Proc. ASA **5** (4) 1984

The Detection of Shocked CO Emission From G333.6-0.2

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I wrote my abstract, sent it in,
With words that don't offend.
Imagine my horror, to find that I
Am scheduled at the end.

Let me say, to be last speaker,
There are very few things worse.
And so this talk, to get revenge,
Will be entirely in verse.

The subject I address today
Is that of star formation,
And what we've found out recently
About the situation.

Stars start out as clouds of gas and
Dust and bits of spinning stuff.
Collapsing gravitationally
Until they're dense enough.

They form themselves in little lumps,
(Or so says this bloke Jeans).
'Dynamic Instabilities'
Whatever that term means.

A protostar is thus created,
Igniting nuclear fuel.
Before too long the star begins
To really lose its cool.

A massive wind begins to blow;
No one's quite sure why.
But it's quite clear the gas and stuff
Begins to really fly.

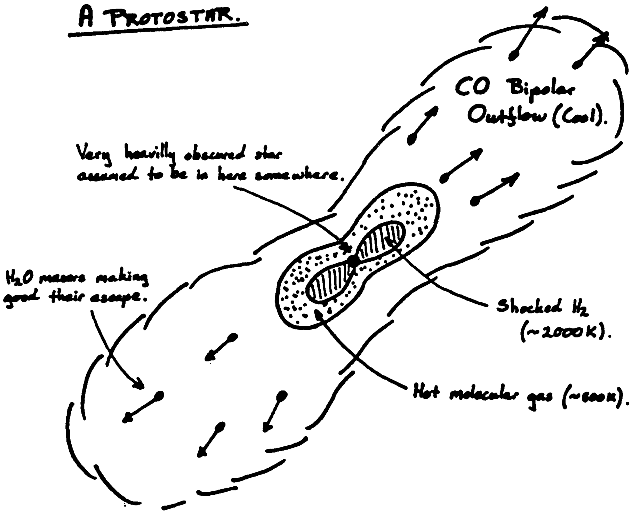
Well, from all this results what's called
Protostellar outflow.
Bipolar, fast, and hot as hell—
We see it in CO.

But radio can't tell us much;
There are but few transitions,
And cool CO's so common, it
Confuses most positions.

So, most of what we know of this
Comes from the infrared—

My co-workers, who almost certainly would wish to dissociate themselves from this presentation, are:

Mike Crawford	(U. C. Berkeley)
Reinhard Genzel	(U.C. Berkeley)
Dan Watson	(Caltech)



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That bit of spectrum in the middle
That decent people dread.

Way back in 1976,
2 Micron lines were found
In Orion where, I'm sure you know,
Molecules abound.

Now everyone was most suprised,
These lines put out much power.
No one thought they'd be that strong—
Not even Neugebauer.

The lines were due to hydrogen
Molecules, and they
Don't emit much until heated
To at least two thousand K.

Well, people studied this for years,
Finding H_2 everywhere.
But still these lines don't tell you what
Kind of density is there.

What we need's another line:
Density dependent.
This view needs no genius
In order to defend it.

I've talked for several minutes now,
(I've half an hour to go),
I'm sure you're most surprised I haven't
Mentioned yet the KAO.

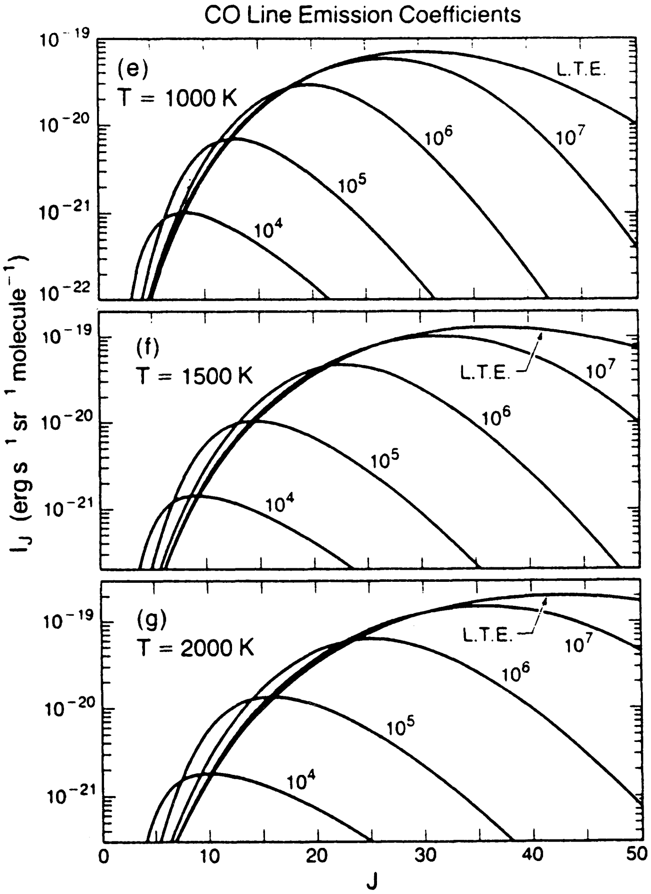
Carbon monoxide, really hot,
Has heaps of good transitions
Depending critically upon
The density conditions.

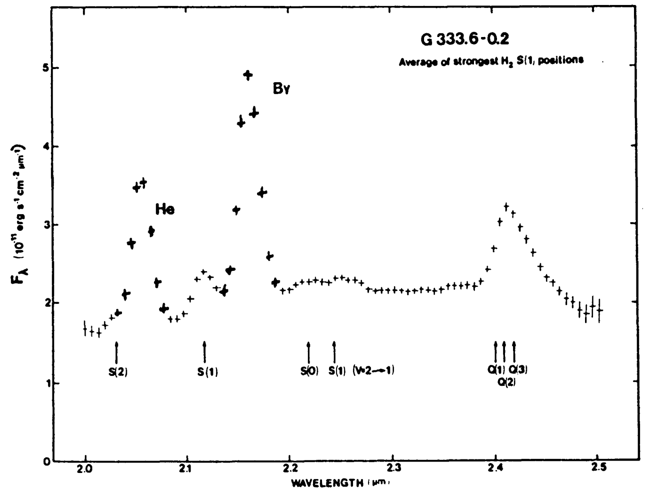
These lines are in the far—IR,
But wait—here's the best bit—
To see them you will need to use
The KAO, you guessed it!

In 1980, from the plane, we
Found it in Orion,
But no more CO could we find
Despite long hours of flyin'.

So models of Orion's shock
Were looking really grand,
But it remained the only source
We claimed to understand.

We needed several other sources,
All of which we'd then compare.
But when we looked for shocked CO,
We always found it wasn't there.





And so, I searched for southern sources
Of this shocked H_2,
And found it, in G333
Point six, minus, nought point two.

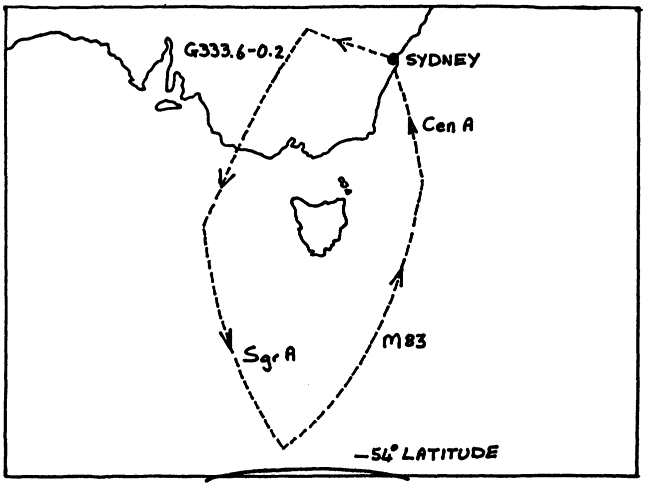
It's really very, very bright,
And made us all quite happy.
The data's good, the lines are strong
(Though the slide don't look real snappy).

So, if we want to search again
For shocked CO, and wouldn't you?
What better place than G333
Point six, minus, nought point two!

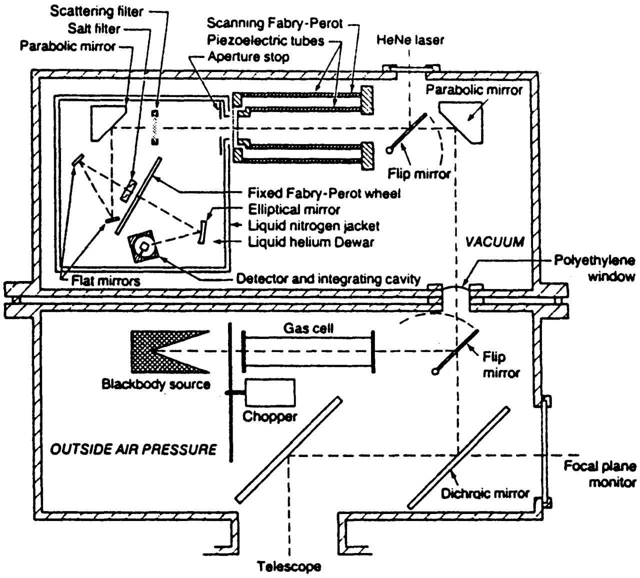
The problem with this new-found source,
I hardly need to warn you,
Is that it's too far south to see
From sunny California.

And so to us the Kuiper came;
In May last year it made it.
The cost was astronomical,
But NASA mainly paid it.

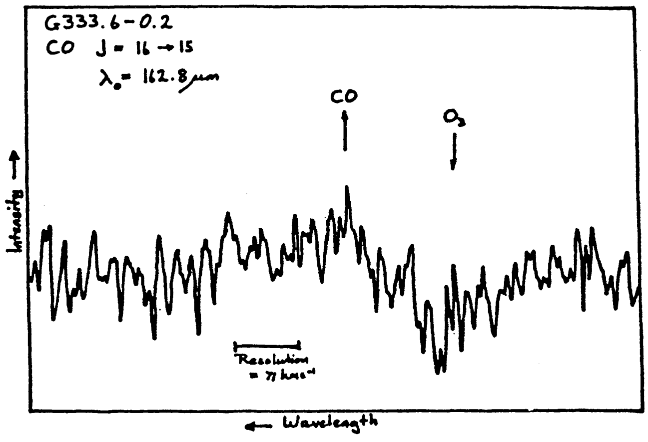
Thus we made a set of flights
From Richmond Airforce Base.
One such flight is shown right here:
Our track's this dotted trace.



How the instrument is made
Upon this slide is told;
It uses liquid helium
To keep all these bits cold.



Well, here's the data—please don't laugh,
It often looks this way.
A few times through the VAX and then
We'll publish it is Ap J.



The line is there, I kid you not,
This dip here's just the sky.
To see the peak you simply need
A good impartial eye.

Least-squares fitting gives a curve
From which derive the facts.
(Oh, let me thank the AAO
For lending me their VAX).

Vlsr is fifty-three.
It's pleasing, as you see,
The radio line velocities
More or less agree.

Intensity is really weak:
It's two point nought by ten

To the minus eighteenth power
(In watts per square cm).

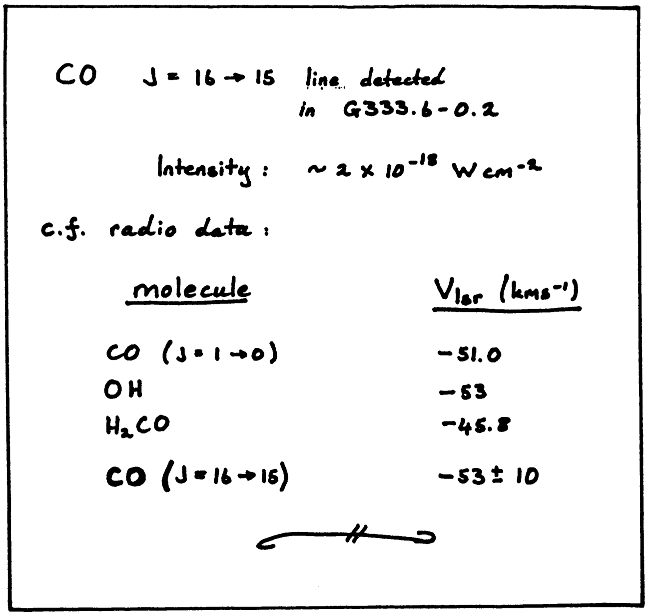
That's thirty times as weak as we
Detected in Orion.
No wonder it took several years
Of concentrated tryin'.

Well, as you see, I don't yet have
Any numbers clear
For density, and things like that.
(It's only been a year).

But now we have not one, but two
CO sources, it is true:
Orion, and this G333
Point six, minus, nought point two.

In fact, the sources now are three
Because, again last May,
The very next flight that we did
Found CO in Sgr A.

Well, thank you all for listening
(Though some of you have slept).
I wonder now, will Dick McGee
This manuscript accept?



Published by popular demand. Ed.

Instrumental

The Molonglo Observatory Transient Event Recorder

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Introduction

In its normal synthesis mode of operation, the Molonglo Observatory Synthesis Telescope (MOST) tracks a region of sky for a period of 12 hours with 64 real-time fan beams having high sensitivity at 843 MHz (Mills 1981). It thus provides an excellent opportunity to monitor the sky at the same time for transient radio events. During a 12 hour synthesis observation the fan beams rotate 180° on the field. Thus any sources producing occasional radio transients can be located by analysing the positions of the beams on which the events are recorded. Futhermore, by rejecting events which occur simultaneously on non-adjacent beams, local terrestrial sources of impulsive interference may be eliminated. This technique for recognizing extra-terrestrial sources was of considerable value in the first Molonglo pulsar search when only two beams were used.

The transient event recorder has been designed to exploit the characteristics of the MOST over the widest possible range of transient time scales: the 3 MHz bandwidth sets the shortest usable time constant at about 1/3 microsecond, and the basic 2 s switching time used to step the beam positions in time sharing mode sets the greatest usable time scale at about 1 s. The range of pulse widths to which the system is sensitive is not restricted to the observed widths of pulsar pulses nor is it restricted by any assumption about probable pulse broadening due to interstellar dispersion or scattering.

The sensitivity of the MOST to pulsars is comparable to that of the E W arm of the 408 MHz Molonglo Radio Telescope, which was used in the discovery of 31 pulsars by single pulse techniques (Large and Vaughan 1971) and of 155 pulsars by period folding with observation times of one or two minutes (Manchester *et al.* 1978). Thus the transient event recorder is not expected to discover new pulsars having reasonably constant pulse energy, but it does have a good chance of discovering weak sporadic pulsars that produce occasional large pulses.

Since the advent of 'short time scale astronomy' heralded by the discovery of pulsars, there have been many estimations of the radio pulse energy and pulse width to be expected from various types of celestial event. One detailed study (Meikle and