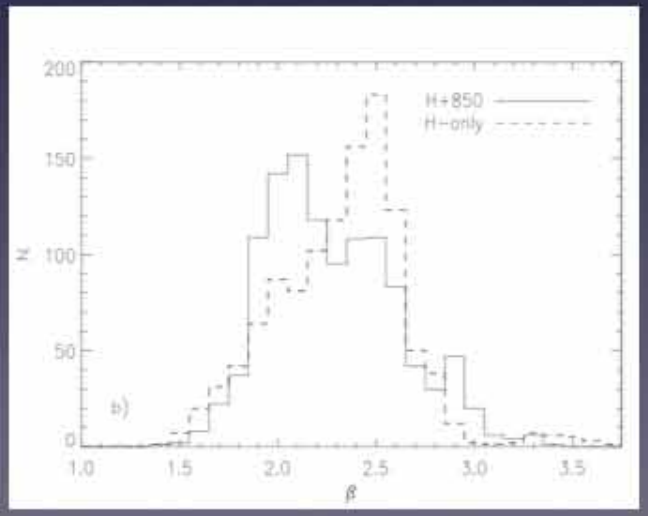
- Filamentary structure
- Fragmentation
- A better constrain dust properties
- Stellar feedback





G207.3-19.8: SCUBA 850 μm, HCO+

T_d (Herschel data)



Galactic Splinter Discussions – Possible Projects 4

New: Molecular line chemistry – complex organic molecule formation – the search for life(!)

New: Magnetic fields, geometry and strengths – POL2 – role of B-fields in star formation and cloud formation and evolution

New: Isolated star formation – Planck follow-up with SUBA2 (mass) and HARP (kinematics, turbulence and virial balance)

Observations in 15A and 15B:

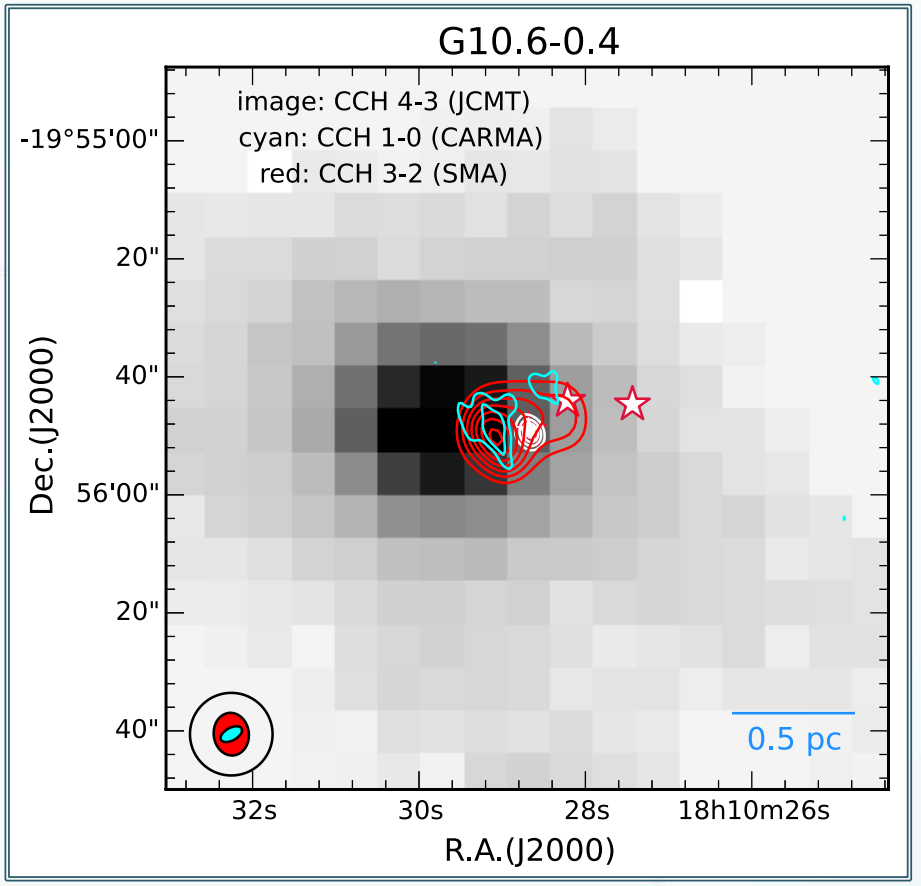
Chemistry of Carbon-chain (C_2H, HC_3N etc.) in Massive SF Regions

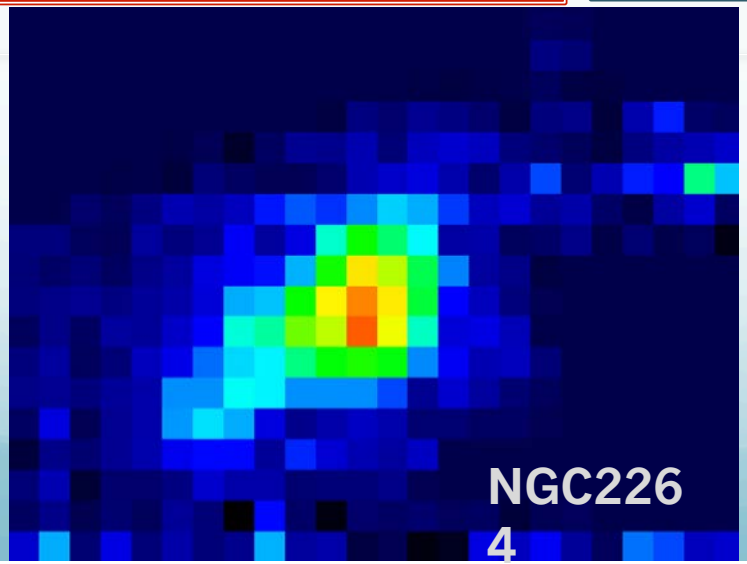
PI: Xue-Jian Jiang

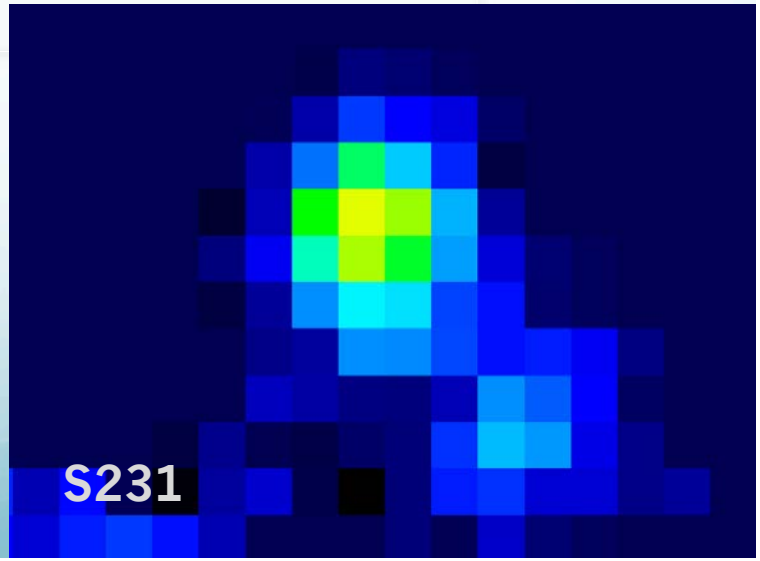
C_2H: PDR tracer, abundant in ISM;
may be chemically active near hot cores.

Chemically study of C_2H and other simple hydrocarbon, to understand the role of hydrocarbon (carbon-chain) in SF environment.

JCMT (HARP) provides large FOV and fast mapping of ~15 sources.
combine with our SMA & CARMA data to compare their properties on different scales.



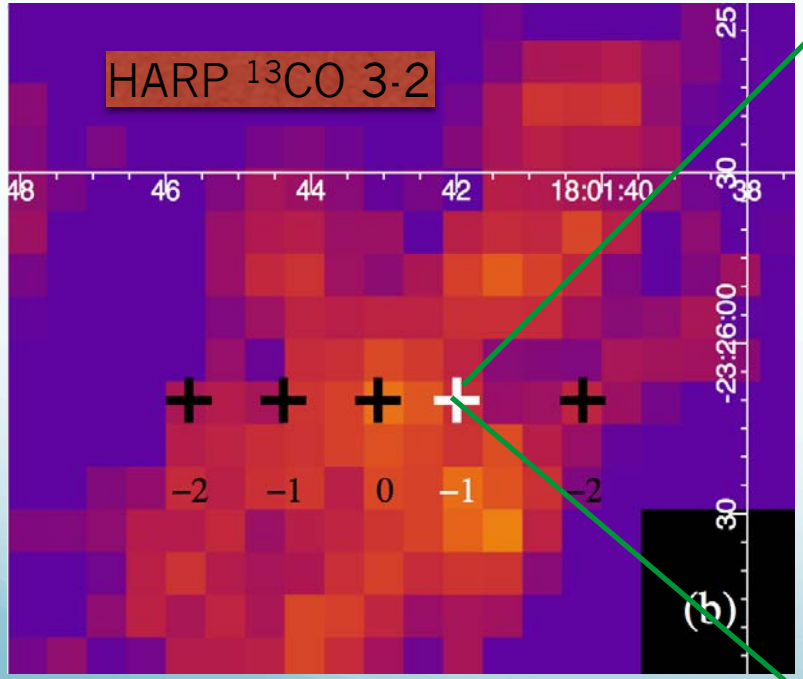




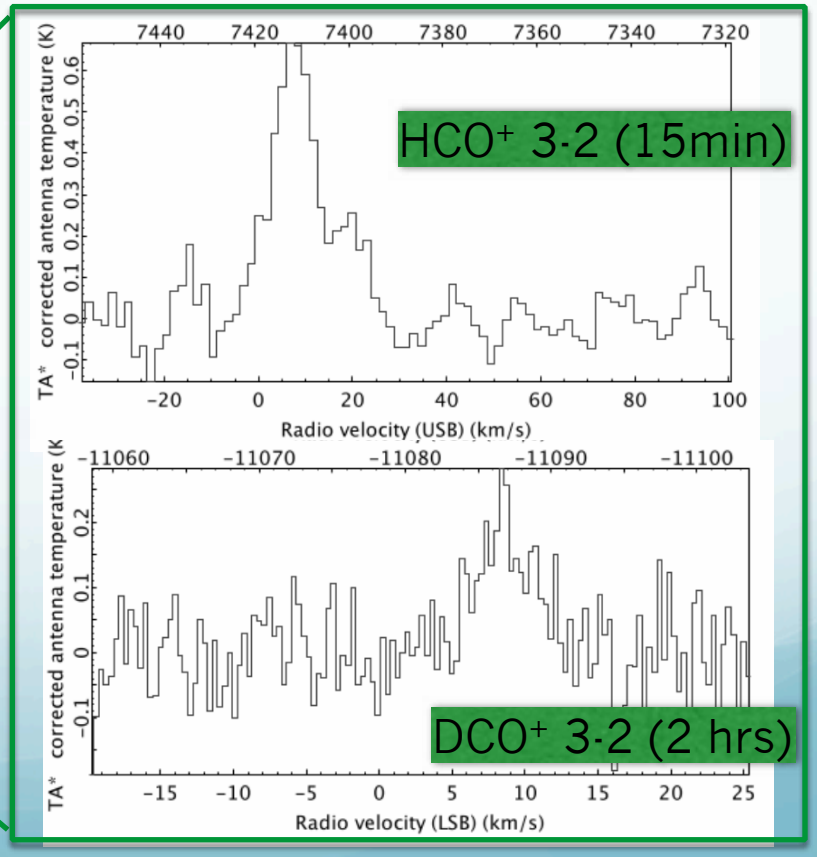
Cosmic-ray-induced ionisation in MCs near supernova remnants

Ping Zhou, Samar Safi-Harb (Canada), Yang Chen & Zhi-Yu Zhang

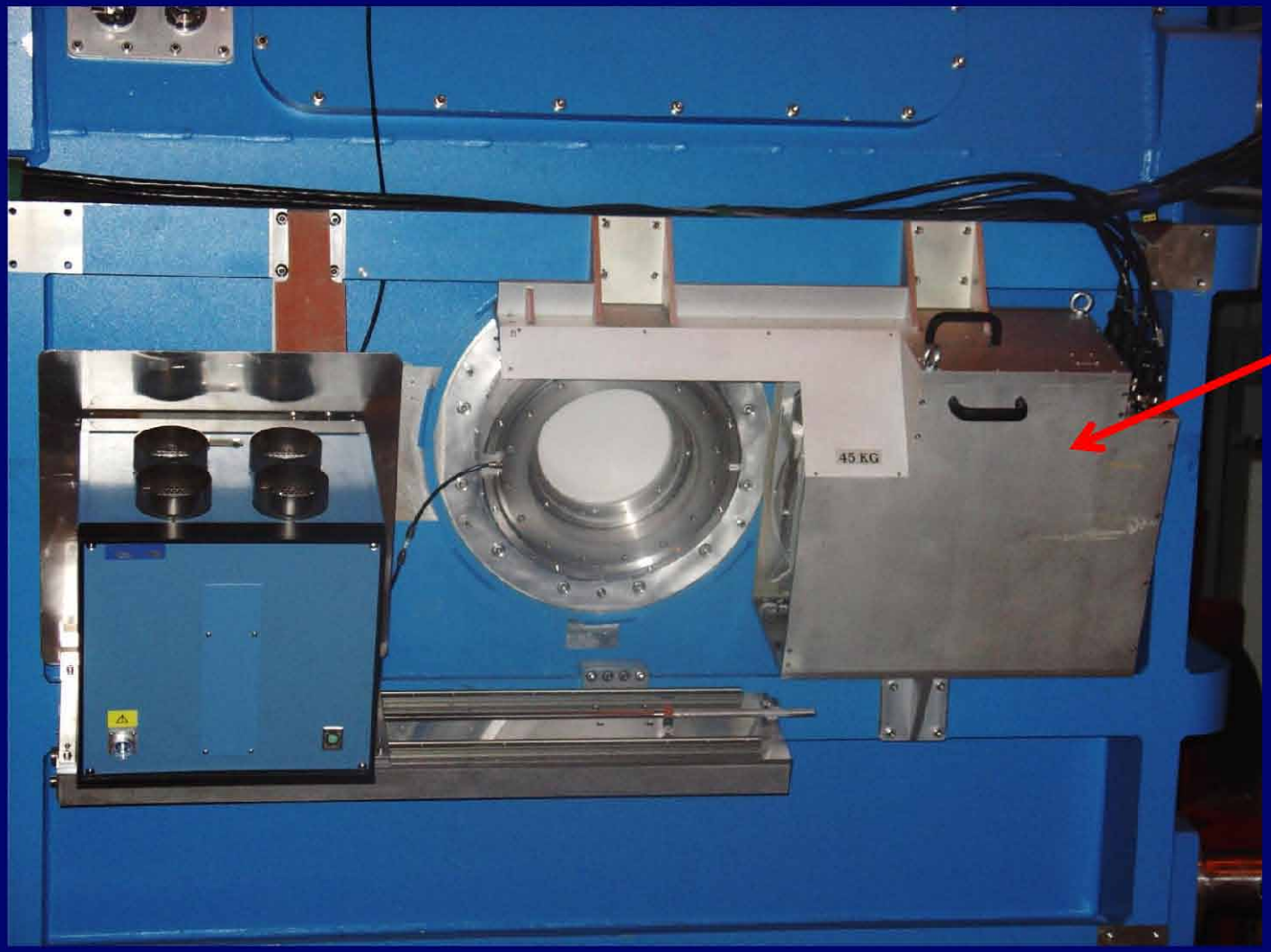
- Cosmic-rays (CRs) are the main regulators for the ionisation of dense cores.
- This on-going project is targeted to a spatially resolved study the CR-induced ionisation in the dense (>10^5 cm^{-3}) core exposed in the extreme-density CRs.
- HCO^+, DCO^+, together with CO, provide a sensitive way to estimate the degree of ionisation.
- 13.5 hrs JCMT observation has been conducted. Another 15 hrs are scheduled in this August.



a gamma-ray bright molecular core near supernova remnant W28

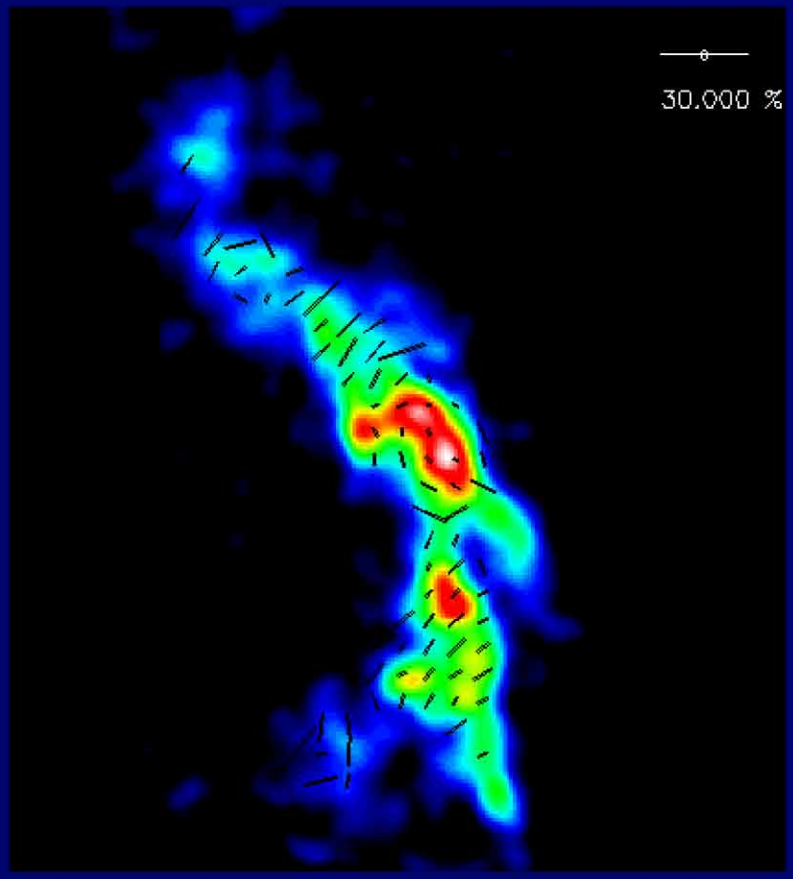


POL-2 installation at JCMT



'Blade' housing containing the spinning waveplate, analyser and calibrating wire-grid polarisers

W3-AFGL333 with SCUBAPOL



Greaves & Holland, 2002, JCMT Newsletter, 19, p.36

Orion A with POL-2 - commissioning data