The Australia Telescope Compact Array

the first southern millimetre interferometer

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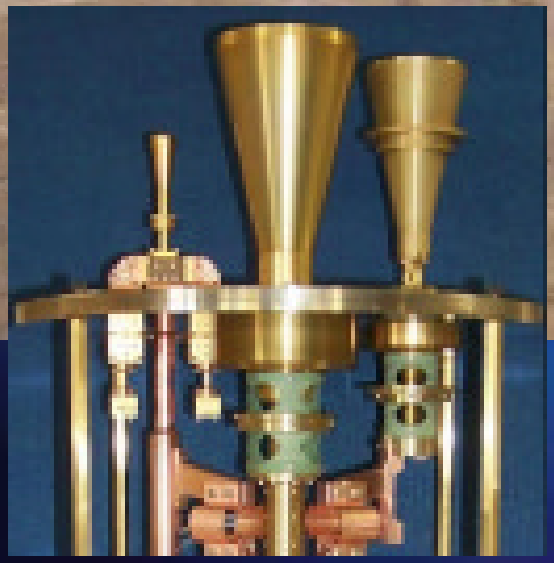
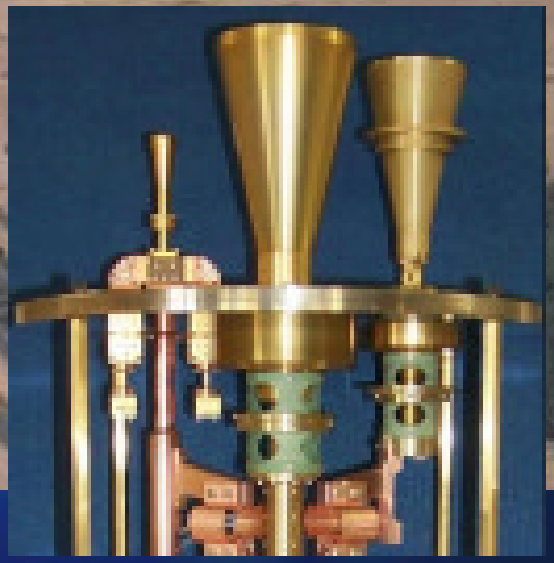
But first: The Marsfield 100 GHz interferometer (1973-77, 2 x 30cm)

- PhD project by John Archer (now CTIP)
- variable baseline
- Lubrun & Archer: 3mm synthesis image of the Sun
- Resolution 1.6 arcmin

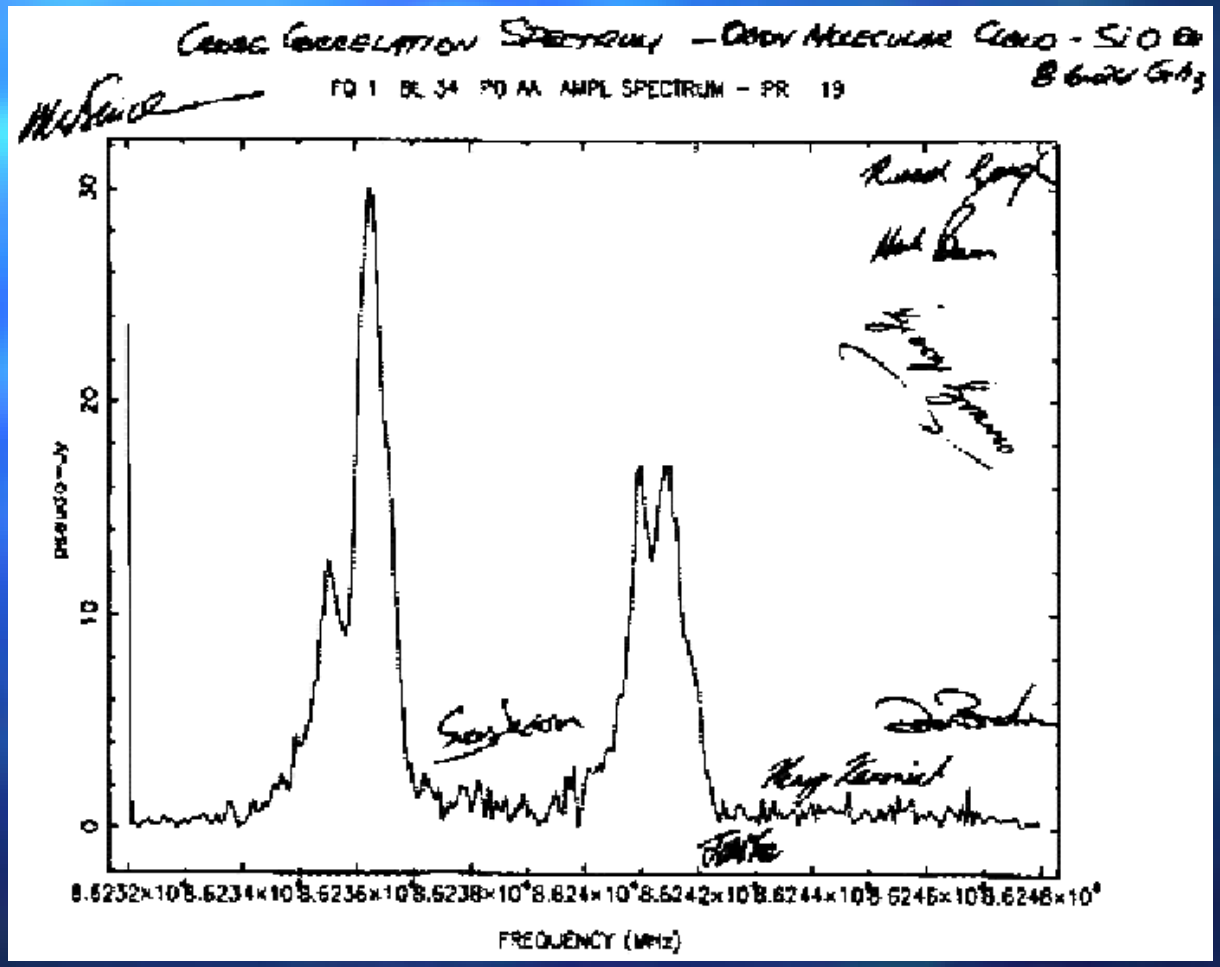
Aerial photo by Dave McConnell

ATCA mm observing





First light
on 30-November-2000 at 11:45pm



Orion SiO

86.243 GHz

3mm Receiver Timeline:

- 30. Nov 2000: First Light !!
  using only 1 baseline and 1 polarisation
- 10. Dec 2000: first test observations
- July 2001: upgrade to 2 polarisations !
- September 2001:
  upgrade to 3 baselines
- early 2003: final receivers arriving

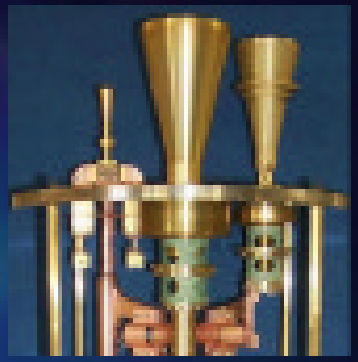
AT Compact Array : cm -> mm

(various bands between 1 and 115 GHz)

- 20cm (1.3-1.7 GHz)
- 13cm (2.2-2.5 GHz)
- 6cm (4.4-6.8 GHz)
- 3cm (8.0–9.2 GHz)

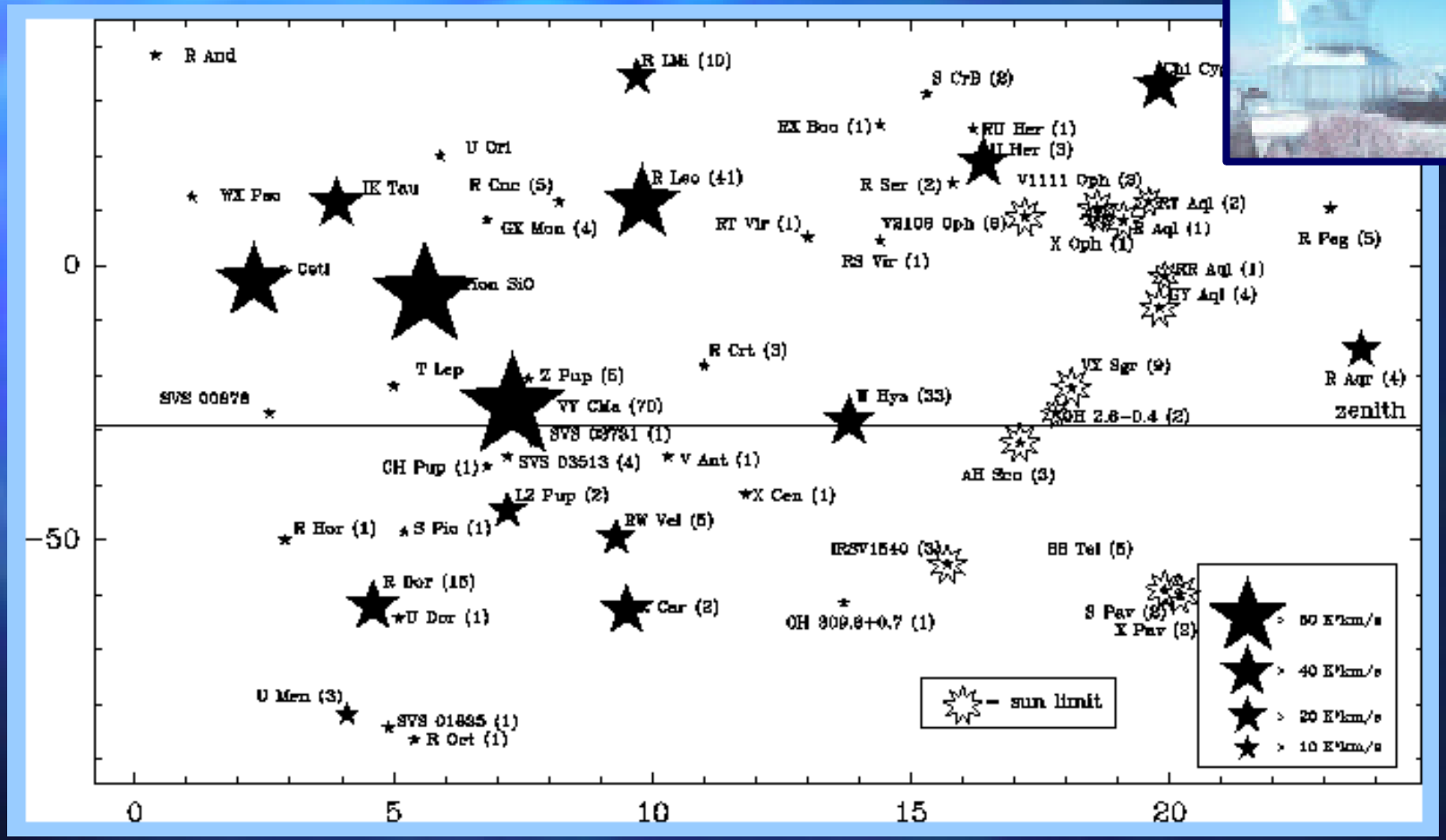
- 1.2cm (16-25 GHz)
- 0.3cm (85-115 GHz)

3mm Prototype System



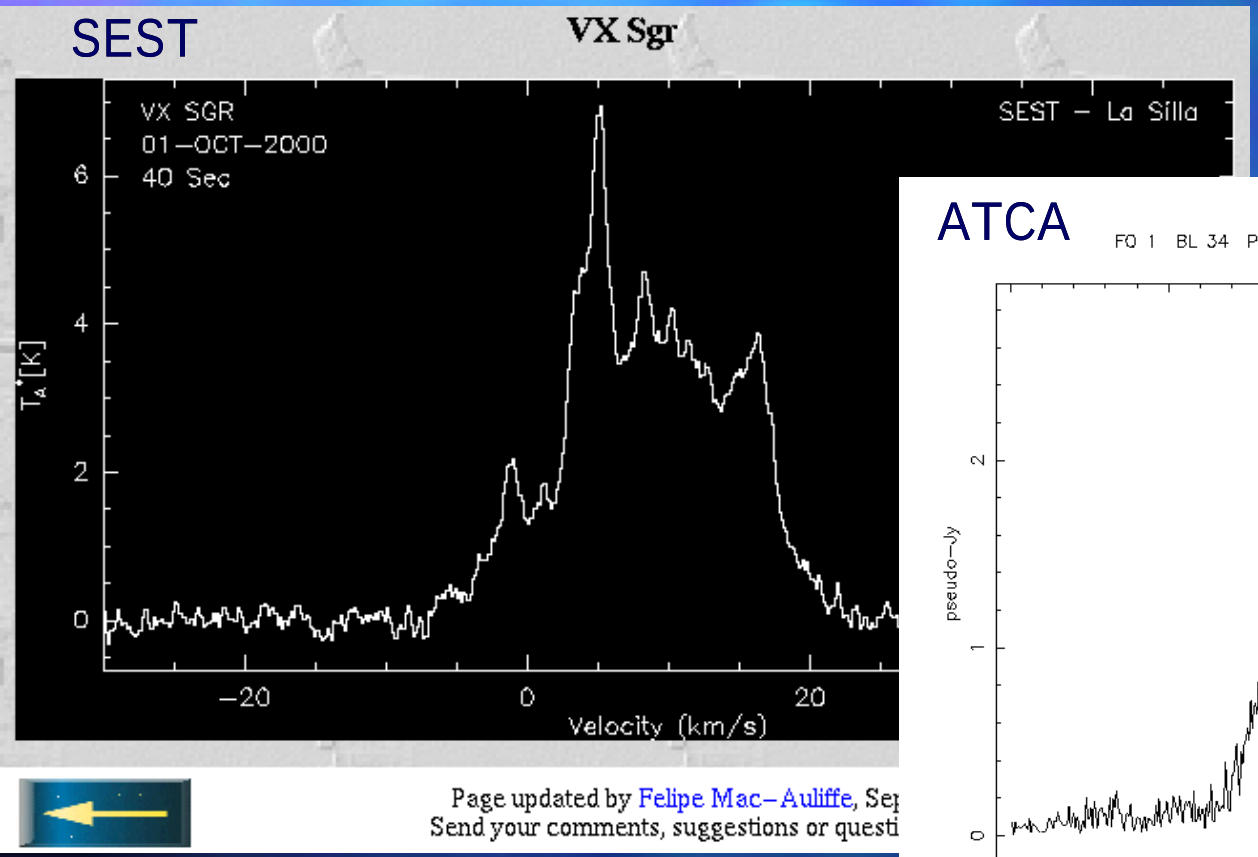
- Frequency range:
  (1) 84.906-87.305 GHz
  (2) 88.506-91.305 GHz
  (no tuning needed !)
- Receiver Temp.:
  CA02: 150-200 K
  CA03: 150-175 K
  CA04: 250-300 K
- Pointing ~5”
- Expected antenna sensitivity: 16 Jy/K
  (currently about 25 Jy/K)
- 3 baselines, 2 pol.:
  CA02, CA03, CA04
- New technology:
  InP MMICs
  (ATNF – CTIP collaboration)
- Project Leader: Mal Sinclair

SiO pointing sources commonly used at the SEST

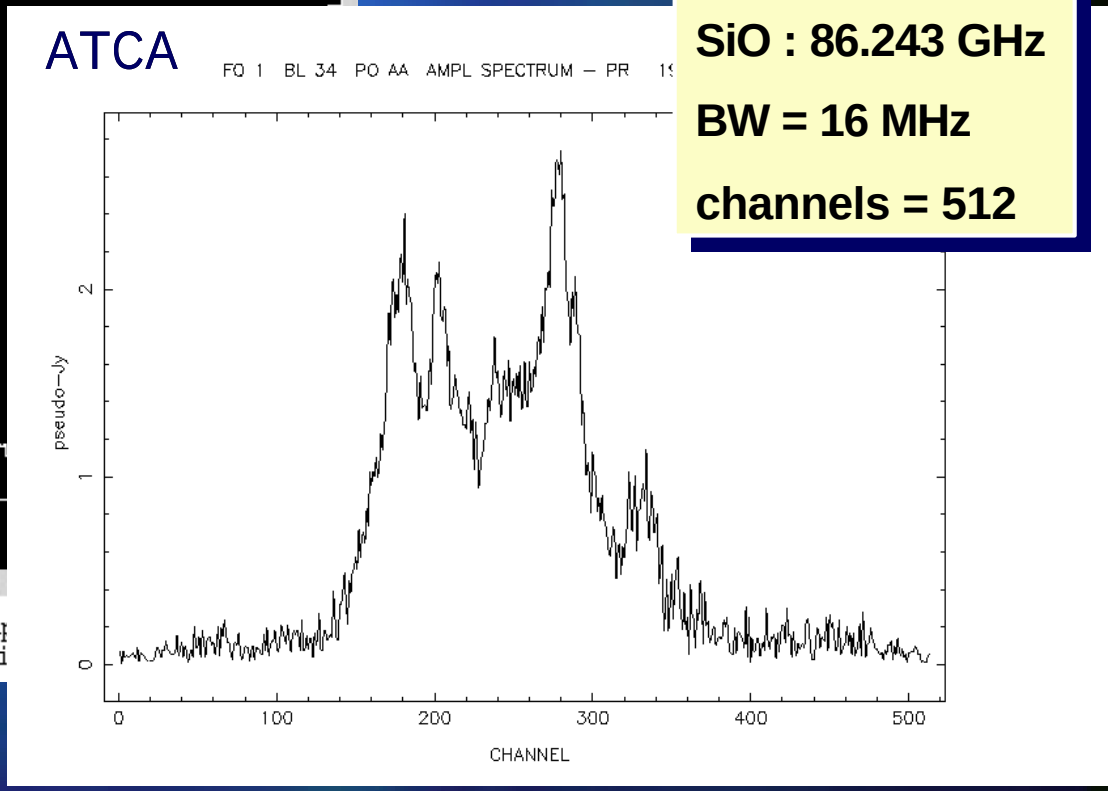


VX Sgr: SiO maser @ 86.243 GHz

SEST



ATCA



ATCA – Narrabri

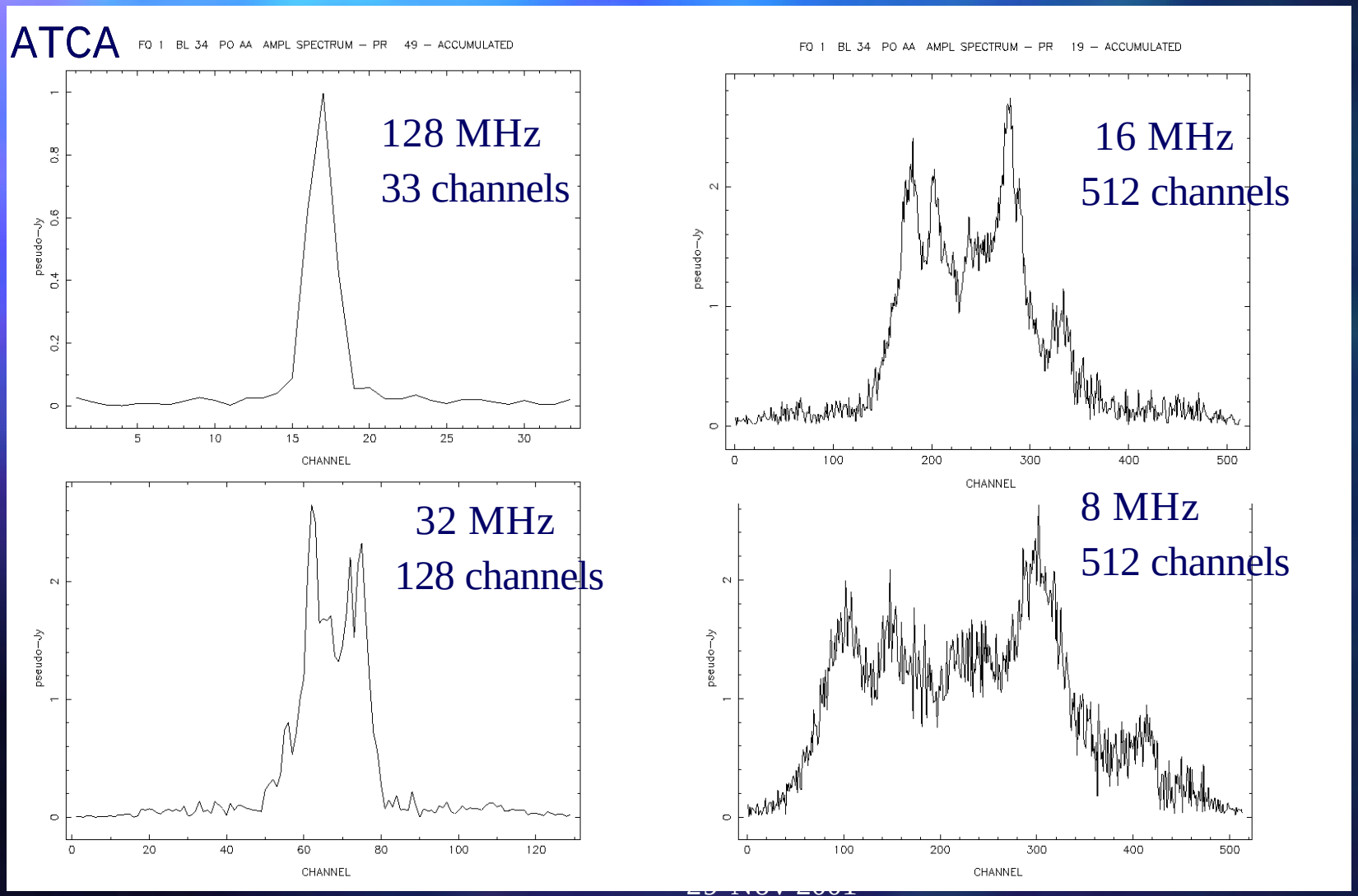
31 m baseline

SiO : 86.243 GHz

BW = 16 MHz

channels = 512

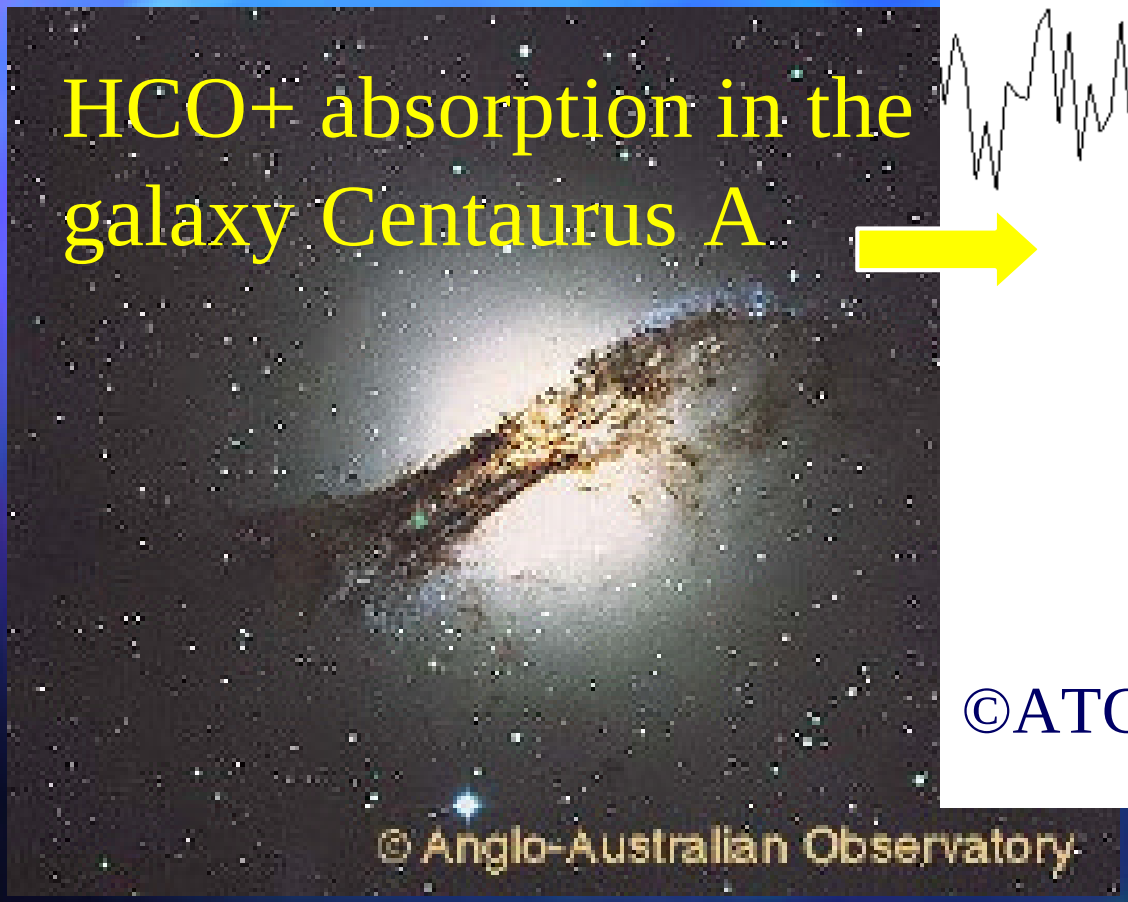
VX Sgr: SiO maser @ 86.243 GHz

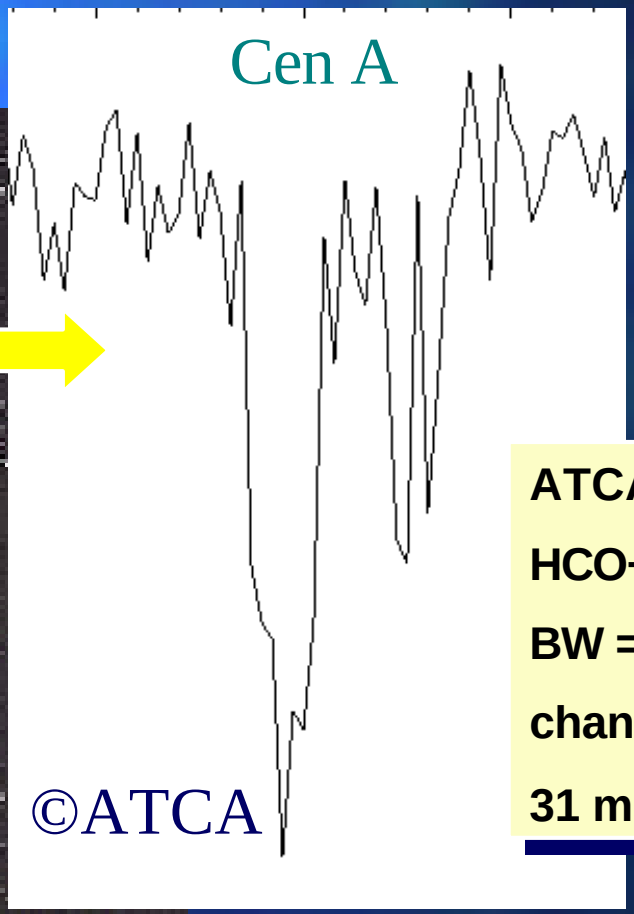


Some recent projects:

- Planets (pointing, flux & bandpass calibration)
- Molecular clouds (e.g. N113, NGC 6334)
- Molecular gas in nearby galaxies (e.g. Cen A, NGC 253, Circinus)
- Molecular absorption lines against bright quasars (e.g. 1921-293)
- Circumstellar envelopes (e.g. IRC+10216)

Highlight of the night ! (December 10th, 2000)





ATCA - Narrabri

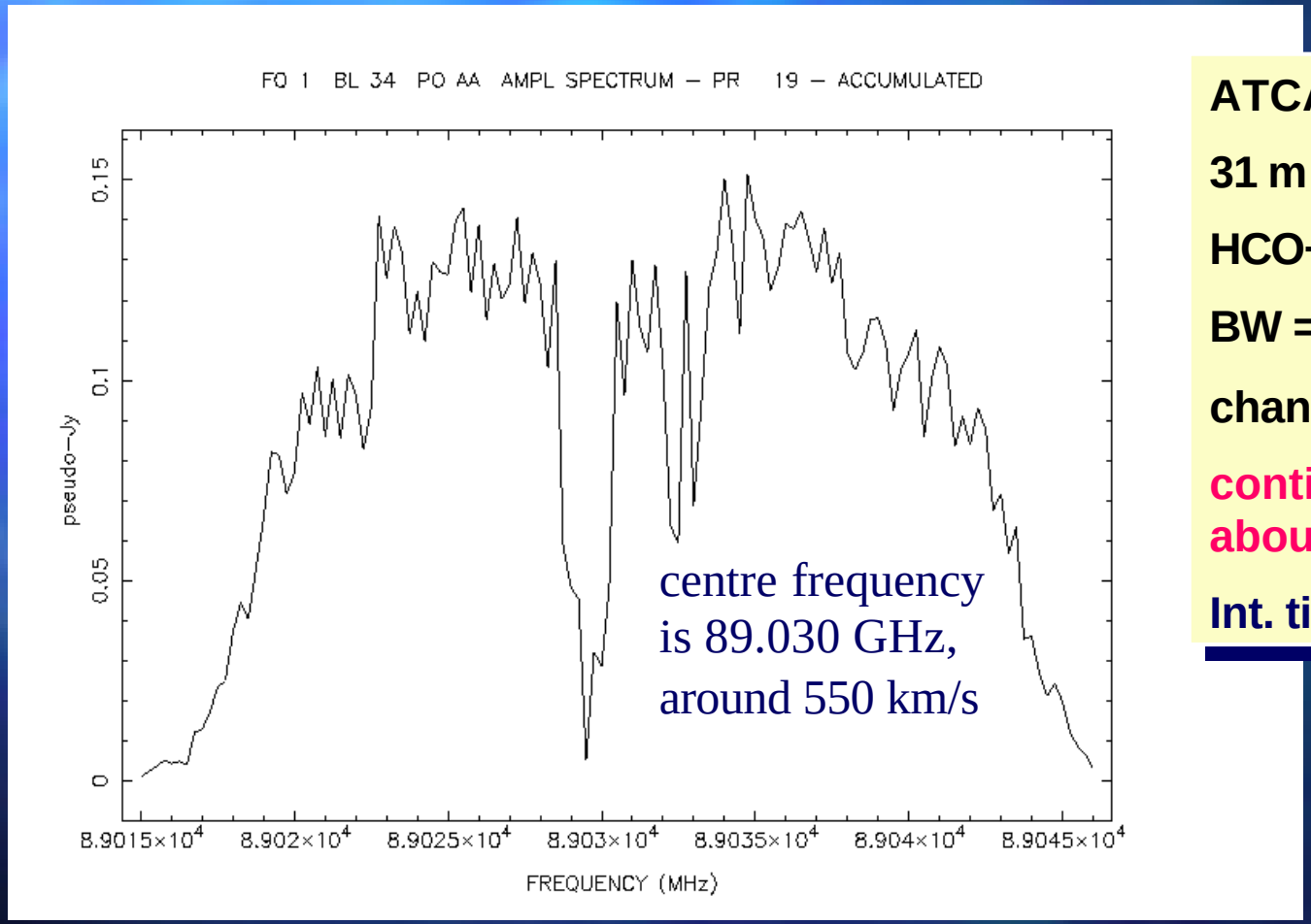
HCO+ : 89.188 GHz

BW = 32 MHz

channels = 128

31 m baseline

HCO+ absorption in the nearby elliptical radio galaxy Centaurus A



ATCA – Narrabri

31 m baseline

HCO+ : 89.188 GHz

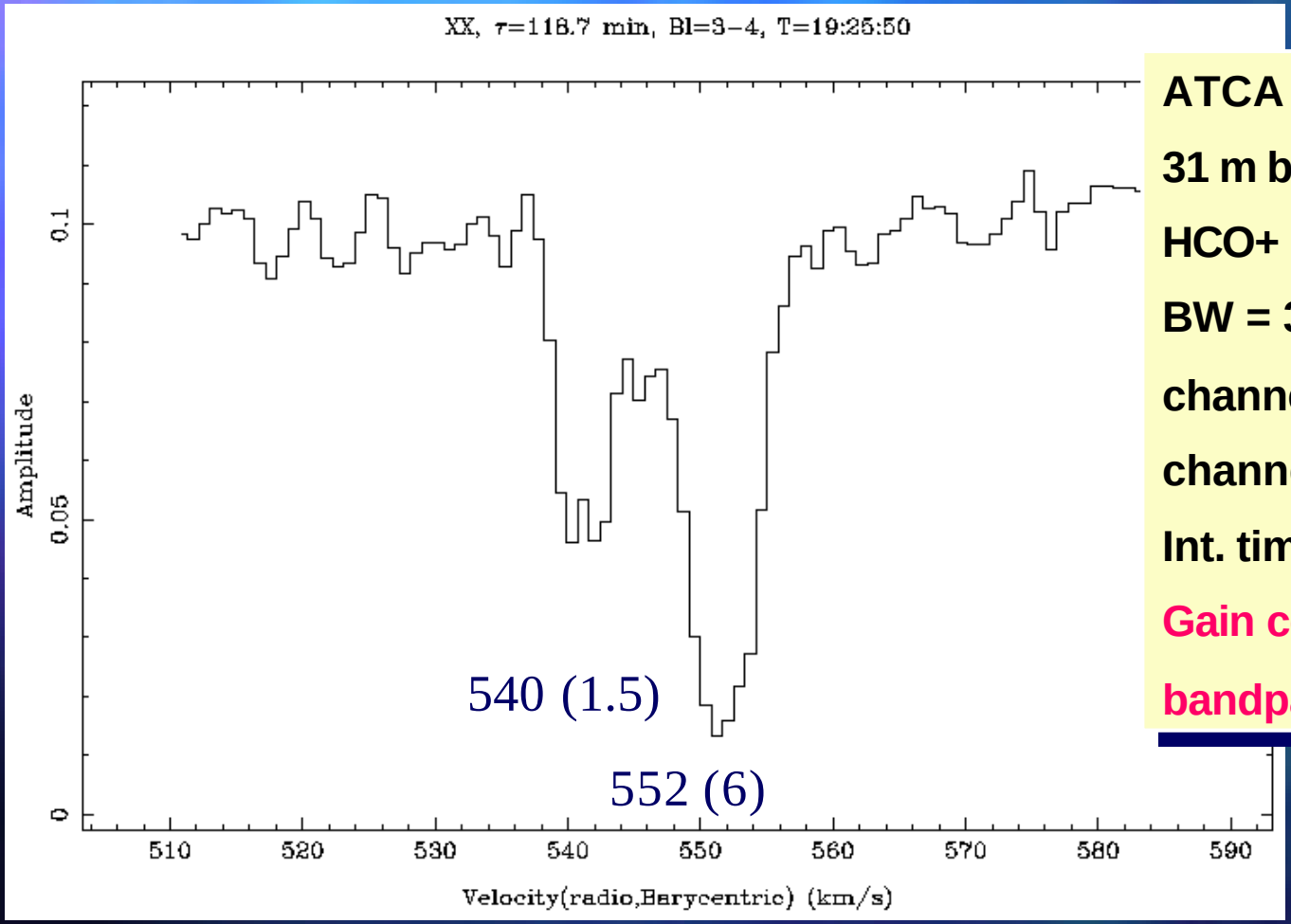
BW = 32 MHz

channels = 128

continuum flux about 420 mK

Int. time: 2 hours

calibrated HCO+ absorption spectrum against the core of Centaurus A



ATCA – Narrabri

31 m baseline

HCO+ : 89.188 GHz

BW = 32 MHz or 100 km/s

channels = 128

channel width = 0.84 km/s

Int. time: 2 hours

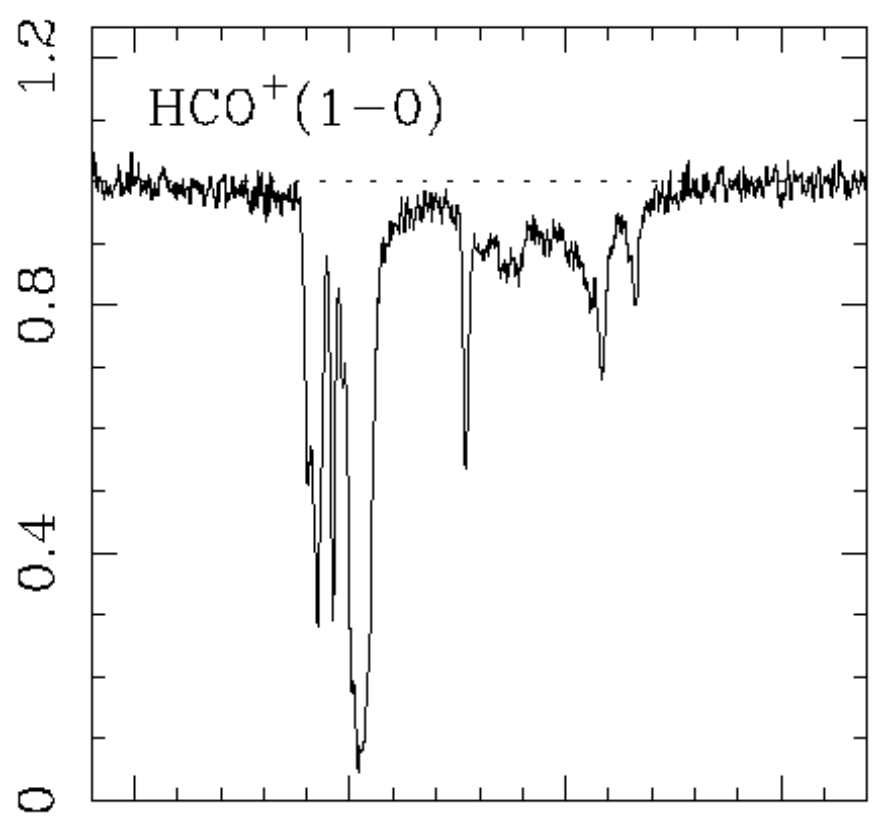
Gain correction: YES

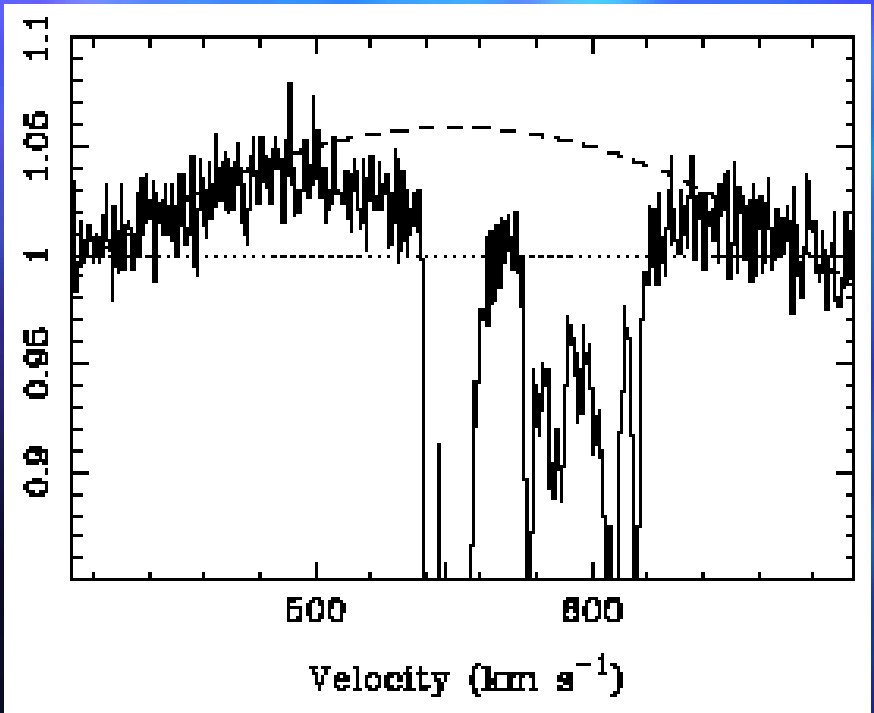
bandpass correction: (YES)

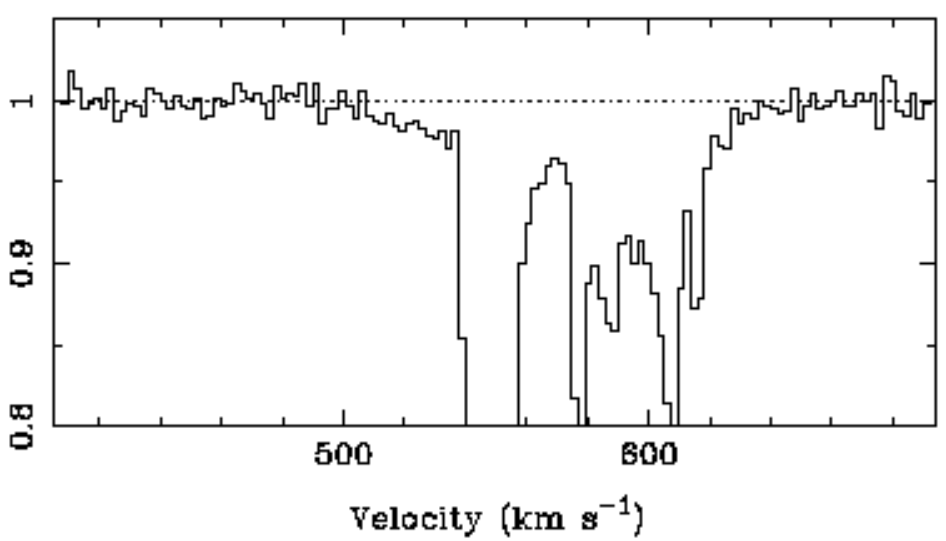
HCO+ absorption in Centaurus A

(Wiklind & Combes 1997)

SEST spectra before and after baseline subtraction





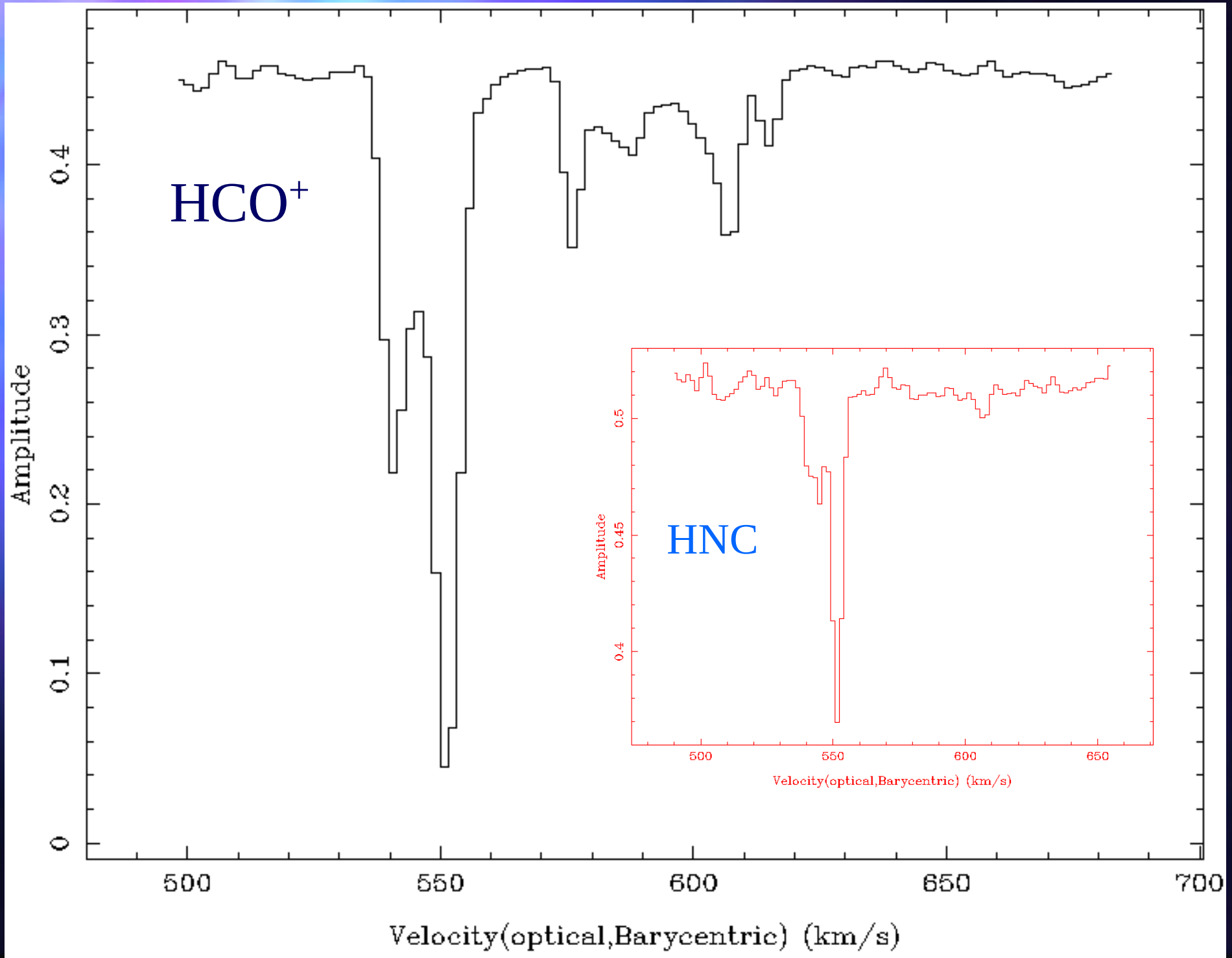


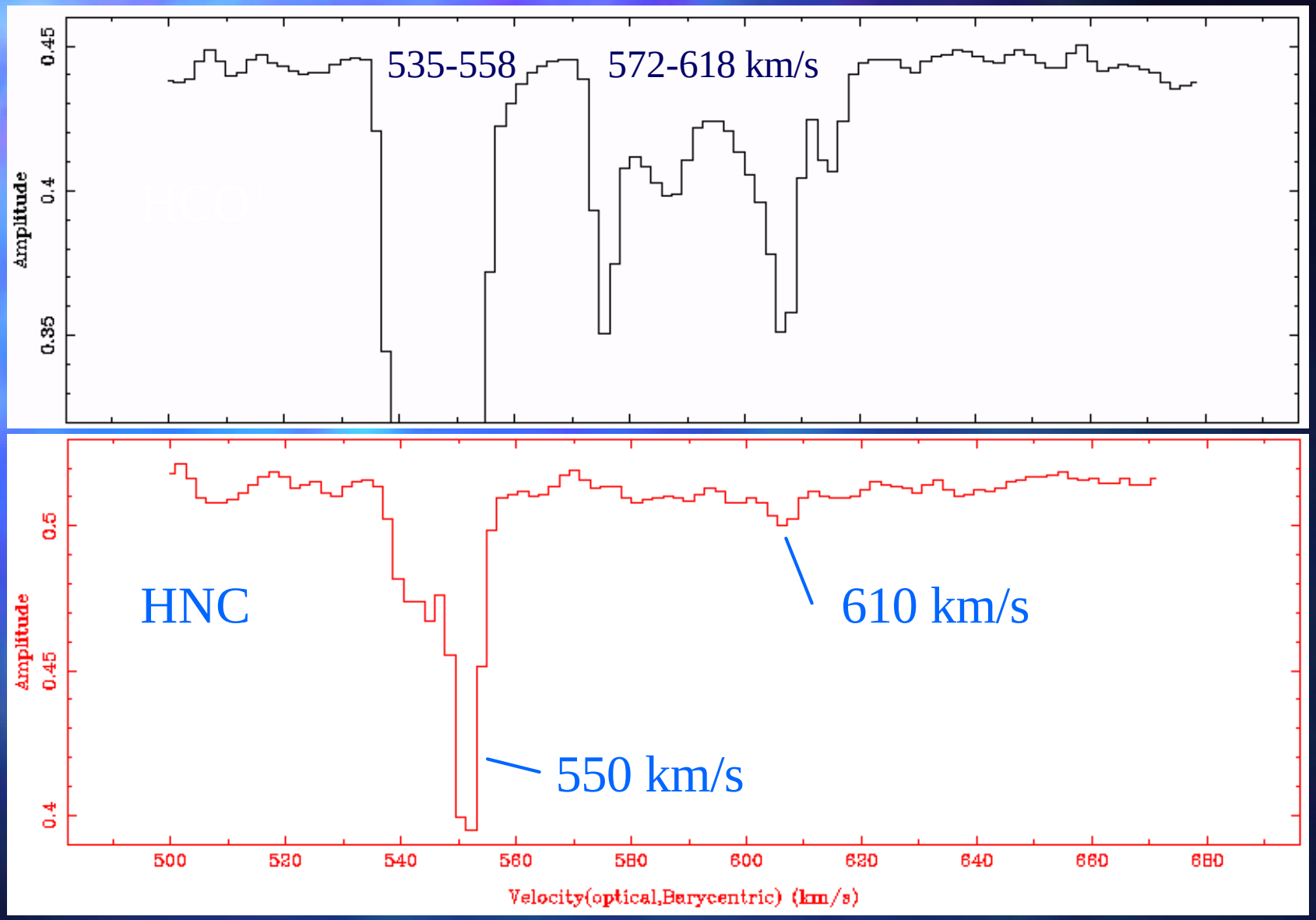
The radio galaxy Centaurus A

- v = 550 km/s
- ≈6 Jy @ 90 GHz

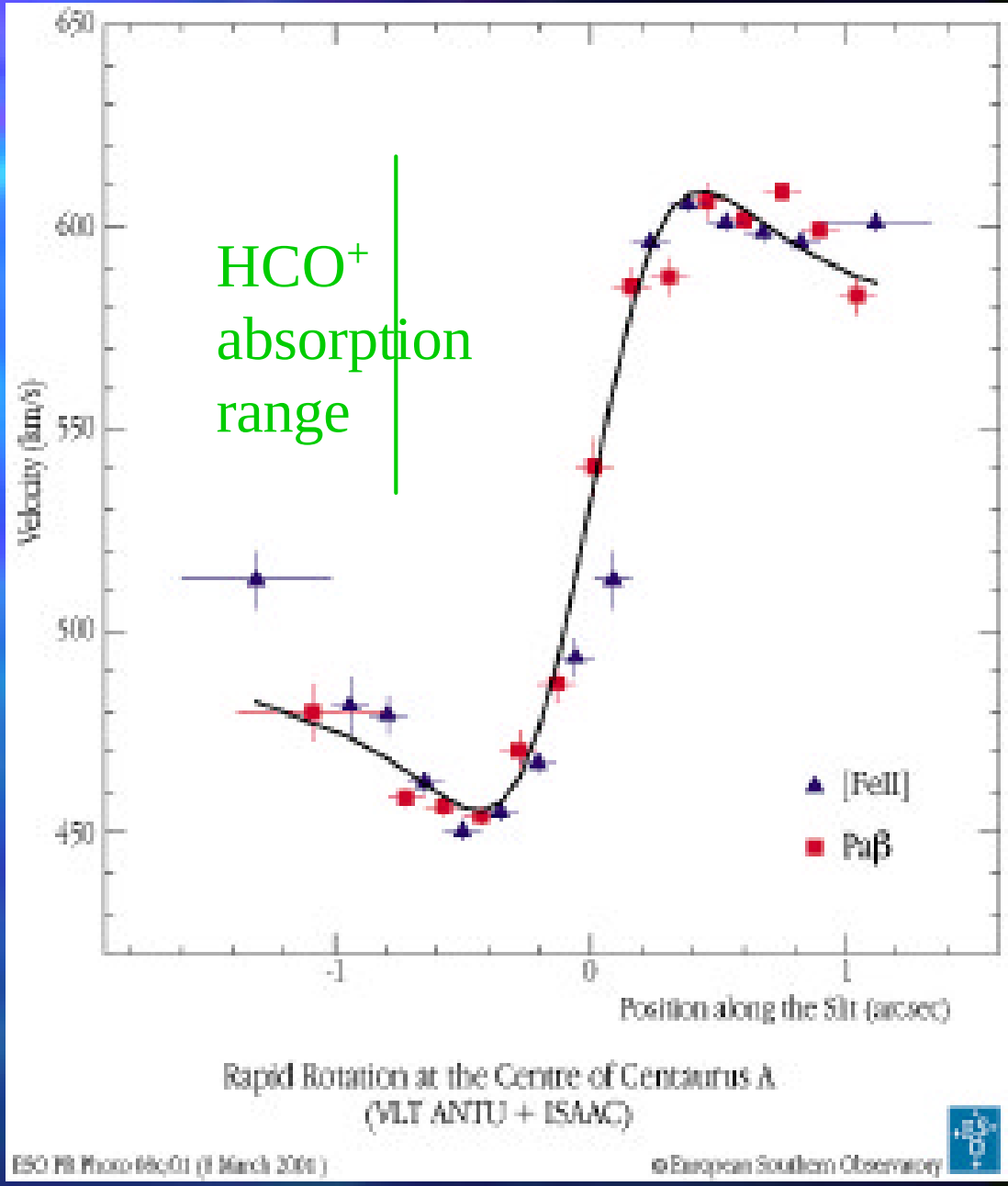
Observing parameters:

- 2 IFs: BW= 64 MHz
  128 channels, each
- IF1: 89.010 GHz
- IF2: 90.485 GHz
- => velocity range:
  500 - 680 km/s
- EW352: 45, 75, 120m


HCO+
HNC
Amplitude
0
0.1
0.2
0.3
0.4
500
550
600
650
700
Velocity(optical,Barycentric) (km/s)
Amplitude
0.4
0.45
0.5
500
550
600
650
Velocity(optical,Barycentric) (km/s)

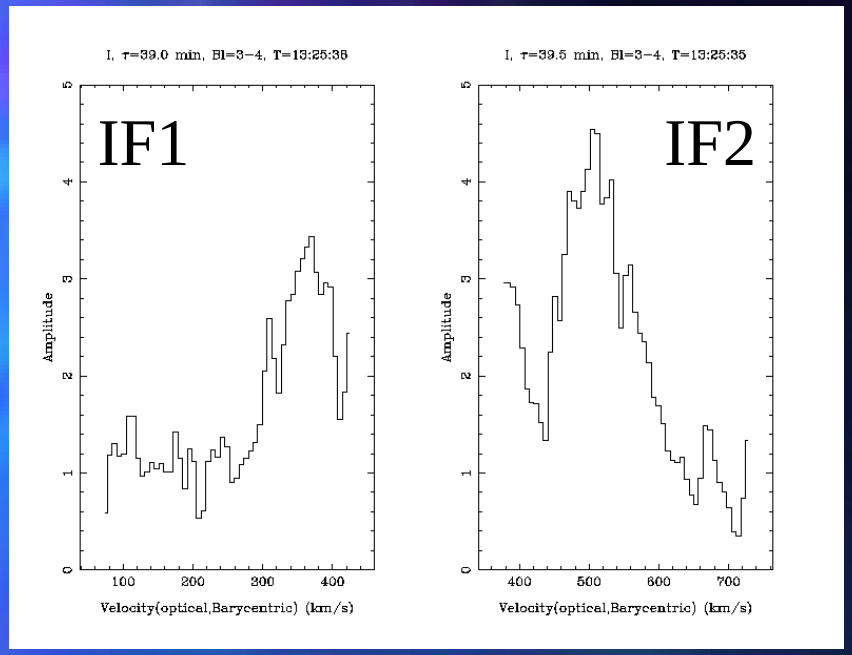

535-558
572-618 km/s
Amplitude
0.45
0.4
0.35
HNC
610 km/s
550 km/s
Amplitude
0.5
0.45
0.4
500
520
540
560
580
600
620
640
660
680
Velocity(optical,Barycentric) (km/s)

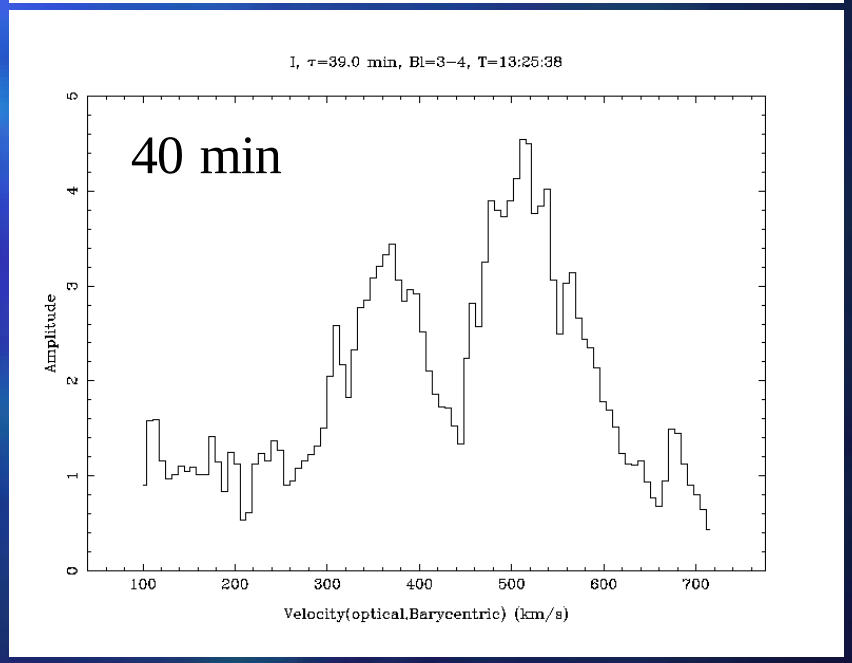
ESO Press Releases



The Circinus Galaxy

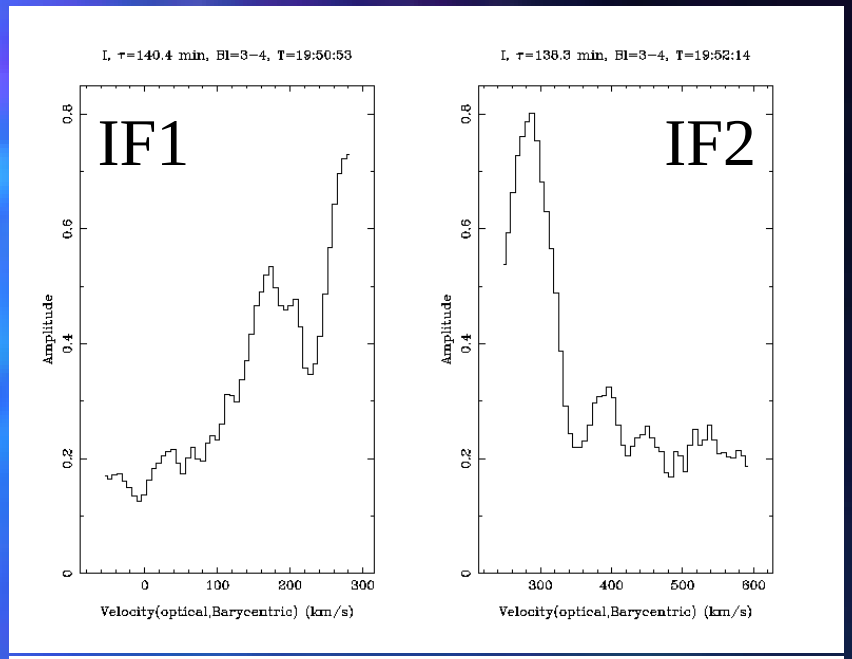
- 10 July 2001
- 30m baseline
- HCO+(1-0)
- Tsys about 350 K
- 2IFs, 128 MHz BW, 64 channels each
- IF 1: 89.110 GHz
- IF 2: 89.020 GHz

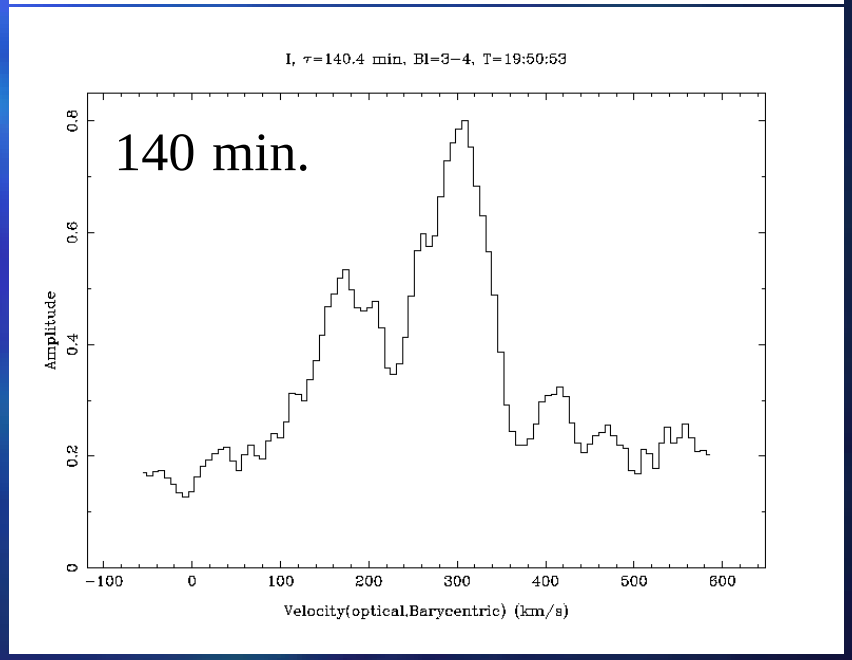




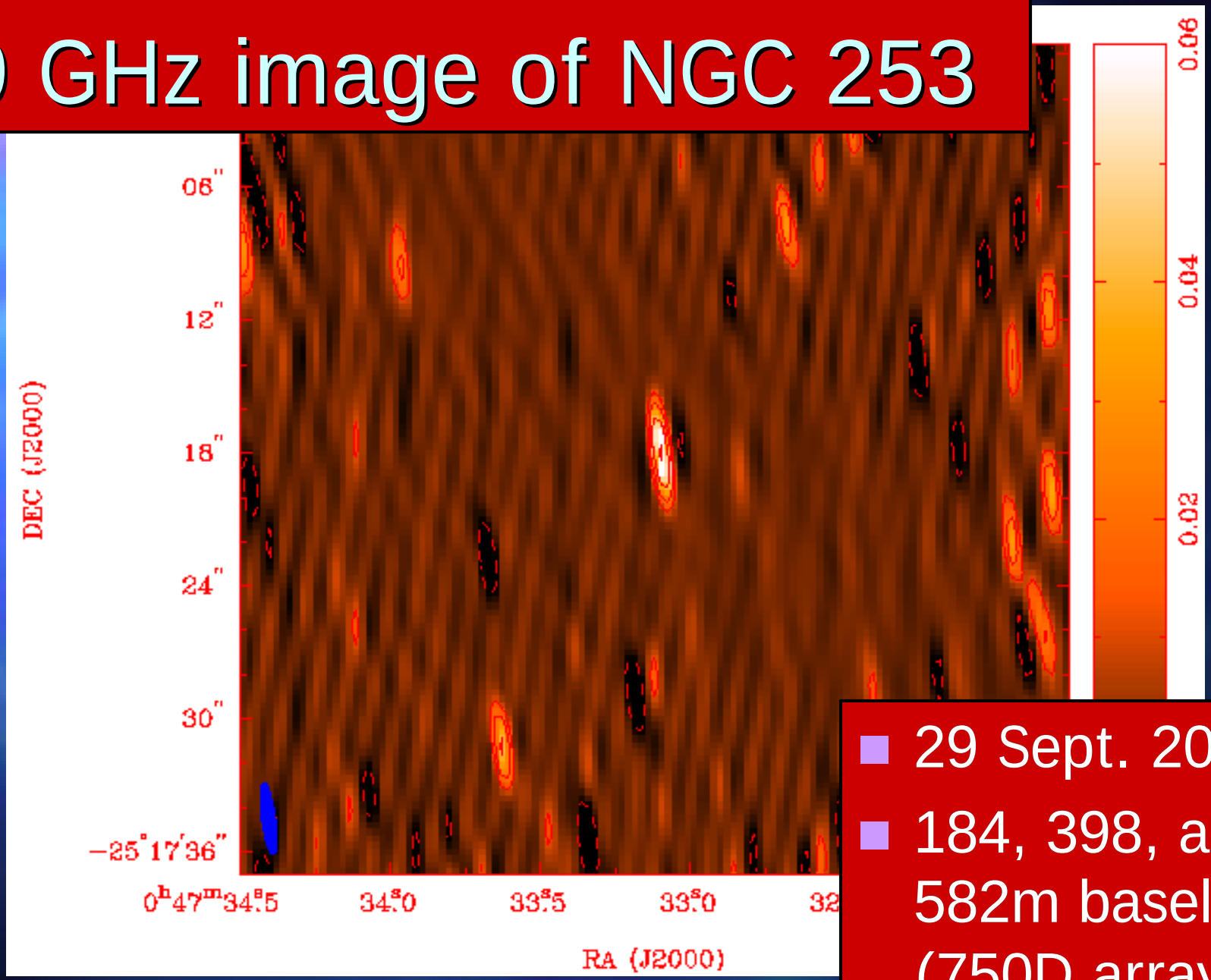
The Galaxy NGC 253

- 11 July 2001
- 30m baseline
- HCO^+(1-0)
- Tsys about 350 K
- 2IFs, 128 MHz BW, 64 channels each
- IF 1: 89.162 GHz
- IF 2: 89.072 GHz



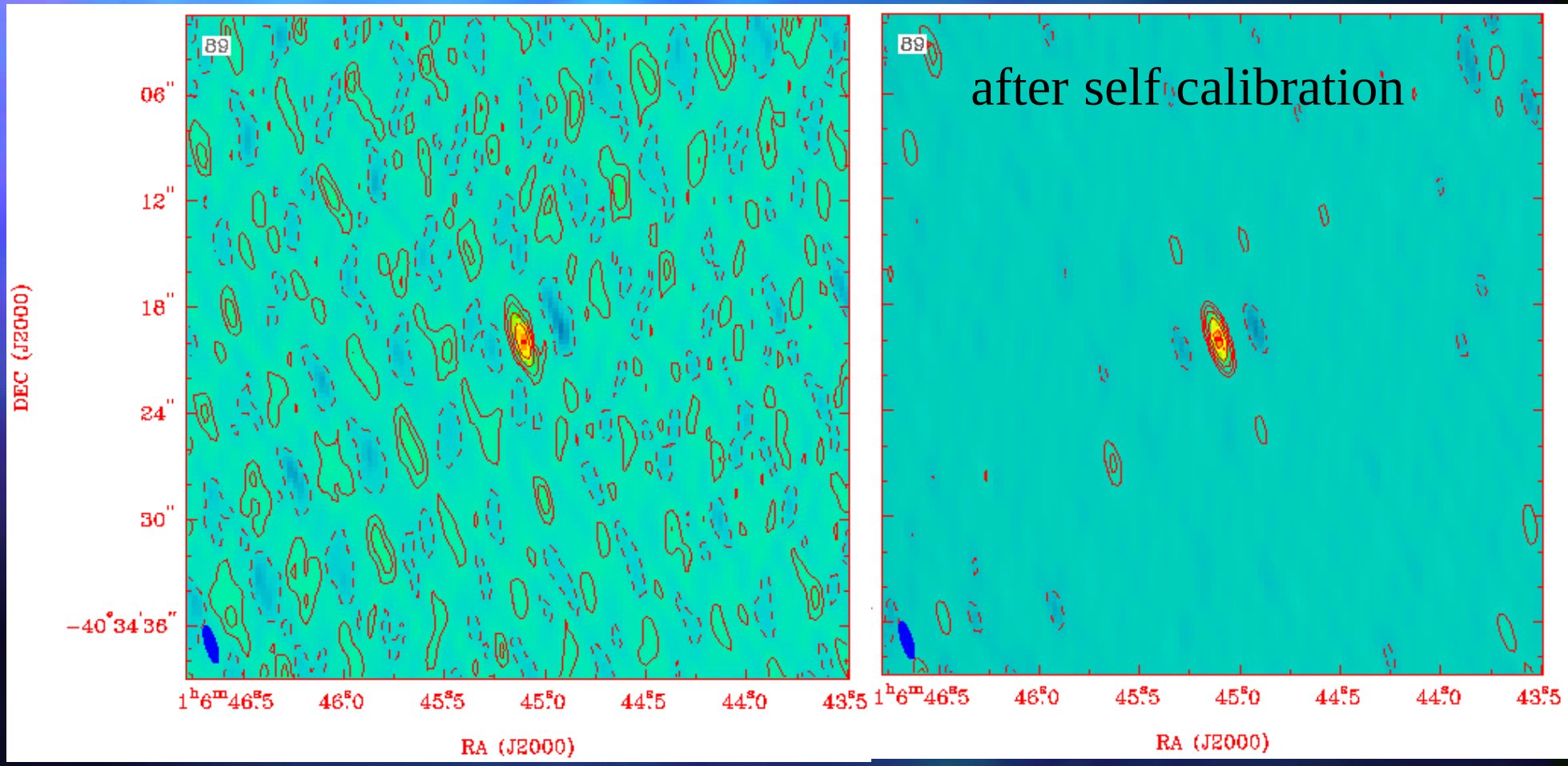


89 GHz image of NGC 253



- 29 Sept. 2001
- 184, 398, and 582m baselines (750D array)

Phase Calibrator: 0104-408



The radio-loud blazar **1921-293** (OV-236)

- z = 0.3525+-5
- v = 105.527 km/s
- redshifted CO(1-0) at 85.260 GHz !!
- ≈12 Jy @ 90 GHz (highly variable)

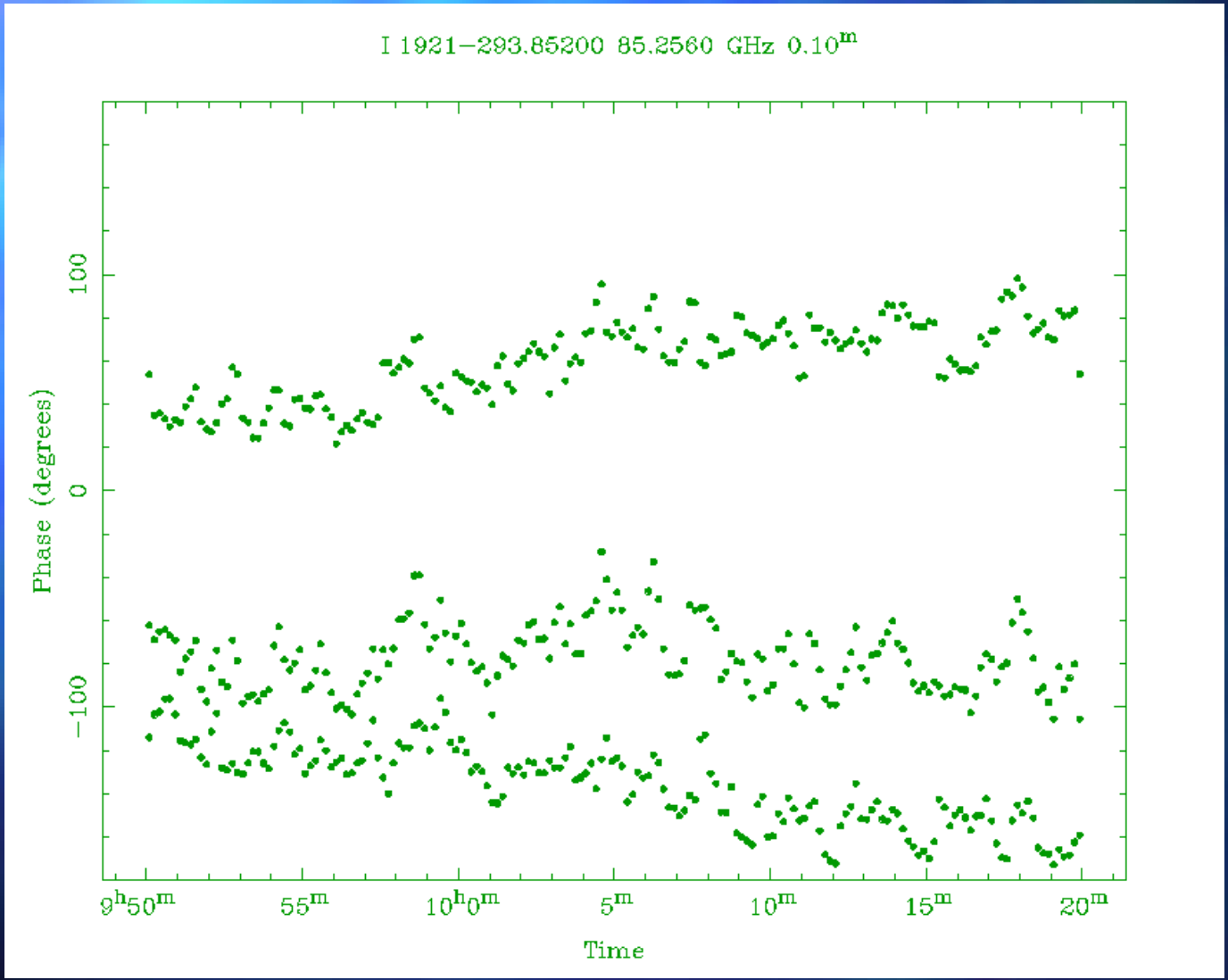
Observing parameters:

- 2 IFs: BW=128 MHz 64 channels, each
- IF1: 85.200 GHz
- IF2: 85.290 GHz
- => velocity range: 105.150-106.000 km/s
- EW352: 46, 77, 122m

1921-293: phase vs time (30min.)

+100

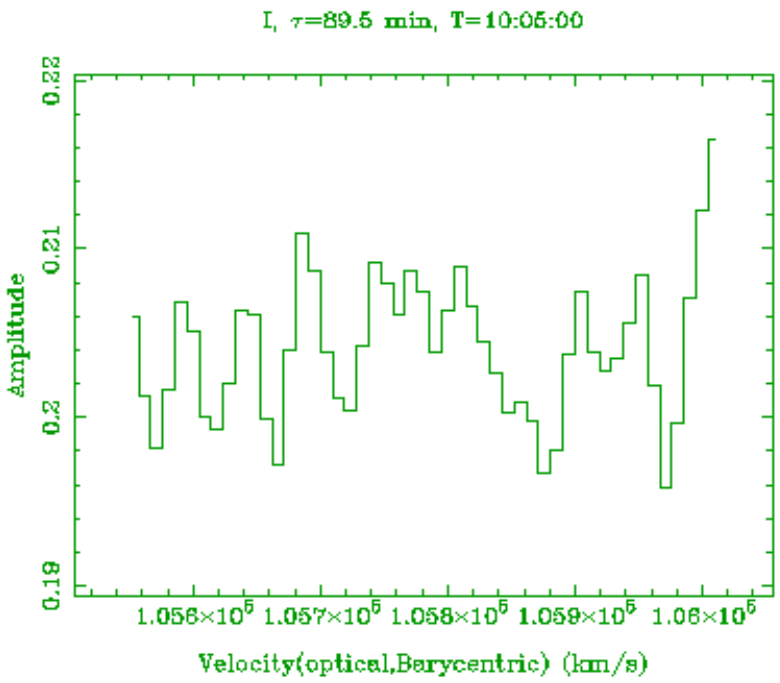
-100

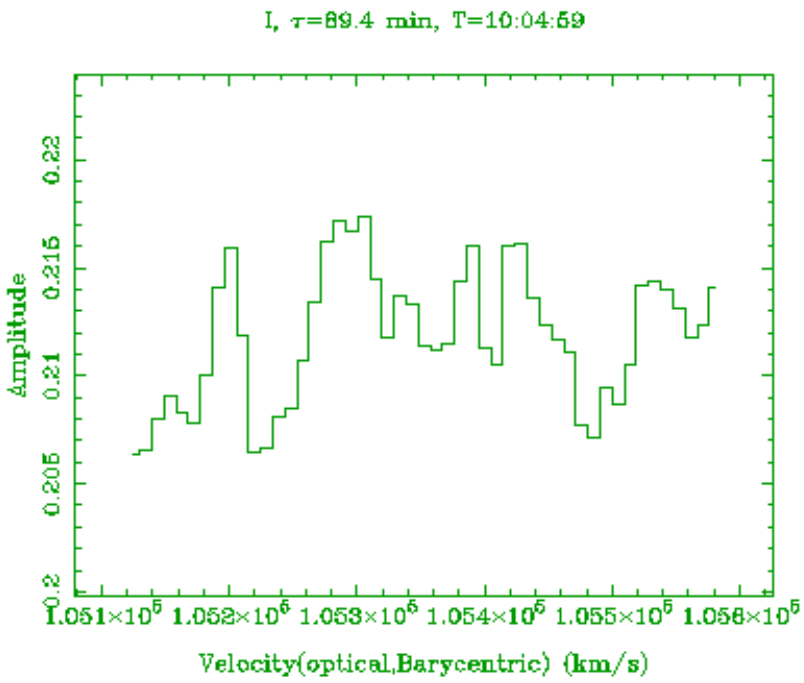


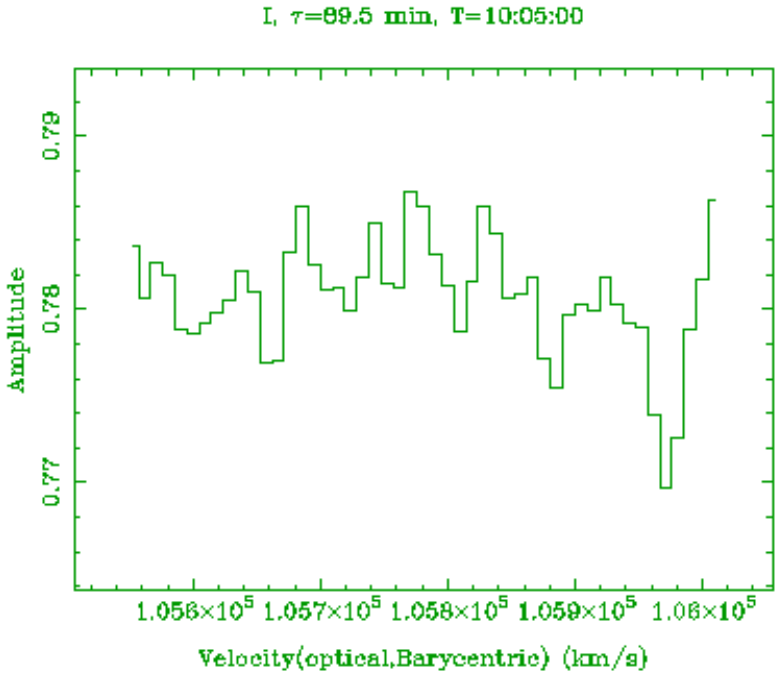
3-4 (46m)

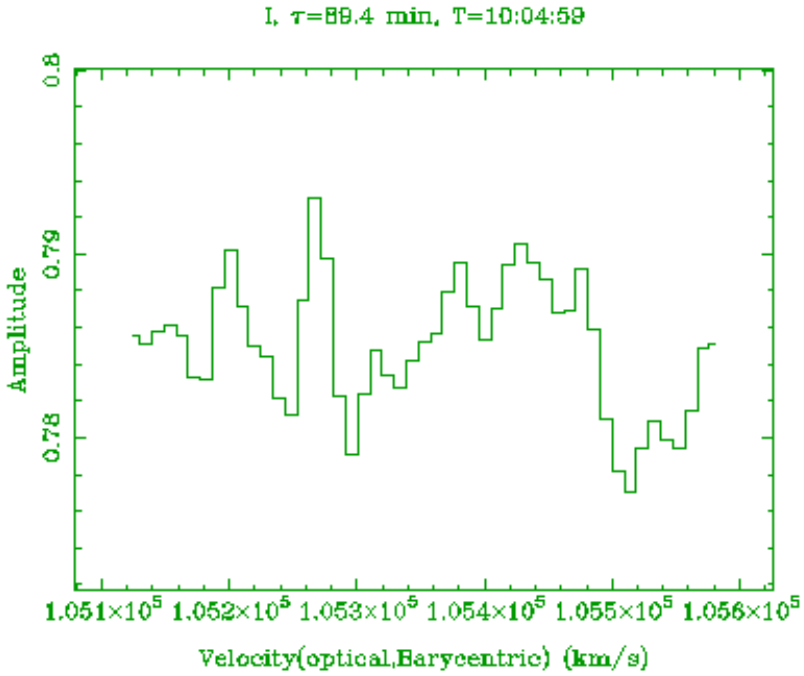
2-4 (122m)

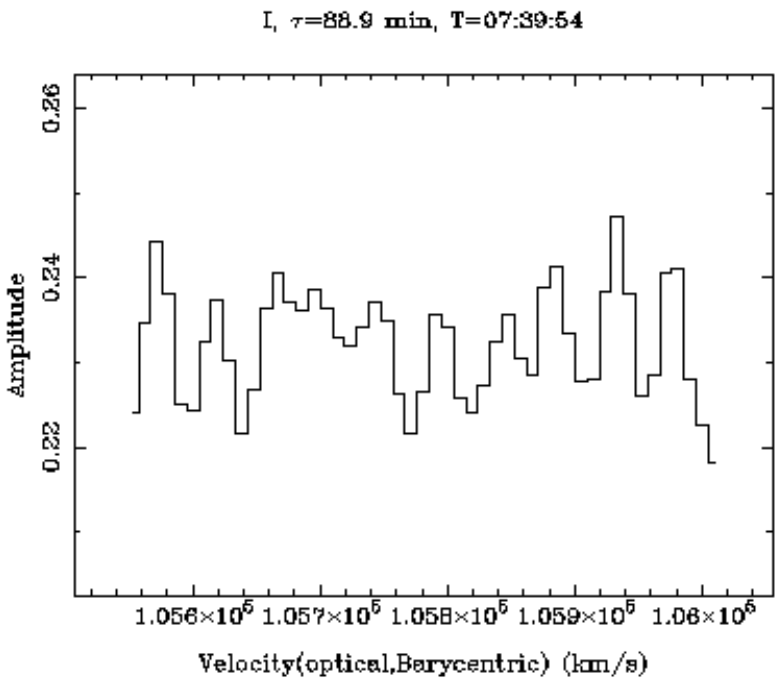
2-3 (77m)

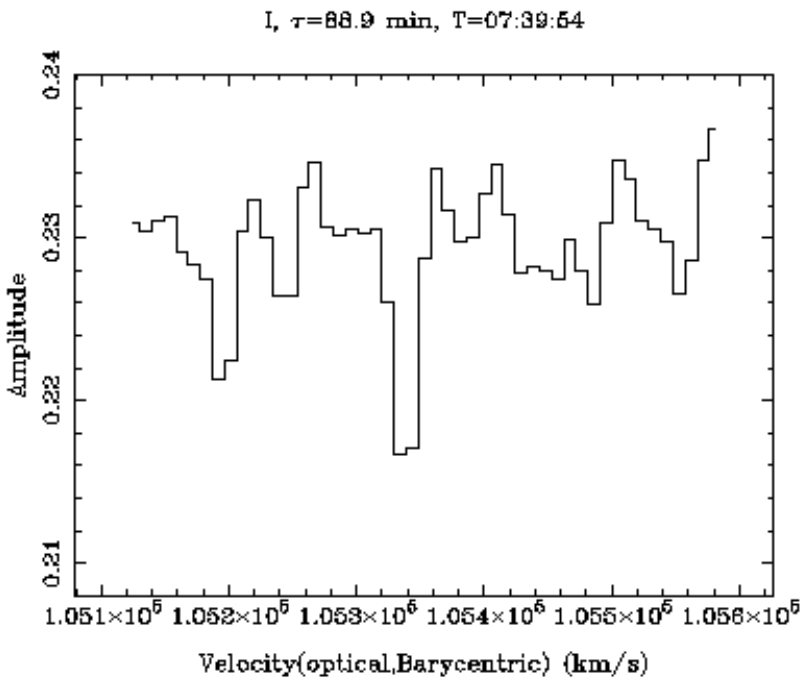

I, τ=89.5 min, T=10:05:00
Amplitude
0.19
0.2
0.21
0.22
1.056×10^5 1.057×10^5 1.058×10^5 1.059×10^5 1.06×10^5
Velocity(optical,Barycentric) (km/s)

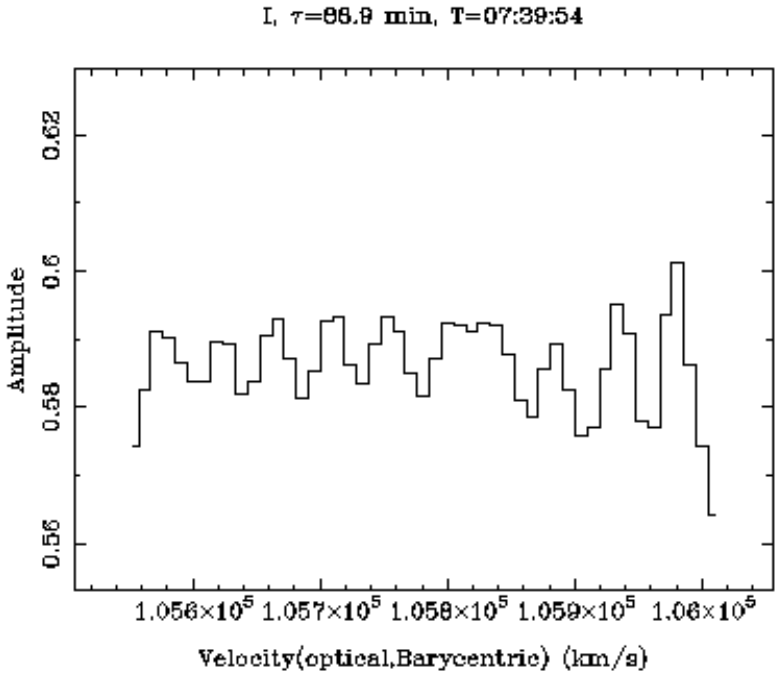

I, τ=89.4 min, T=10:04:59
Amplitude
0.2
0.205
0.21
0.215
0.22
1.051×10^5 1.052×10^5 1.053×10^5 1.054×10^5 1.055×10^5 1.056×10^5
Velocity(optical,Barycentric) (km/s)

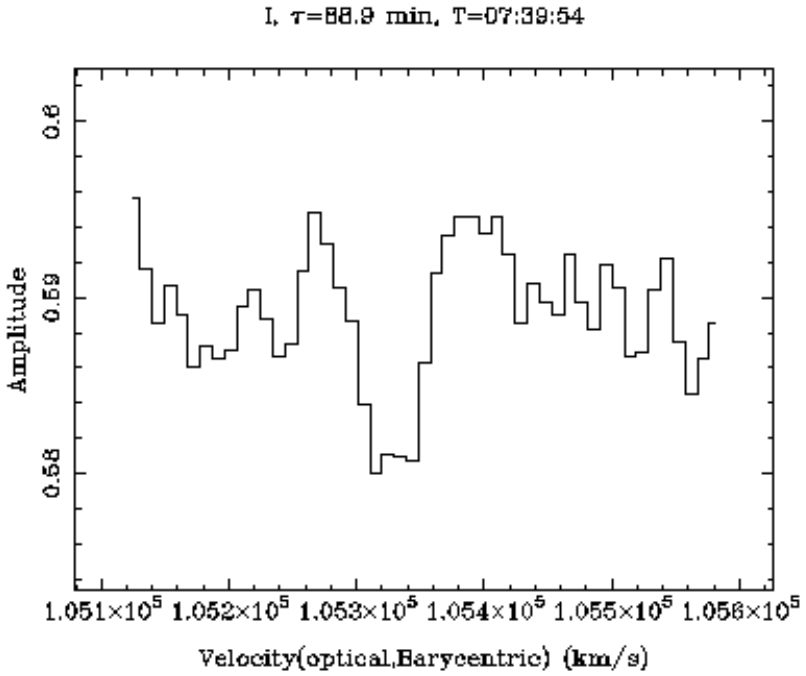

I, τ=89.5 min, T=10:05:00
Amplitude
0.77
0.78
0.79
1.056×10^5 1.057×10^5 1.058×10^5 1.059×10^5 1.06×10^5
Velocity(optical,Barycentric) (km/s)


I, τ=89.4 min, T=10:04:59
Amplitude
0.78
0.79
0.8
1.051×10^5 1.052×10^5 1.053×10^5 1.054×10^5 1.055×10^5 1.056×10^5
Velocity(optical,Barycentric) (km/s)

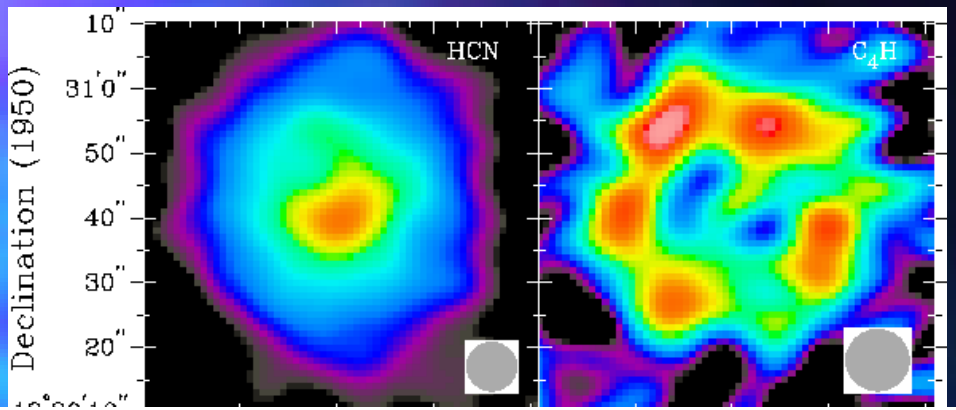

I, τ=88.9 min, T=07:39:54
Amplitude
0.22
0.24
0.26
1.056×10^5 1.057×10^5 1.058×10^5 1.059×10^5 1.06×10^5
Velocity(optical,Barycentric) (km/s)


I, τ=88.9 min, T=07:39:54
Amplitude
0.21
0.22
0.23
0.24
1.051×10^5 1.052×10^5 1.053×10^5 1.054×10^5 1.055×10^5 1.056×10^5
Velocity(optical,Barycentric) (km/s)


I, τ=88.9 min, T=07:39:54
Amplitude
0.56
0.58
0.6
0.62
1.056×10^5 1.057×10^5 1.058×10^5 1.059×10^5 1.06×10^5
Velocity(optical,Barycentric) (km/s)


I, τ=88.9 min, T=07:39:54
Amplitude
0.58
0.59
0.6
1.051×10^5 1.052×10^5 1.053×10^5 1.054×10^5 1.055×10^5 1.056×10^5
Velocity(optical,Barycentric) (km/s)

AGB star IRC+10216



BIMA images

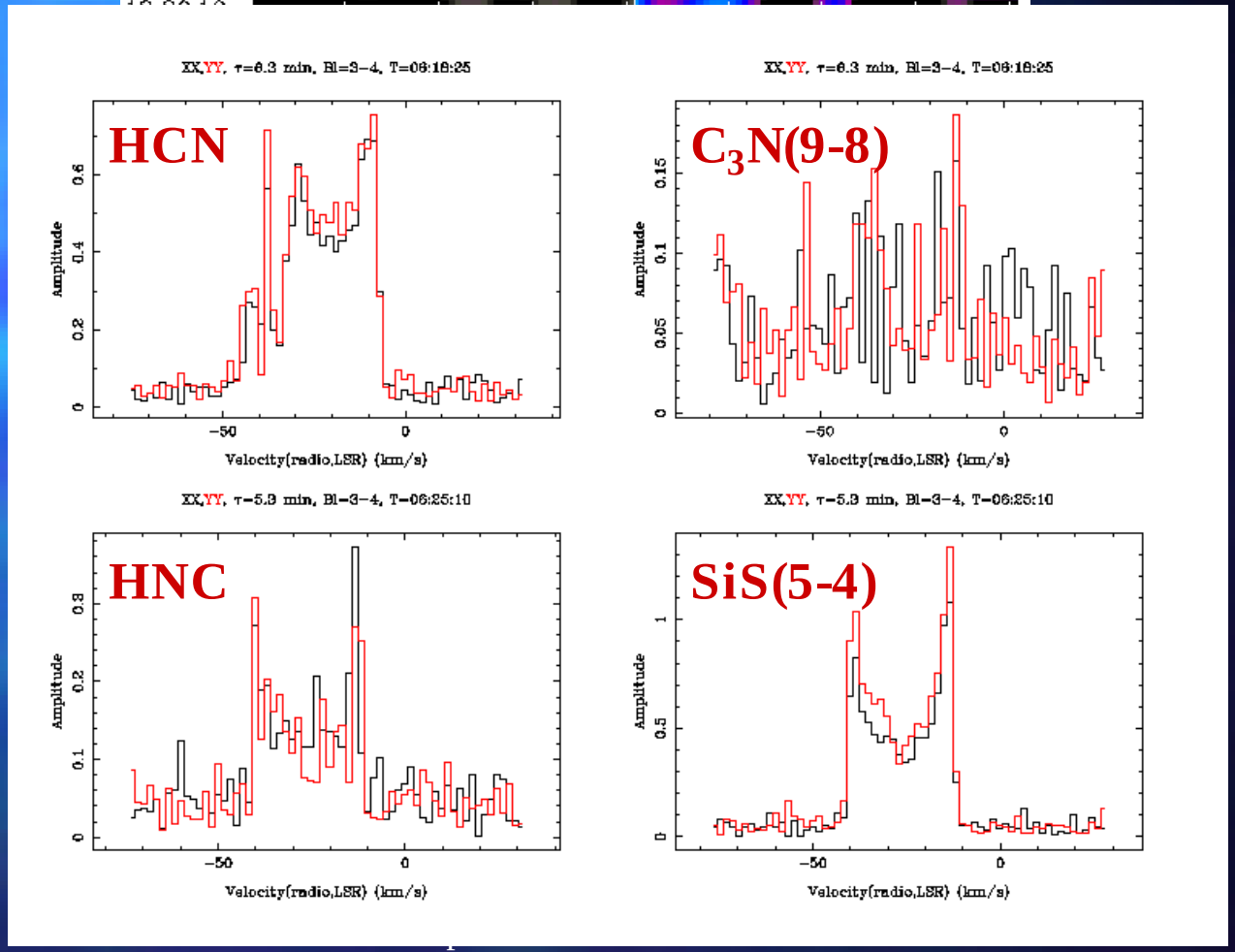
ATCA

July 2001

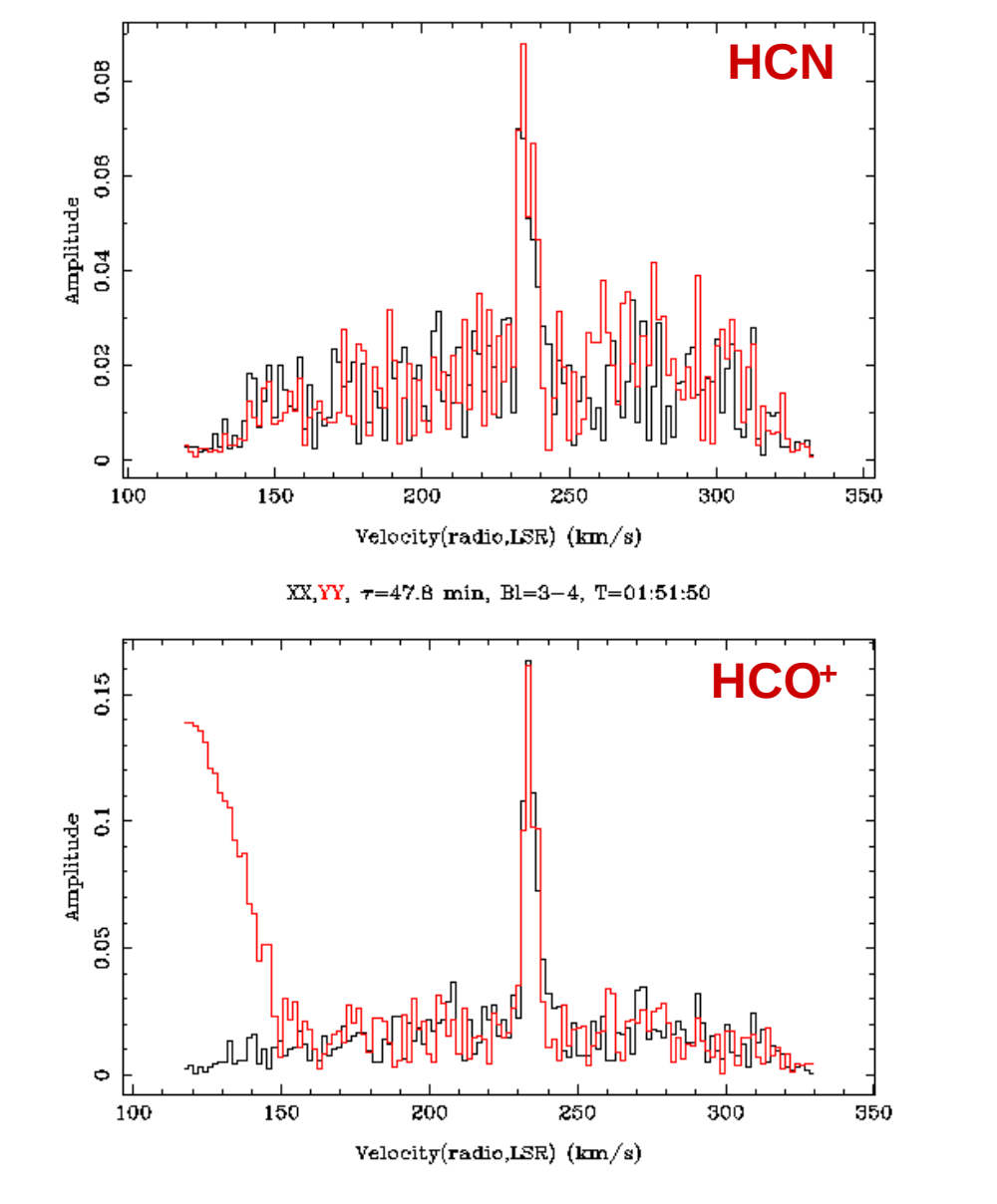
30m baseline

2 pol.

uncalibrated

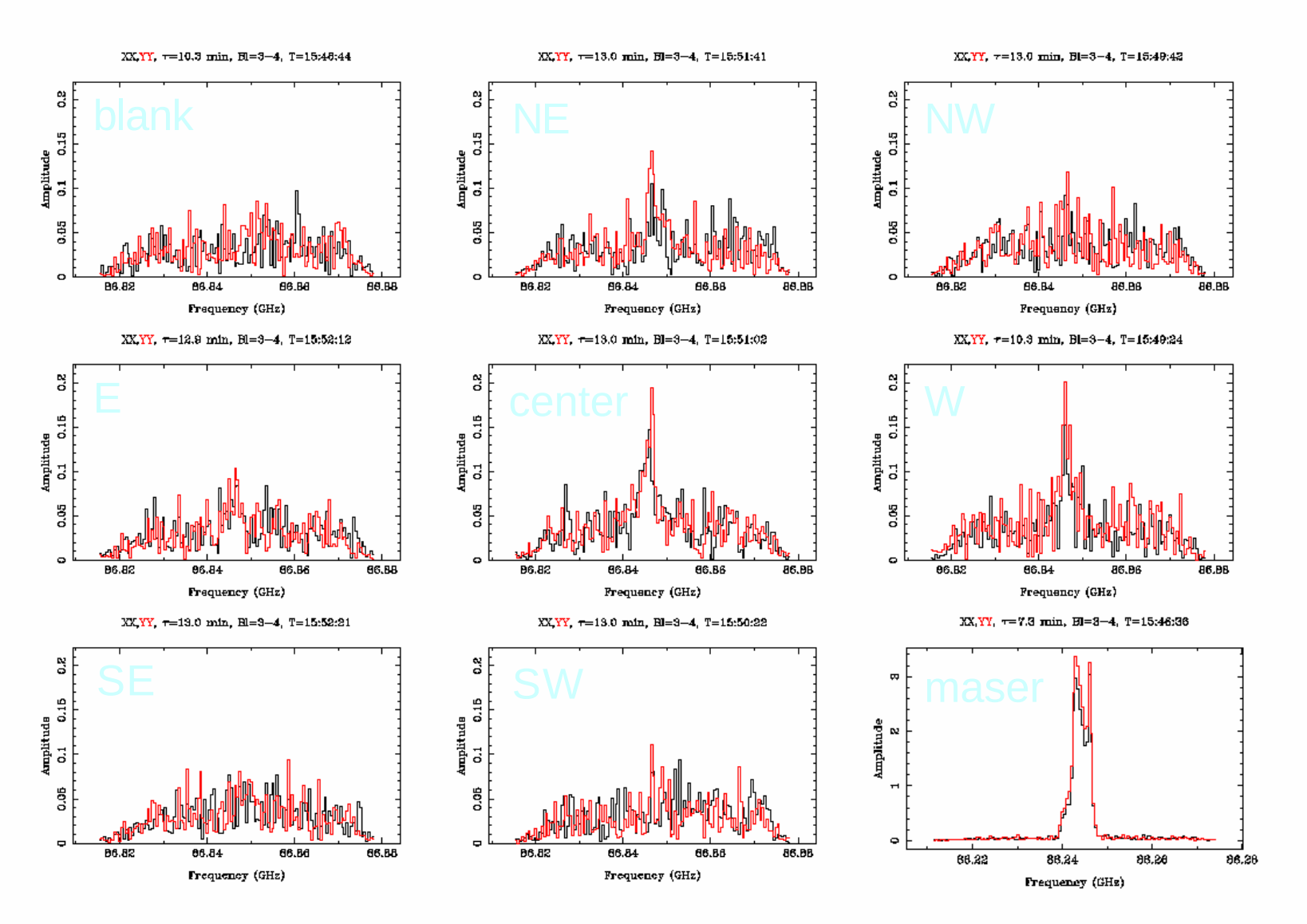


N113 Cloud in the LMC



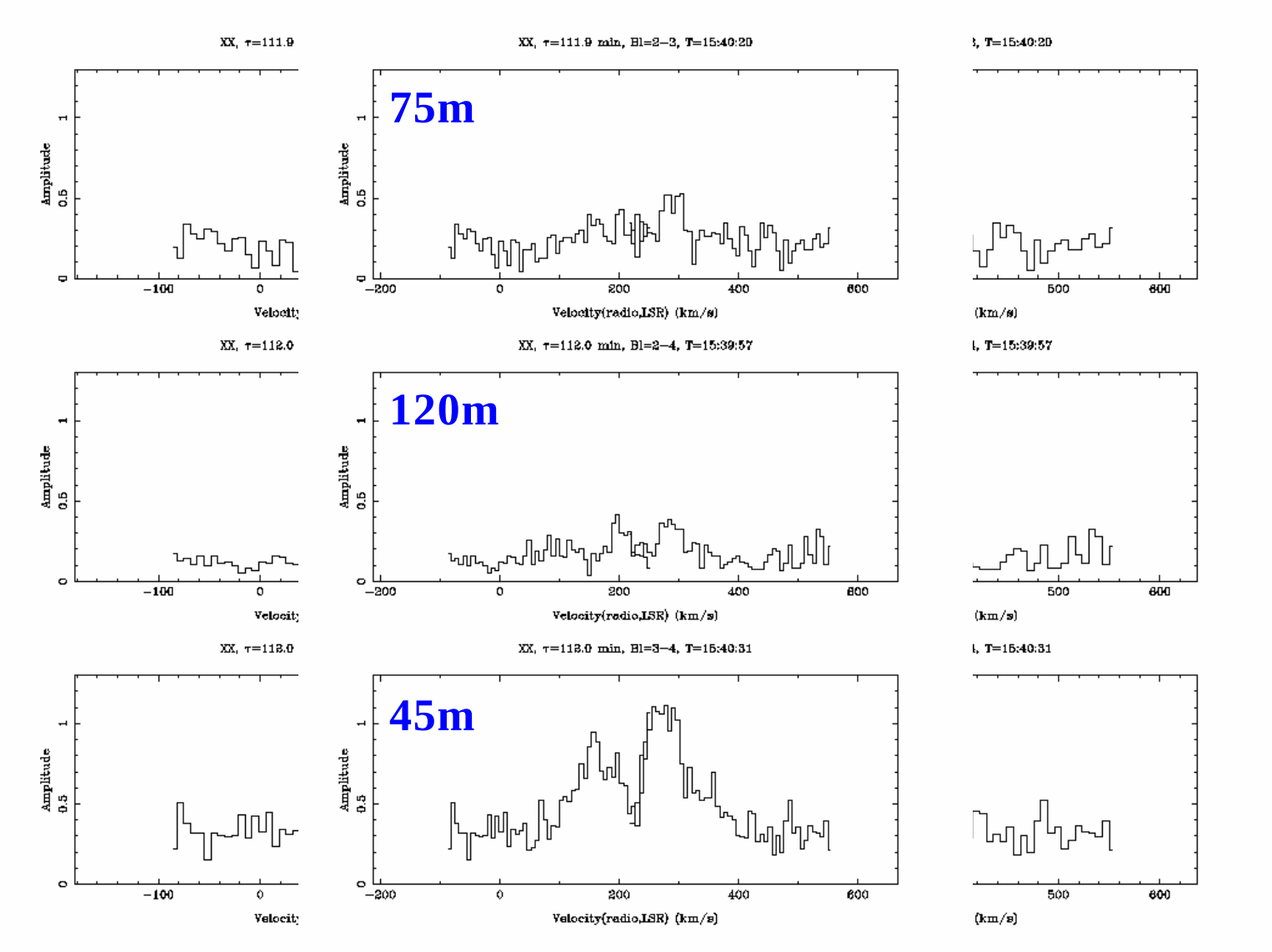
- **The Magellanic Clouds will be prime targets, despite being well situated for nighttime viewing only in the summer.**

Thermal SiO in NGC 6334 I(N)



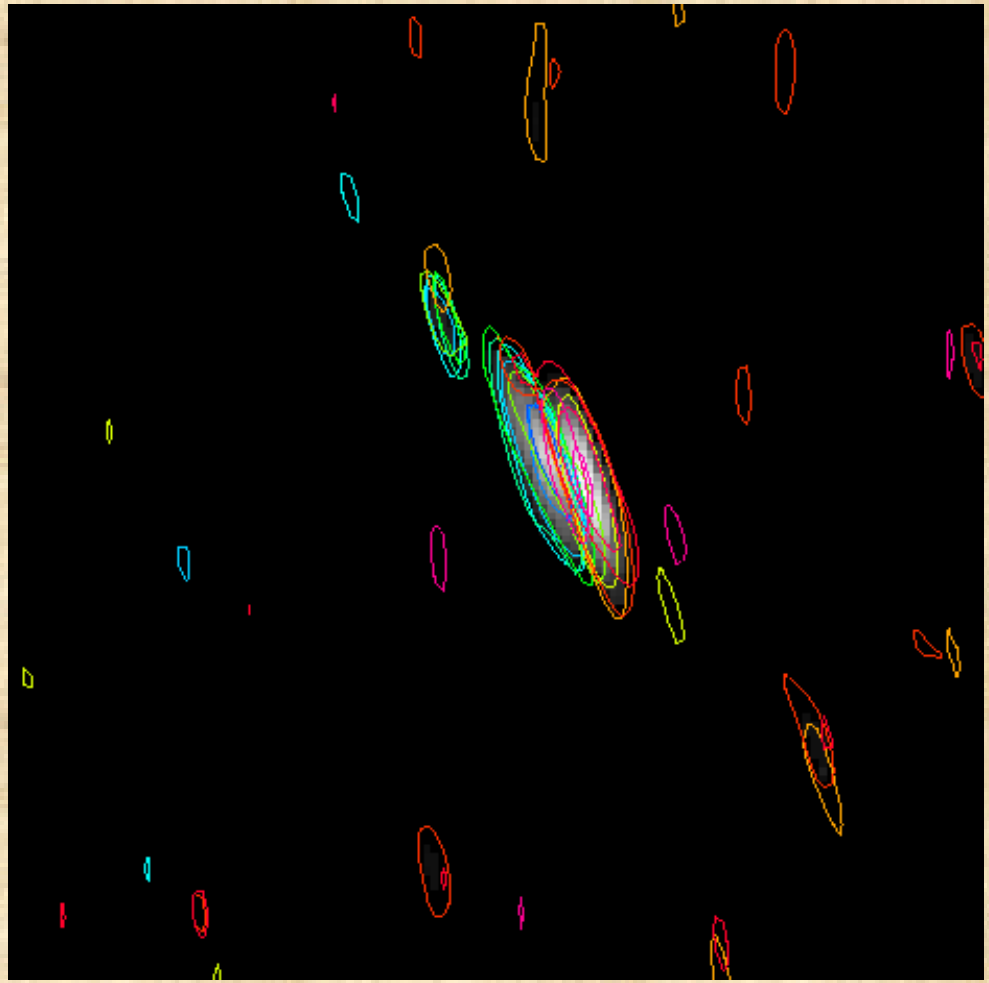
Single-baseline ATCA, July 2001

HCO^+ in Galaxy NGC 253



HCO^+ line too wide: had to overlap 2 spectral windows.

HCO^+ in Galaxy NGC 253



Beam size 19” x 2.9”

- **5-hr observation on 5 Oct 2001.**
- **Continuum source at center of ~0.2 Jy.**
- **Red and blue shifted line emission of ~1 Jy is detected on either side of the nucleus.**