Astrometry with ALMA

ALMA can detect nearby stars!

Spectral Type	Number of stars in the whole CNS3 (mostly d $\leq$ 25 pc)	Number of stars in the CNS3 at d $\leq$ 10 pc	Number of stars detectable by ALMA	Fraction of the CNS3
O	0	0	0	0 %
B	3	1	2	66 %
A	69	5	54	78 %
F	266	11	158	59 %
G	495	30	125	35 %
K	824	57	71	9 %
M	1804	291	36	2 %
Total	3461	395	446	13 %

Table 1 : Distribution of spectral type in the catalogue CNS3. Distribution of stars detectable by ALMA above 0.1 milliJansky at 345 GHz. For some stars, the catalogue provides only approximate spectral types that have been interpreted in our analysis as the following : a-f=F0, f=F5, f-g=G0, g=G5, g-k=K0, k=K5, k-m=M0, m=M2, m+=M6.

Lestrade (2003)

$$\dot{\phi}_{\max} \approx 0.2(\mathrm{mas/yr}) \left(\frac{d}{10\mathrm{pc}}\right)^{-1} \left(\frac{m_p/M_*}{10^{-3}}\right) \left(\frac{M_*}{1M_\odot}\right)^{0.5} \left(\frac{r_p}{10\mathrm{AU}}\right)^{-0.5}$$

Astrometry Observations ?

- **Astrometric Accuracy ≈ (λ/D_{max})/SNR ≈ 0.1 θ_{beam}**
- **ALMA Specification: ≈ 0.01” = 10 mas**
- **“ALMA Extended Array” (proposed by Kameno+)**
  - add ~6 antennas, up to ~300km Baseline
  - θ_{beam} ~ 0.6 mas
- **(Mass, Period) of the planet**
  - R (or ρ) may also be derived if the emission of the planet is detected ....

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Science Target for ALMA extended (BL≈ 300km) Array ?

SKA

Did you know ...

The SKA will be so sensitive that it will be able to detect an airport radar on a planet 50 light years away.

(SKA Web Page)

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The SKA Science Case
(in Design Reference Mission)

1. Probing Dark Ages and Epoch of Reionization

2. Galaxy Evolution, Cosmology and Dark Energy

3. The Origin and Evolution of Cosmic Magnetism

4. Strong Field Tests of Gravity using Pulsars and Black Holes

5. The Cradle of Life

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Pre-biotic Molecules in PP Disks

Table 3.1. Examples of Detected Transitions of Complex Organic Species at Frequencies Below 10 GHz

Species		Transition	Frequency (MHz)	Reference
Formamide	$HCONH_2$	3_{12}-3_{13}(= 4 – 4)	9237.03	Hollis et al. (2006b)
Acetamide	CH_3CONH_2	2_{20}-2_{11} A	9254.42	Hollis et al. (2006b)
Acetaldehyde	CH_3CHO	1_{10}-1_{11}E...	1849.63	Hollis et al. (2006a)
		1_{11}-2_{02}A…	8243.46	
Cyanoformaldehyde	CNCHO	5_{15}-6_{06}	2078.068	Remijan et al. (2008)
		7_{07}-6_{16}	8574.116	
Cyclopropenone	c-H2C_3O	7_{25}-7_{26}	8373.74	Hollis et al. (2004a)
		3_{12}-3_{13}	9263.46	
Ketenimine	CH_2CNH	$9_{1,8}$-$10_{0,10}$ (= 9-10)	4929.92	Lovas et al. (2006)
		$9_{1,8}$ -$10_{0,10}$ (= 10-11)	4930.49	

Molecular Transitions recently detected toward Sgr B*

N = (0.5-10)× 10^{17} cm^{-2}

Relative Abundance ~ 10^{-10} - 10^{-9}

Not easy even for SKA; require ~12-hr integ. at 0.5” ??