25m Telescope

High Spectral Resolution – Heterodyne

Compare with ALMA

a). 1 x 25m vs 64 x 12m

b). Better Rx; Changeout; Arrays;
Larger IF bandwidth (20 GHz?)
Frequency-agile…..

c). Lower water vapor site; higher frequency operation.

2. Small beam (~2”) on sky implies narrow spectral lines,
e.g. Kolmogorov Δ v ~ l 1/3

ISM Δ v ~ .1km/s – 20 GHz IF at high resolution ALMA Correlator?

Better than ALMA for line-surveys (broad band).
Combination of better receivers (~x2), wider IF (~x2); better site (x2?) almost compensates for the larger area of ALMA. But ALMA cannot correlate all antennas at full IF, at 0.1km/sec

25m Telescope

High Spectral Resolution – Heterodyne

3. Telescope beam ~ 2”.

   a). Galaxy nuclei as continuum sources for absorption spectroscopy

   Synchrotron or dust?
   Galactic Center, 2’ at 10 Kpc/0.1” at 10 Mpc
   Cen A, other galaxies?

   b). YSO disks (1”-2”) – line-surveys!

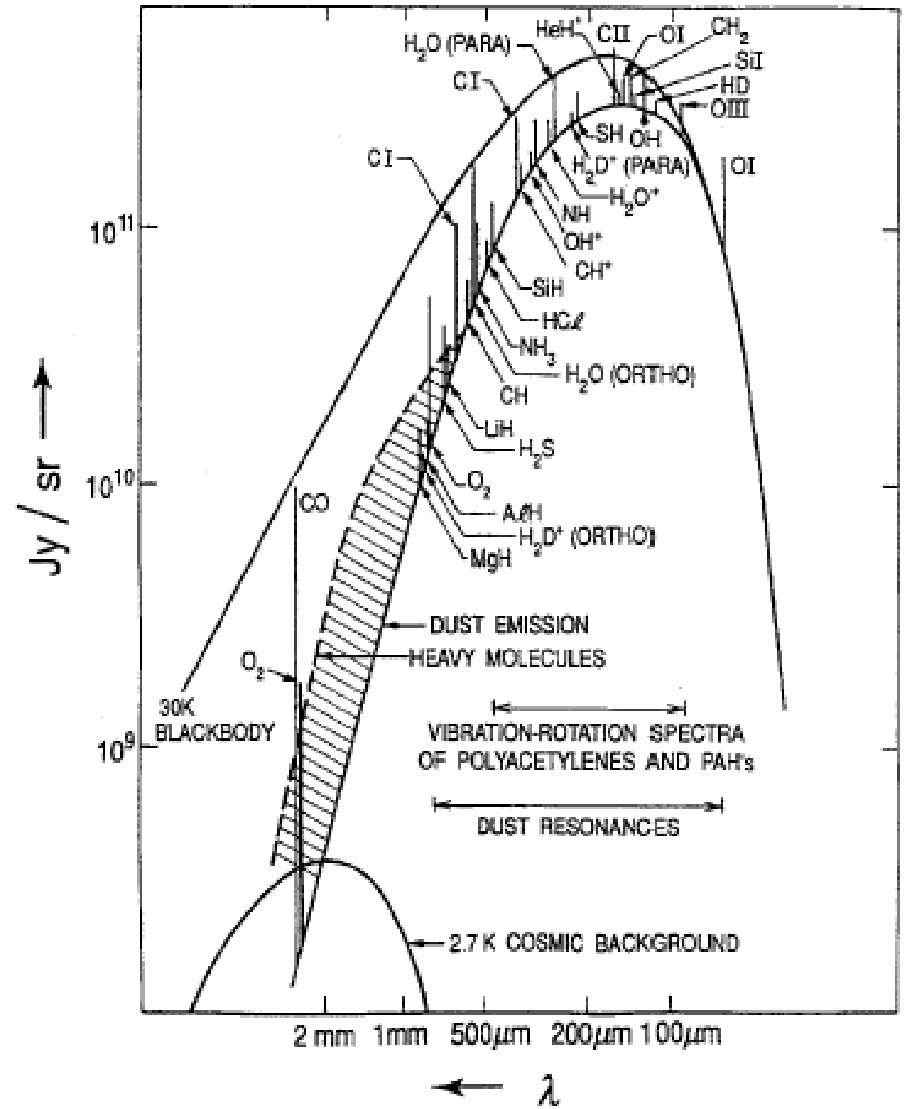
   c). ISM line-surveys need large IF/agile Rx/wide atmospheric windows/high frequency windows.

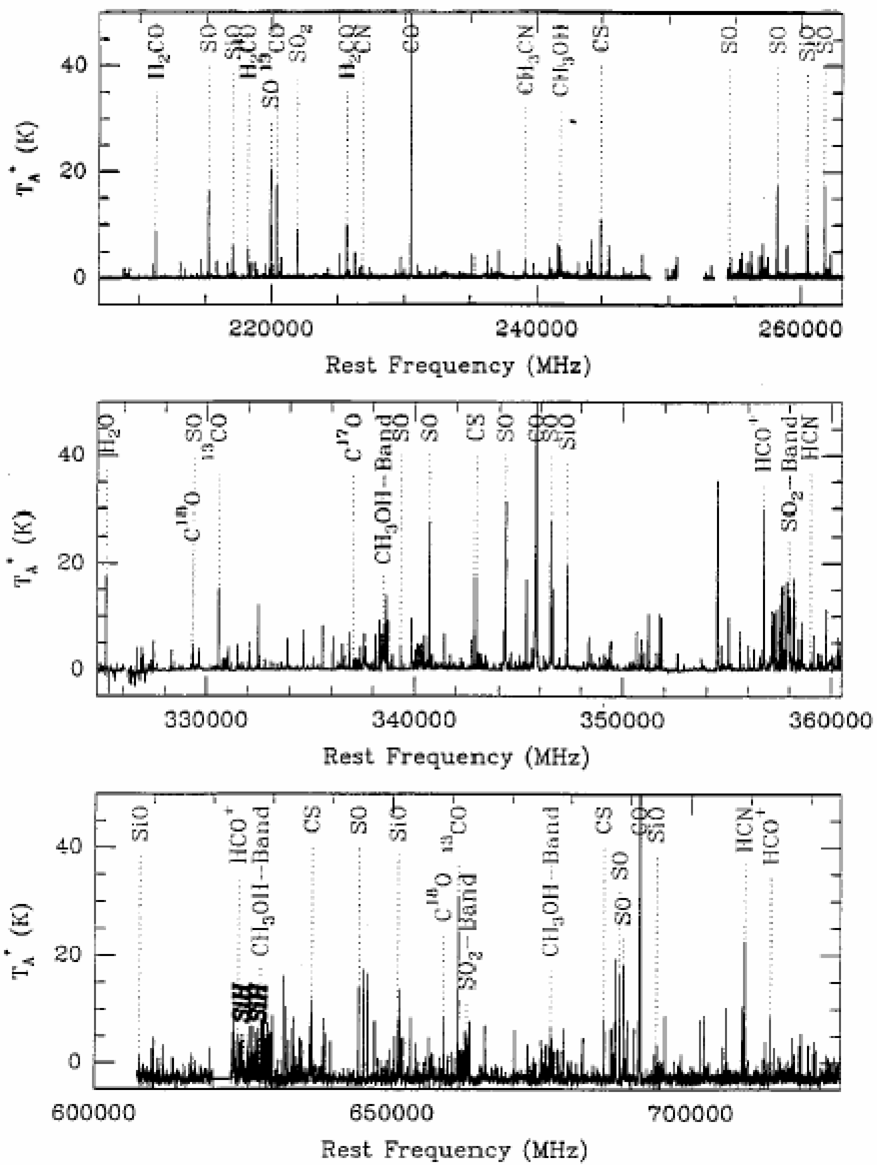
4. 25m suitable for zero spacing adjunct to ALMA.

5. Conclusion:

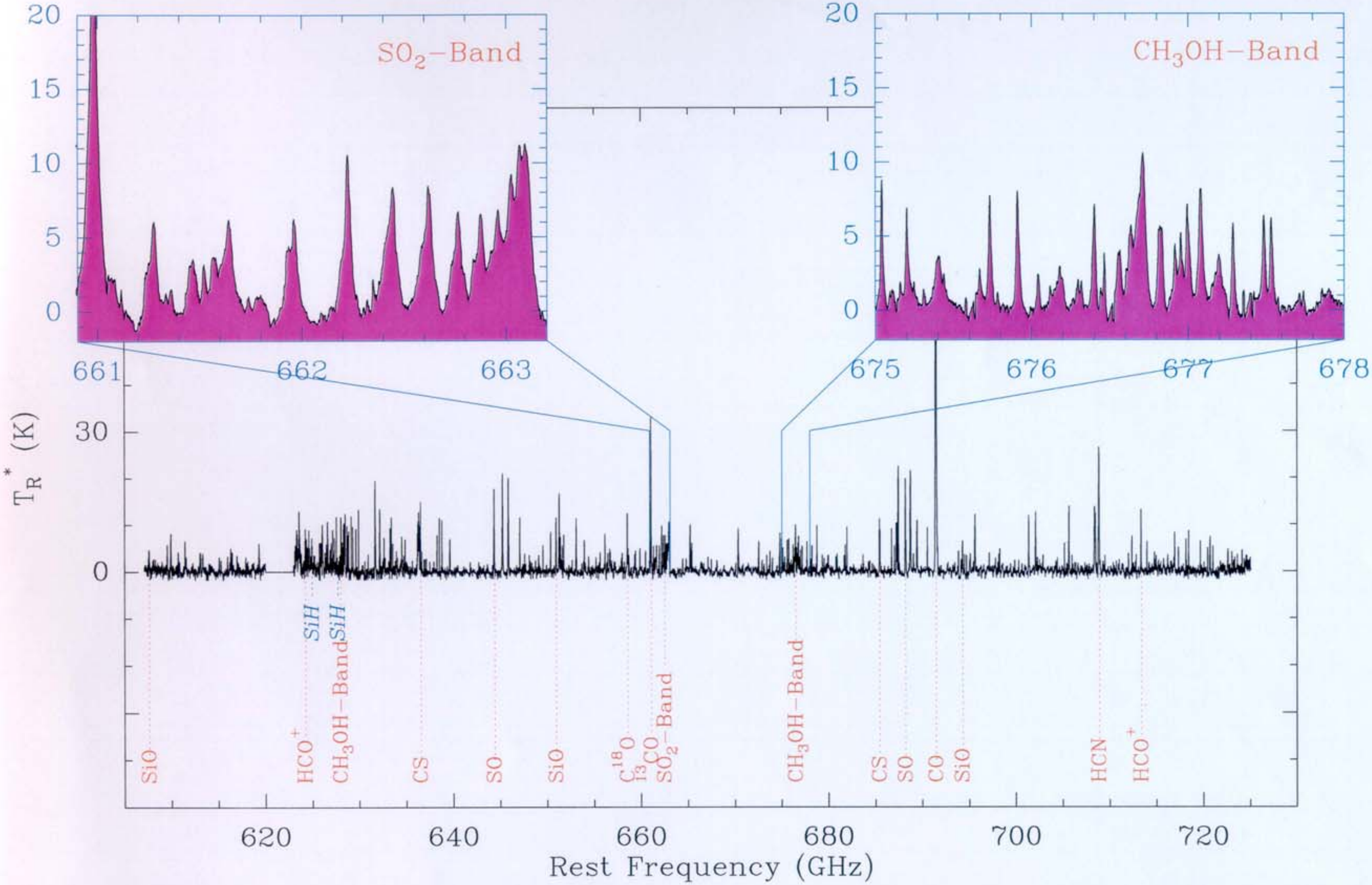
   2.5m is superior for high resolution line-surveys of YSOs and possibly galaxy nuclei absorption spectroscopy

Figure I.2 Submillimeter spectrum of a cloud from Phillips and Keene (1992).





Rest Frequency (MHz)
T_A^* (K)
220000
240000
260000
330000
340000
350000
360000
600000
650000
700000



SO2−Band
CH3OH−Band
661
662
663
675
676
677
678
TR* (K)
Rest Frequency (GHz)
SiO
HCO+
SiH
SiH
CH3OH−Band
CS
SO
SiO
C18O
13CO
SO2−Band
CH3OH−Band
CS
SO
CO
SiO
HCN
HCO+

New Receivers

High Sensitivity Receivers:	Gain in t (W.r.t. 90s)
Dual Polarization	2
On-off instantaneous subtraction	2
Sideband separation	~2
Cross-Correlation	?
Wideband IF (4 GHz; 20 GHz?)	4
Wideband back-ends	
High frequency – 3 THz (HEB)	-
Low noise – 2 h ν/k (SIS)	4
	> 100

New Advantages:

- >10 more sensitivity
- Fast line-surveys
- Wideband at high resolution (high spatial resolution=> high Spectral resolution) (Alma needs reduced baselines - full correlator mode?)

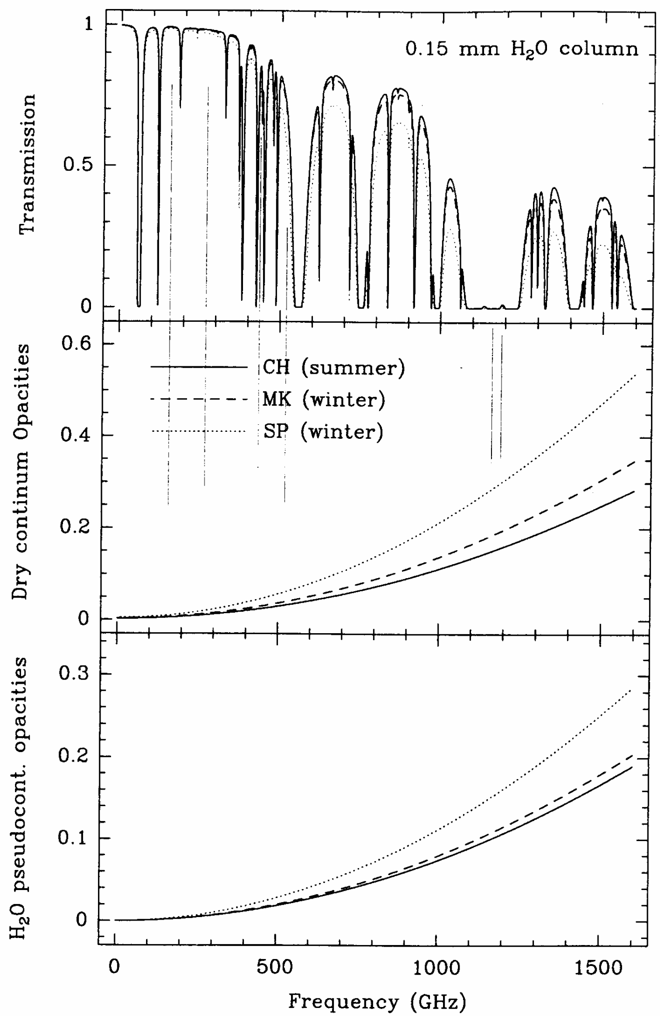


Fig. 3. Calculated atmospheric transmissions and continuum-like opacities for the three atmospheric profiles of Figure 2. Solid, dashed and dotted line indications apply also for the upper panel. Minor gases have been removed for clarity.

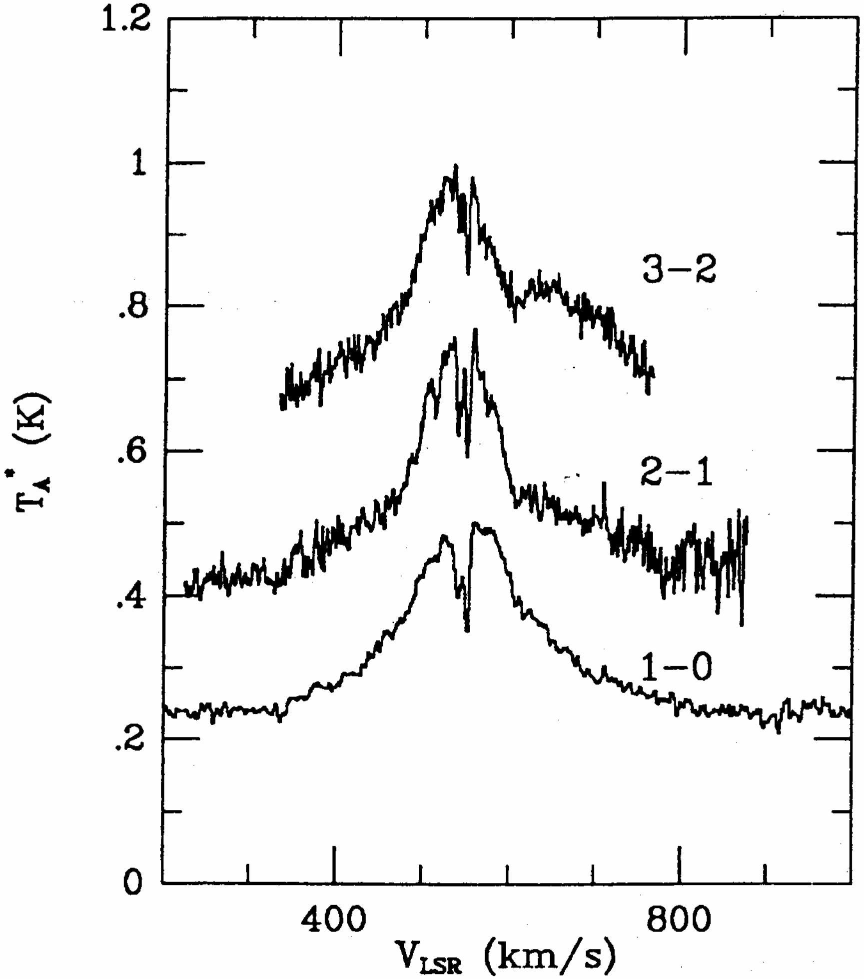


Fig. 1. ^{12}CO 1–0, 2–1 and 3–2 spectra toward the nucleus of Centaurus A, smoothed to 2.8, 0.9 and 0.9 km s^{-1} resolution. The 2–1 and 3–2 spectra have been shifted in T_A^* by +0.25 and +0.45 K respectively.

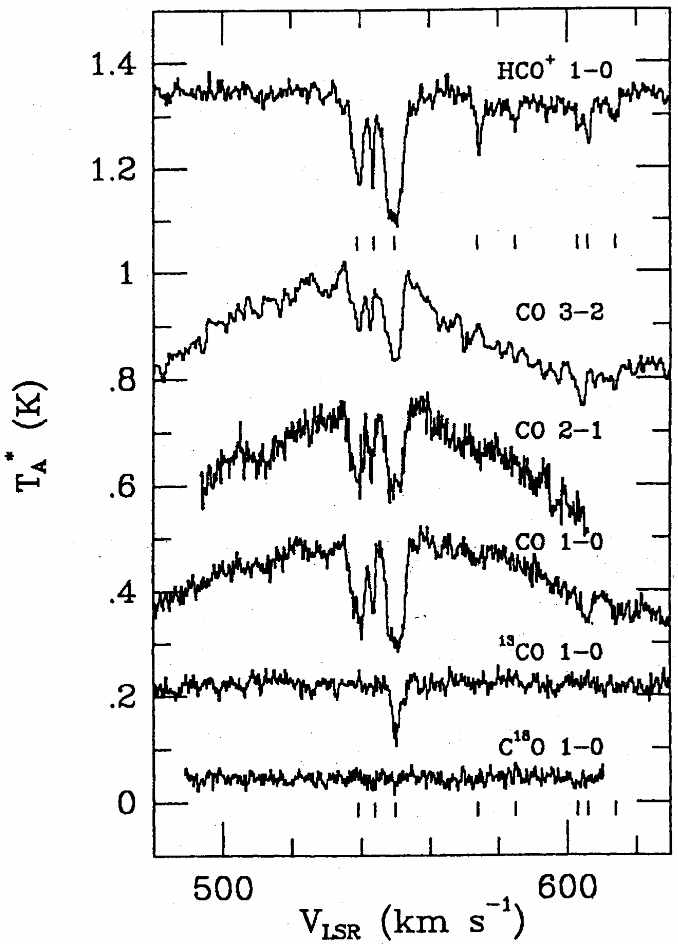


Fig. 2. High–resolution spectra of HCO^+ 1–0, ^{12}CO 3–2, 2–1 and 1–0, ^{13}CO 1–0 and $C^{18}O$ 1–0 toward the nucleus of Centaurus A. The spectra have been shifted in T_A^* by +1.05, +0.4, +0.25, 0.0, -0.05 K and -0.20 K, and have velocity resolutions of 0.29, 0.9, 0.23, 0.23, 0.23 and 0.23 km s^{-1}, respectively. Note the numerous absorption components in the HCO^+ spectrum at red–shifted velocities.