The UNSW–CSIRO Millimetre Collaboration:

An overview of the Star Formation Program

Michael Burton

UNSW / CSIRO Collaboration

- MNRF-funded upgrade to ATCA (1997)
- UNSW SIP grant (1999-2001):
  - Extend dish to 22-m for mm-capable performance
  - Operate over mm “season”
- Research Tool
- Teaching Tool *(how to get money from a university)*
  - MM astronomy
  - Using a telescope (“Black Box” national facilities!)
- Extended for 2002 through UNSW RIBG

UNSW / CSIRO Collaboration

- 3 hands-on workshops help at Mopra / SSO

  ~ 20 students / postdocs / academics trained in mm's

- ARC LIEF awarded for 2003/04:

  8 GHz Digital Filterbank (+ Engineering Friend)

  UNSW / CSIRO / U Sydney / Monash

- New science opportunities:
  - Extra-galactic molecular lines
  - High-z (ie uncertain wavelength)
  - Multiple lines
  - MM-continuum

The Mopra 22-m Millimetre-Wave Observatory

- The biggest in the South
- Soon to be the only significantly sized 3-mm capable system too!

Mopra Operations

- MOU between UNSW & CSIRO
  - 3-4 month mm “season”
  - VLBI, then split between UNSW and Ope[illegible]
  - Maintenance/support/operations
    (Ramesh Balasubramanyam, Lucyna Kedziora-Chudczer)
  - Documentation, communication, software

    www.phys.unsw.edu.au/astro/mopra
- Maintenance and Upgrades
  - Pointing, Surface, Coma, Tuning, Correlator, MMIC
  - An ongoing story…...

Wait for Lucyna's talk!

The Multi-wavelength Milky Way

Optical

Near-Infrared (1–3.5μm, COBE)

Far–Infrared (12–100μm, IRAS)

Methanol Masers (6.6 GHz)

Sites of massive star formation

Pestalozzi, 2002

HII Regions and Molecular Cores

Component	n (cm^{-3})	R (pc)	T (K)	State
(compact) HII region	10^2	>1	10^4	Ionized
Ultra-compact HII (UCHII)	10^4	0.1	10^4	Ionized
Hyper-compact HII region (?!)	10^6	0.01	10^4	Ionized
Hot Molecular Core (HMC)	10		10	Organic Molecules

What's happening here?

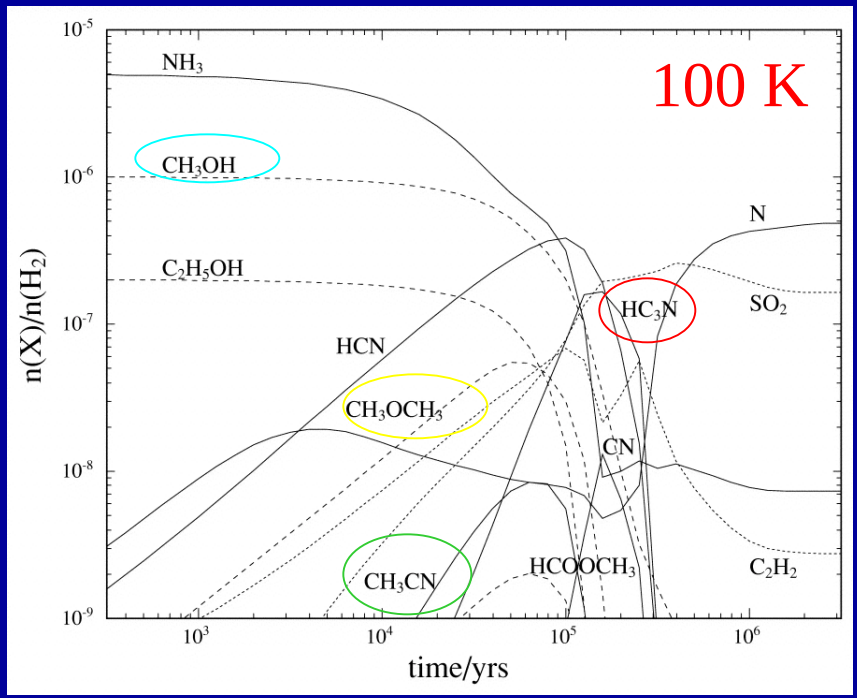
Time-dependent Chemical Signatures?

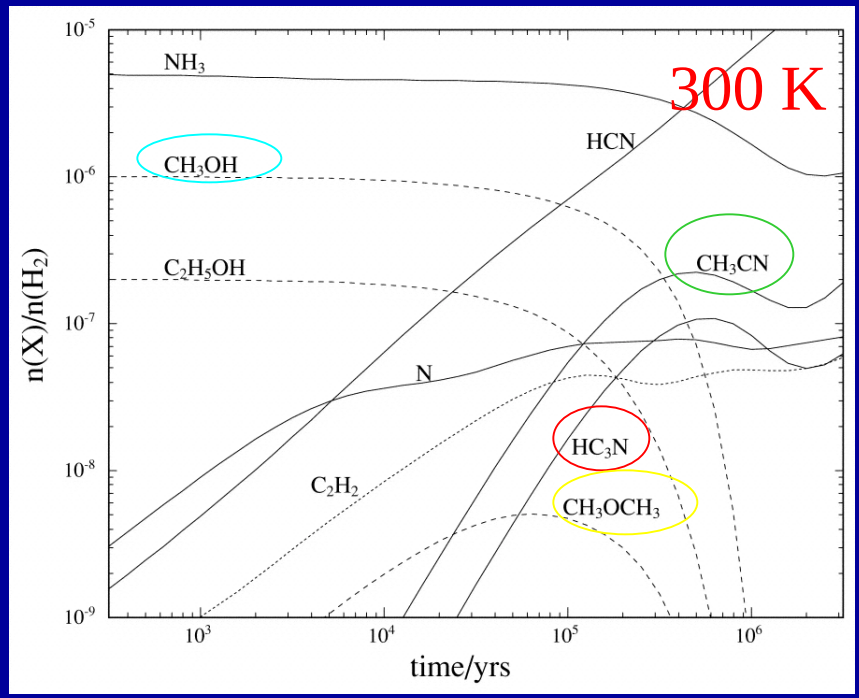
N-rich or C-rich?

CH_3CN CH_3OH

HC_3N CH_3OCH_3

Is there a signature of the progress of star formation? Need to constrain the chemistry with observations!





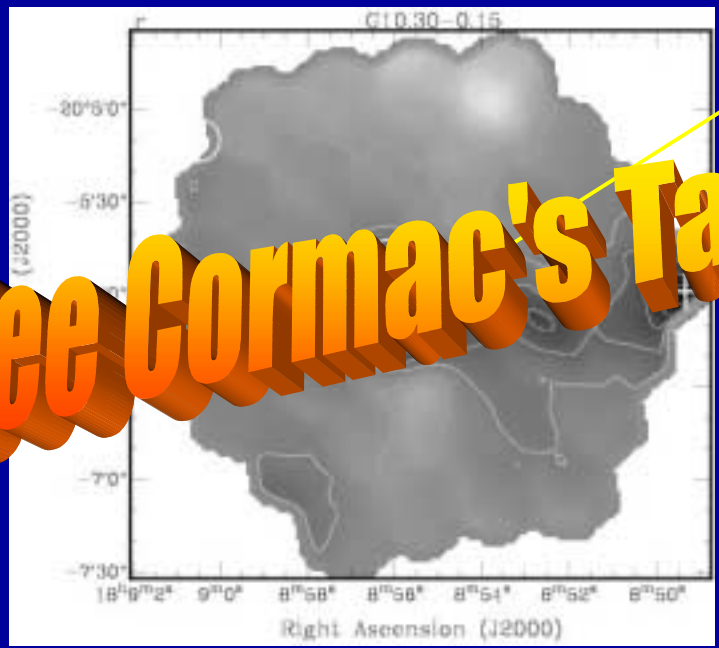
Abundance

Time

Rodgers & Charnley, 2001

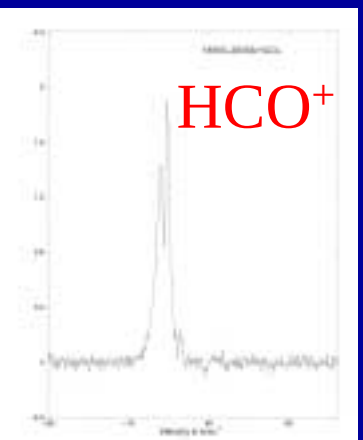
Ammonia injected from ice

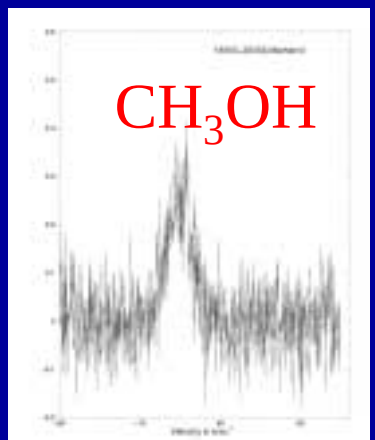
Hot Core Chemistry in 18060-2005A

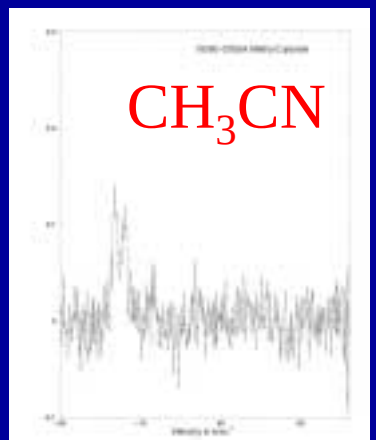


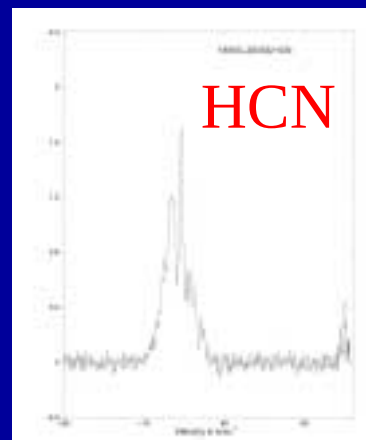
See Cormac's Talk

850μm



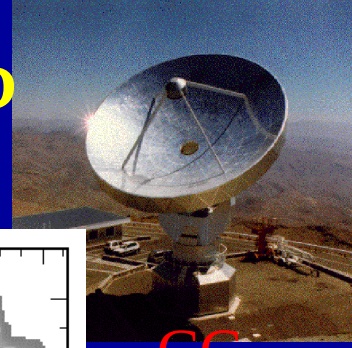






A sequence of mm cores?

850μm Images



JCMT

HMC

CC

HMC

UCHII

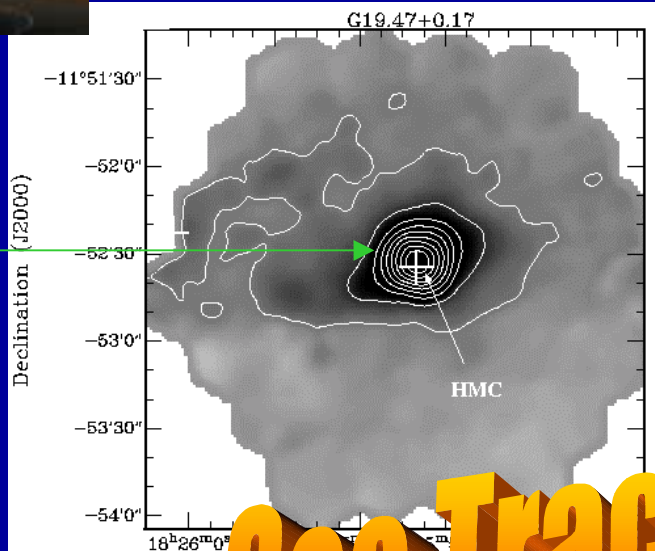
CC

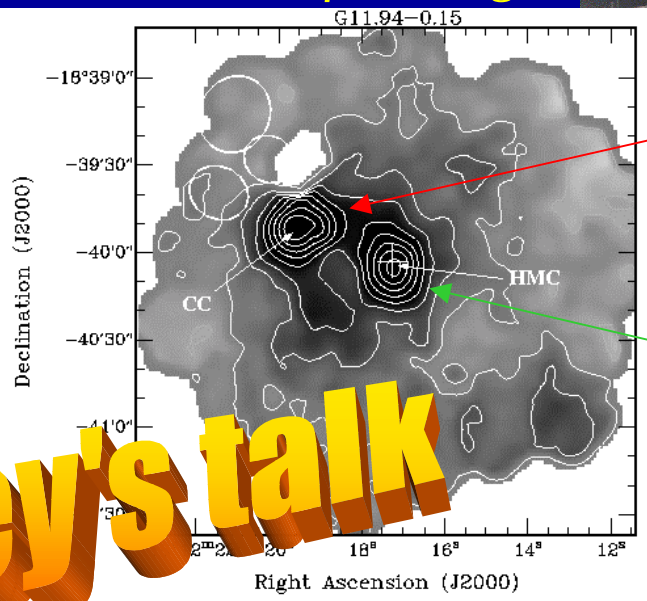
SEST

HMC

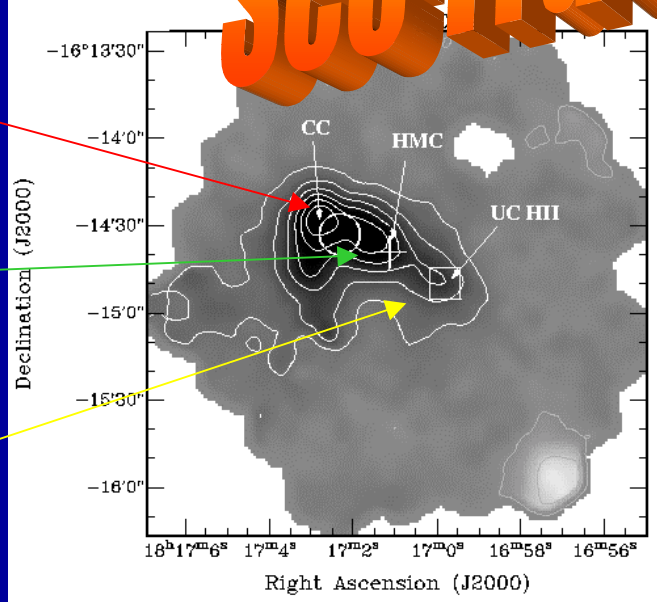
HMC

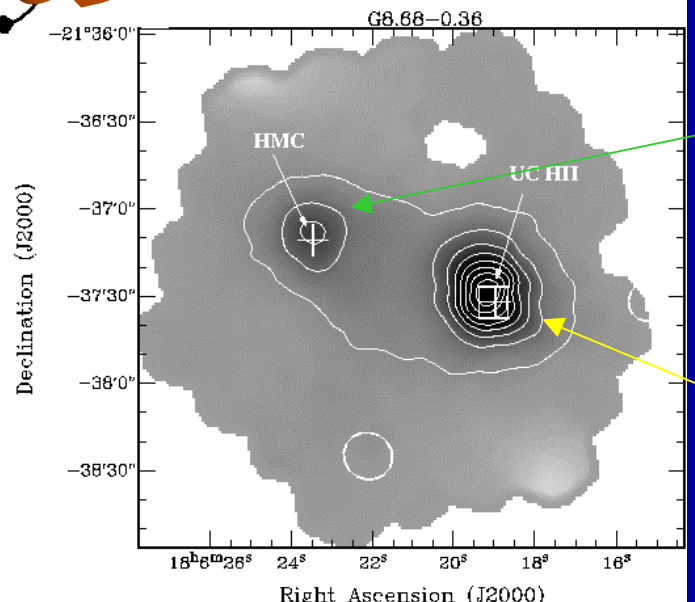
UCHII





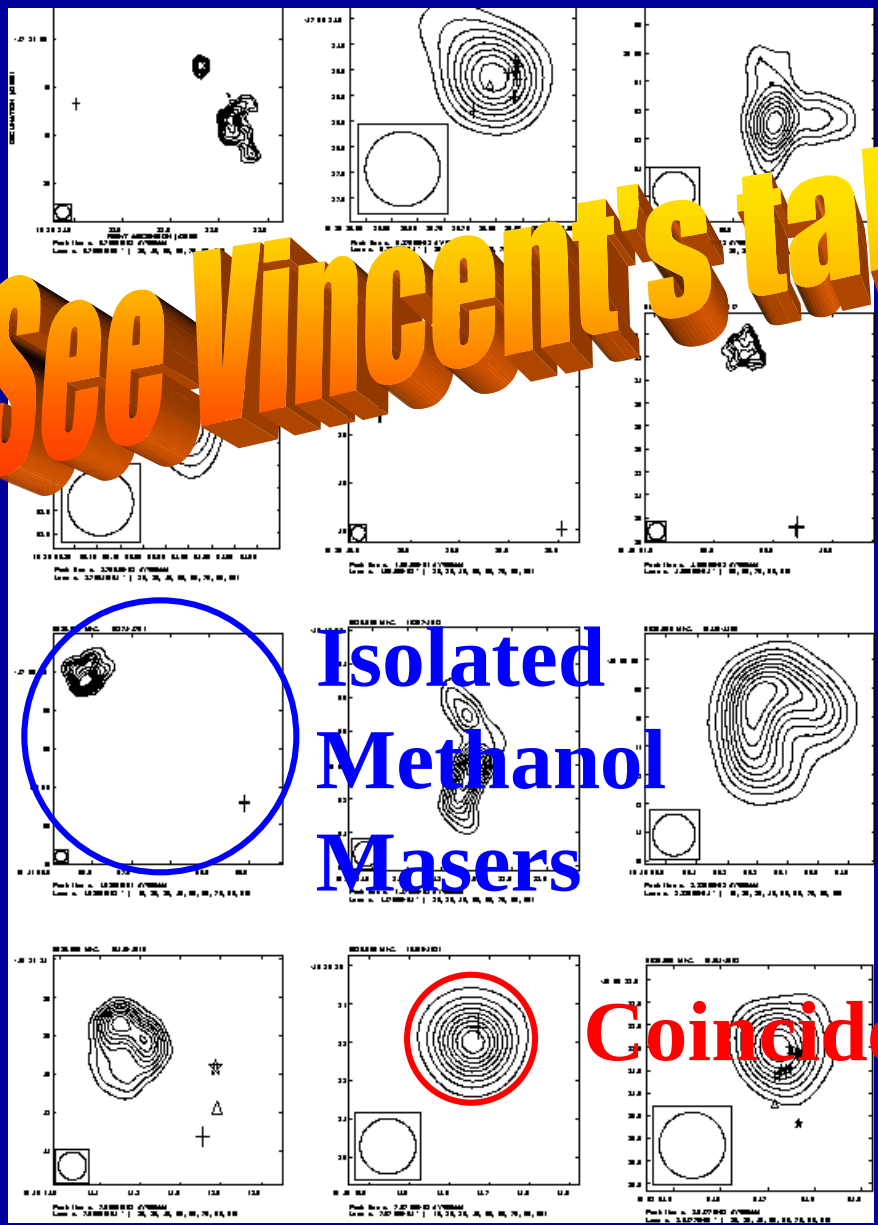
See Tracey's talk





Minier et al, 2003

The structure of star-forming cores?



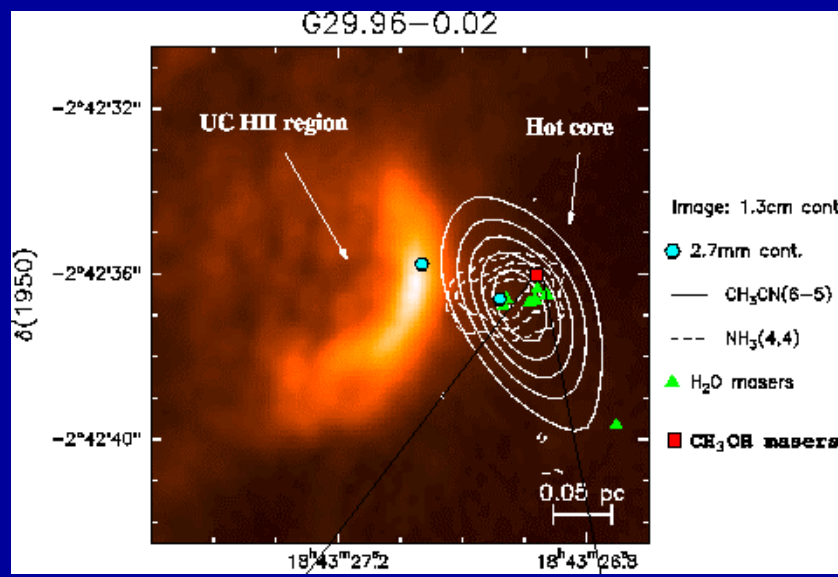
See Vincent's talk

Isolated Methanol Masers

Coincident

Time-dependent chemical segregation (Lines)

Source multiplicity (Continuum)



Other Star Formation Programs

- Distances to MSX-selected sites of massive star formation (Hoare, Lumsden: U. Leeds)
- Methanol maser emission at mm-wavelengths (Cragg, Godfrey: Monash, Ellingsen: Tasmania)
- Massive star formation by coalescence or accretion (Walsh, Myers: CfA)
- Spectral line survey of HMCs (Kim)
- Protostellar disks (Maddison: Swinburne)

Yet more programs……

- “Medium-mass” star formation

  Barnes

- The Search for Biogenic Molecules

  Hunt, Jones

See Peter and Paul's talks!

Finally, a plea

- Three elements or five?
- Over full 85-110 GHz range
- Real-time phase correction
  (300m ≡ 3”; 3km ≡ 0.3”)

- Australia’s radio future depends on our achieving it soon!

Mopra + ATCA provides

a unique facility for

mm-wave astronomy