




ALMA
ATACAMA LARGE MILLIMETER ARRAY



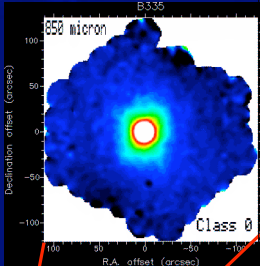
ALMA: Imaging the cold Universe
Great observatories May 2006
C. Carilli (NRAO)



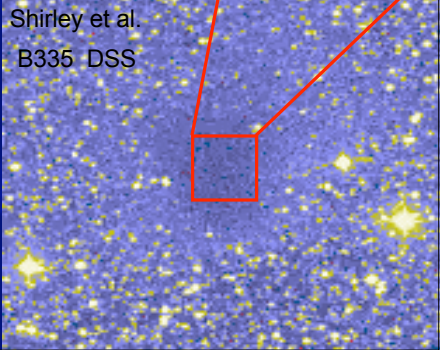
(sub)mm astronomy: unveiling the cold, obscured universe



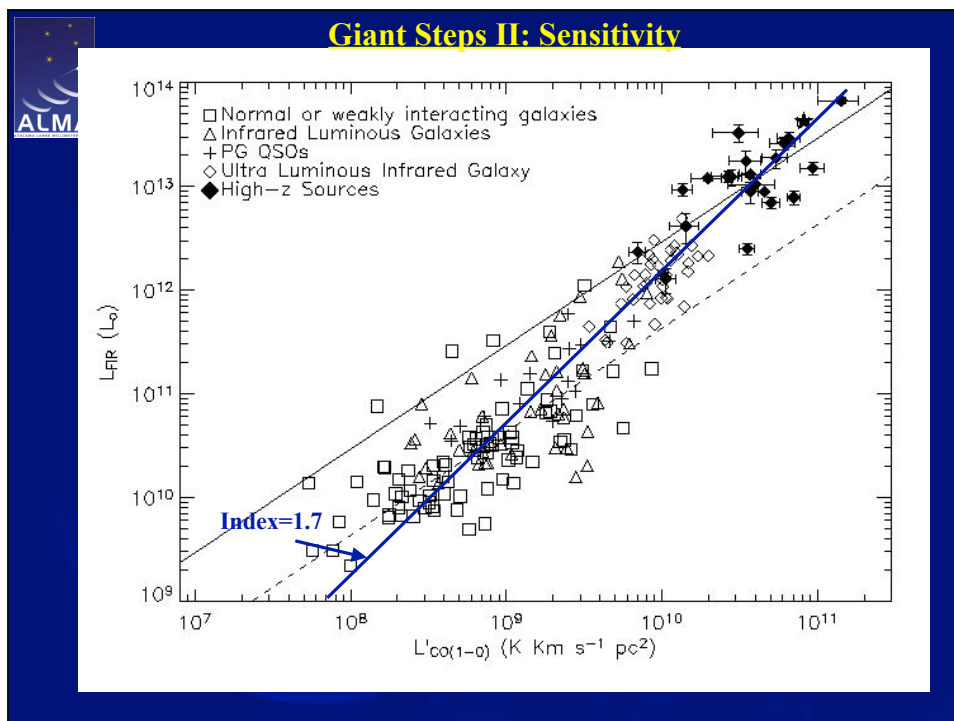
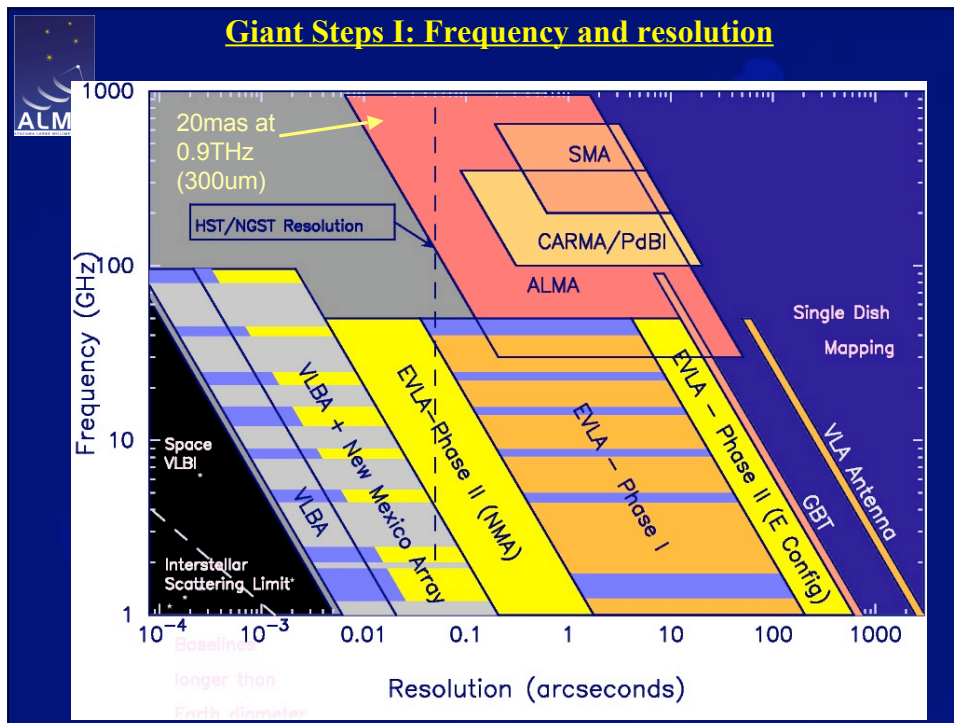
Wilson et al.
HST / OVRO CO

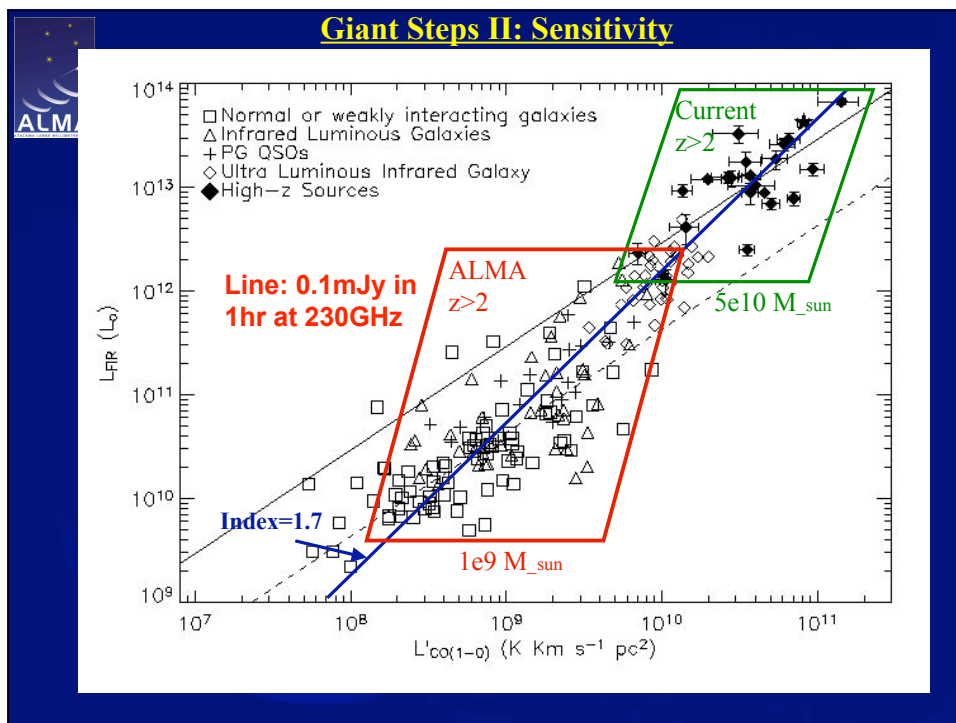
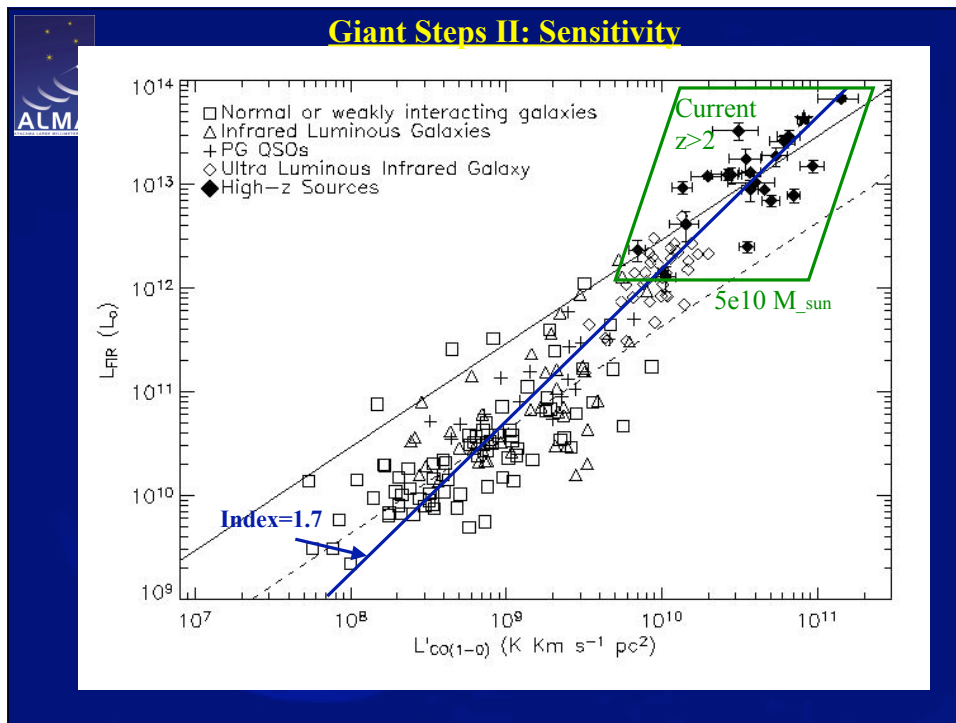


SCUBA
850 micron
B335
Class 0




Shirley et al.
B335 DSS



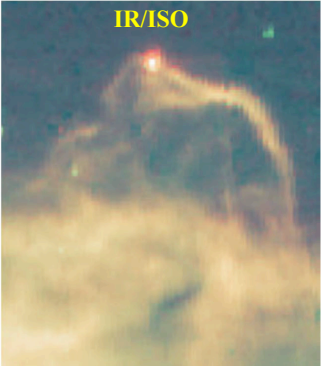


Giant Steps III: Image quality – 50+ ant, ACA, TP

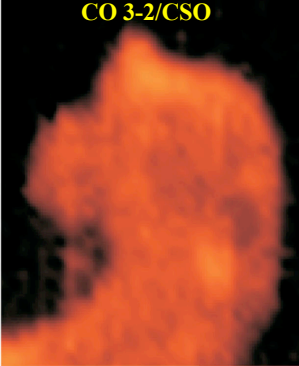
Optical/ESO



IR/ISO





CO 3-2/CSO

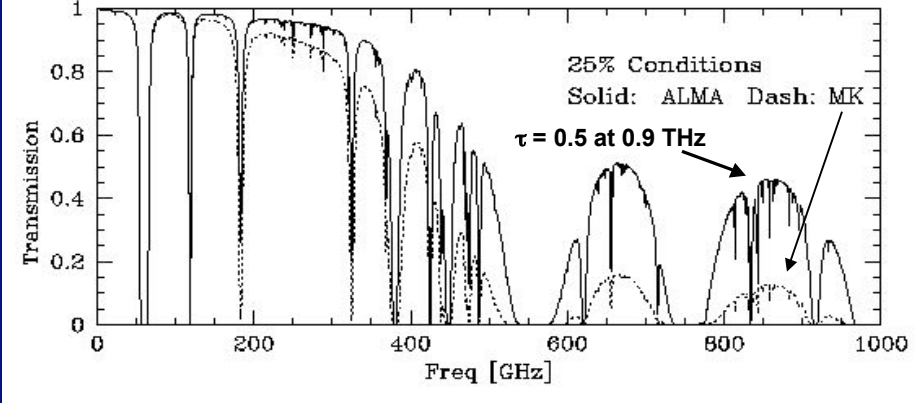


- $T_{\text{line}} = \text{sub-K}$ at 0.25 arcsec res.
- $T_{\text{cont}} = \text{mK}$ at 0.25 arcsec res.

Giant Steps IV: Site quality







25% Conditions
Solid: ALMA Dash: MK
 $\tau = 0.5$ at 0.9 THz

Birth of planets

Orion Trapezium
HST+SMA

Williams +

HST

- $M_{\text{planet}} / M_{\text{star}} = 1.0 M_{\text{Jup}} / .5 M_{\text{sun}}$
- Orbital radius: 5AU at 50pc distance
- Disk mass = circumstellar disk around the Butterfly Star in Taurus

ALMA 850 GHz

5AU Wolf

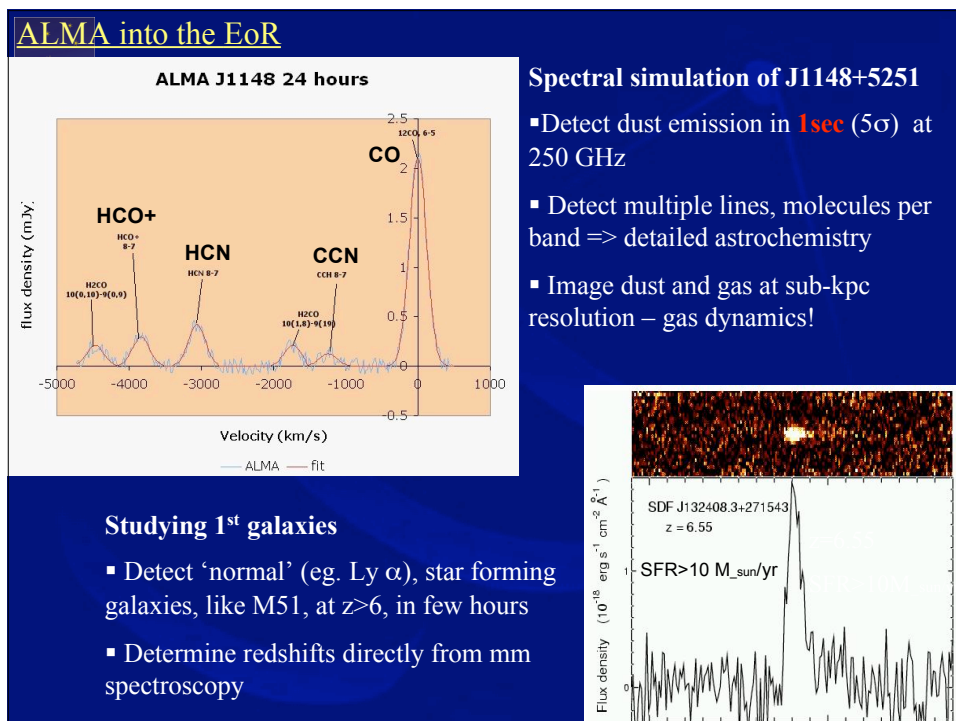
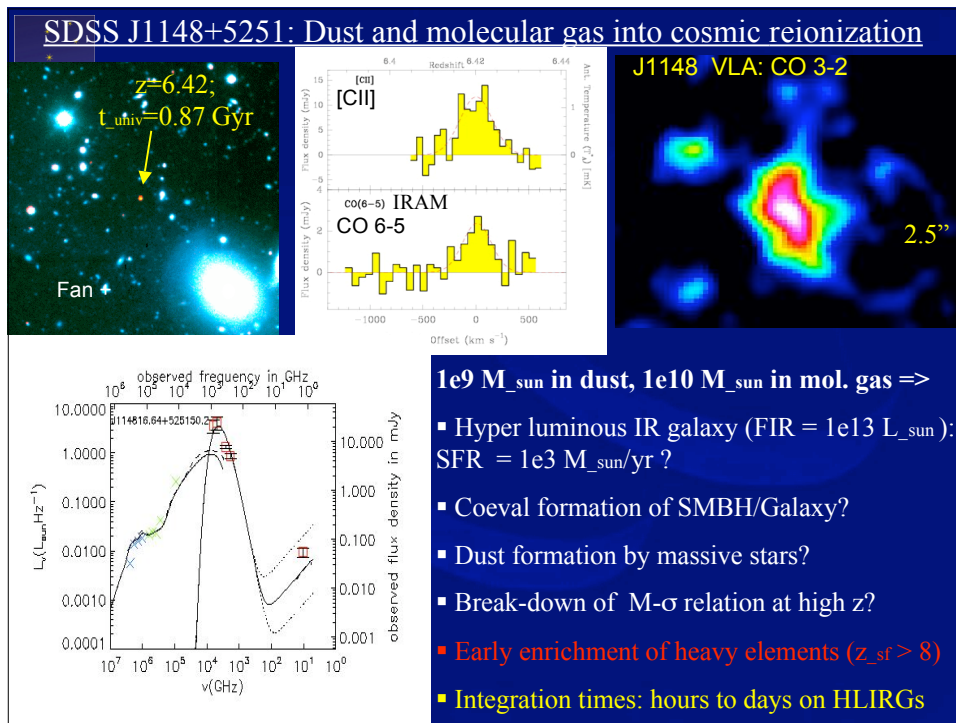
ALMA Deep field: 'normal' galaxies at high z

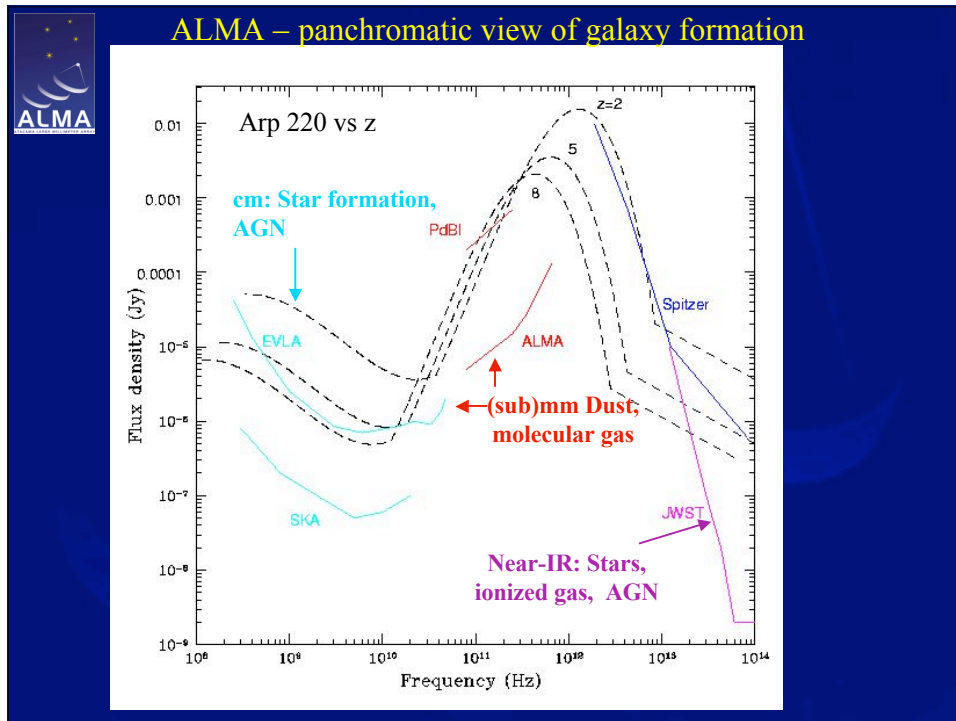
ALMA

Galaxies $z < 1.5$

Galaxies $z > 1.5$

- Detect current submm gal in **seconds!**
- ALMA deep survey: 3days, **0.1 mJy (5 σ)**, 4'
- HST: few 1000 Gal, most at $z < 1.5$
- ALMA: few 100 Gal, most at $z > 1.5$
- Parallel spectroscopic surveys, 100 and 200 GHz: CO/other lines in majority of sources
- Redshifts, dust, gas masses, plus high res. images of gas dynamics, star formation






ALMA Status

- Rebaselining: (50 + 4) x 12m + ACA - extensive reviews, antenna contracts signed, **NSB approved**
- Antennas, receivers, correlator all fully prototyped and evaluated: best mm receivers and antennas ever
- Site construction has started: Observation Support Facility and Array Operations Site

lle): gearing up for science


16 - 500m




What can the Great Observatories do for ALMA?

Targets


FoV(350 GHz) = 15''




<http://www.oan.es/alma2006/>




MINISTERIO DE FOMENTO



Atacama Large Millimeter Array



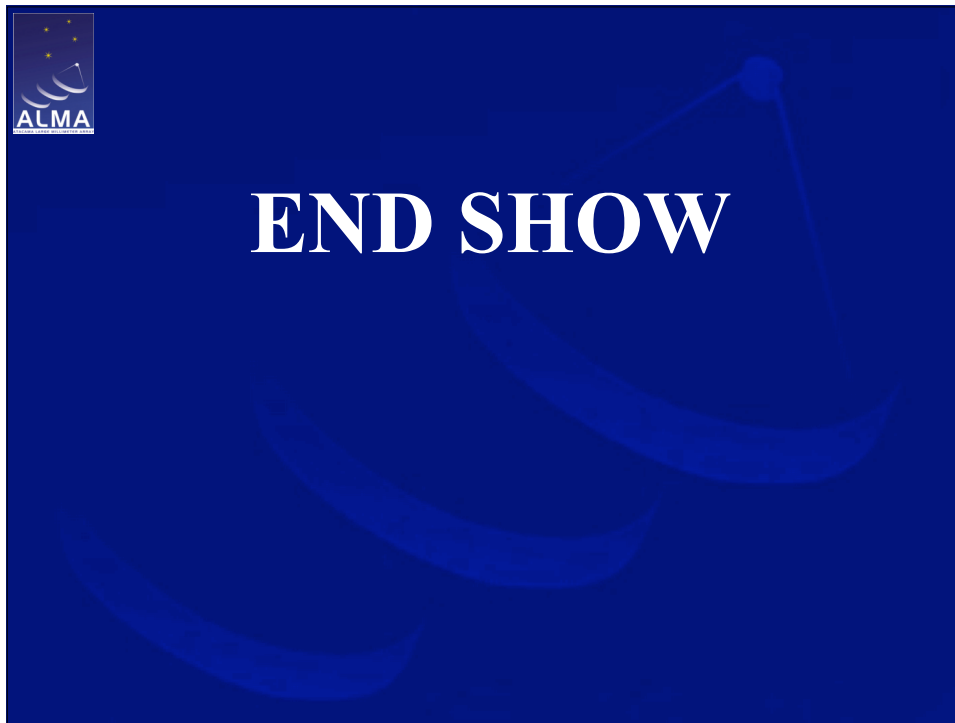
MINISTERIO DE EDUCACIÓN Y CIENCIA



Science with ALMA: a new era for Astrophysics

International Conference, 2006

13 - 16 November 2006
Madrid, Spain



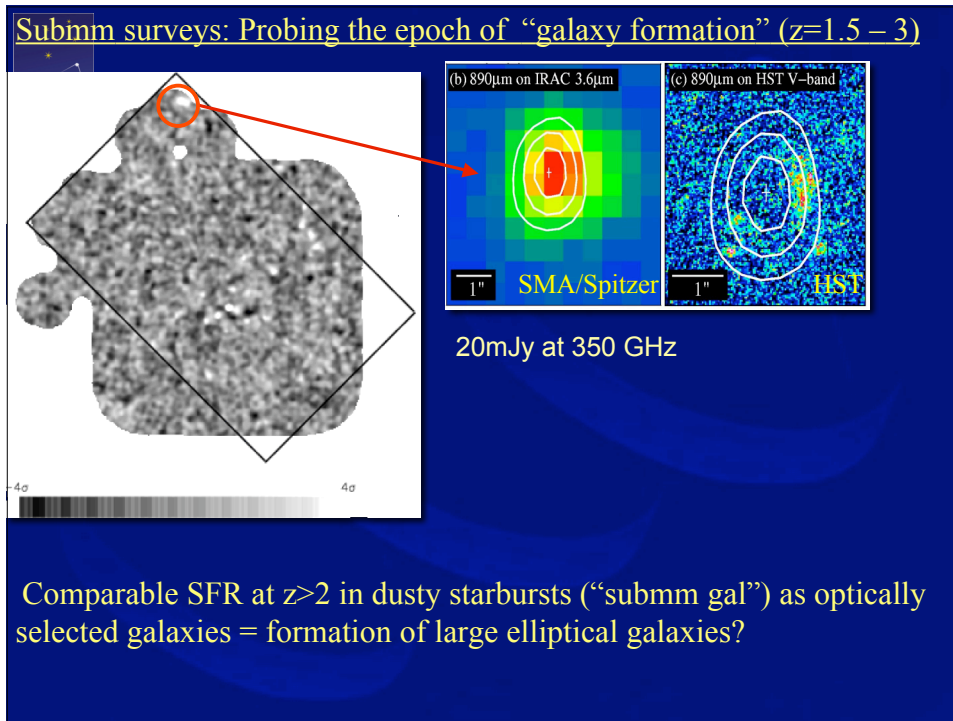
Birth of stars: physics/chemistry of star formation in 3D

Line confusion limited => new mode of operation: targeted line studies

- Select lines as probes of: density, temperature, excitation, evolutionary state, or dynamics
- Puts pressure on laboratory astrophysics, and data analysis/visualization S/W

Orion Nebula
CISCO (J, K' & Hz (v=1-0 S(1))
 Subaru Telescope, National Astronomical Observatory of Japan
 January 28, 1999

The plot shows the brightness temperature T_b^* (K) on the y-axis (0 to 20) versus Rest Frequency (GHz) on the x-axis (620 to 720). Two inset plots show zoomed-in views of the SO_2 -Band (661-668 GHz) and CH_3OH -Band (675-678 GHz). The main plot is filled with a yellow-green color gradient. Various molecular bands are labeled at the bottom: SiO, HCO⁺-SHF, CH₃OH-Band, CS, SO, SiO, C₂H₂, SO₂-Band, CH₃OH-Band, CS, CO, SiO, HCN, and HCO.



Summary of detailed requirements

Frequency	30 to 950 GHz (initially only 84–720 GHz)
Bandwidth	8 GHz, fully tunable
Spectral resolution	31.5 kHz (0.01 km/s) at 100 GHz
Angular resolution	1.4 to 0.015" at 300 GHz
Dynamic range	10000:1 (spectral); 50000:1 (imaging)
Flux sensitivity	0.2 mJy in 1 min at 345 GHz (median conditions)
Antenna complement	64 antennas of 12m diameter
Polarization	All cross products simultaneously

