THE CHEMICAL INVENTORY OF INTERSTELLAR CLOUDS

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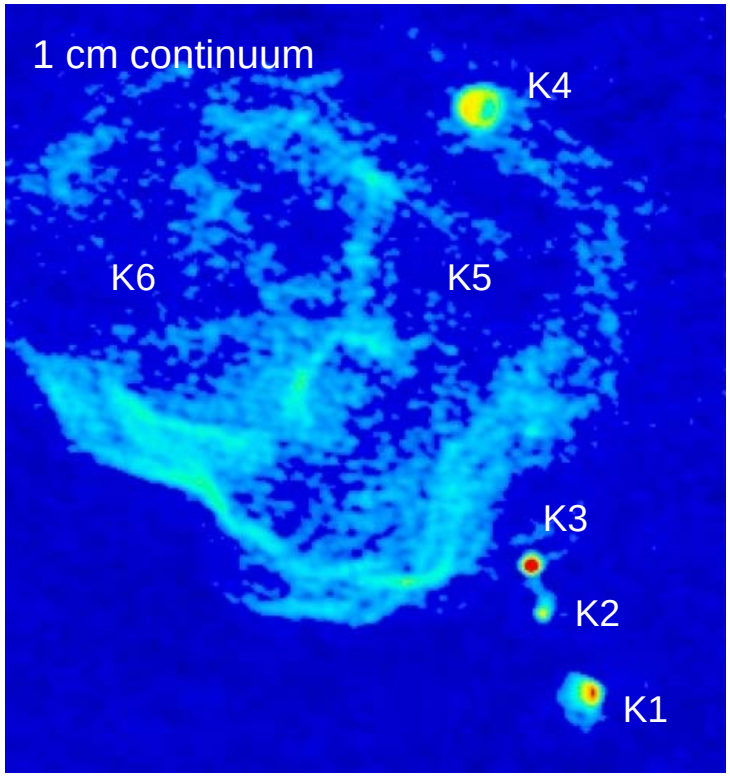
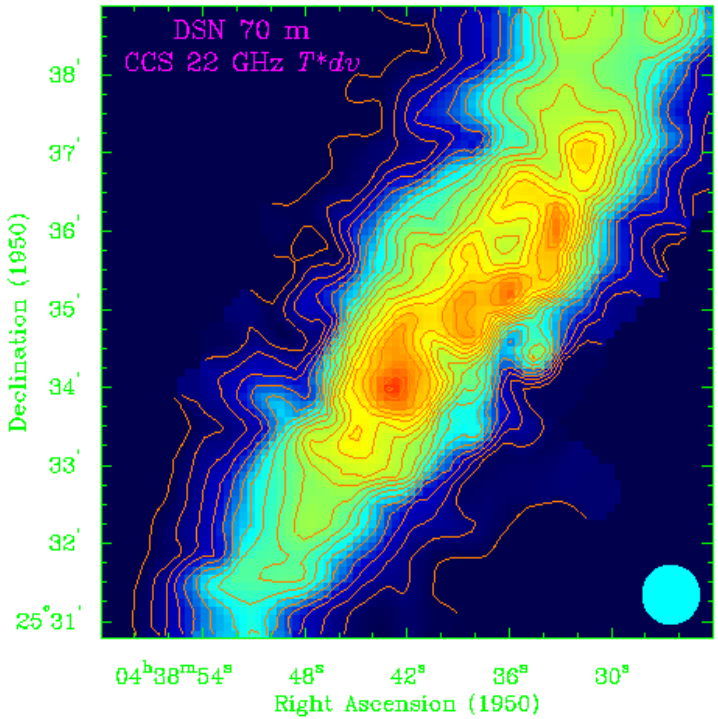
OUTLINE

- Propose GBT molecular spectral line surveys of SgrB2(N) and TMC-1 In the frequency range of 300 MHz to 50 GHz (target rms = 2 mK)
- Why SgrB2(N) and TMC-1?
- Why the frequency range of 300 MHz to 50 GHz?
- Why are deep surveys useful?
- Why use the GBT?
- Why SLiSE is an ideal tool to disseminate survey data.

Why Sgr B2 and TMC-1?



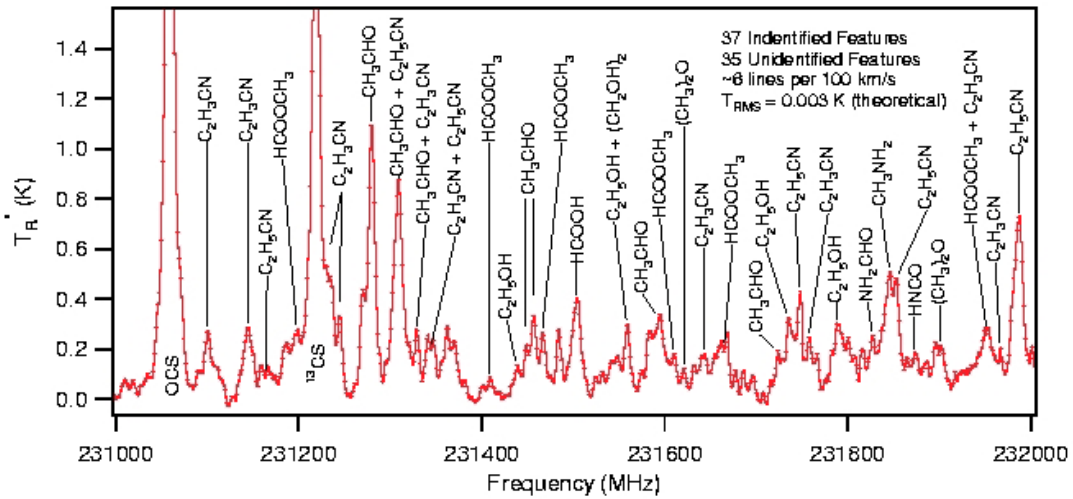


- Sagittarius B2(N) is the largest repository of large molecules in the interstellar medium. Of the 140 interstellar molecules detected, more than half have been detected first in the Sagittarius B2 star-forming region.
- One region is called the "LMH" - the "Large Molecule Heimat (Homeland)"

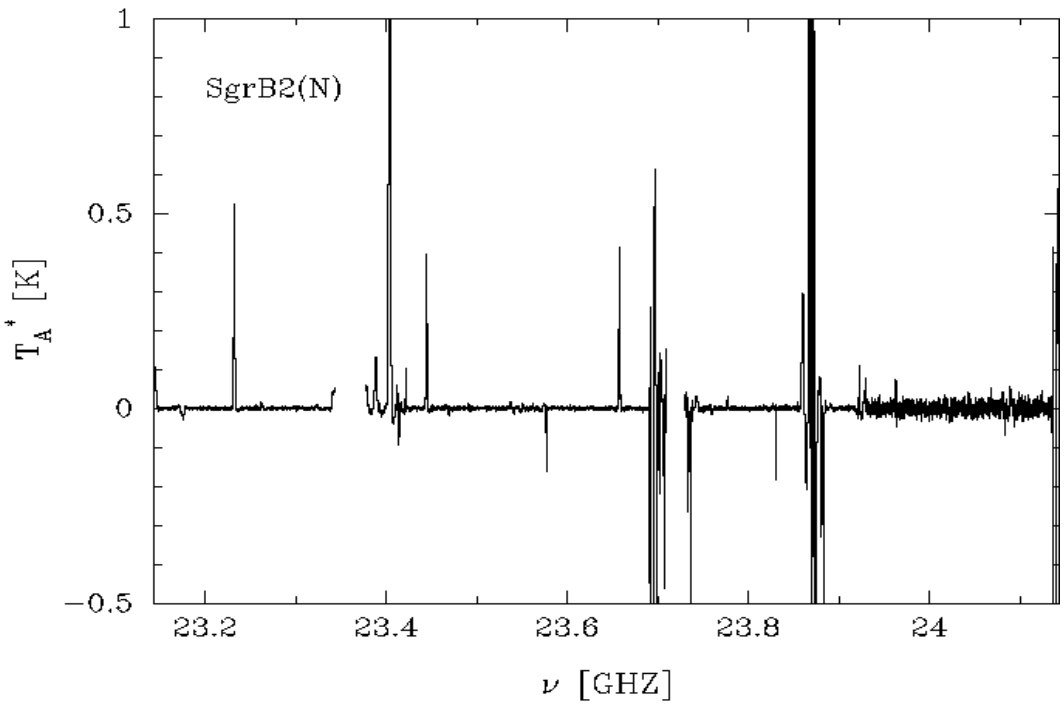
- TMC-1 is a prototypical dark cloud that has been a primary target of several molecular line surveys.
- The cursory surveys document that TMC-1 contains a number of different carbon chain sequences and thus, TMC-1 is the optimal source for investigating the formation of carbon chain species.

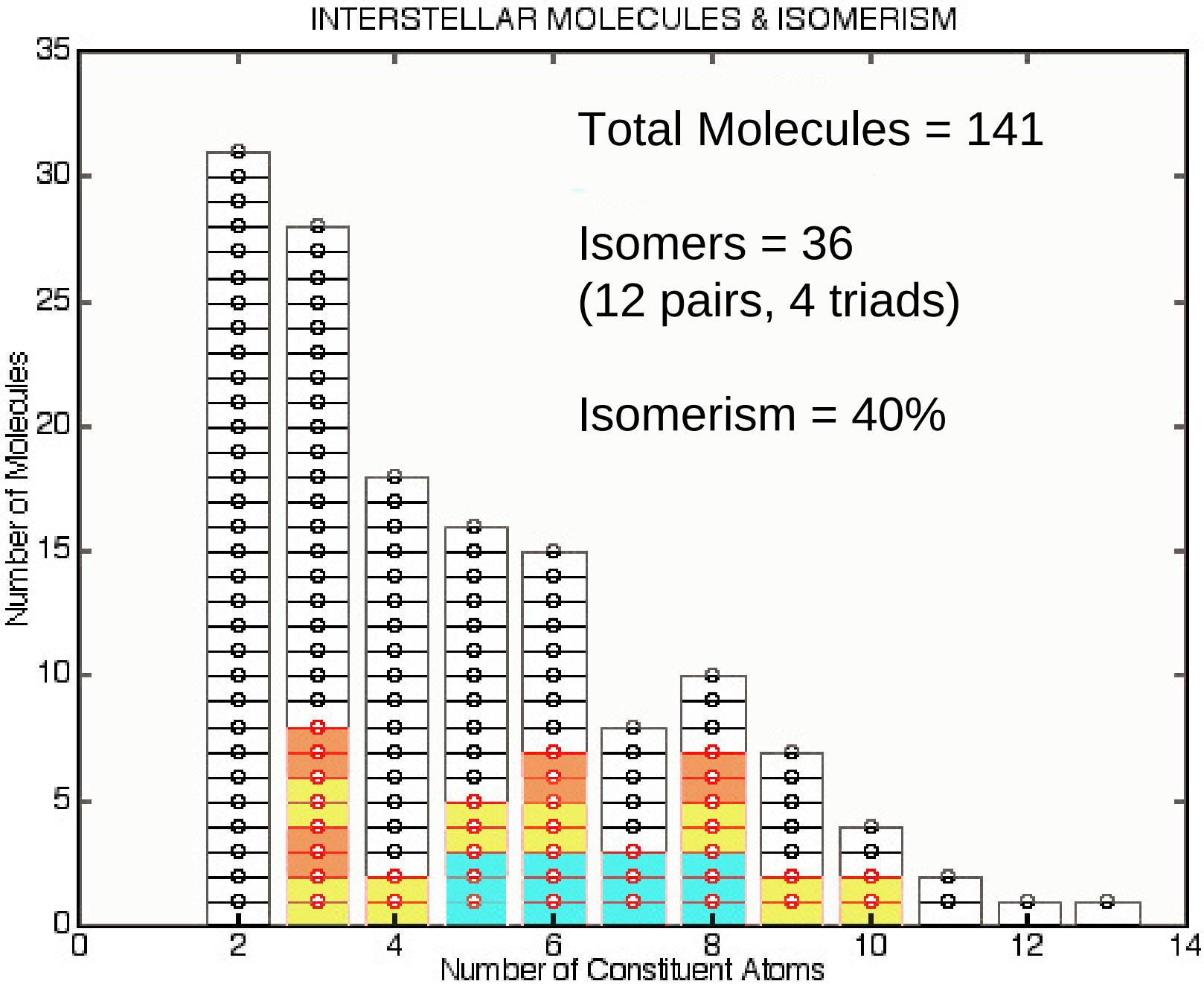
Why the frequency range of 300 MHz to 50 GHz?

1 GHz Band at 231.5 GHz using SMT (ALMA Band 6)



1 GHz Band at 23.6 GHz using GBT




INTERSTELLAR MOLECULES & ISOMERISM
Total Molecules = 141
Isomers = 36
(12 pairs, 4 triads)
Isomerism = 40%
Number of Molecules
Number of Constituent Atoms
0
5
10
15
20
25
30
35
0
2
4
6
8
10
12
14

Why are deep surveys useful?

- To fully understand the role of interstellar clouds in our molecular origins, an inventory of molecular species is necessary in prototypical sources. For example, the trends in molecules provide the keys to how they are formed.

- Weak signatures of complex molecular species emitting or absorbing in the 300 MHz to 50 GHz region were not amenable to detection until the advent of the GBT. Such weak species are largely organic prebiotic molecules that are important to astrochemistry, and chemical evolution in space (astrobiology).

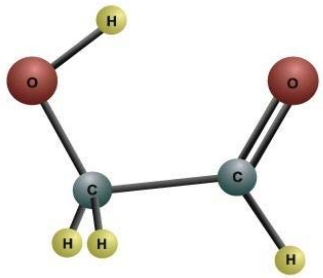
- The legacy survey will produce a complete inventory of known interstellar molecules and their transitions that can be evaluated and synergistically used as multiple probes of physical conditions.

- The legacy survey will contain unidentified molecular lines that can be assigned to new interstellar species in a spectral region that contains low-energy transitions of complex prebiotic molecules.

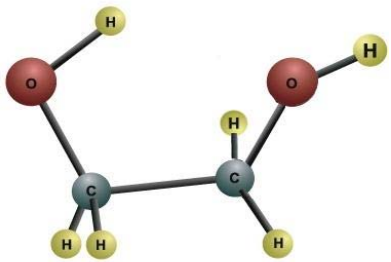
Why the GBT?

- The GBT has already detected 8 new interstellar molecules, proving its worth as a spectral line search instrument.
- GBT beams below 50 GHz couple well to extended interstellar clouds.
- Sensitivity (RMS ~2 mK in two Sgr tracks)
- Versatile Spectrometer (e.g., 4x200 MHz = 24.4 kHz resolution; 4x50 MHz = 6.1 kHz resolution)
- Large Spectral Bandpass (e.g., 800 MHz for Sgr; 200 MHz for TMC-1)

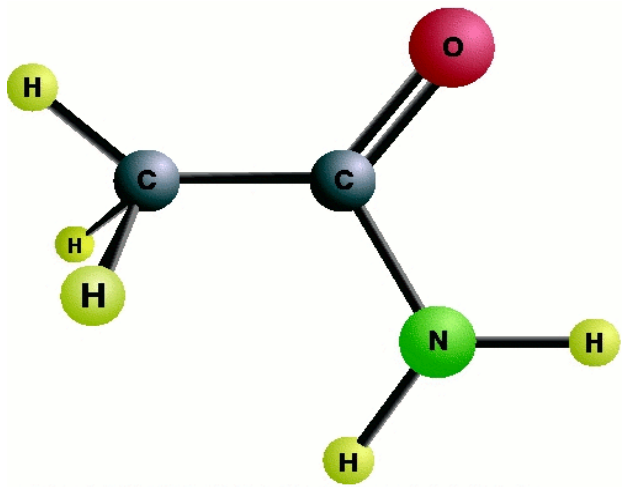
Species Detected Towards Sgr B2N with the GBT



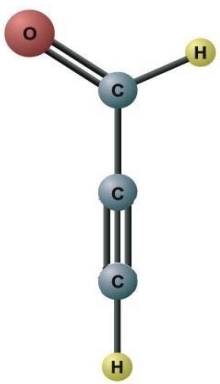
GLYCOLALDEHYDE



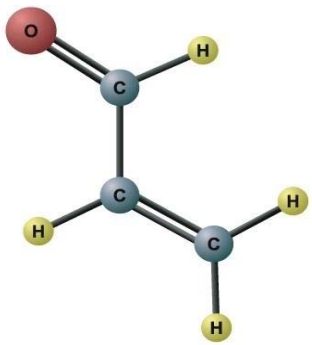
ETHYLENE GLYCOL



ACETAMIDE



PROPYNAL



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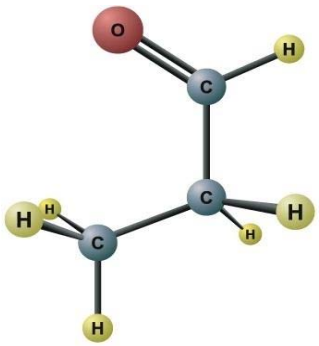

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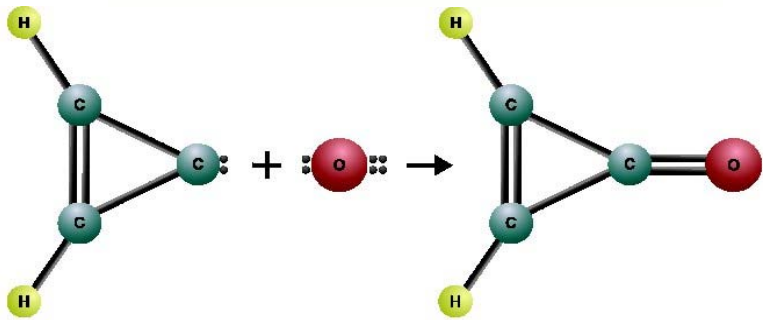
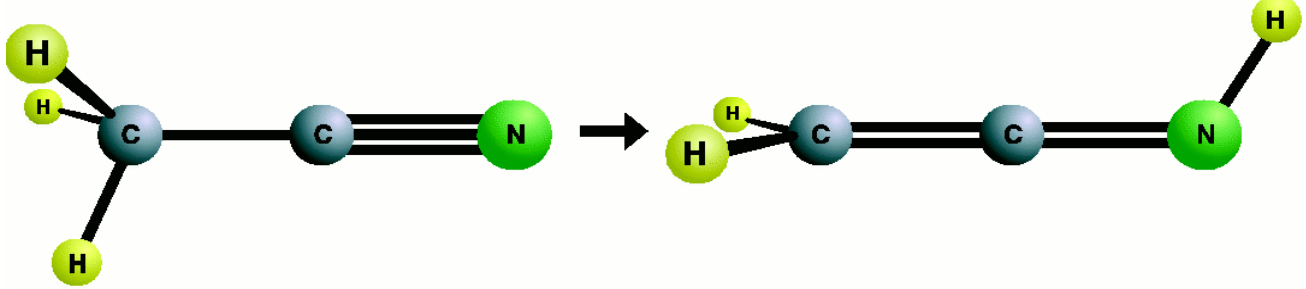


CYCLOPROPENYLIDENE

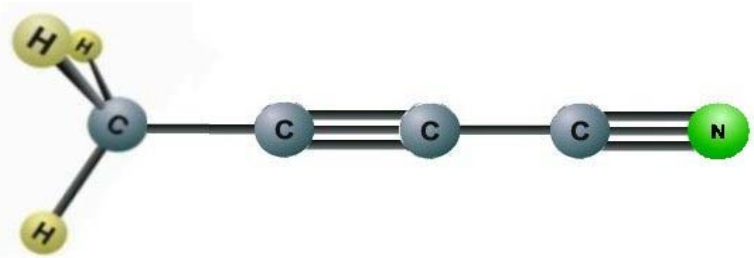
CYCLOPROPENONE



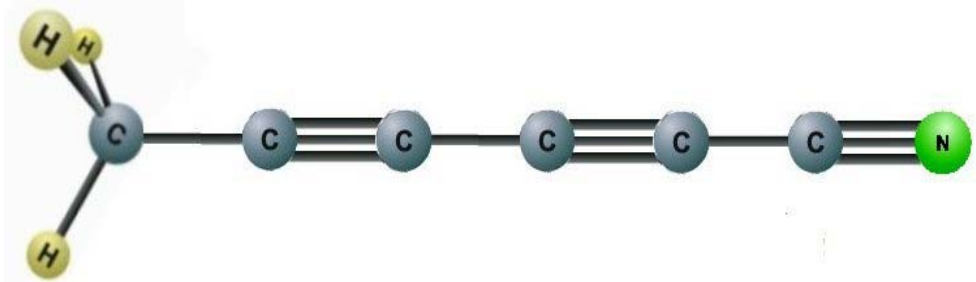
METHYL CYANIDE

KETENIMINE

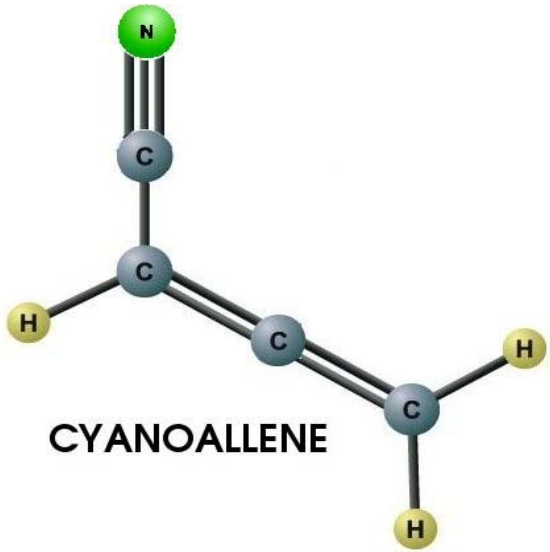
Species Detected Towards TMC-1 with the GBT



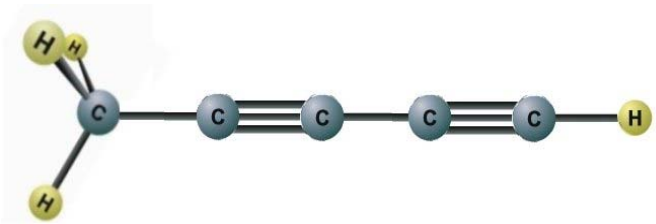
METHYLCYANOACETYLENE



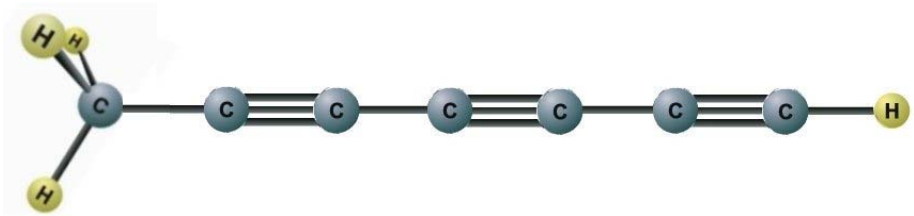
METHYLCYANODIACETYLENE



CYANOALLENE



METHYLDIACETYLENE



METHYLTRIACETYLENE

Why the SLiSE is an ideal tool to disseminate survey data.

- **COMPUTER-INDEPENDENT TOOL**

  The Spectral Line Search Engine (SLiSE) is a java-based applet.

- **USED WEB-BASED OR STANDALONE**

  SLiSE and survey databases can be searched via the web or downloaded for use on a personal machine.

- **USEFUL FOR NRAO PROPOSAL SYSTEM**
  - Avoid overlap with other proposals.
  - Investigate passbands already observed.
  - Identify any contamination from known interstellar molecules or RFI.