

Cyanopolyynes Chemistry towards HMSF Regions

7mm spectroscopy at MOPRA

Nick Tothill (Exeter/UNSW)

Michael Burton (UNSW)

Mark Wardle & Jackie Chapman (Macquarie)

Andrew Walsh (JCU), Tom Millar (QUB), Cormac Purcell (JBCA)

Cyanopolyynes

- $\text{HC}(2n+1)\text{N}$, i.e. HC_3N , HC_5N , HC_7N ...
- Cold ($< \sim 10\text{K}$), dense, dark, undisturbed gas eg Taurus (Hirota & Yamamoto 2006, Rathborne et al 2008)
 - also CCS , C_nH , C_nH_2 (eg C_5H)
- warm cloud chemistry
 - found around low-mass YSOs (Sakai et al 2008)
 - dominated by hydrocarbons (C_4H , C_6H , C_6H_2)

Cyanopolyynes and HMSF

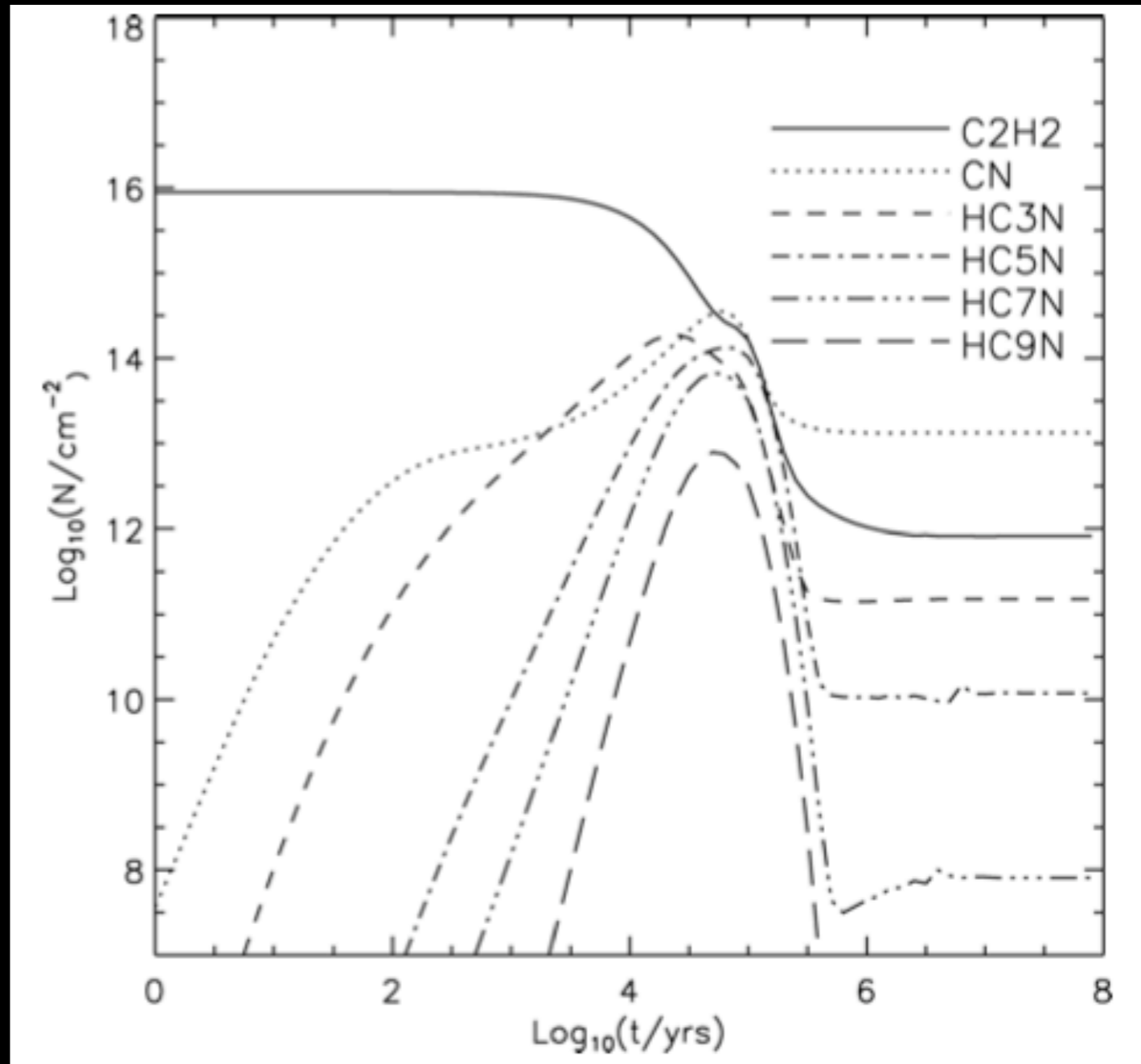
- MGB searched for HC5N towards candidate hot-core regions with Tidbinbilla 34m at 7mm...
- ...and found it in about a third.
- but hot cores are dominated by saturated species eg CH3OH, CH3CN...

What are they doing there?

- cold clouds in the beam
- warm clouds in the beam
- hot-core cyanopolyynes chemistry
 - based on acetylene (C_2H_2) released from dust grains by the YSO switch-on

Chemical Diagnostics

- Models suggest patterns of chemical abundances
- HC(5,7,9)N correlated
- HC3N may be found on its own
- C4H, C4H2
- chronology...?



Chapman et al 2009

7mm survey

- all of the molecules implicated in these chemistries have 7mm transitions
 - $\text{HC}(2n+1)\text{N}$, C_4H , C_4H_2
 - CCS , C_5H
 - C_6H
- we can use the new MOPRA 7mm system
 - Usable in worse weather than 3mm
 - But still very new...

Spectral setup (I)

LSB: 34 GHz

16 windows in groups of 4
20m integration

HC9N 30.213		H57a 34596	
HC7N 30.455		HC5N 34614	} CH3OH 36164
HC9N 30.794		C6H 34654-8	
C6H 31881-5	} HC9N 32537	C4H2 35577	H56a 36466
HC5N 31951		HC7N 32711	C4H2 35727
HC9N 31956	CCS 33751	C5H 35803-7	} HC7N 37223
	HC9N 33699	HC9N 36023	
	HC7N 33839	C5H 36048	} C4H 38050-88
		HC7N 36095	

Spectral setup (2)

USB: 46 GHz
40m integration

HC5N 42602	CCS 43981		
HCS+ 42674	HC7N 43991	}	
HC7N 42863	CH3OH 44069		
SiO 43424	HC7N 45119		
	HC5N 45264		
	H52a 45454	}	
	HC3N 45488-92		
		HC7N 46246	HC5N 47927
		HC7N 47374	H51a 48154
		C4H 47567-605	C34S 48207
		HC9N 47643	OCS 48652
			CS 48991

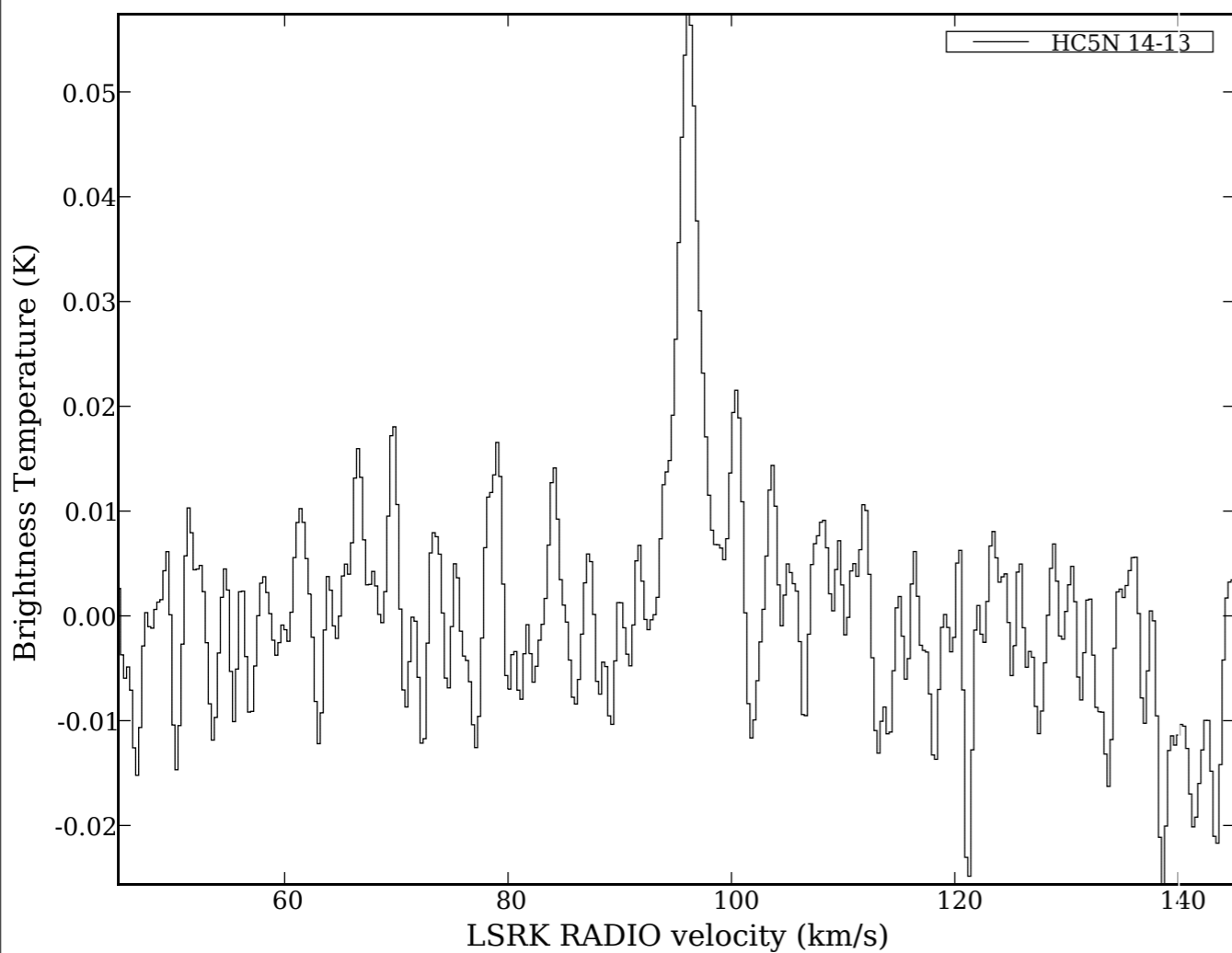
Preliminary Results

- 8 shifts in March/April 2009
 - 1 lost to weather/technical problems
- The system works well at 20-30mm pwv
 - but baselines much better $< \sim 25$ mm pwv
- $T_{\text{sys}} \sim 100\text{K}$

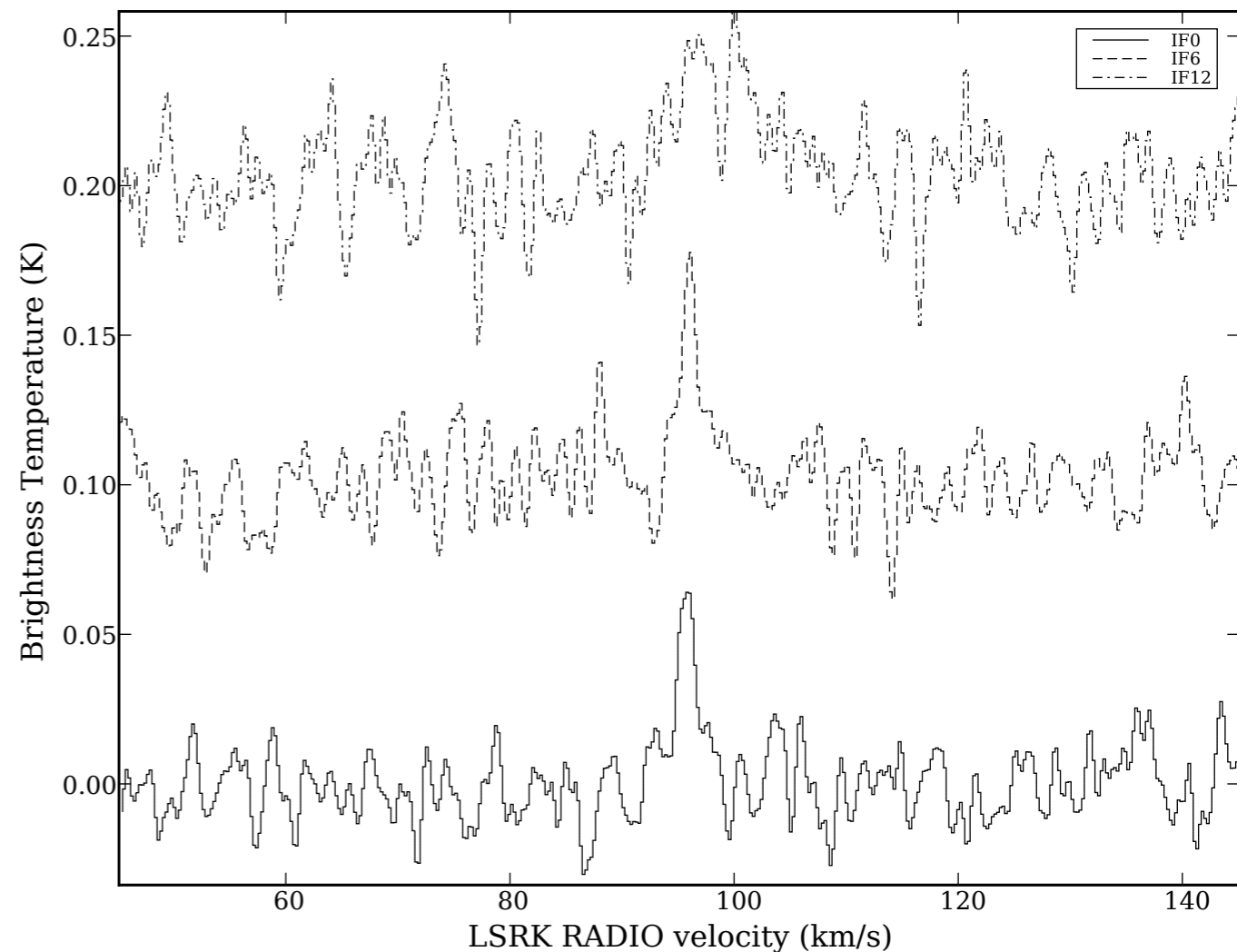
Preliminary results

- 84 methanol masers, 53 probable hot cores (CH₃CN)
- 35 surveyed, 22 detected in HC5N
- e.g. G28.20-0.05 at 28mm pwv

G28.20-0.05 - HC5N - 37GHz



G28.20-0.05



Next Steps

- Finish the survey
 - calibrate the data
 - column densities, Boltzmann diagrams, hyperfine analysis etc
- 12mm transitions?
- ATCA for positions?

Perspectives

- 7mm is a useful waveband, highly accessible
- Some molecules are exotic, but may turn up more often than you think...
- Frequency coverage is important
 - multi-frequency
 - 45-50 GHz
- Multi-beam arrays...?