The Pierre Kaufmann Radio Observatory

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IAG/USP

Summary

- **Description of the equipment available along the last 50 years (hardware and software)**
- **Insertion of the Observatory in the International context**
- **Relation of equipment available with frontier science at different epochs.**
- **Future of the Observatory (Radiotelescope).**

The PK Radio Observatory

- Located in Atibaia, SP, 800 m above sea level.
- First radio telescope covered by a radome, built by ESSCO, which made radomes for radars, such as Haystack.
- Operates between 10 and 100 GHz (<50 GHz because of the atmosphere)

The Radio Telescope

- **Radiotelescope**:
- 13.8 m de diameter,
- Cassegrain focus
- Alt-azimuth mount

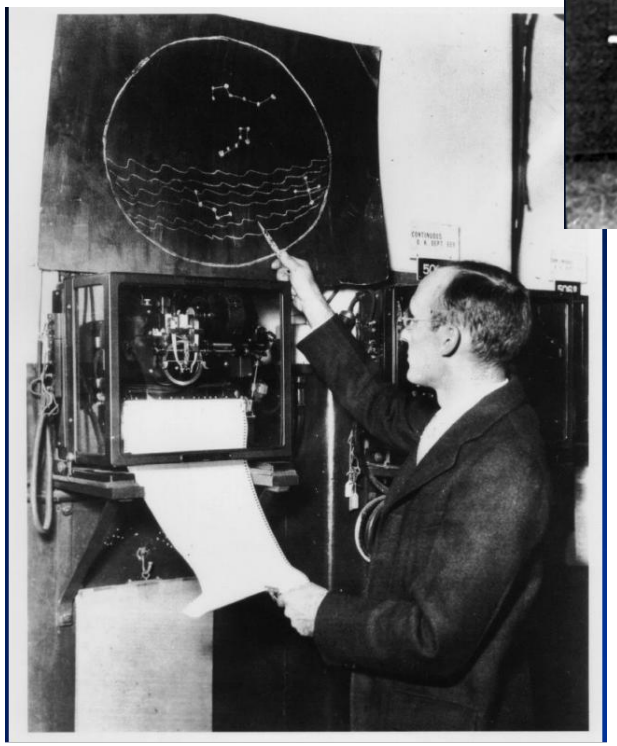
- **Vantages of the radome**
- Lightweight Frame
- Pointing accuracy
- Can observe the Sun

- **Disadvantages**
- Absorption
- Standing waves.

Construction (1971)

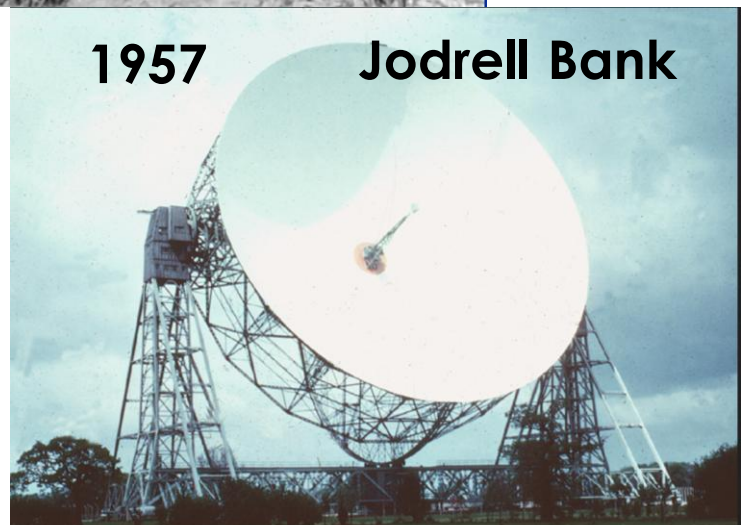
History of radioastronomy: 40-20 years before

1930 Jansky

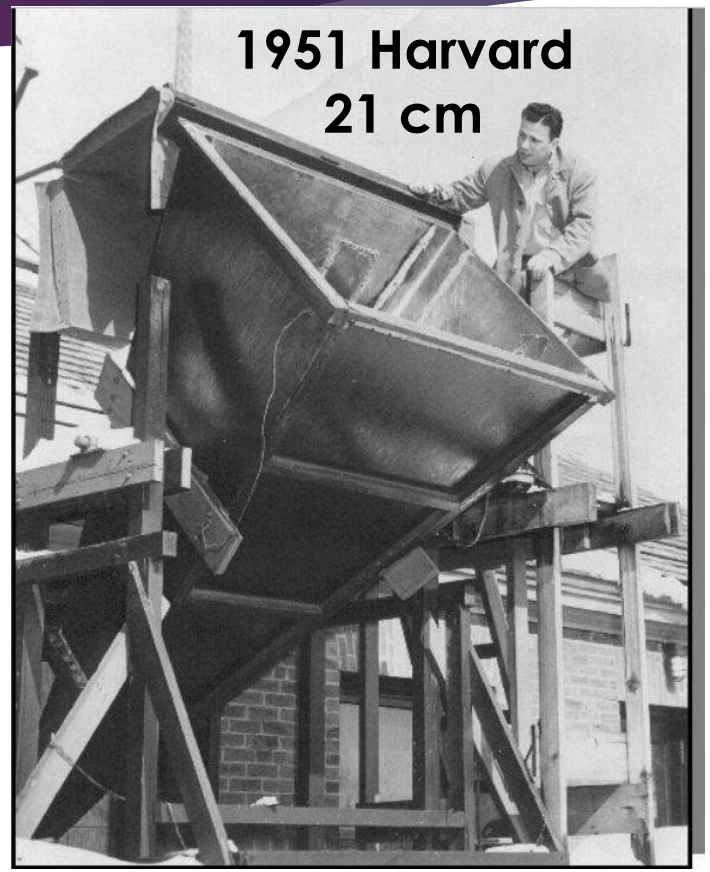


1945 Jodrell Bank

1957 Jodrell Bank



1951 Harvard 21 cm



Science in the 60s

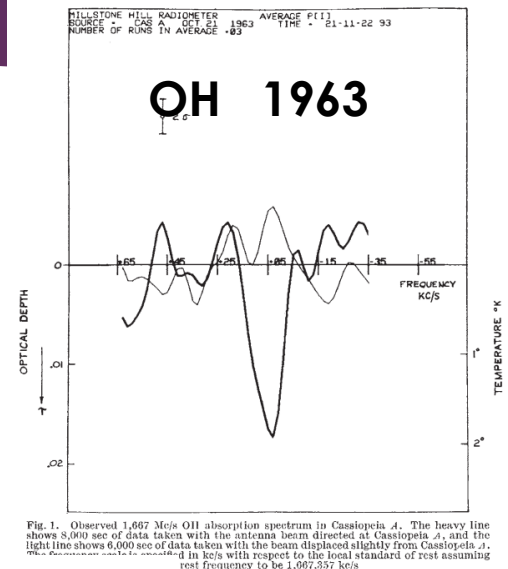
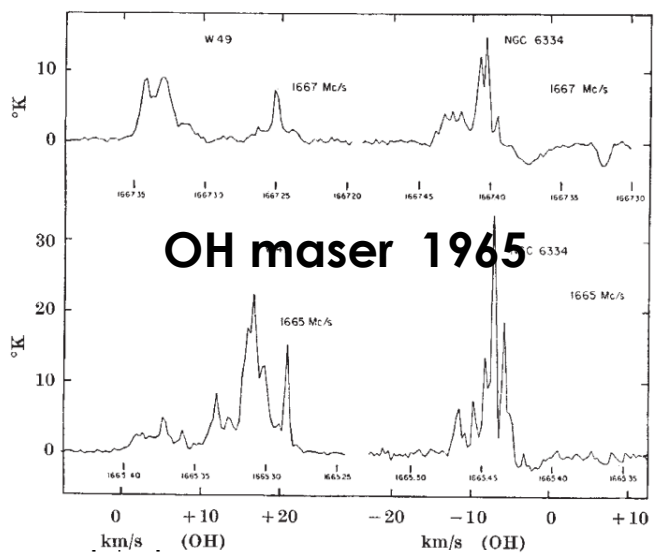


Fig. 1. Observed 1,667 Mc/s OH absorption spectrum in Cassiopeia *A*. The heavy line shows 8,000 sec of data taken with the antenna beam directed at Cassiopeia *A*, and the light line shows 6,000 sec of data taken with the beam displaced slightly from Cassiopeia *A*. The frequency scale is graduated in kc/s with respect to the local standard of rest assuming rest frequency to be 1,667,357 kc/s



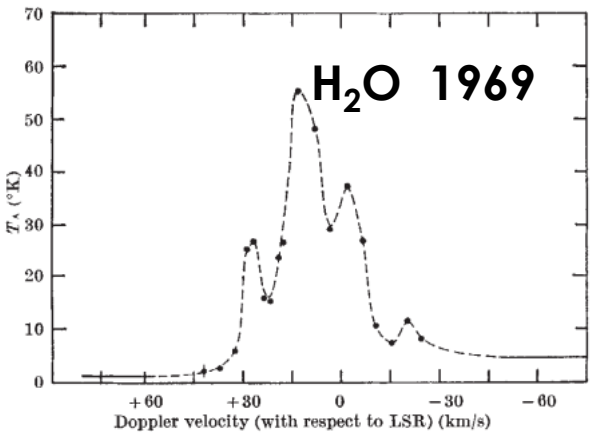
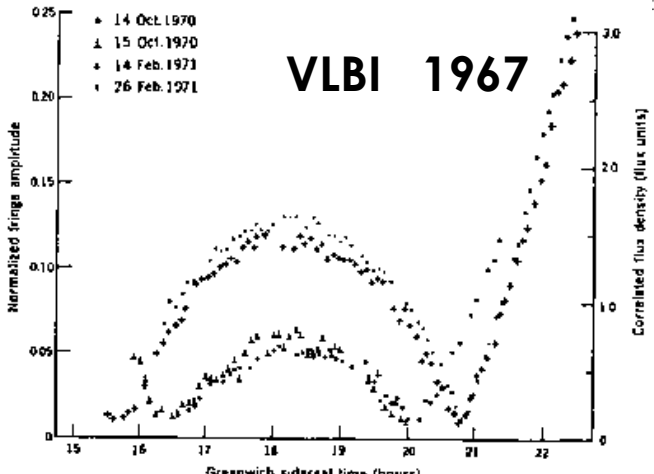
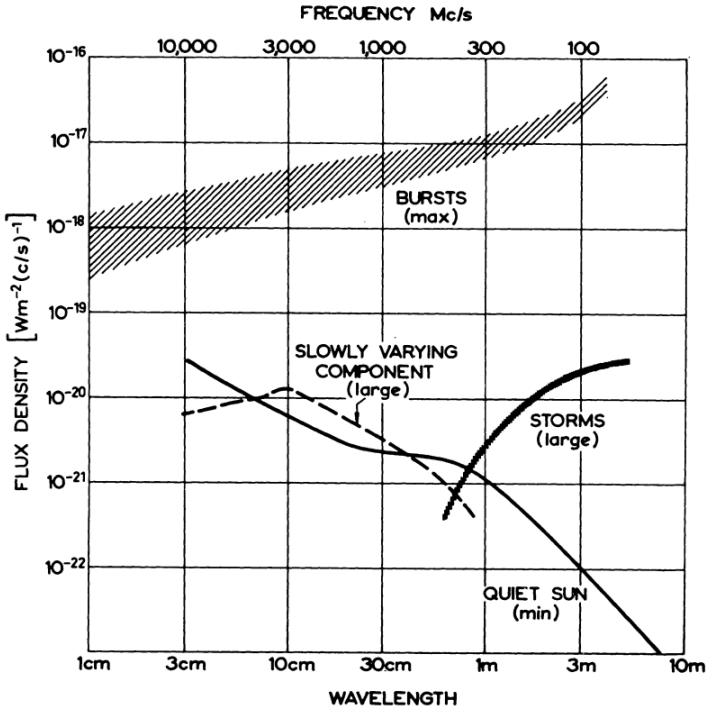
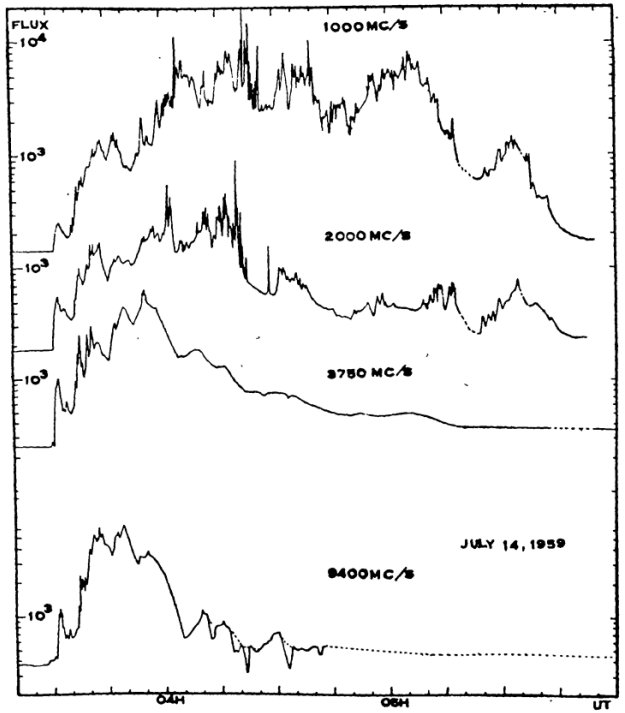


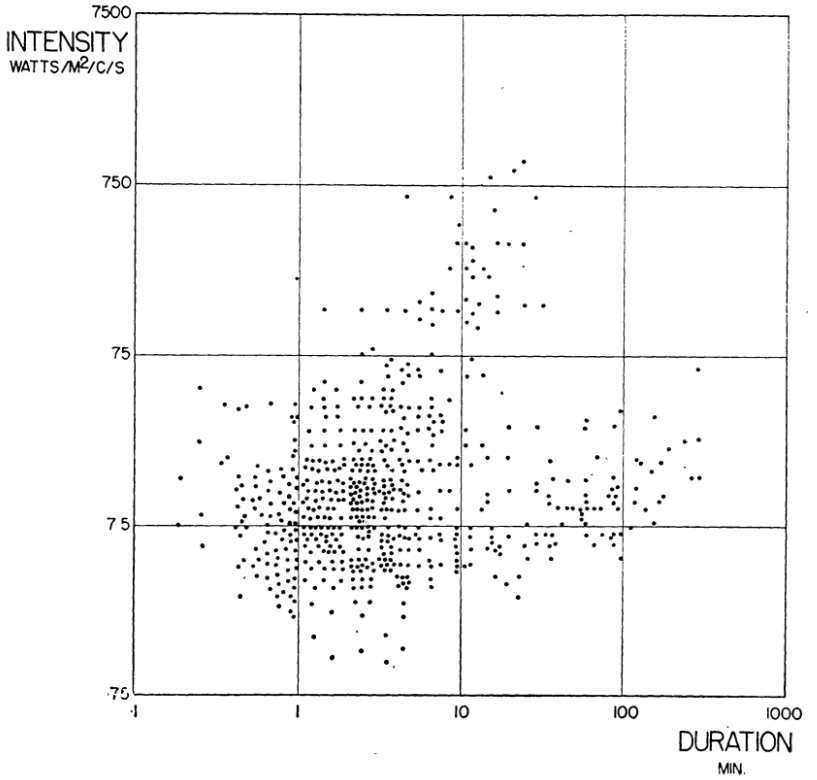
Fig. 3. Observed spectral intensity of H_2O transition in the direction of *W*49. The position of peak emission is $\alpha_{1950\cdot0} = 19\,h\,07\,m\,55\,s \pm 5\,s$,



Scientific motivation: Solar physics







First Observations: AGNs, H_2O masers , HII regions (1974)

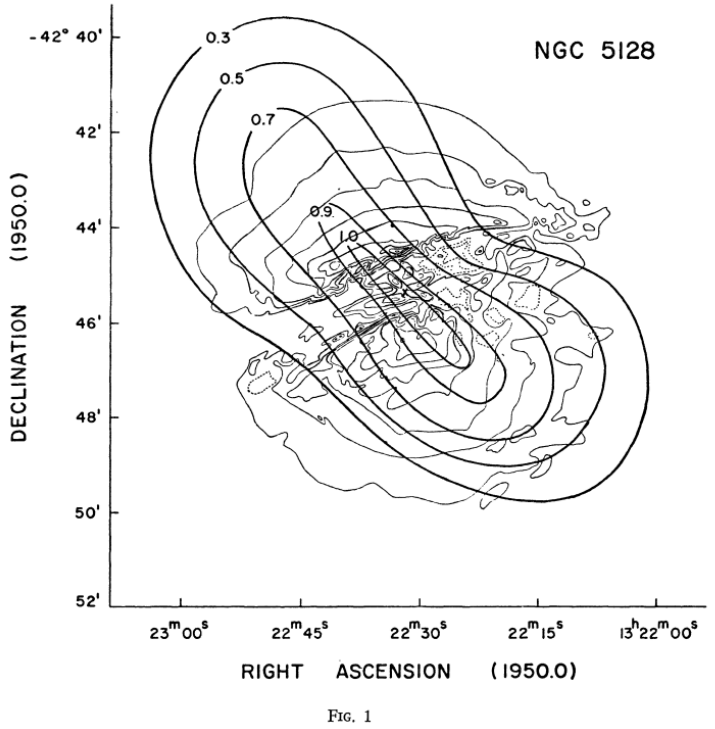
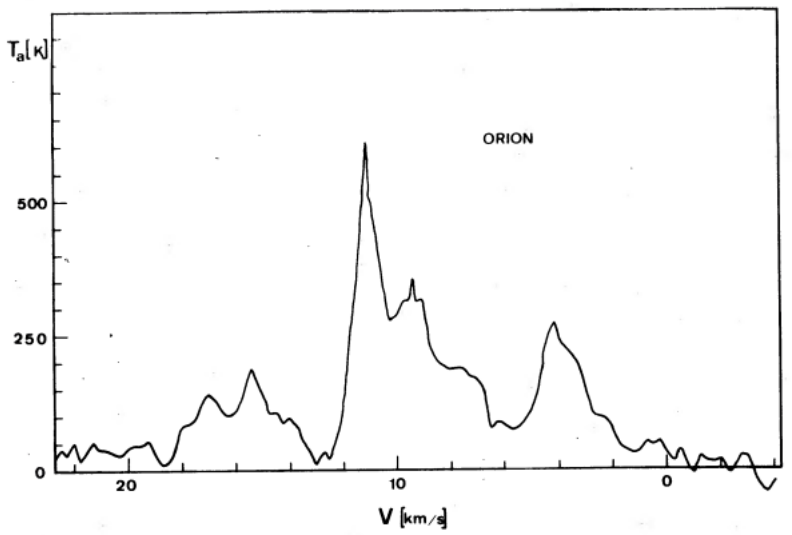


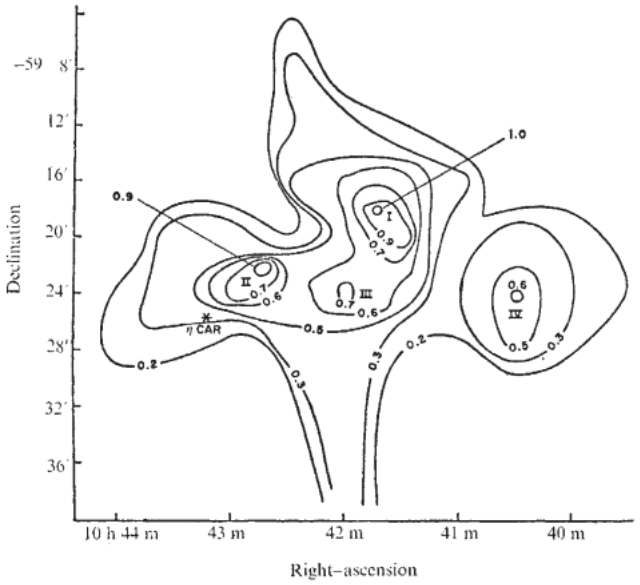
FIG. 1

Centaurus A
Kaufmann et al. AJ 1974

Receptor de banda larga com analisador espectral

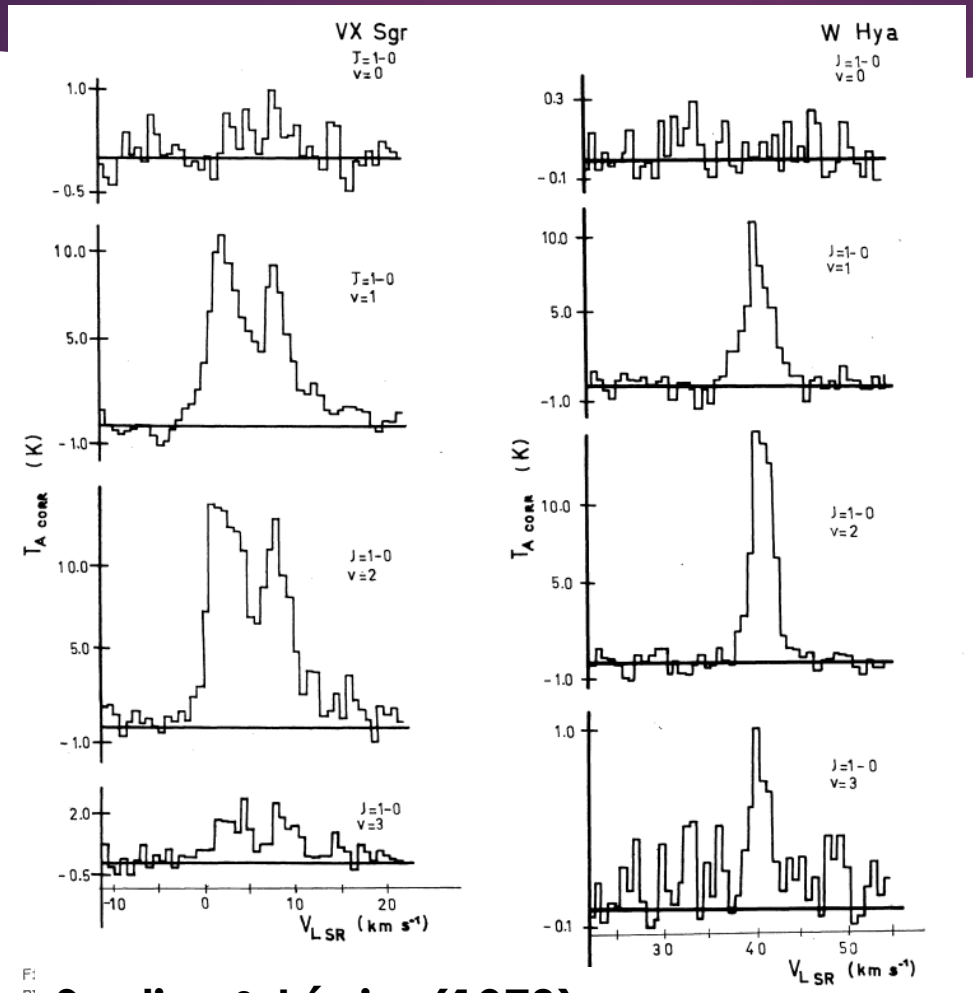


Maser de H2Oem Orion
Kaufmann et al. 1974



Carina HII region 22 GHz
Scalise et al. Nature
1974

The43 GHz receiver: SiO masers



Scalise & Lépine(1978)

The maser receiver and multichannel spectrometer (1976)

22 GHz receiver

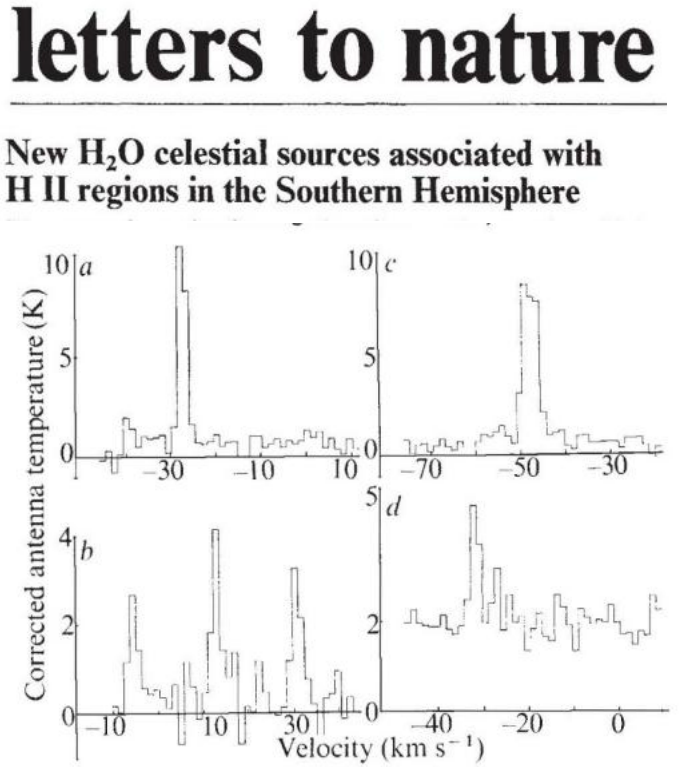
Ruby Traveling Wave Maser cooled with liquid He (open cycle), donated by Haystack

Spectrometer

47 channels of 100 kHz (1.3 km/s)

Observing method

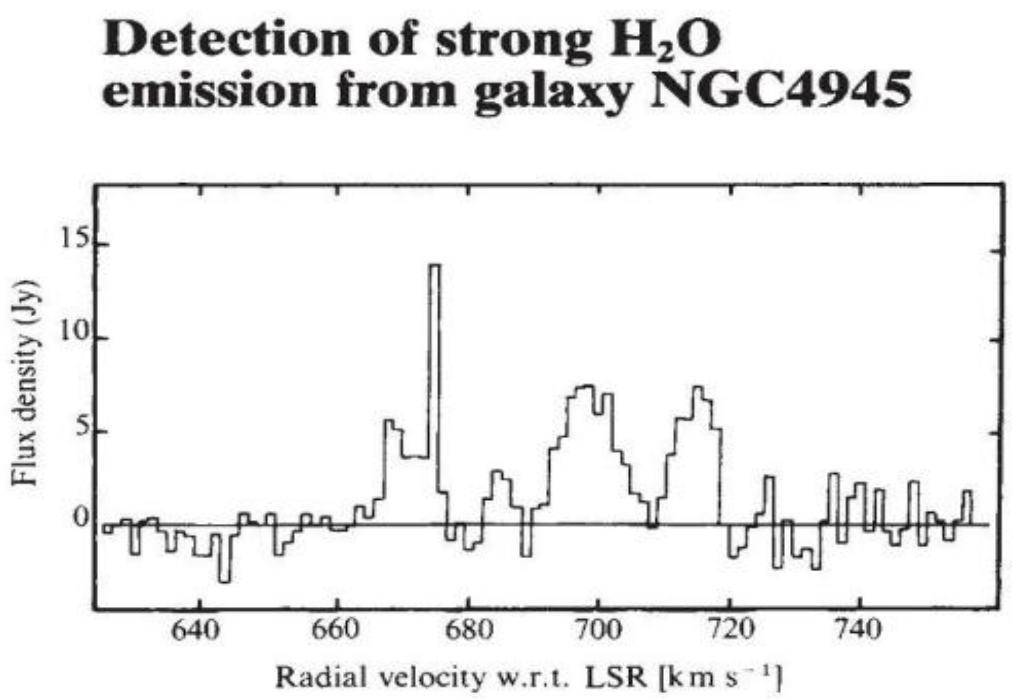
Beam-switching (2 horns)


letters to nature

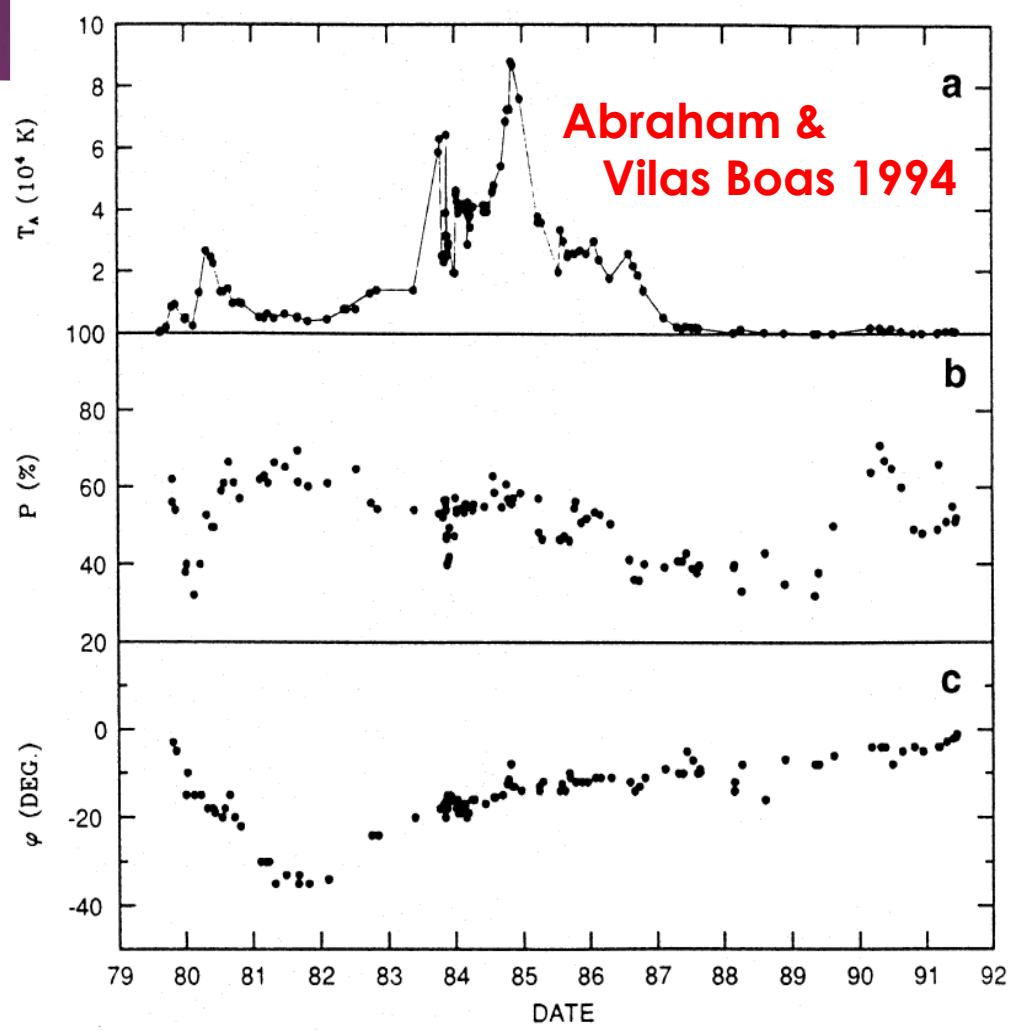
New H_2O celestial sources associated with H II regions in the Southern Hemisphere

Kaufmann et al. (1976)

The maser receiver and multichannel spectrometer (1979)



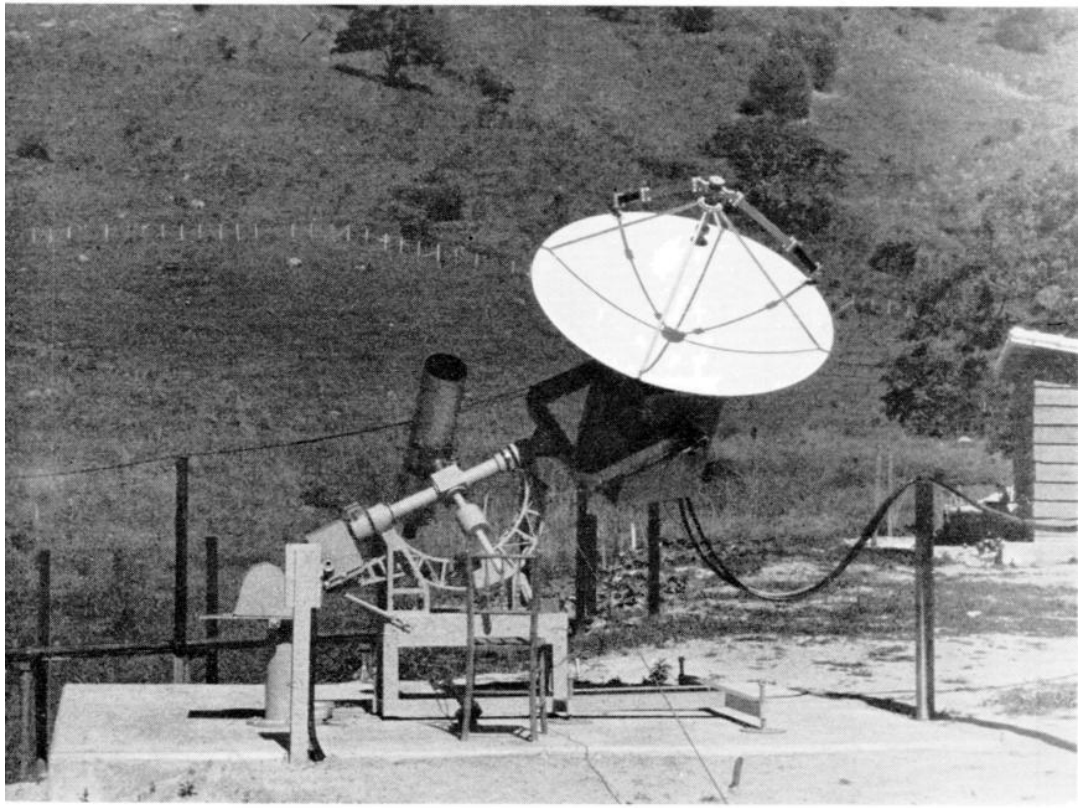
dos Santos e Lépine (1979)



Solar Observations?

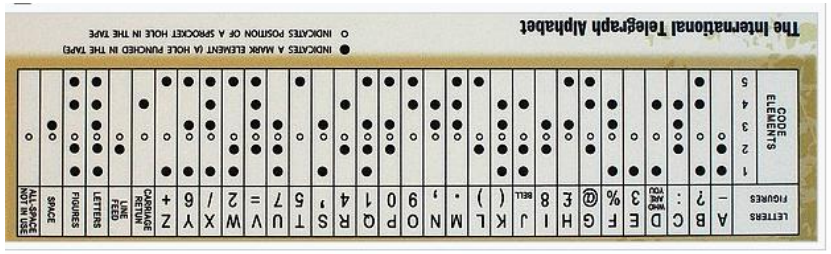
7 GHz with a 1.5 m antenna

- Motivation:
- Antenna did not track the Sun
- Antena beam (4') << Size of the Sun (30').
- It was not possible to storage the data while waiting for a flare
- The receiver saturated.



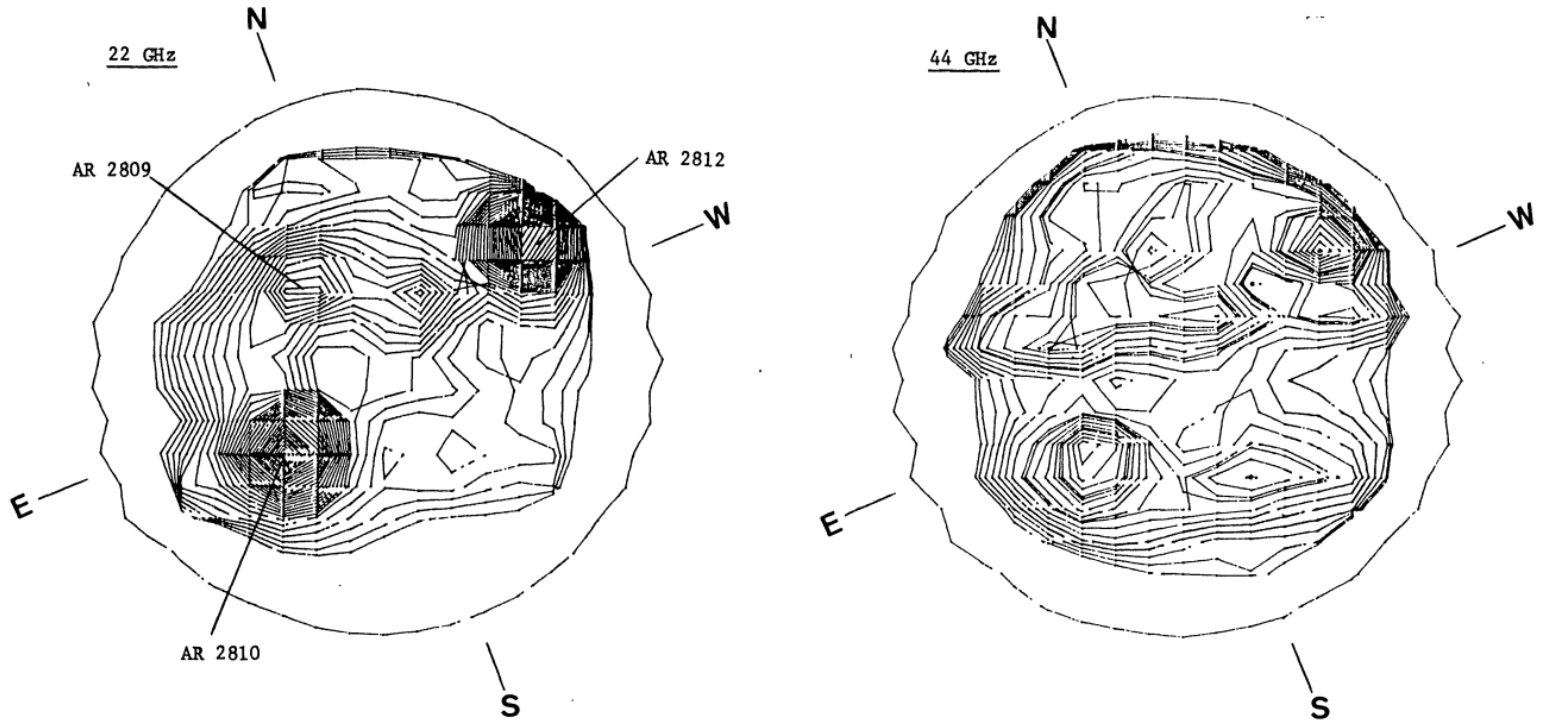
First tracking and data acquisition computers

HP 2114, 4 kB memory
No operational system



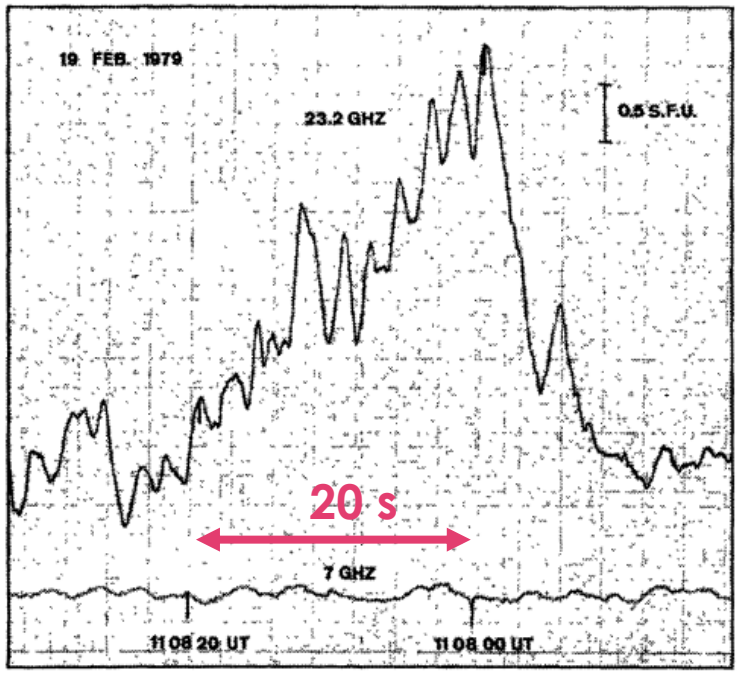
HP 9810, data acquisition

1980s New software: Tracking and solar maps (6 min)

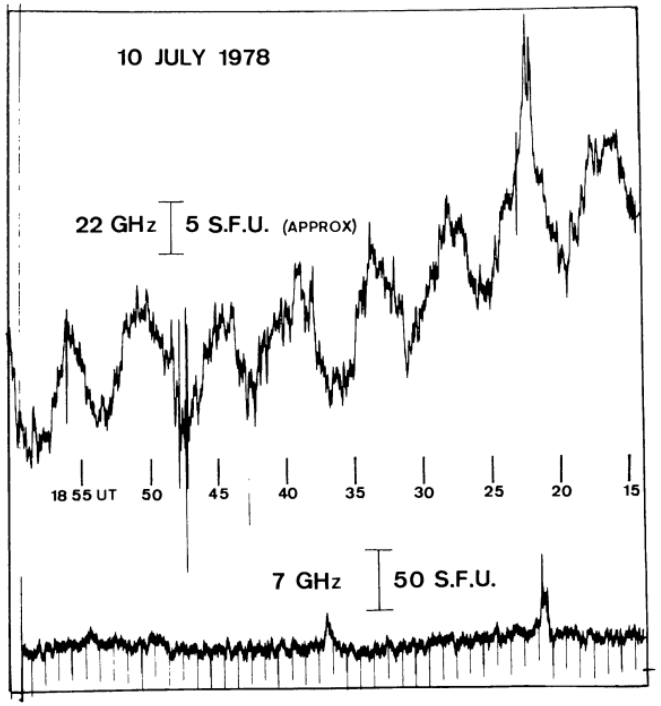


Kaufmann et al. (1981)

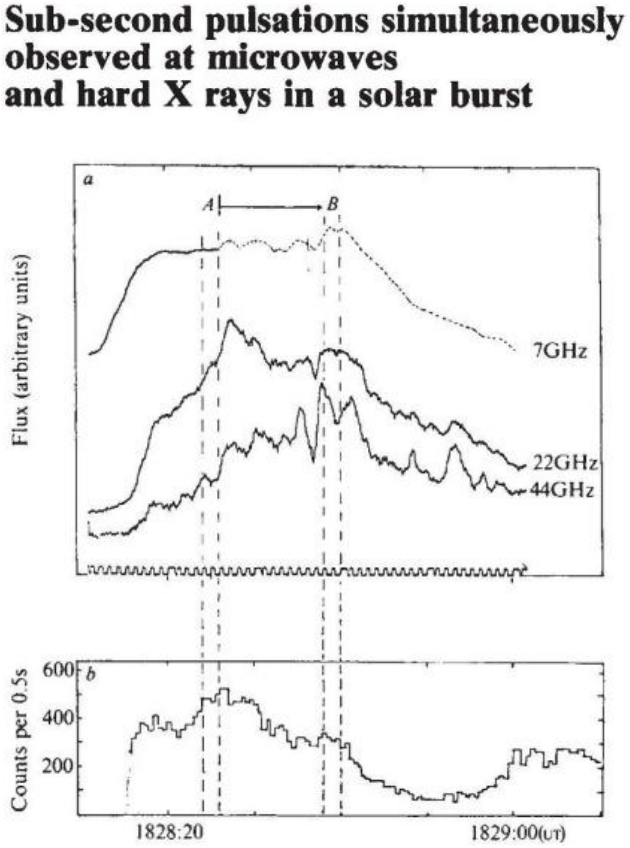
Solar observations: high spatial and temporal resolution



Kaufmann et al. (1980)

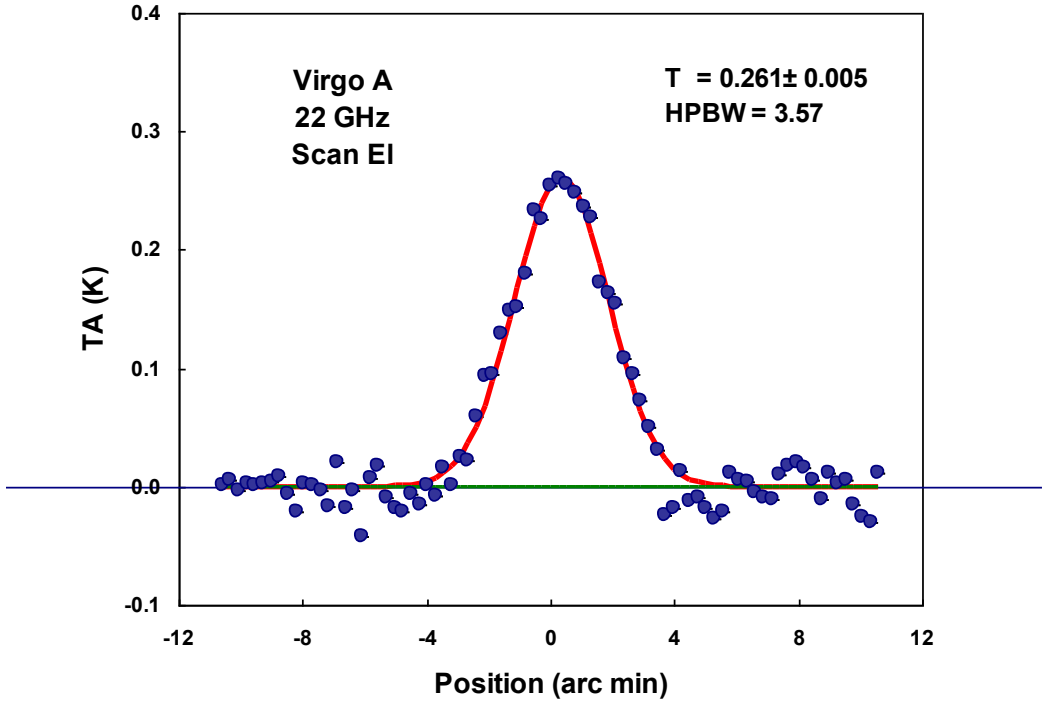


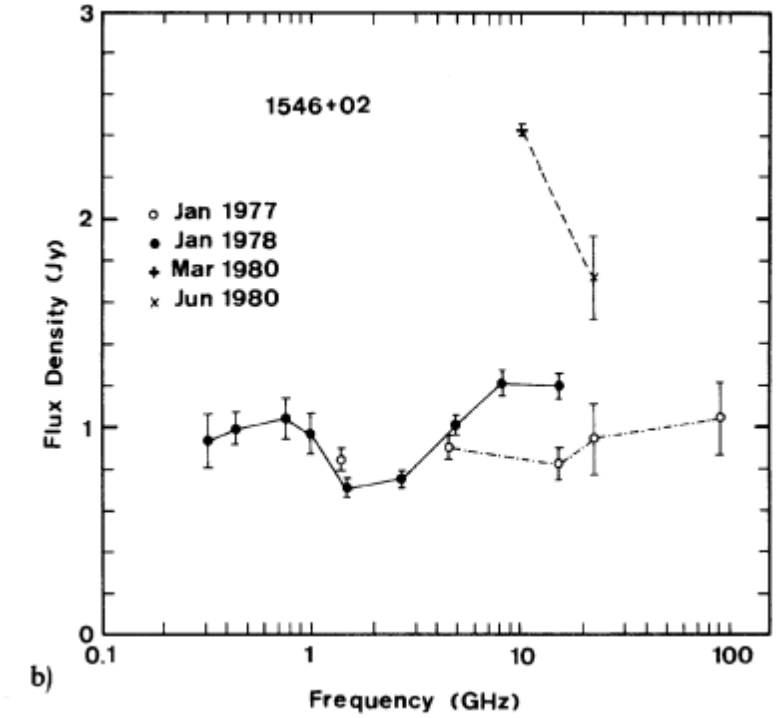
Strauss et al. (1980)



Takakura et al. (1982)

New software: Scans (on-the-fly) for the continuum





Abraham, et al. 1984

VLBI: MarkII (1985)

Biretta et al. 1985

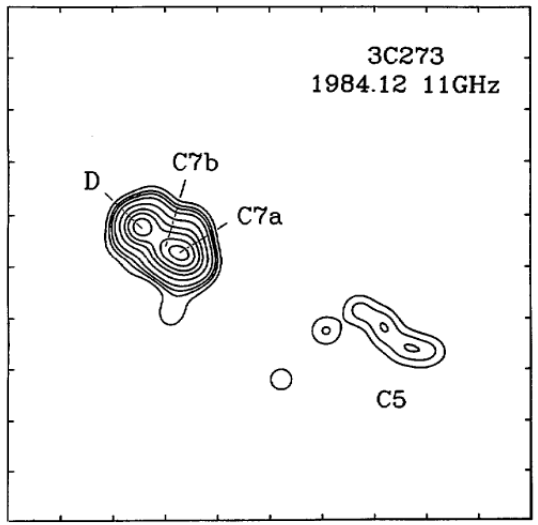


FIG. 1*a*

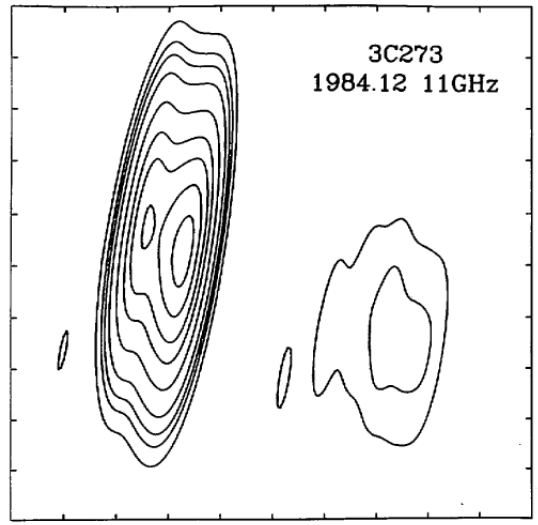


FIG. 1*b*

Max Plank 100 m; Owens Valey 40 m, Haystack 37 m, Green Bank 43, Fort Davies 26 m, Itapetinga 14 m

1990s New tracking computer: PC

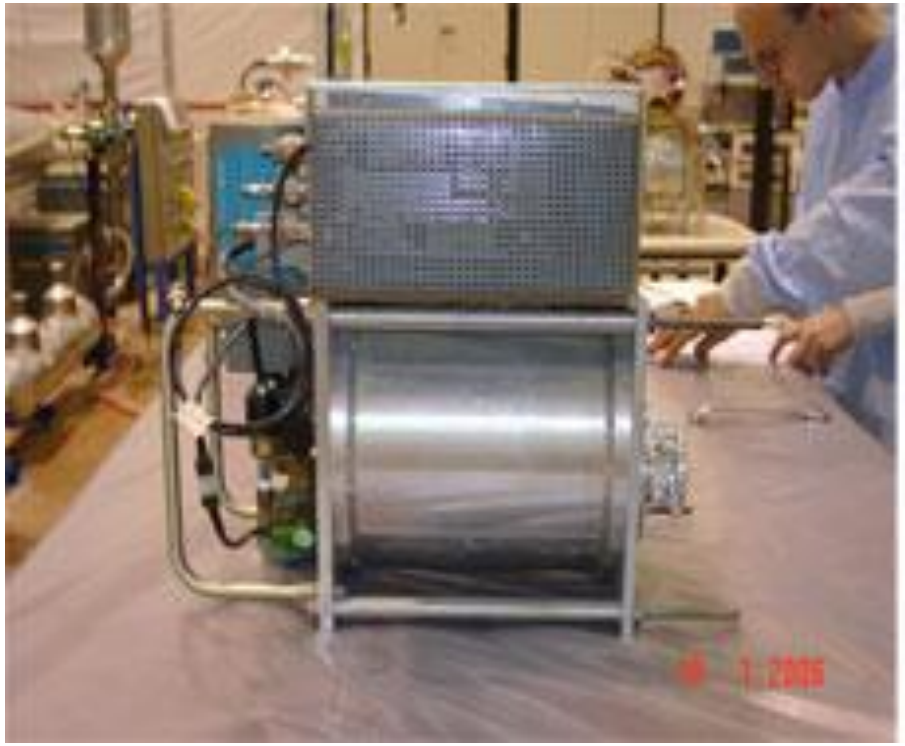
- **Program in C++**
- **Interface with Instruments: HPIB, serial, parallel**
- **Back-end: Digital programable voltmeter for the continuum, with memory to storage the data of each scan**

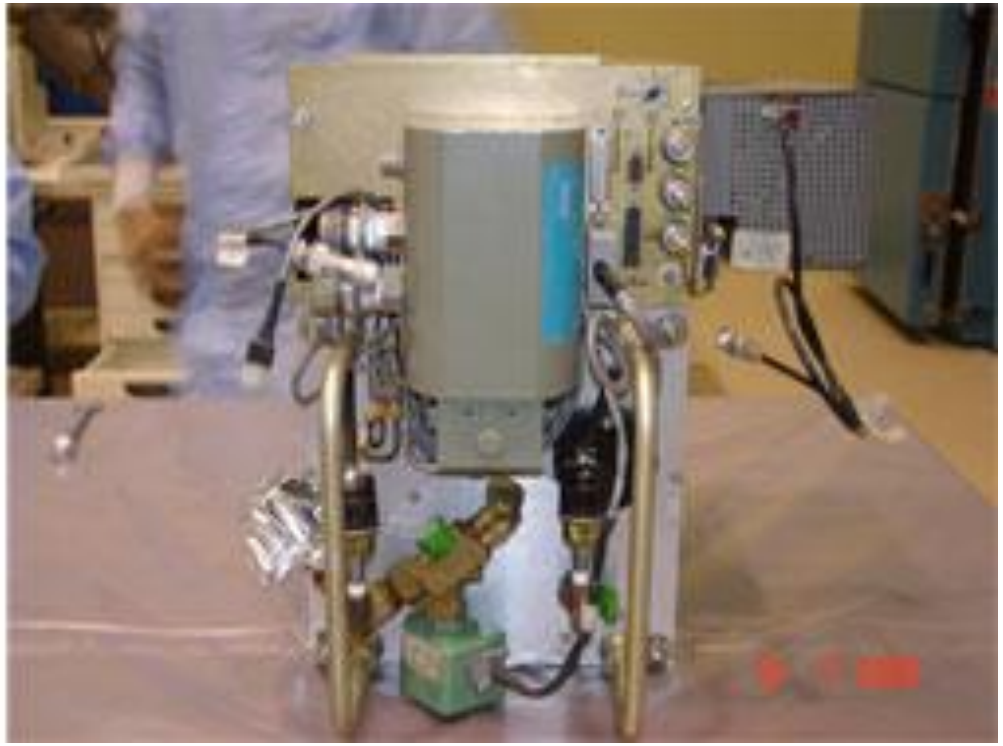
1990´s: data acquisition computer (Work Station)

16 kB memory, no hard disk for storage

Used “floppy disks”

1990´s: cryogenic 18-24 GHz line receiver

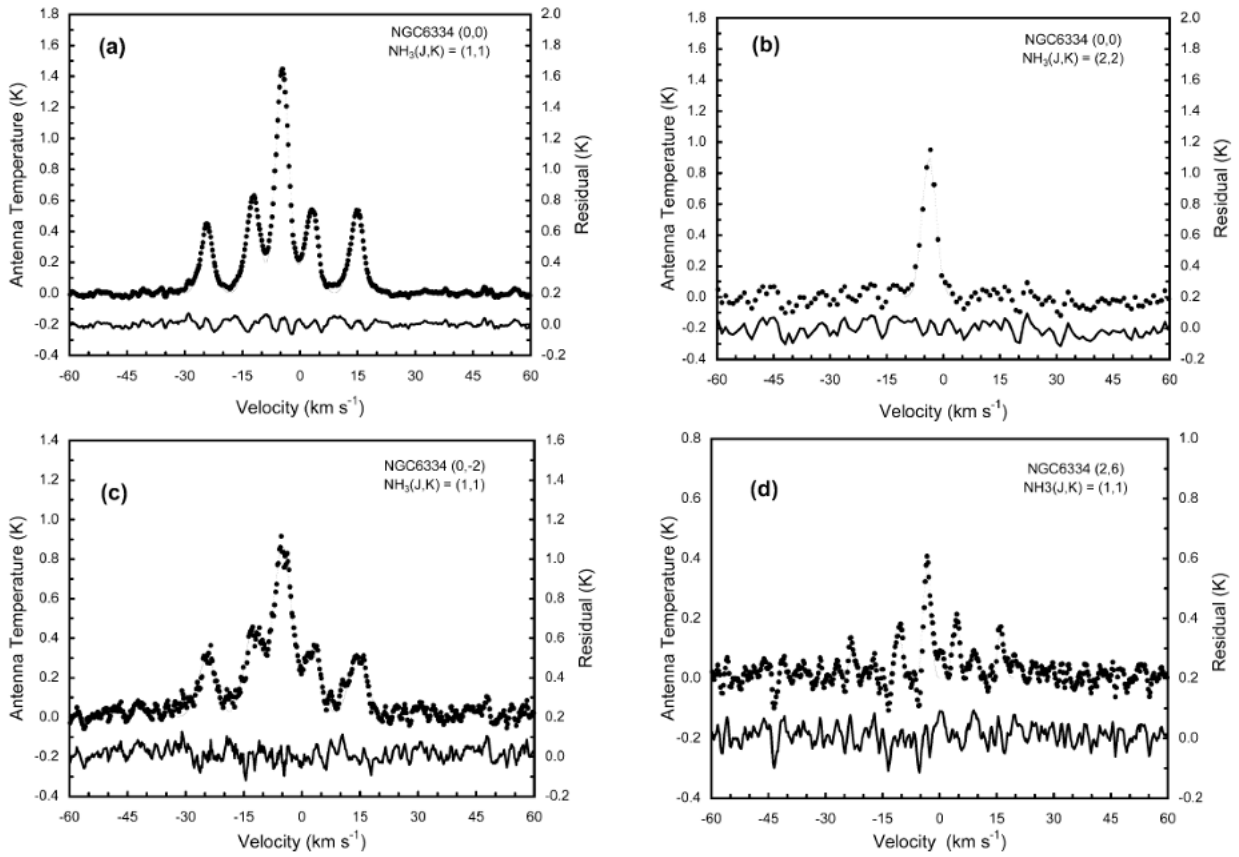


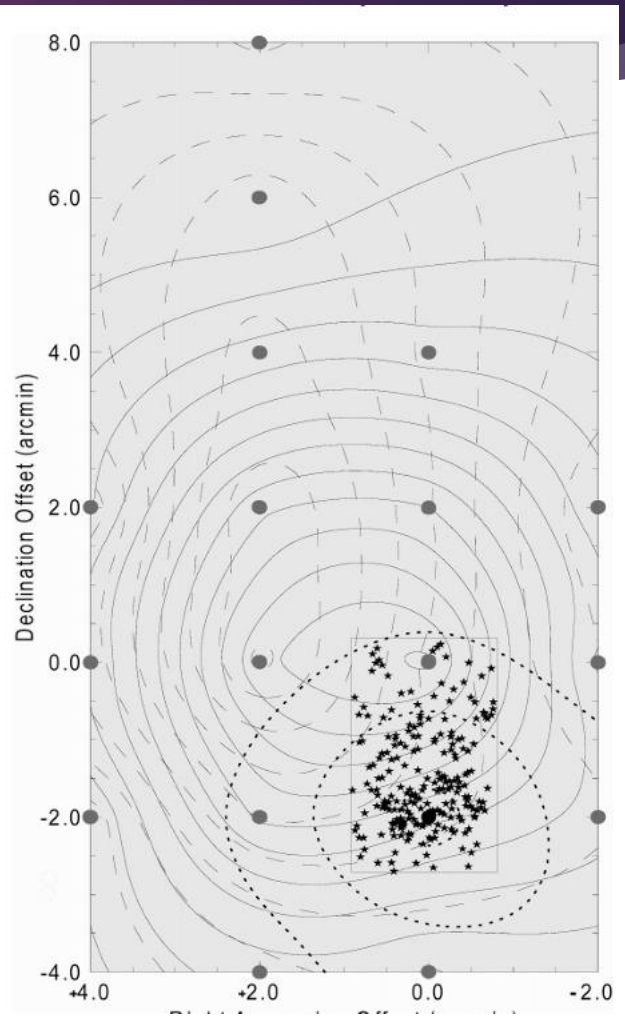


1990´s: Observations of NH_3

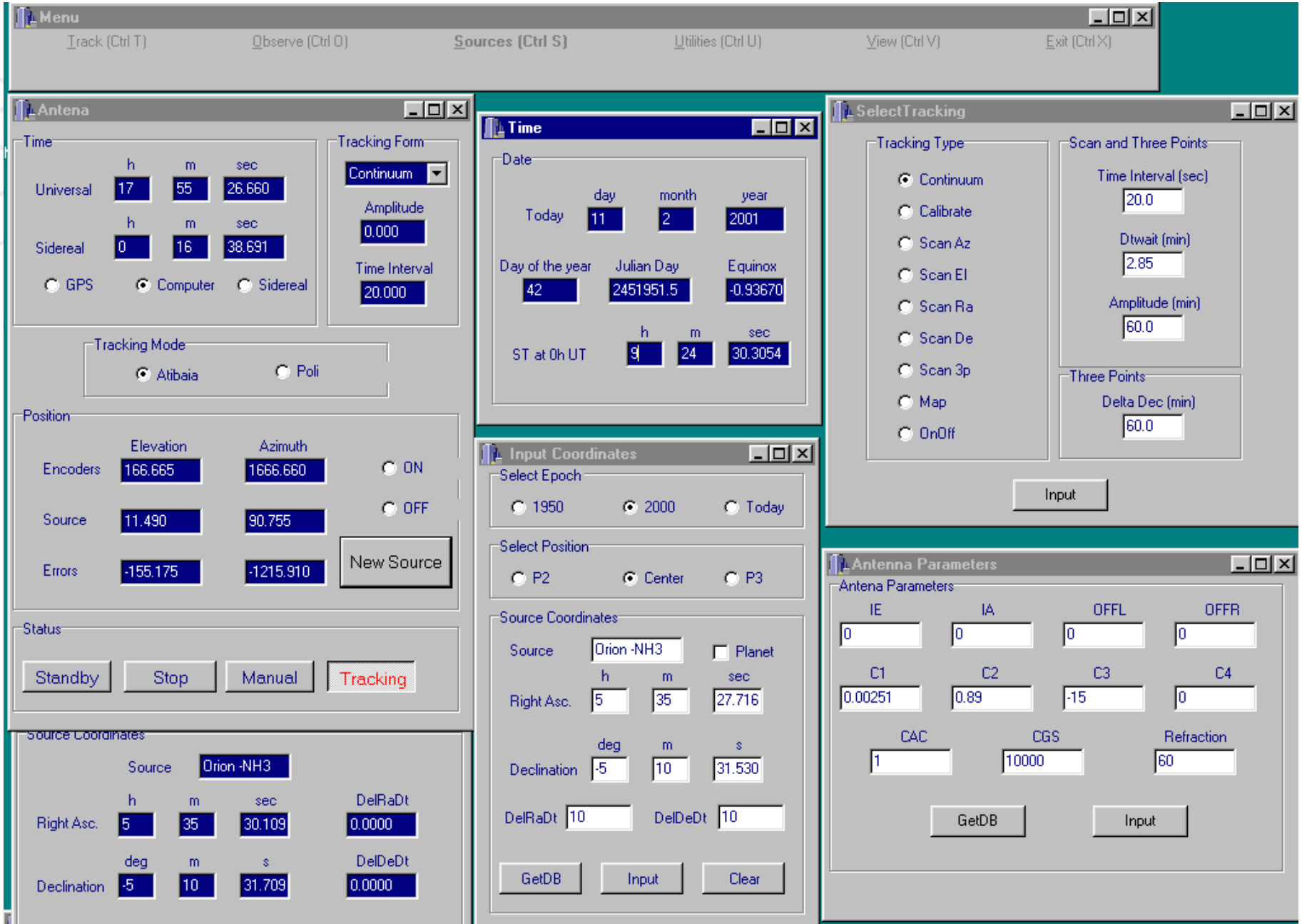
Study of the ammonia emission in the NGC 6334 region

A. Caproni[1], Z. Abraham[1], and J.W.S. Vilas-Boas[2] A&A (2000)

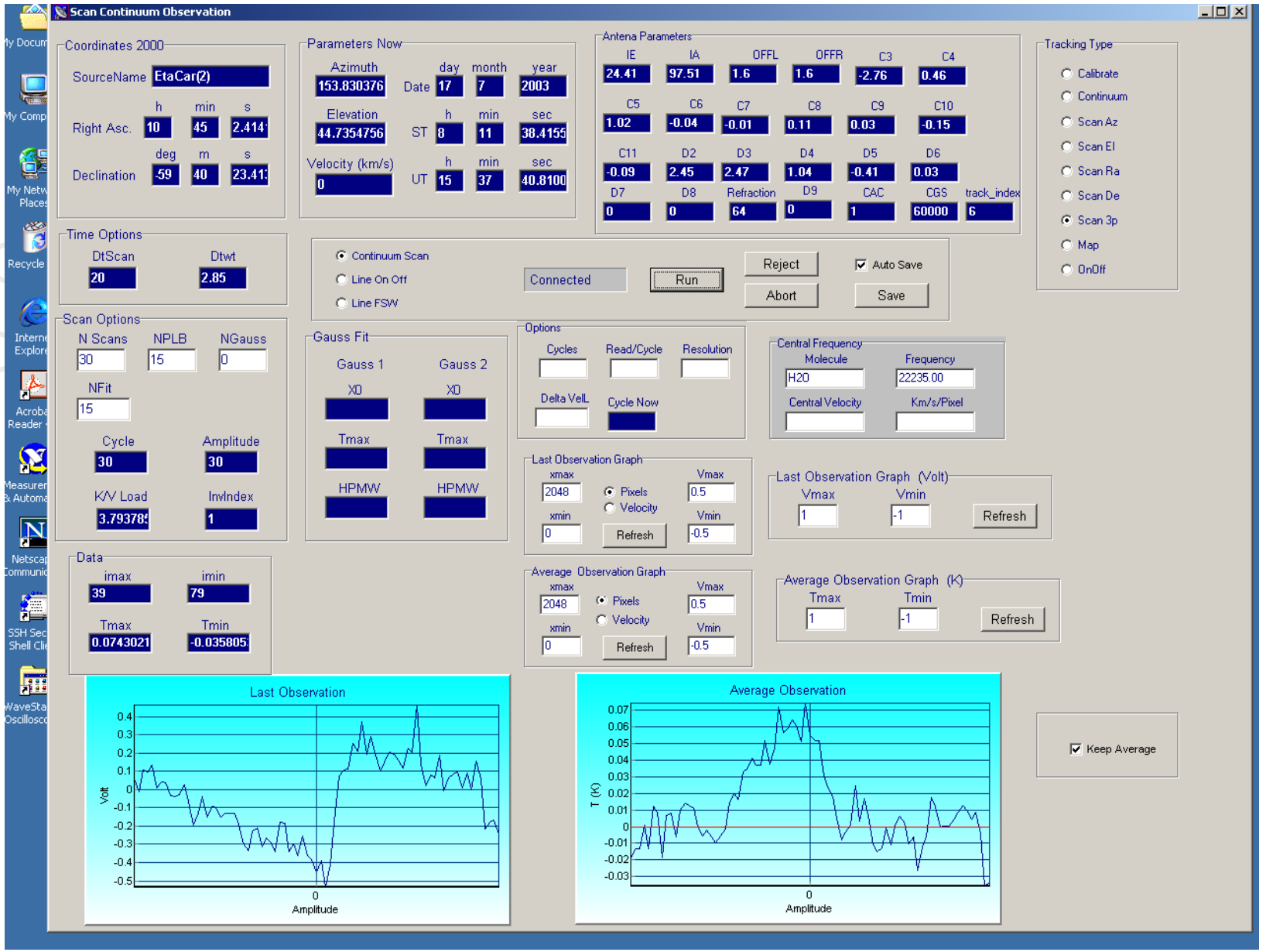




2000´s: tracking (new PC)



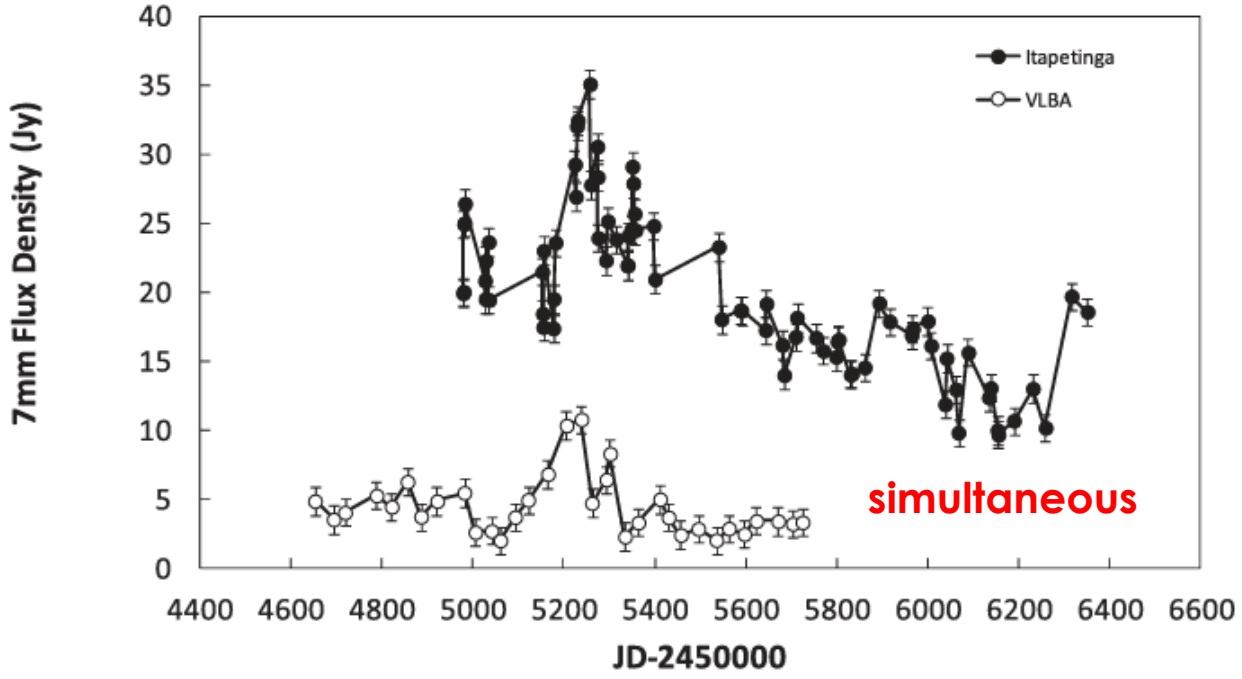
2000´s: data acquisition (another PC)

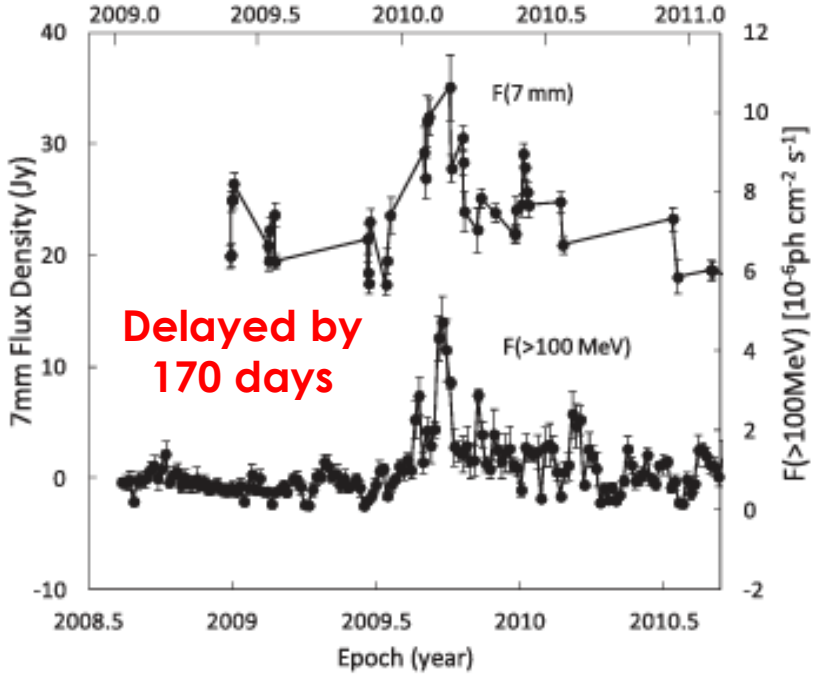


2000´s Science: variability

3C 273 variability at 7 mm: evidence of shocks and precession in the jet

Pedro Paulo B. Beaklini★ and Zulema Abraham **MNRAS (2014)**





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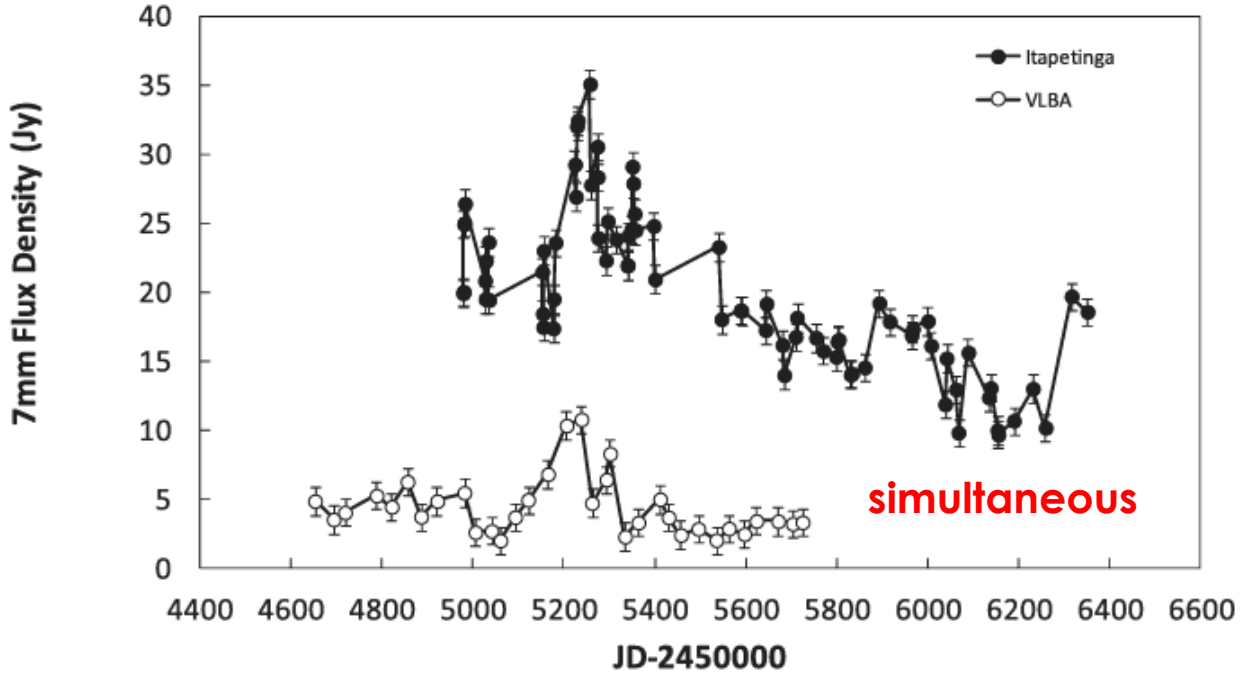
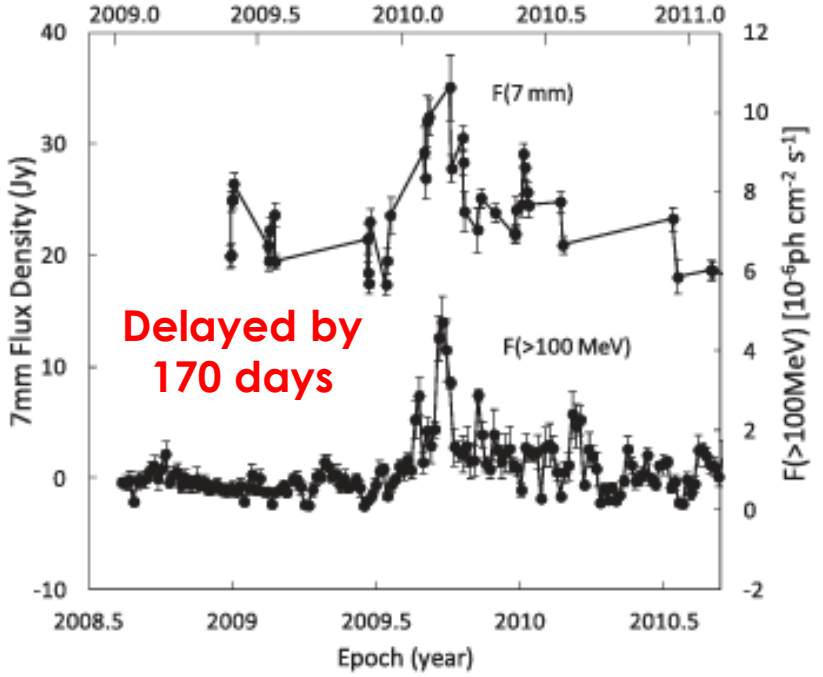
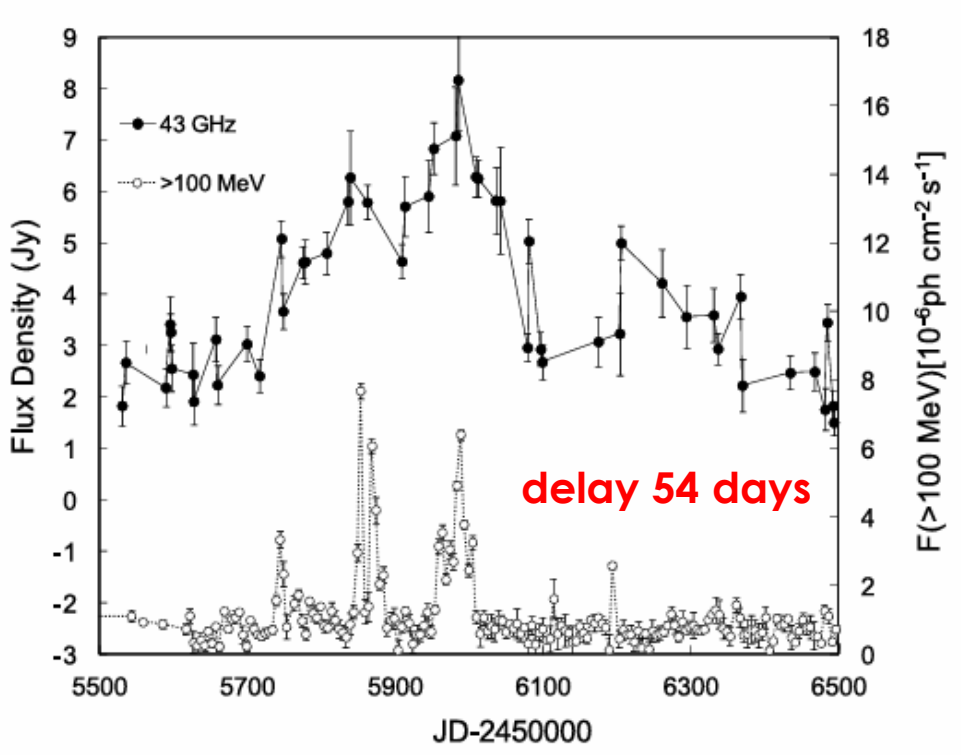


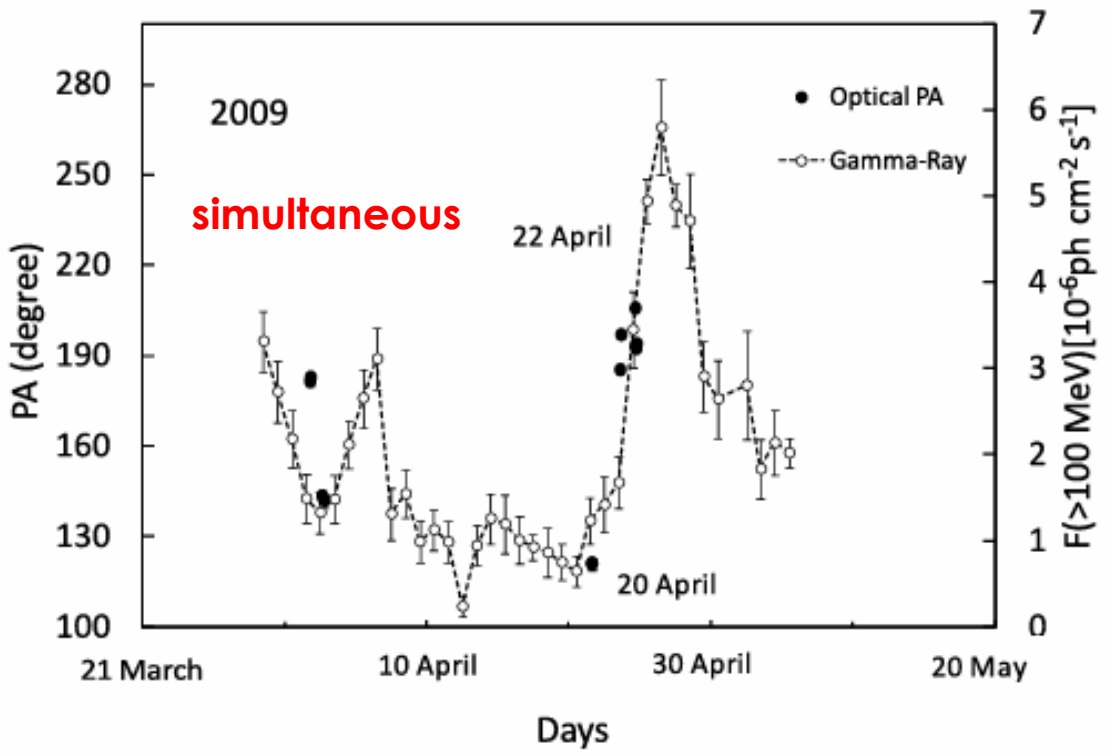


2000´s Science: variability

Multiwavelength flaring activity of PKS 1510-089

Pedro P. B. Beaklini[1], Tânia P. Dominici[2], and Zulema Abraham[1] **A&A (1017)**





Future

- **Finish the upgrade of the radiotelescope (in progress, next talk)**
- **Continue with variability studies, entering into the multi-messenger era for AGNs**
- **Include variability of H_2O and SiO masers.**
- **Open the radiotelescope to the community, calling for proposals**

Thank you