GEco

Galactic Science with CCAT-prime

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With input from
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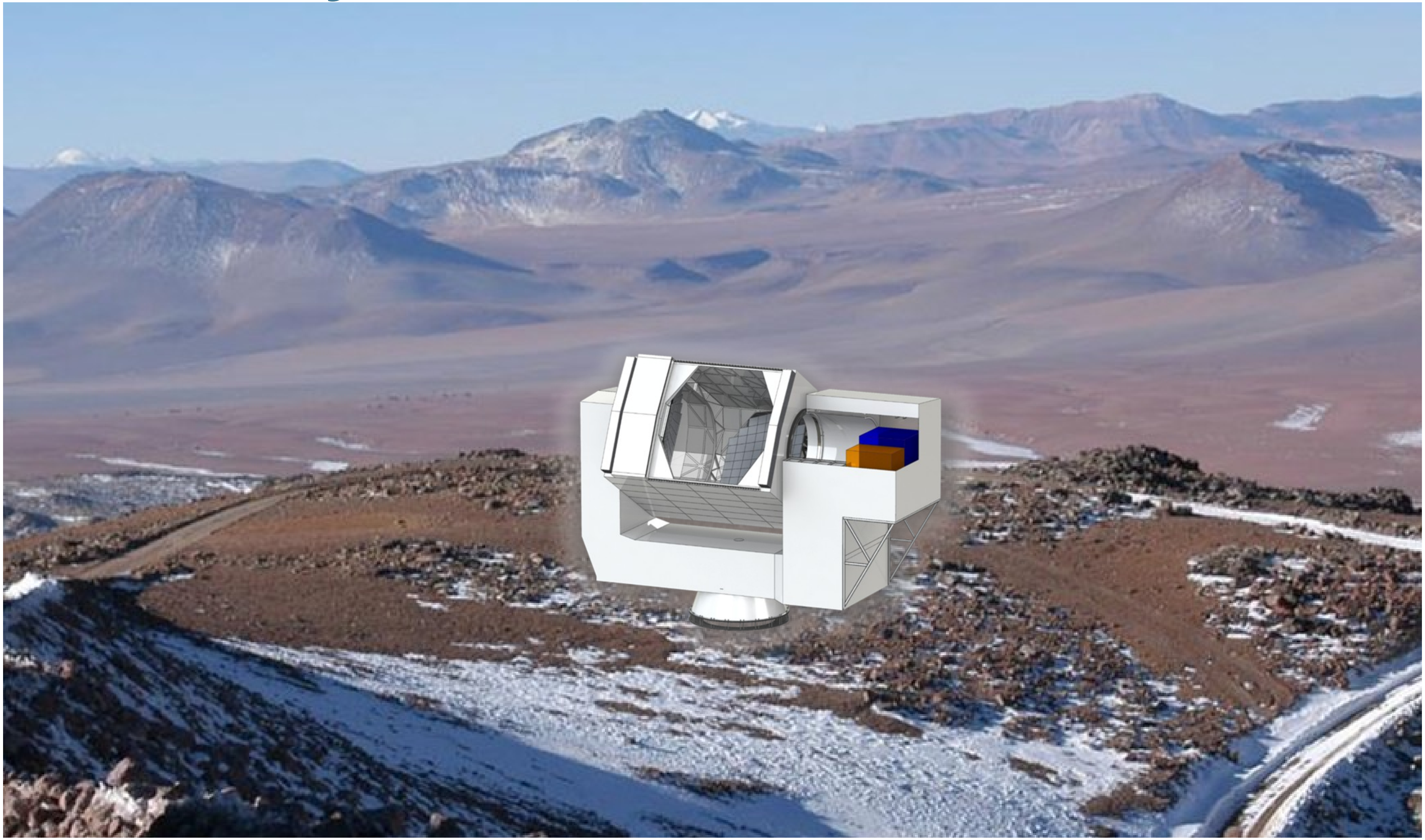
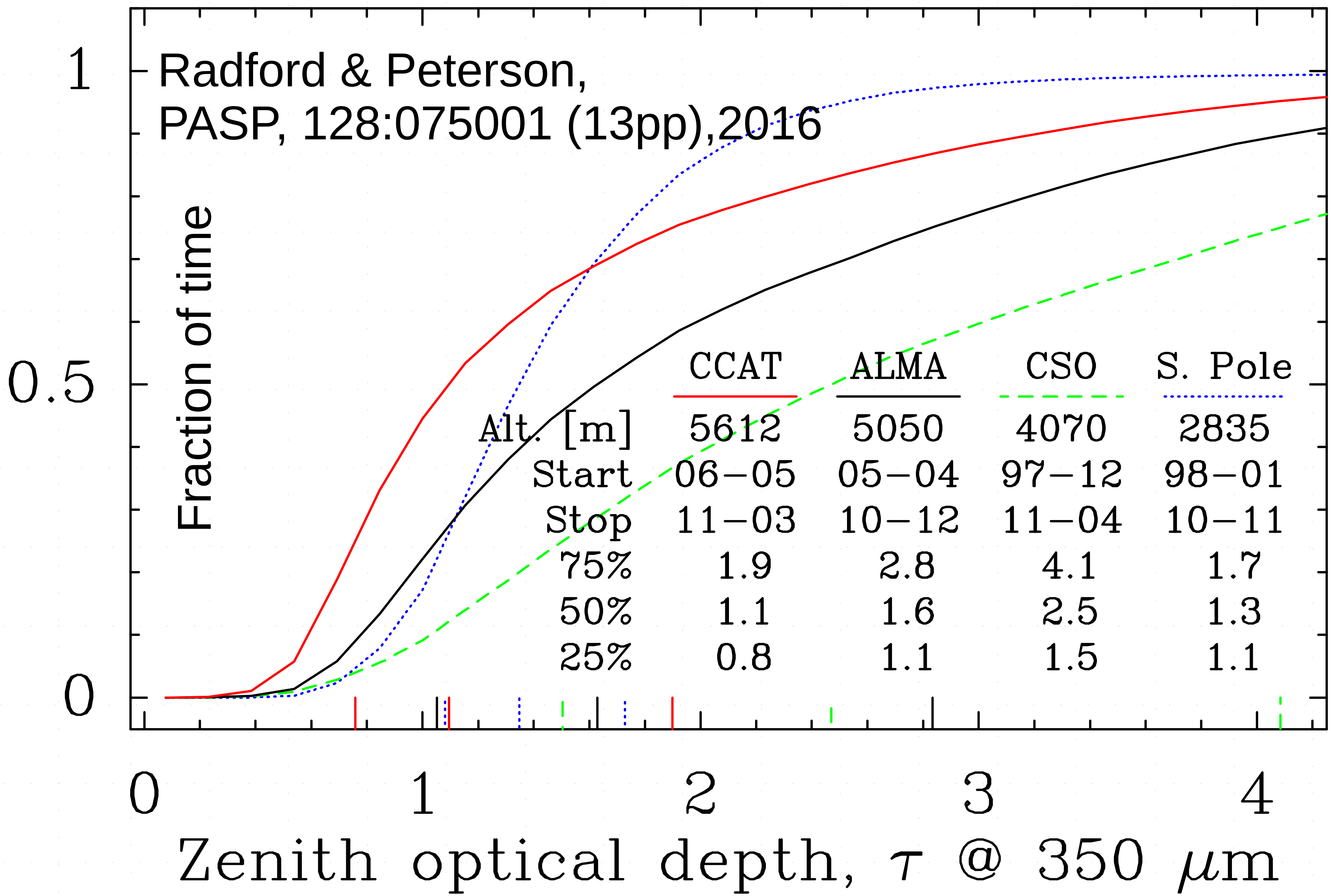
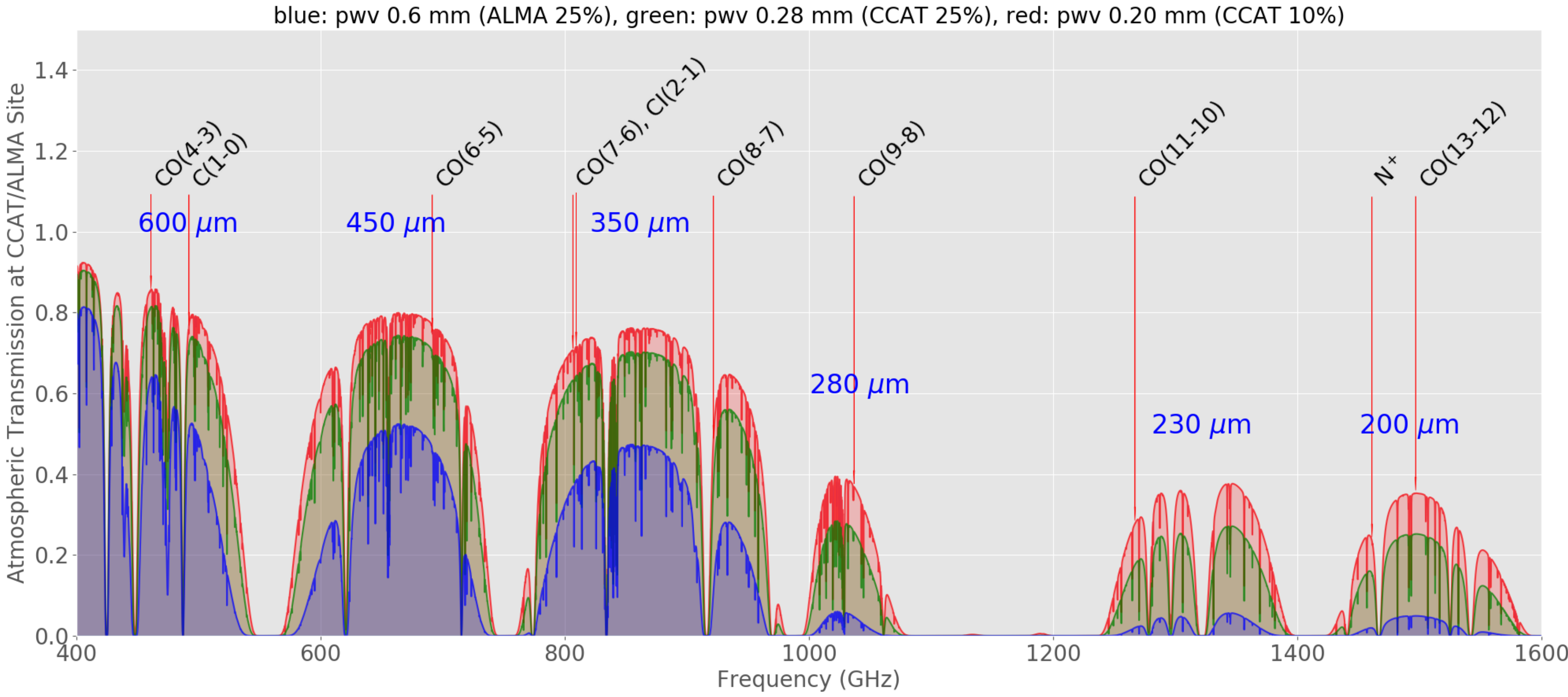
Cerro Chajnantor at 5600 m





Radford & Peterson,
PASP, 128:075001 (13pp),2016
Fraction of time
Zenith optical depth, τ @ 350 μm
0
0.5
1
0
1
2
3
4
CCAT
ALMA
CSO
S. Pole
Alt. [m] 5612 5050 4070 2835
Start 06–05 05–04 97–12 98–01
Stop 11–03 10–12 11–04 10–11
75% 1.9 2.8 4.1 1.7
50% 1.1 1.6 2.5 1.3
25% 0.8 1.1 1.5 1.1

Chajnantor Site opens up THz Windows



Cosmology/Early Universe

Talk by Dominik Riechers

Galactic Science

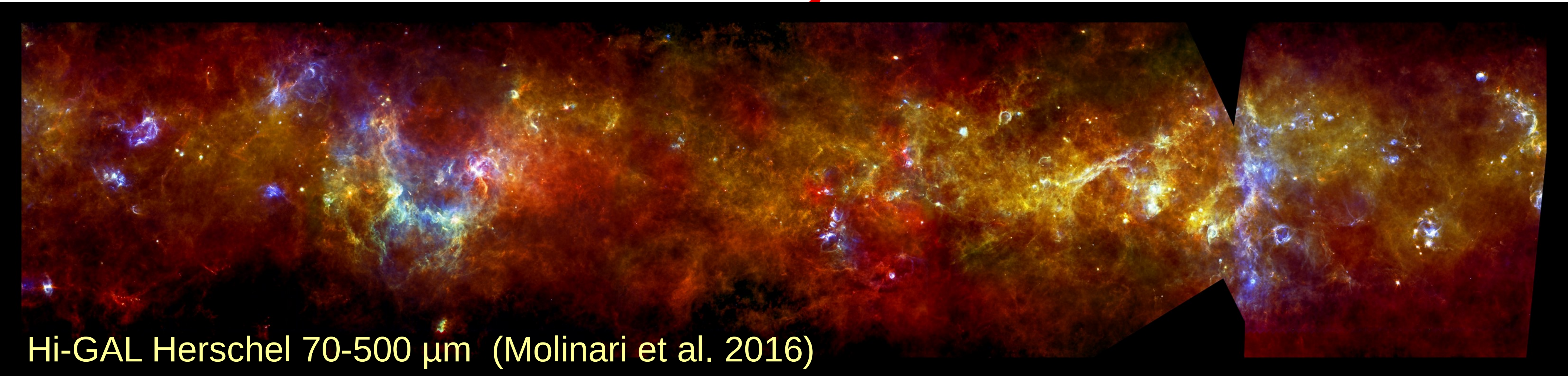
What is the unique science we do with a 6 m telescope?

Large Surveys!

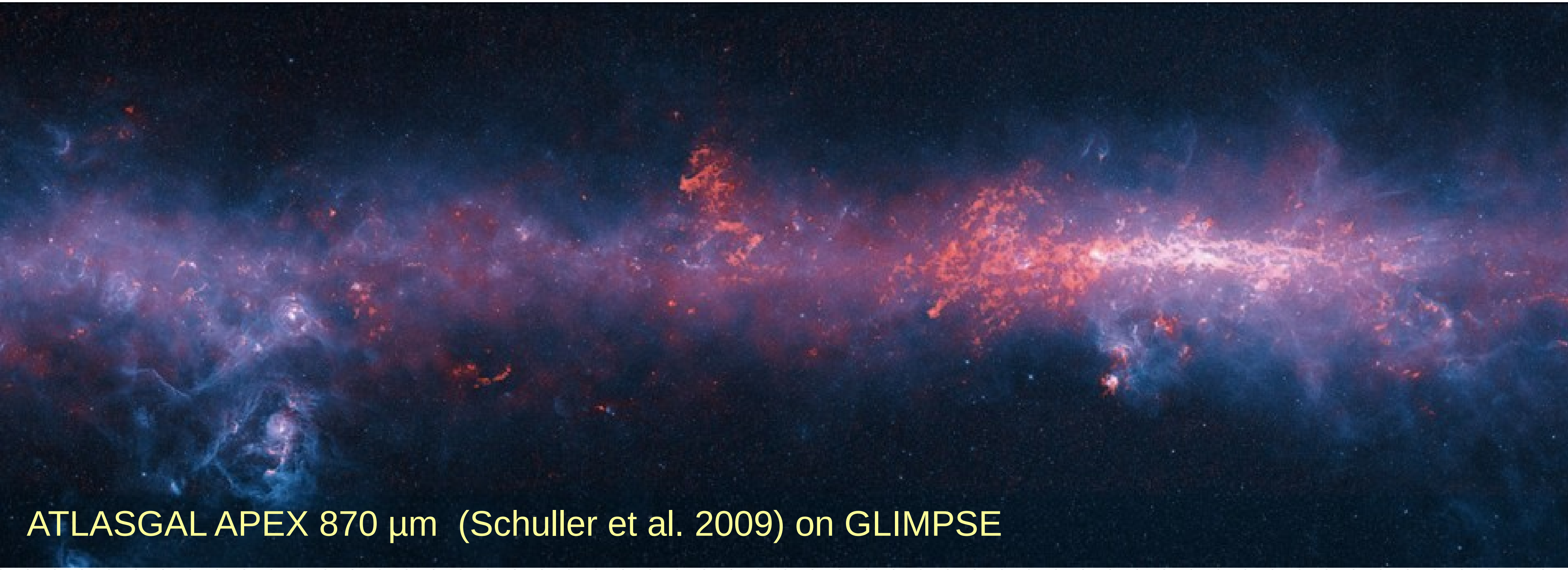
If it is on a good site?

Large Submm surveys!

Galactic Surveys in Continuum

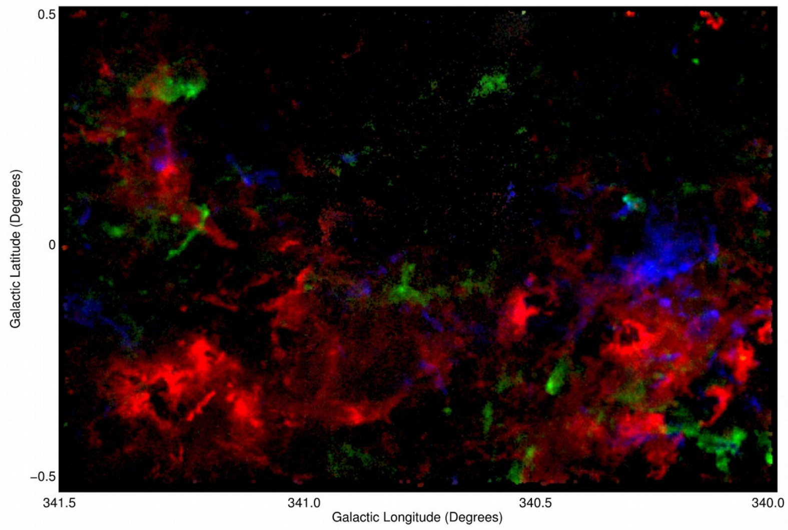


Hi-GAL Herschel 70-500 µm (Molinari et al. 2016)

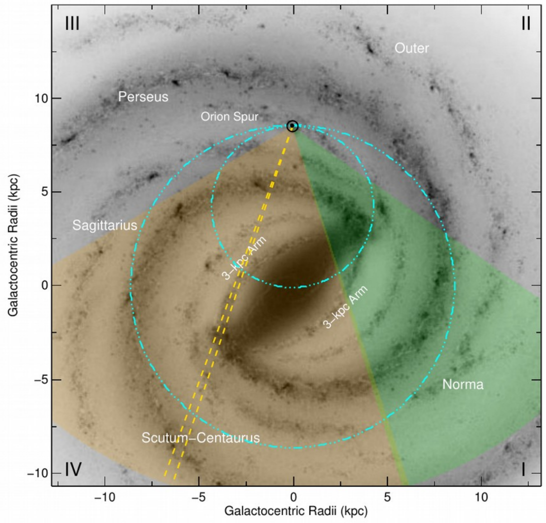


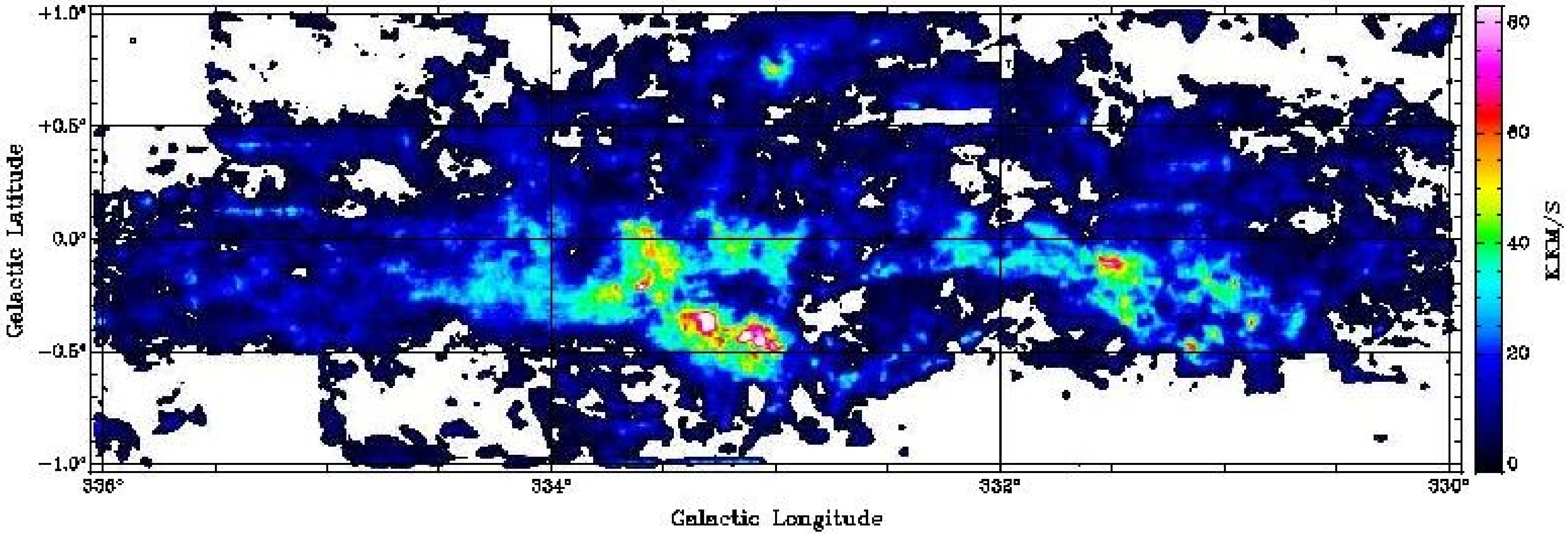
ATLASGAL APEX 870 µm (Schuller et al. 2009) on GLIMPSE

Galactic Surveys in Lines



SEDIGISM ^{13}CO(2-1) APEX
(orange wedge)
(Schuller et al. 2017)





ThrUMMS Mopra 12CO, ^{13}CO, $C^{18}O$(1-0) (Barnes et al. 2015)

Missing Ingredient: atomic C

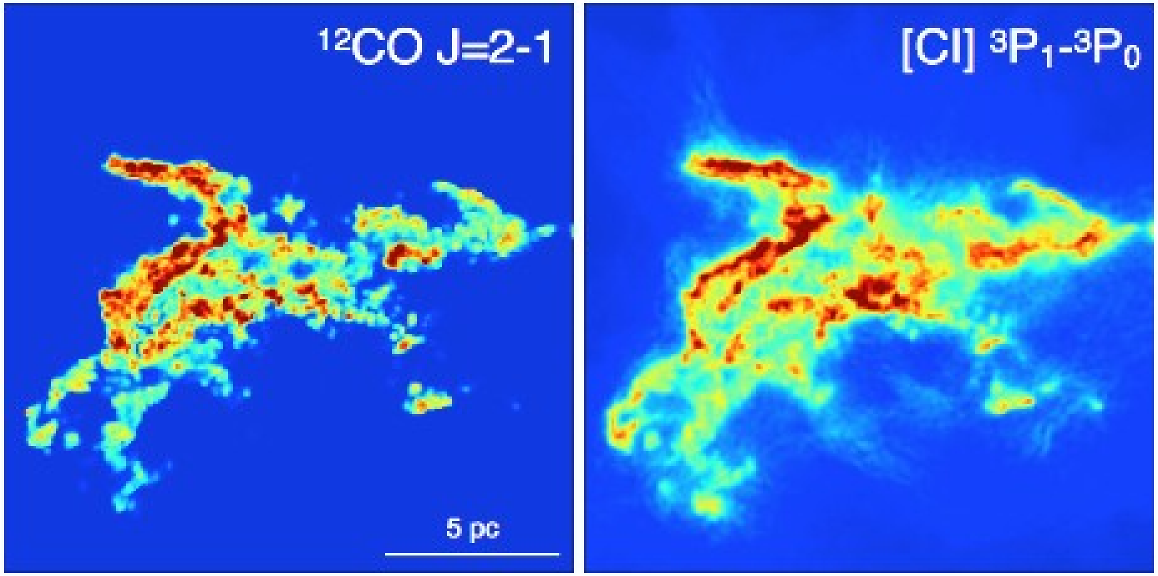


Figure 6: Simulation of the ^{12}CO J=2-1 (left) and [CI] $^3P_1 - ^3P_0$ (right) for a molecular cloud exposed to the interstellar radiation field in the inner Galaxy. In these models, the neutral carbon traces the cloud volume in both the dense regions detected with ^{12}CO, and the extended diffuse regions at are free of ^{12}CO. Simulations from Faviola Molina and Simon Glover.

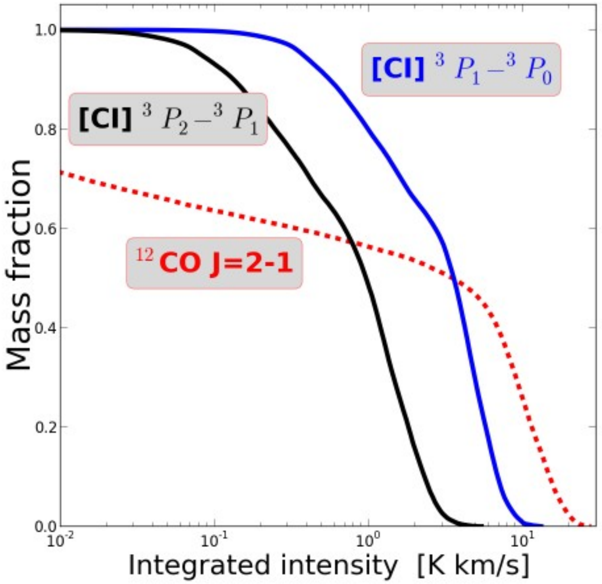
Traces cloud formation and PDRs (feedback)

Tracer of CO dark gas

Not contaminated by atomic gas like C^+

Mapping with 64 element CHAI array (Talk Urs Graf)

Gives a more complete picture of molecular clouds than ^{13}CO



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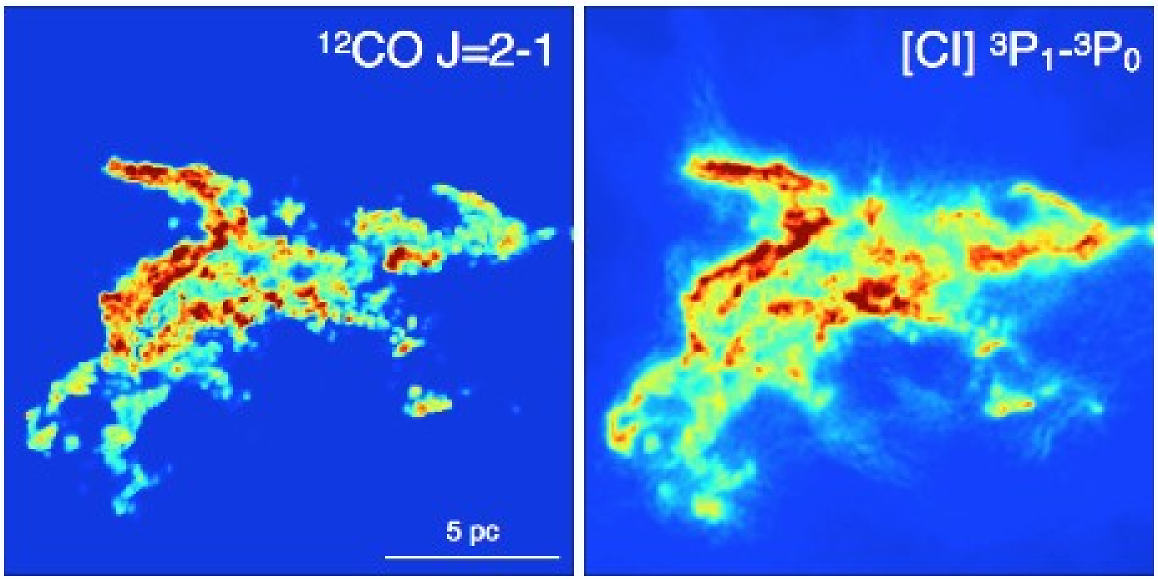

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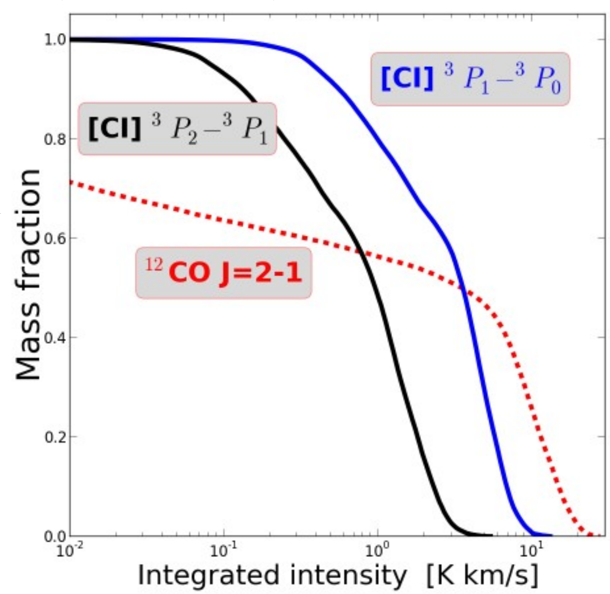
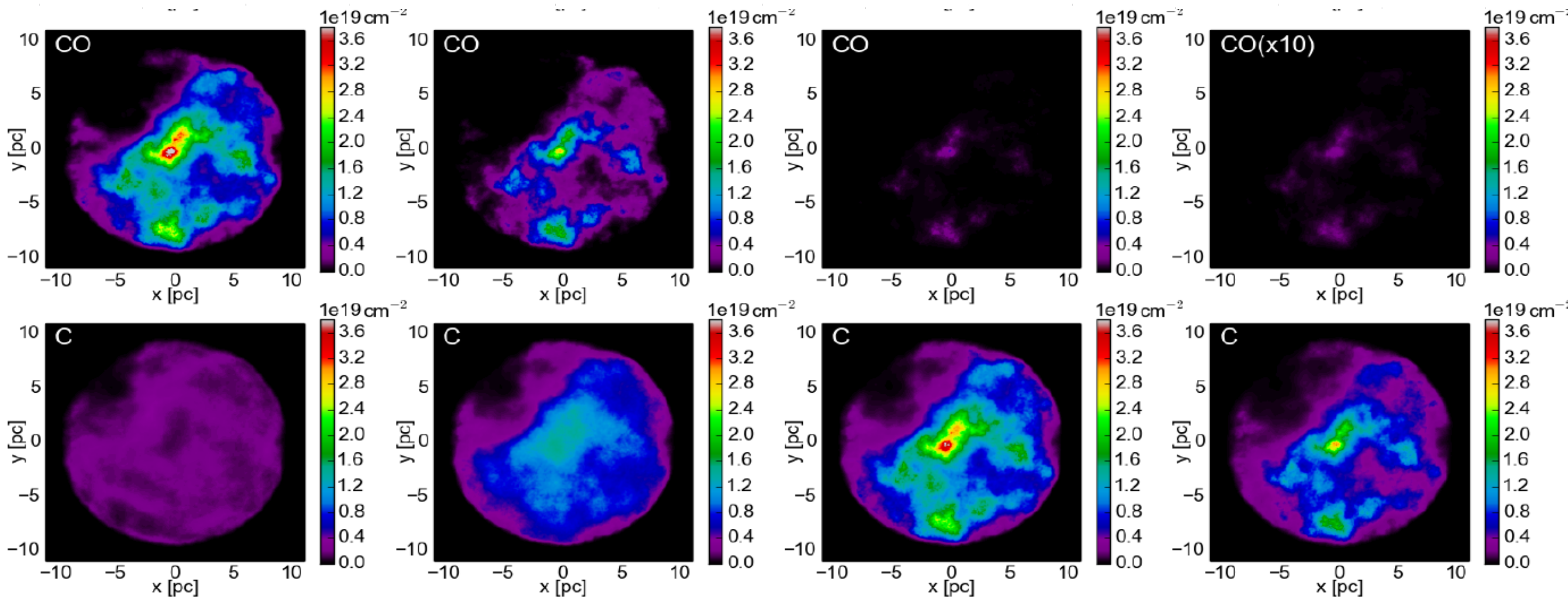


Is it really that much more?
Is it worth the effort?

Gives a more complete picture of molecular clouds than ^{13}CO

Tracer of cosmic ray flux: CO dark gas

ζ= 10-17 ζ= 10-16 ζ= 10-15 ζ=10-14



Bisbas et al., 2017

INDRIOLO ET AL. 2016

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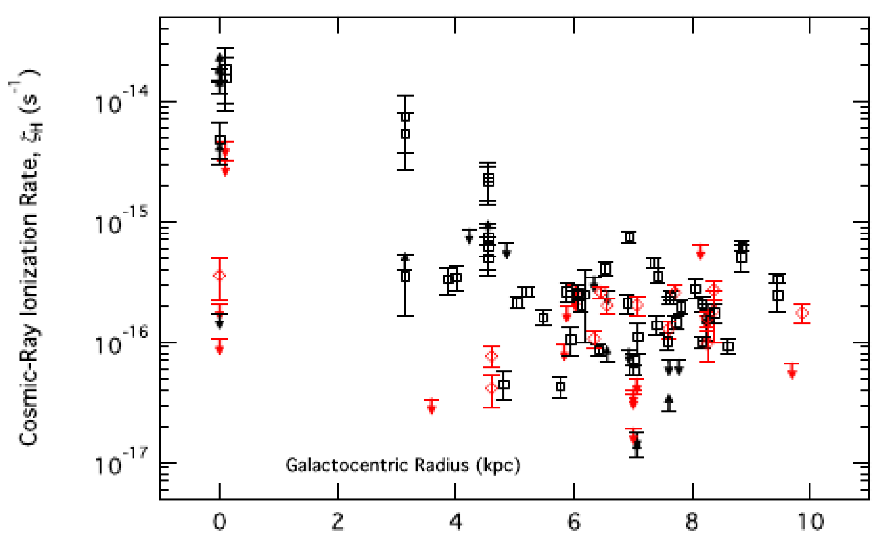


There are theoretical models predicting different distributions – is that observable?

Is it really that much more?
Is it worth the effort?

There is observational evidence for very different distributions -

how widespread is that?

Maezawa et al. 1999

Mt. Fuji telescope

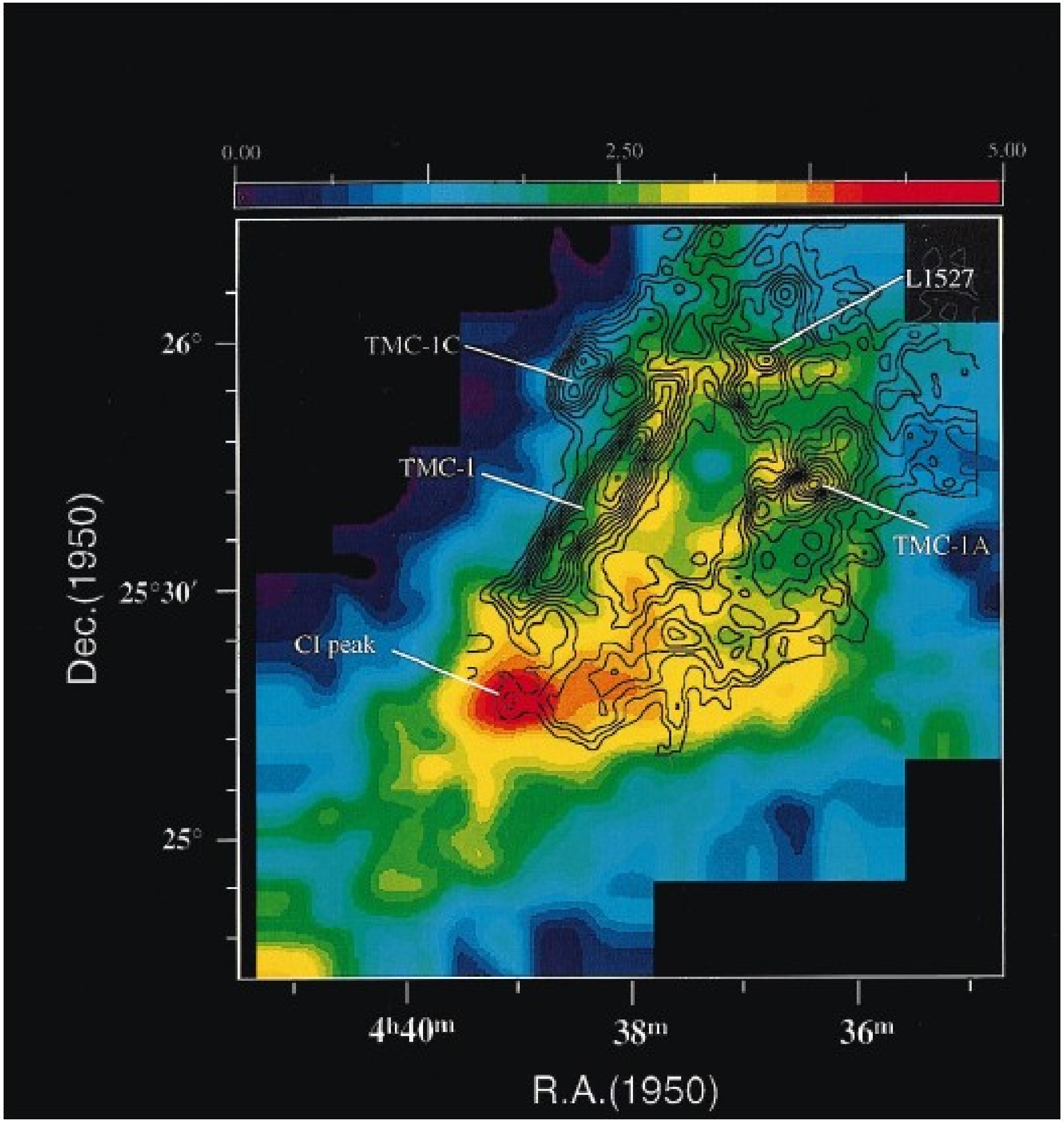


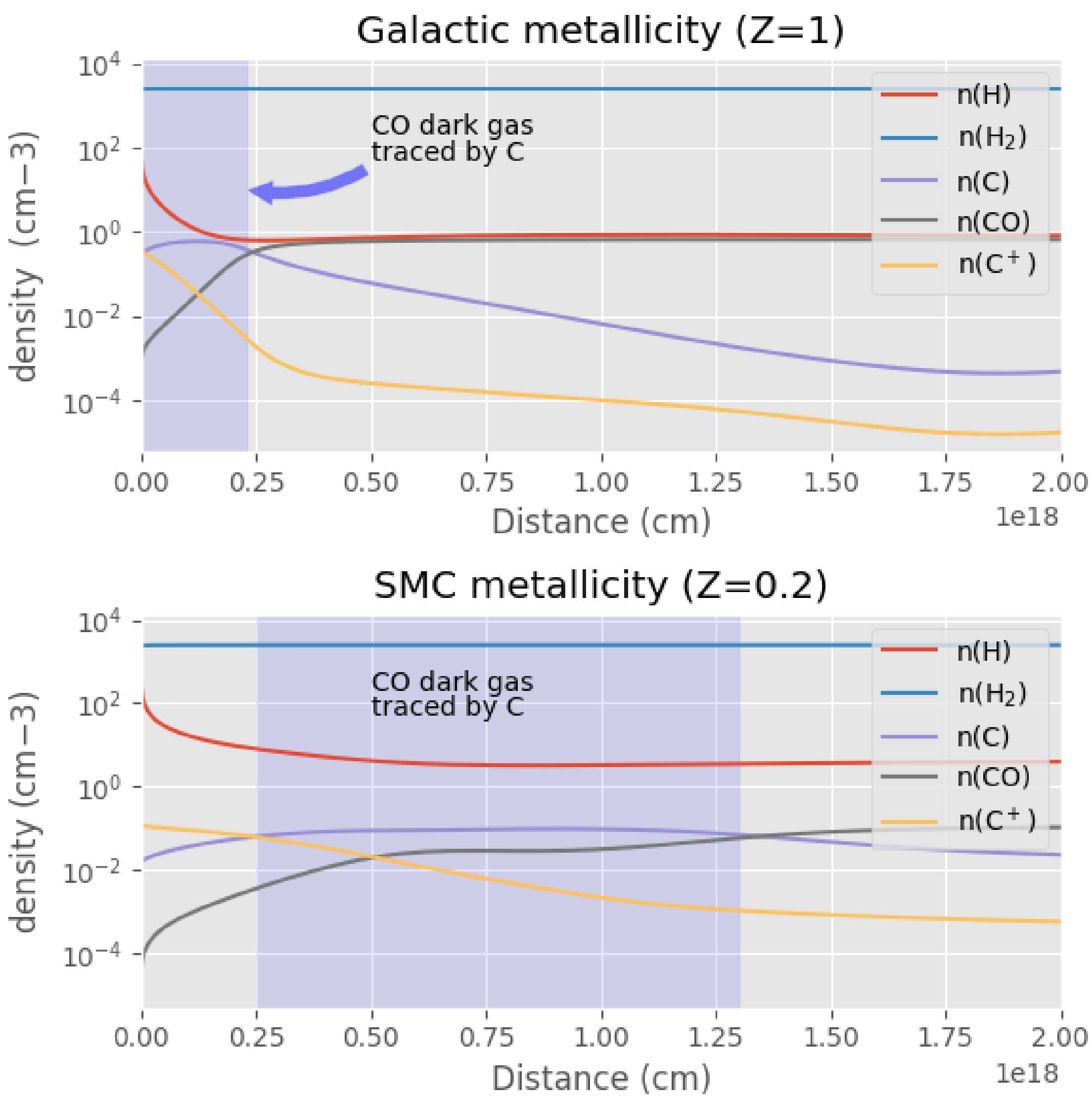
FIG. 2.—C I integrated intensity map of HCL2 (*color image*) superposed on the contour map of the $C^{18}O$ integrated intensity observed with the NRO 45 m telescope by Sunada & Kitamura (1999).

Magellanic Clouds

templates for high-z galaxies

Lower metallicities lead to larger regions of CO dark gas traced best by atomic carbon

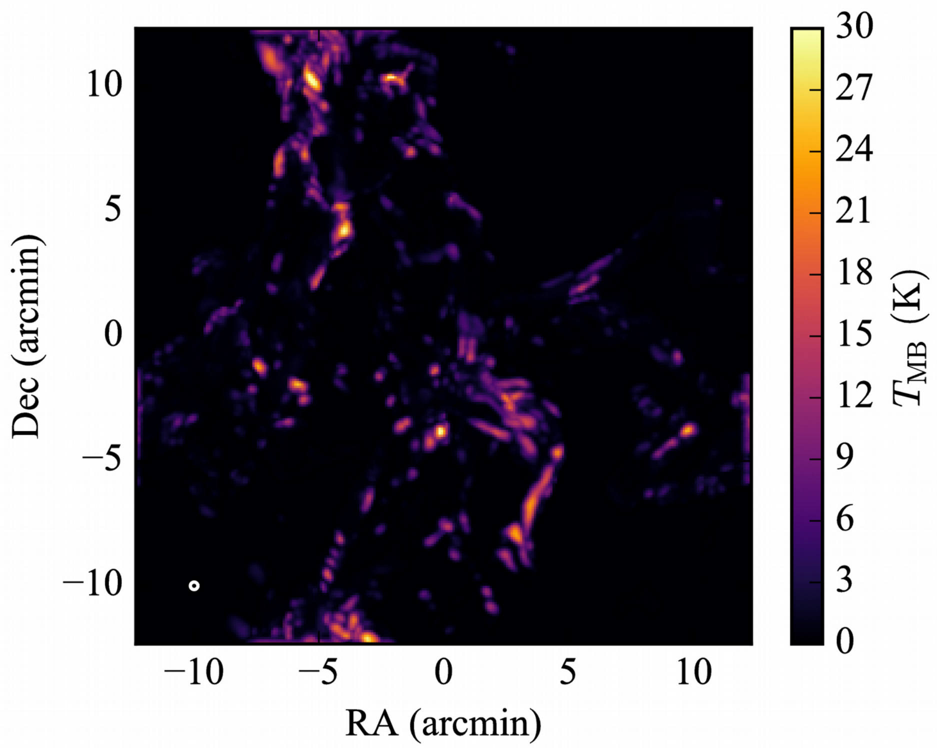
⇒ Atomic carbon traces the star-forming gas better than CO



Le Petit et al. 2006, http://ism.obspm.fr).

More GEco CCAT Science

- Turbulence dissipation in Molecular Clouds traced through high-J CO lines
- Multi-wavelength time variability due to episodic accretion (continuum, see talk by Doug Johnstone) with Prime-Cam



Predicted CO(6-5) emission from the simulation of Offner et al. (2014) for a molecular cloud observed by CCAT-p at 250 pc. (Simulation data courtesy of S. Offner)

GEco template surveys

See poster by Robert Simon

Survey	Line	Size (sq.deg)	rms (K)	Δv (km/s)	Beam (")	Percentile	Time (h)	Days (8 h)
Gal. Plane	CI(1-0)	200	0.25	0.5	26	50	1000	125
	CO(4-3)	200	0.25	0.5	26	50	400	50
LMC	CI(1-0)	64	0.10	1	26	50	1000	125
	CO(4-3)	64	0.10	1	26	50	395	50
SMC	CI(1-0)	20	0.10	1	26	50	310	39
	CO(4-3)	20	0.10	1	26	50	125	16
Gould Belt	CO(7-6)	30	0.25	0.25	16	25	800	100
	^{13}CO(8-7)	30	0.25	0.25	14	25	485	61
Zoom-ins	CI(2-1)	50	0.25	0.5	16	25	610	76
	CO(11-10)	1	0.25	0.5	10	10	96	12
	CO(13-12)	1	0.25	0.5	8	10	63	8
Nearby galaxies	Line	Size (sq.arcmin)	rms (K)	Δv (km/s)	Beam (")	Percentile	Time (h)	Days (8 h)
	CI(1-0)	10	0.01	1	26	50	4.5	--
	CO(4-3)	10	0.03	1	26	50	1.7	--
	CI(2-1)	10	0.006	1	16	25	30	--
	CO(7-6)	10	0.02	1	16	25	3	--