Table 1. Comparison of EVLA, ALMA for two NH_2D transitions

Array	**Resolution [ΔV]**[2]	**Synth Beam, Primary Beam**	**Integration**	**Sensitivity**
		49.9 GHz		
ALMA Compact	0.2 km s^{-1}	8".4, 127"	1 hr	1.8 mJy/bm; 0.01K
EVLA D array	0.2 km s^{-1}	1".6[3], 60"	1 hr	17 mJy/bm; 2.5K
EVLA D array	0.2 km s^{-1}	1".6, 60"	39 hr	2.7 mJy/bm; 0.4K
ALMA 0.8km	0.2 km s^{-1}	1".6, 127"	1 hr	1.8 mJy/bm; 0.4K
		43 GHz		
ALMA Compact	0.2 km s^{-1}	9".6, 145"	1 hr	1.7 mJy/bm; 0.01K
EVLA D array	0.2 km s^{-1}	1".6, 60"	1 hr	2.8 mJy/bm; 0.42K
EVLA D array	0.2 km s^{-1}	1".6, 60"	1 hr	2.8 mJy/bm; 0.42K
ALMA 0.9km	0.2 km s^{-1}	1".6, 145"	1 hr	1.7 mJy/bm; 0.45K

Notes:
[1]EVLA sensitivity calculator used for EVLA; ALMA sensitivity calculated for Trx 35K; Tsys 55K.
[2] 33, 37 and 57 kHz at 49, 43 and 29 GHz.
[3] Note that the arrays use different illuminations: EVLA is 1.03 λ/D (uniform) while ALMA is 1.17 λ/D (Gaussian). For ALMA, the OT uses 1.17 λ/D.

1. Deuteroammonia

NH_2D is an important monitor of grain destruction, as it cannot be created in gas phase chemistry at temperatures above 40K or so in substantial quantities. Detection of transitions between excited states likely arises from molecules newly released from grain surfaces into the gas by heating.

After the lowest energy transitions of ortho ammonia at 86 GHz and para ammonia at 110 GHz the strongest line observable at temperatures above 40 K in the millimeter region will be the ortho 2(2,0)-2(2,1) line at 49.96 GHz. At .25 to .4 of that line's strength is the 3(1,3)-3(0,3) 43 GHz line of para-NH2D, varying in strength according to excitation temperature and observable simultaneously with the 49.9 GHz line with the EVLA or with ALMA. A para 2(1,2)-2(0,2) line at 74 GHz and an ortho 3(2, 1)- 3(2, 2) line at 70 GHz can provide an equivalent ALMA thermometer when ALMA Band 2 becomes available. Thus it is a single observation diagnostic tool, but the sensitivity gradient for the EVLA compromises usefulness; with ALMA there is no strong sensitivity gradient. Other, higher energy transitions are available to the EVLA at 25 [4(1,4)-4(0,4)] and 18.8 [3(1,3)-3(0,3)] GHz. Many other transitions are available in other bands to ALMA.

For this exercise, a value of T_{sys} 53K was assumed for ALMA; the EVLA receivers are more like 50K. In the accompanying table, there are two sections, one for each frequency. In each section the first two lines refer to the most compact configuration for each array. The second two match the EVLA beam to the ALMA beam and calculate the integration time needed for the EVLA to match the ALMA brightness temperature sensitivity.

Fig. 1).

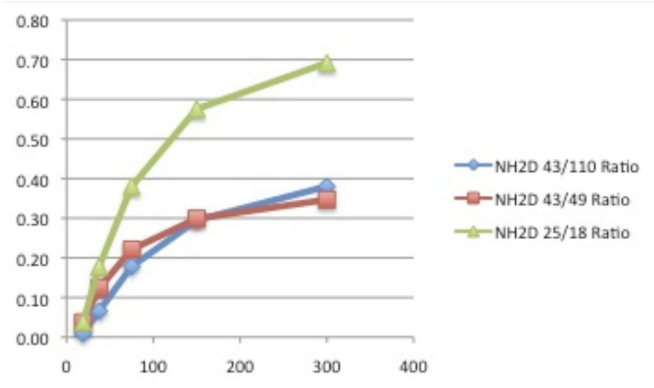

Figure 1. Ratios of lines of NH_2D as a function of temperature.

Table 2. Comparison of EVLA, ALMA for two H_2CO transitions

Array	Resolution [ΔV]	Synth Beam, Primary Beam	Integration	Sensitivity
		48. GHz		
ALMA Compact	0.2 km s^{-1}	8".4, 127"	1 hr	1.8 mJy/bm; 0.01K
EVLA D array	0.2 km s^{-1}	1".4, 60"	1 hr	7 mJy/bm; 0.9K
EVLA D array	0.2 km s^{-1}	1".4, 60"	4.3 hr	3.3 mJy/bm; 0.5K
ALMA 0.9km	0.2 km s^{-1}	1".4, 127"	1 hr	1.8 mJy/bm; 0.5K
		29 GHz		
ALMA Compact	0.2 km s^{-1}	...	...	out of band
EVLA D array	0.2 km s^{-1}	1".4, 60"	1 hr	1.3 mJy/bm; 0.2K
EVLA D array	0.2 km s^{-1}	1".4, 60"	4. hr	0.7 mJy/bm; 0.1K
ALMA 0.9km	0.2 km s^{-1}	...	...	out of band

Notes:
[1]EVLA sensitivity calculator used for EVLA; ALMA sensitivity calculator for ALMA

2. Formaldehyde

The H2CO 312-313 (29GHz) and 413-414 (48GHz) transitions provide excellent densitometers for the interstellar medium. Other lines available to ALMA include 514-515 (72GHz) and 615-515 (101GHz)

Observations were recently reported (McCauley et al. 2011) of the two 7mm transitions of formaldehyde toward 23 well-known molecular clouds, made with the GBT. Adopting kinetic temperatures from the literature, the authors have employed a Large Velocity Gradient (LVG) model to derive the average hydrogen number density [n(H2)] within a 16" beam toward each source. Densities in the range of $10^{5.5}$ to$10^{6.5}$ cm^{-3} and ortho-formaldehyde column densities between $10^{13.5}$ to$10^{14.5}$ are found for most objects, in general agreement with existing measurements. This study represents the first detection of these H2CO K-doublet transitions in all but one source. The ease with which these transitions were detected, coupled with their unique sensitivity to spatial density, make them excellent monitors of density in molecular clouds for future experiments.

For low mass star forming regions, typical GBT brightness temperatures are 40mK within this sample. To reach this level at 5 sigma will take 4 hours with the EVLA for typical winter conditions. Of course for a point source the line could be 10K making detection with the EVLA feasible.

For this exercise, a value of T_{sys}=33K was assumed for ALMA. In the following table, there are two sections, one for each frequency. In each section the first two lines refer to the most compact configuration for each array. The second two match the EVLA beam to the ALMA beam and calculate the integration time needed for the EVLA to match the ALMA brightness temperature sensitivity. In molecular clouds, the higher frequency line is normally not as strong as the lower frequency line. Very long integrations would be required to match brightness temperature sensitivity in the two transitions using the EVLA.