43 GHz Light Curve of the nucleus of Centaurus A

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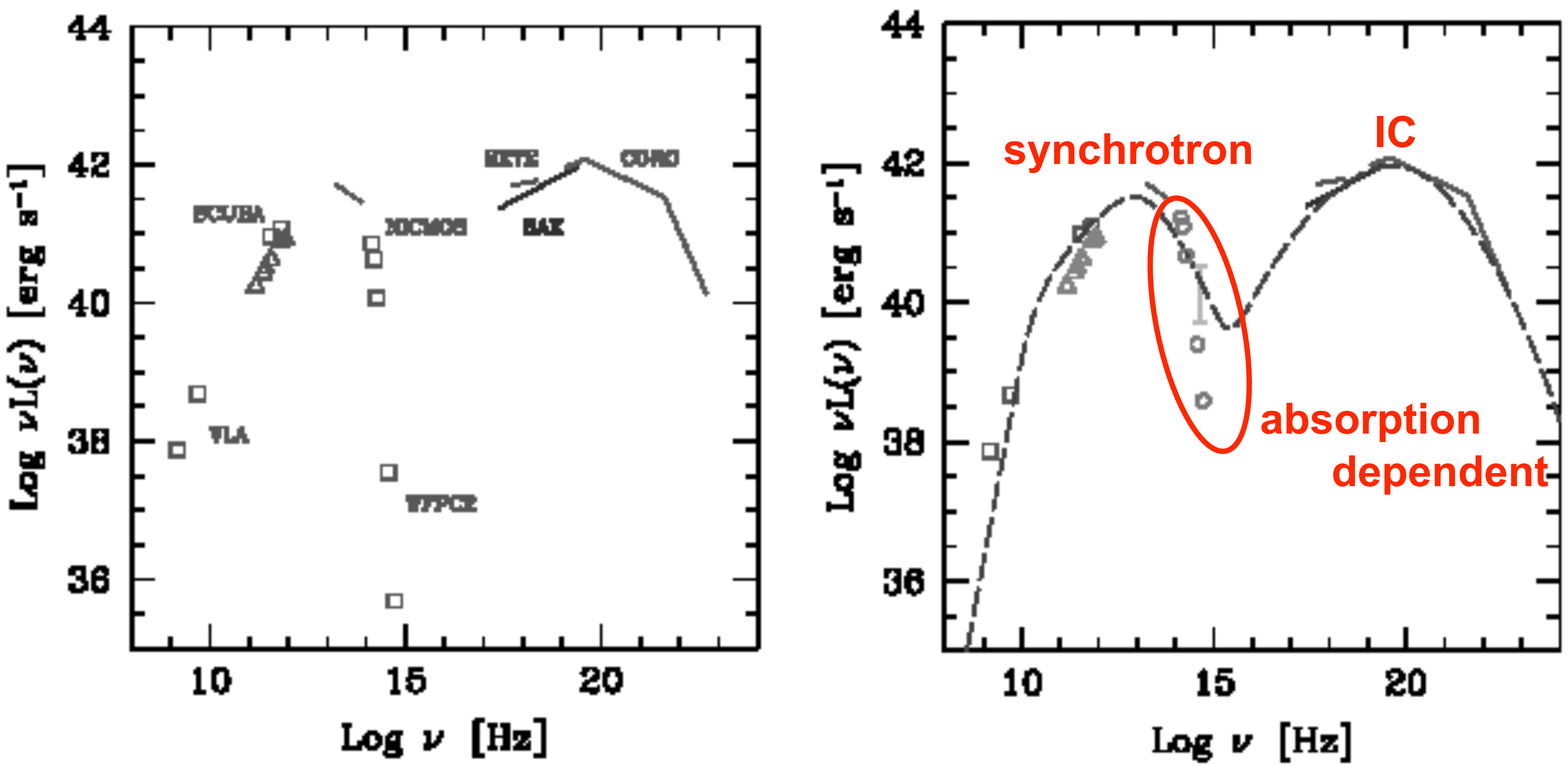
Motivation

Observations at Itapetinga

Results: long and short term variability

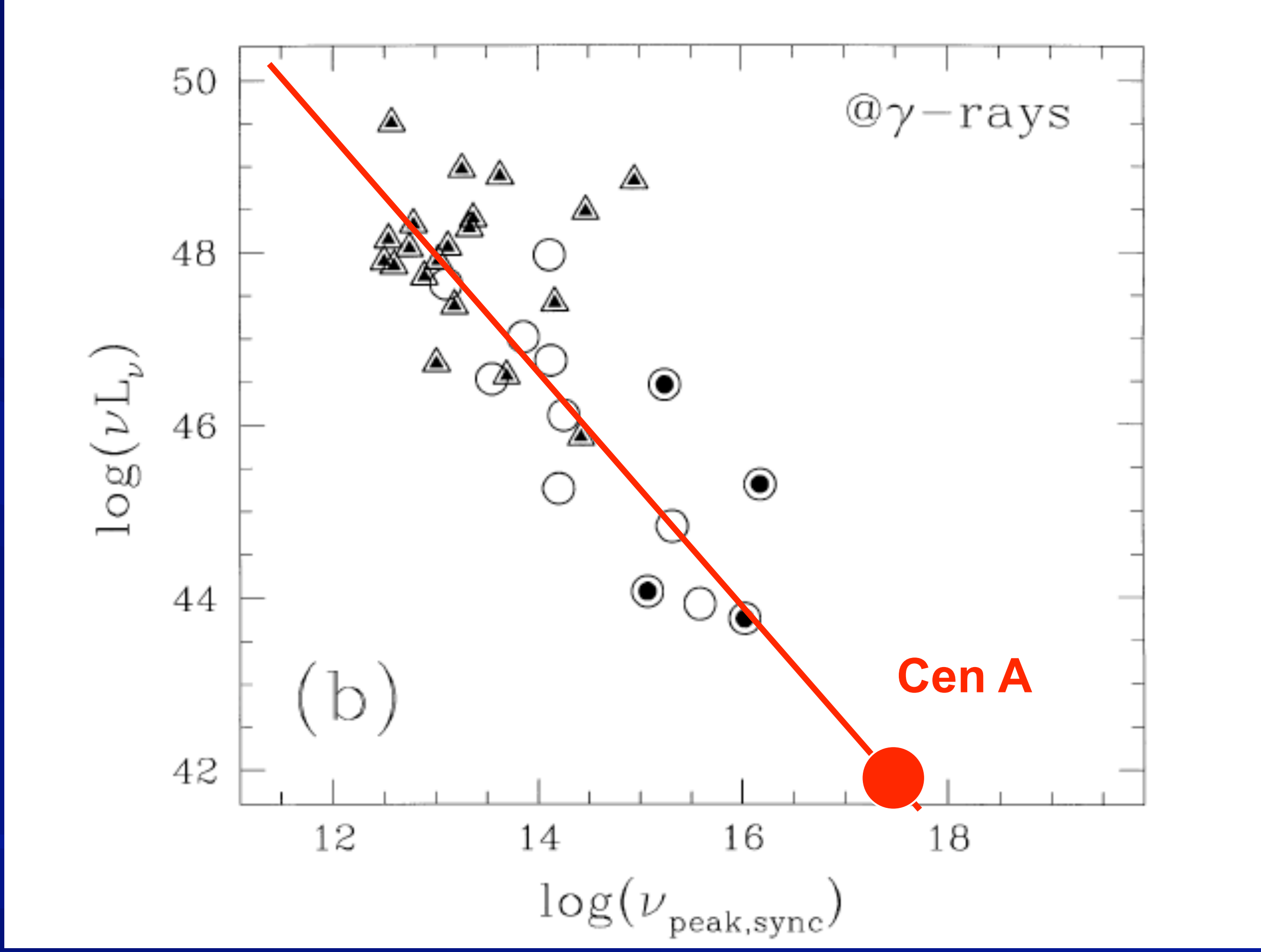
Future

Spectral Energy Distribution resembles a BL Lac



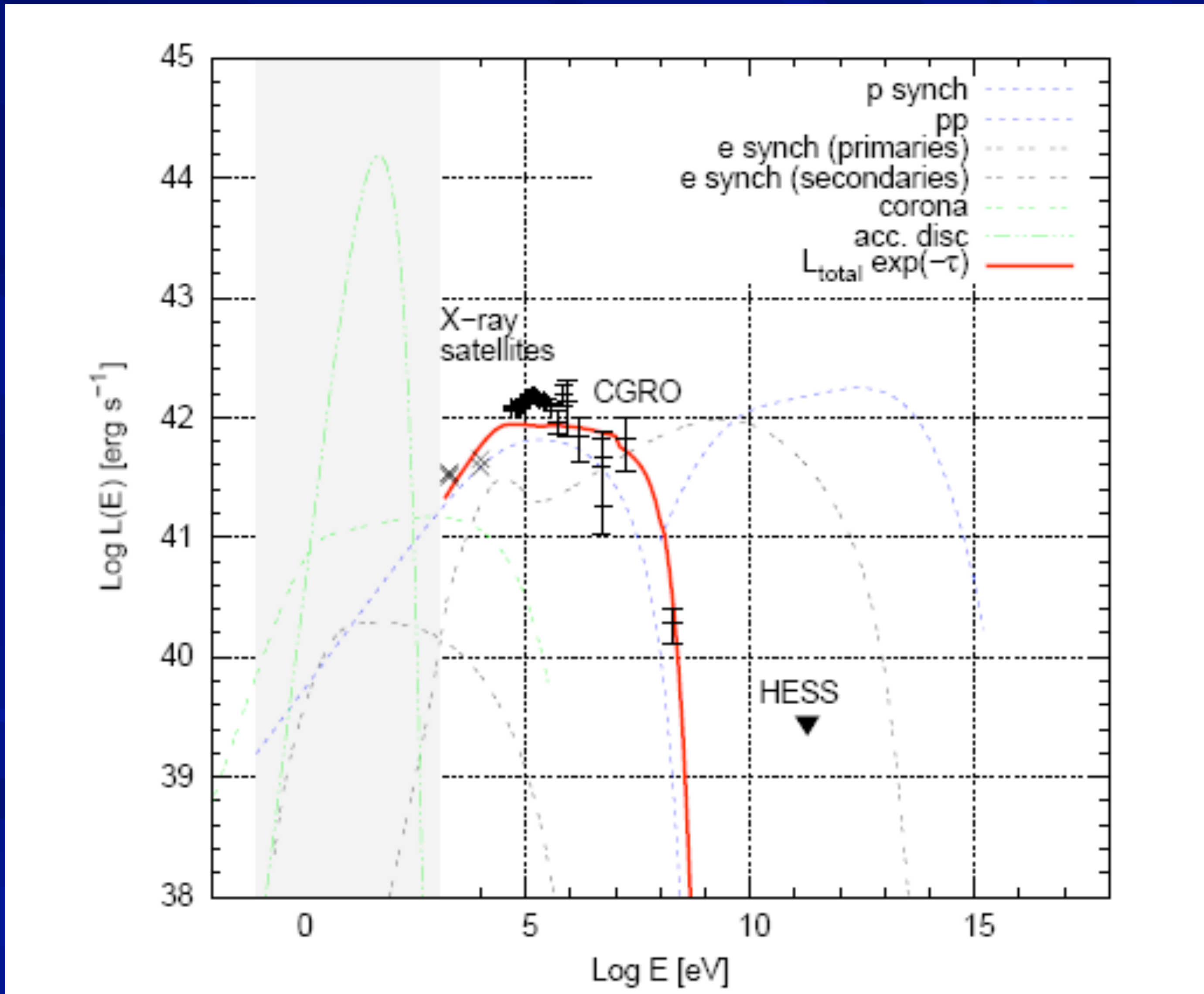
Chiaberge, Capetti & Chelotti (2001), Bai & Lee (2001)

Fossati et al.(1998)



$$\nu L_\nu (100\ \mathrm{MeV}) \approx 10^{42}\ \mathrm{erg\ s^{-1}} \rightarrow \nu_{\mathrm{sync}} \approx 5\times10^{17}\ \mathrm{Hz} \approx 2\ \mathrm{keV}$$

Orellana & Romero, 2009



How to differentiate between the two scenarios?

Look for variability at radio and X-rays

Inverse Compton: there should not be a time lag between them.

If a time lag is detected, it can be explained by a synchtrotron source that becomes optically thin at low frequencies as the source expands

Difficulties: separate the core radio emission from that of the extended lobes

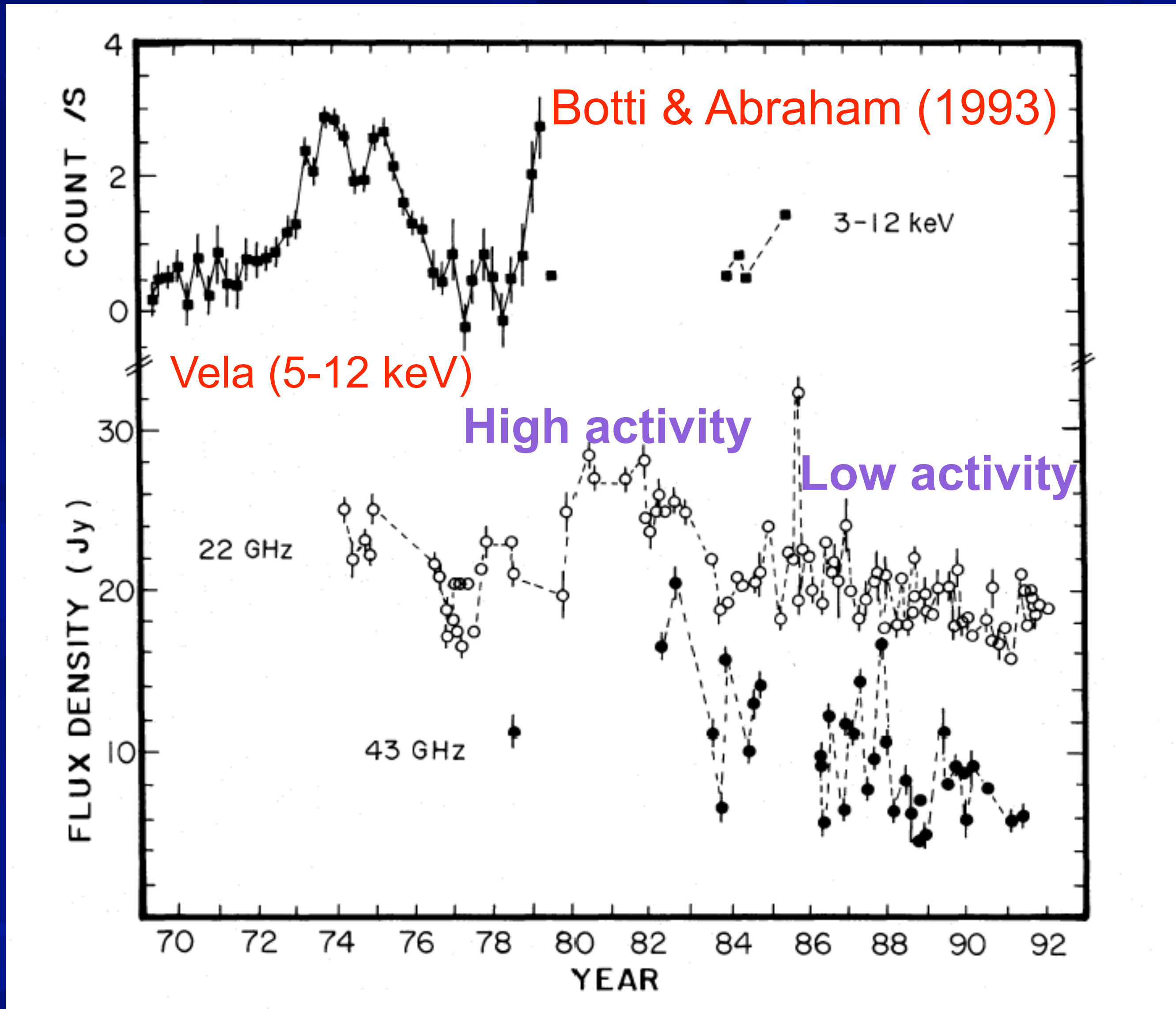
VLBI: not enough time and frequency coverage

Single dish: good at high frequencies (> 20GHz)

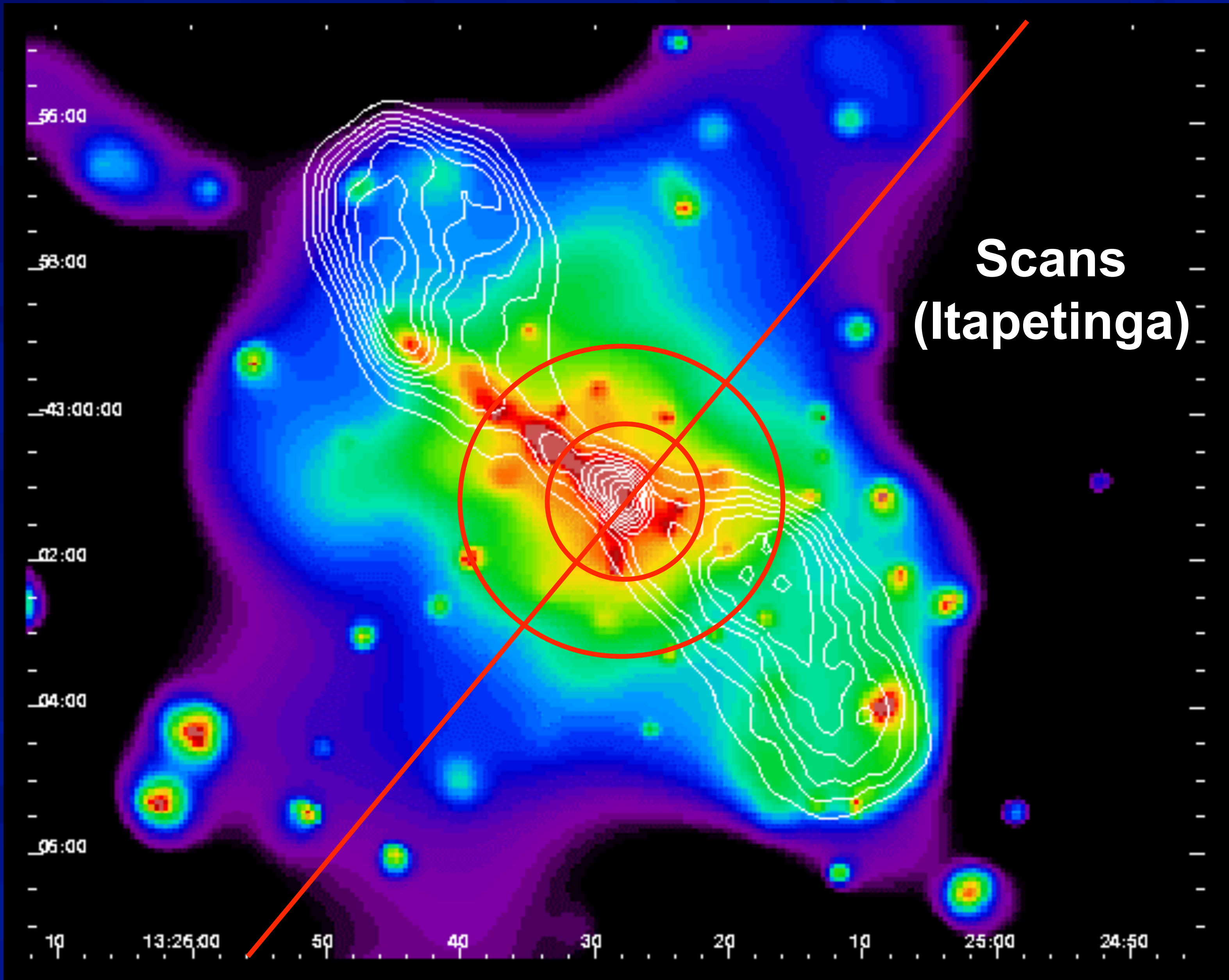
- core becomes optically thin
- emission from the jet is not dominant.

Past and Present Work : Itapetinga Radiotelescope

14 m dish oprating at 22 and 43 GHz (4’ and 2’ beam) (room temperature receivers)

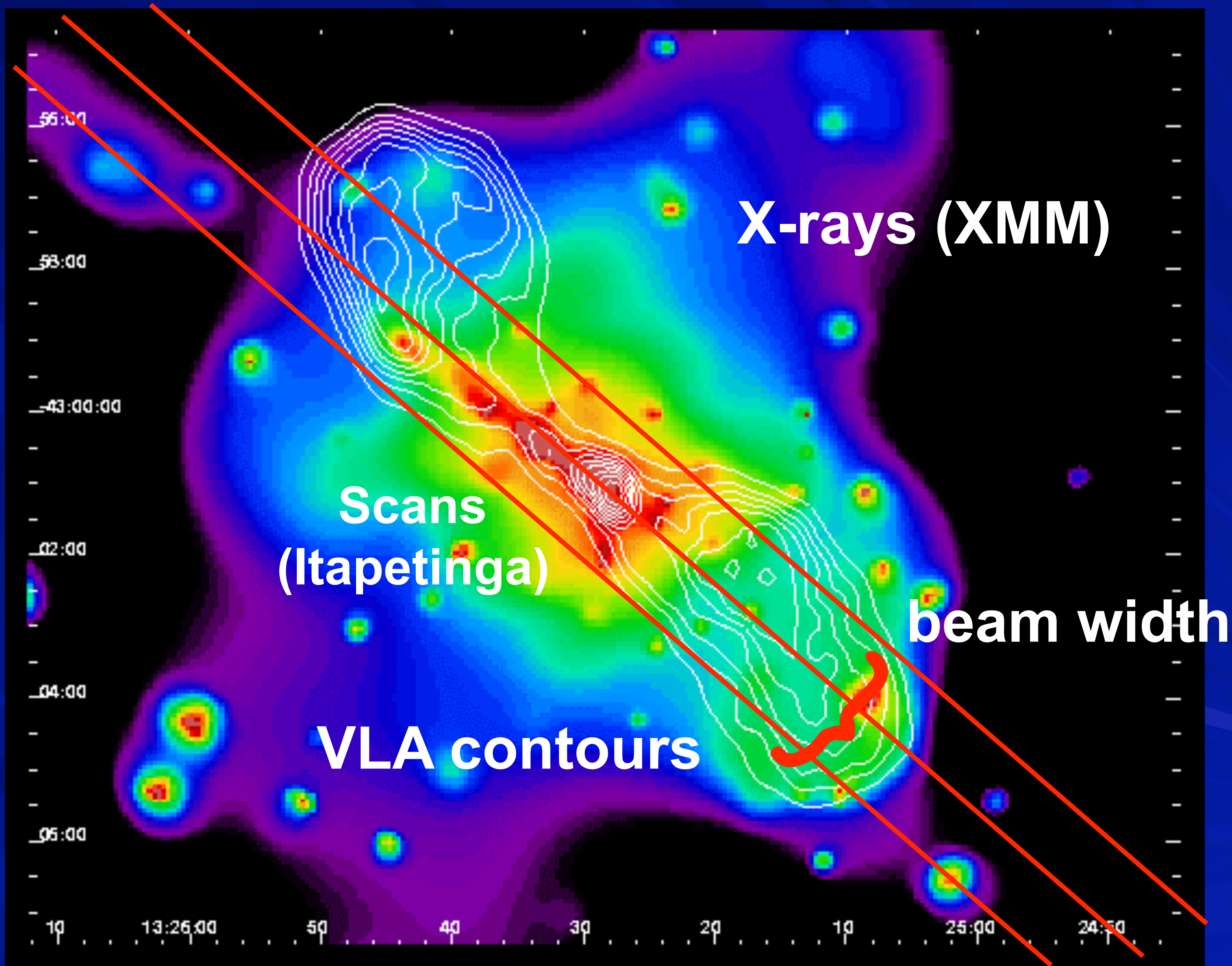


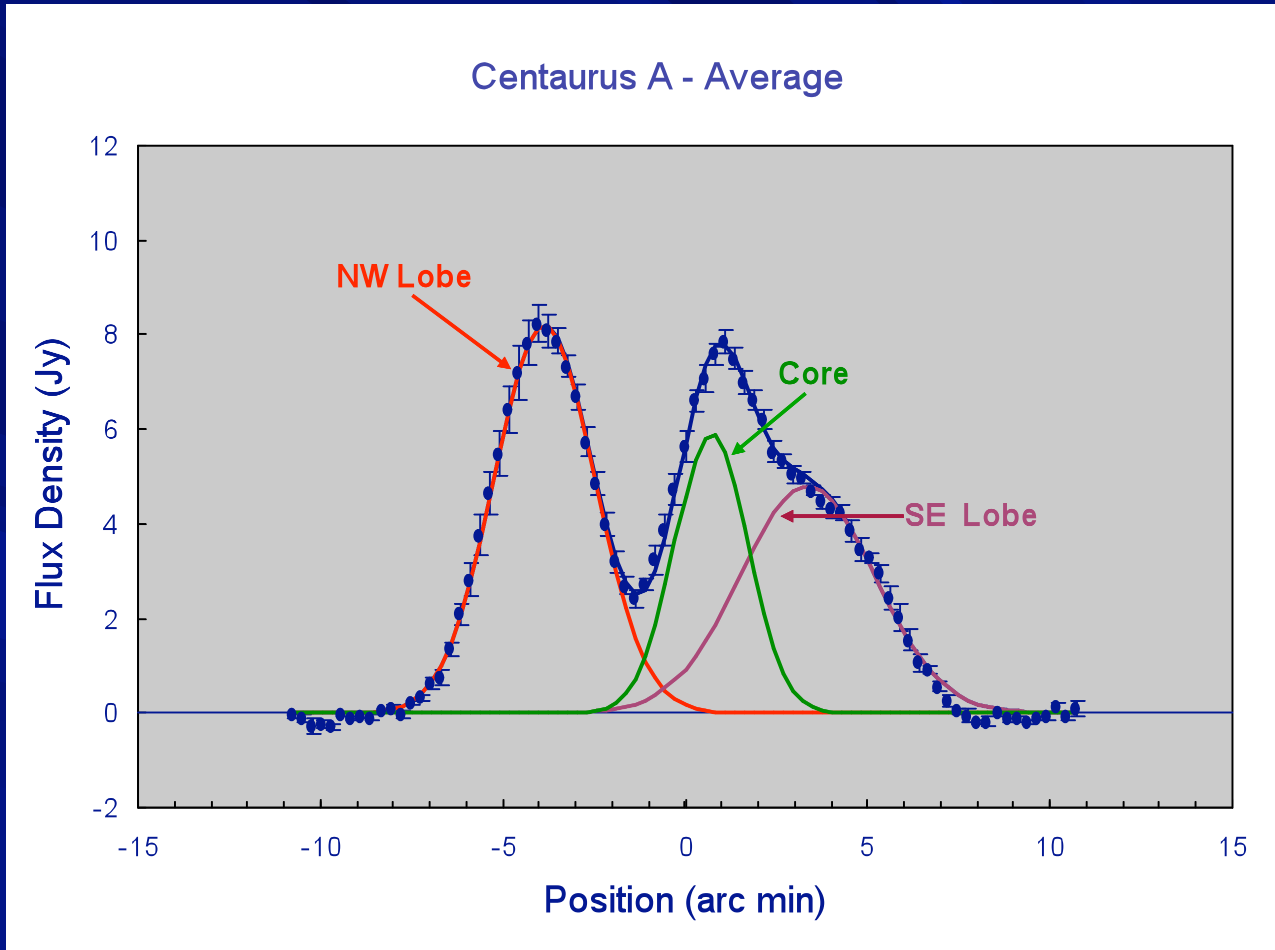
Scans across the center of Cen A in a direction perpendicular to the inner jets.



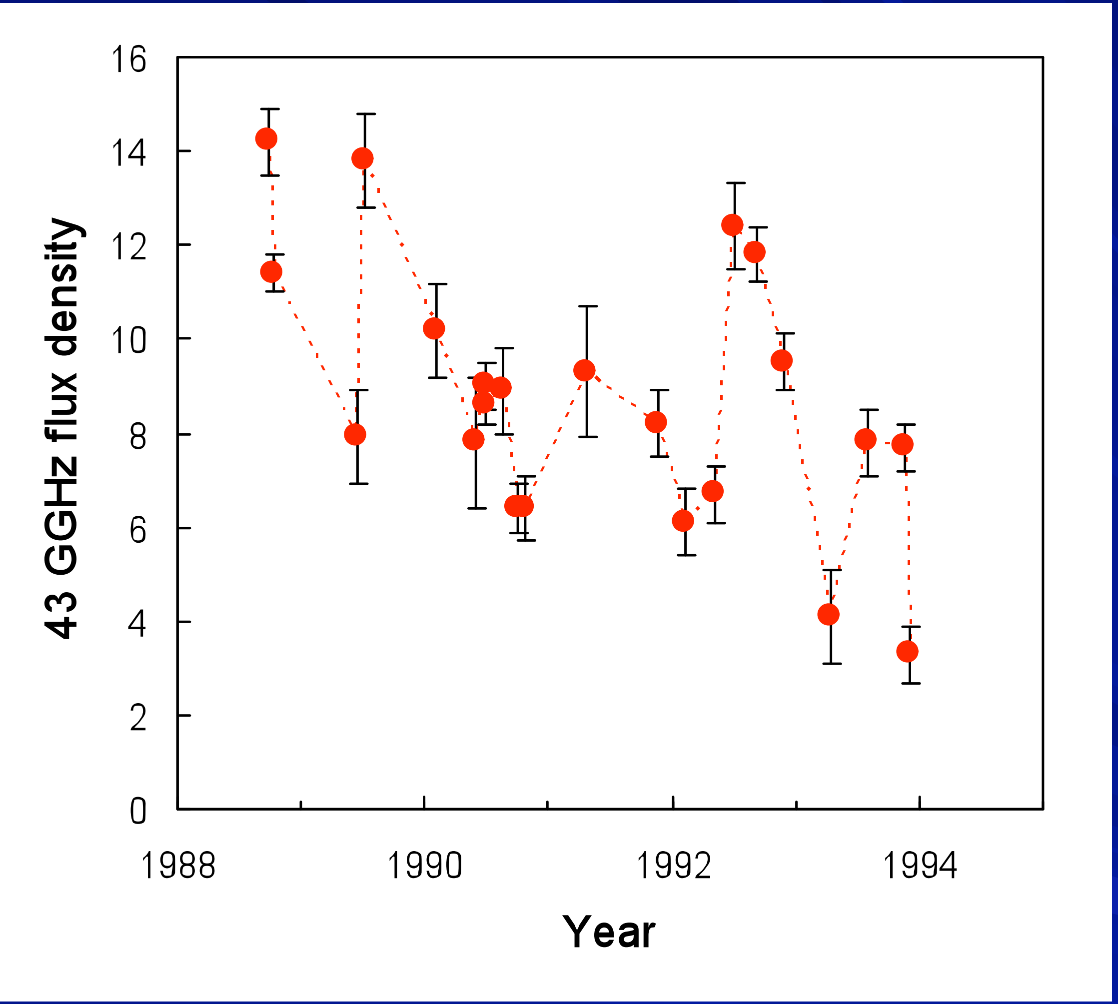
Scans
(Itapetinga)
56:00
58:00
-43:00:00
02:00
04:00
06:00
10
13:26:00
50
40
30
20
10
25:00
24:50

Different approach





NW lobe is used as secondary calibration



(Abraham 1996, IAU Symposium, Bologna)

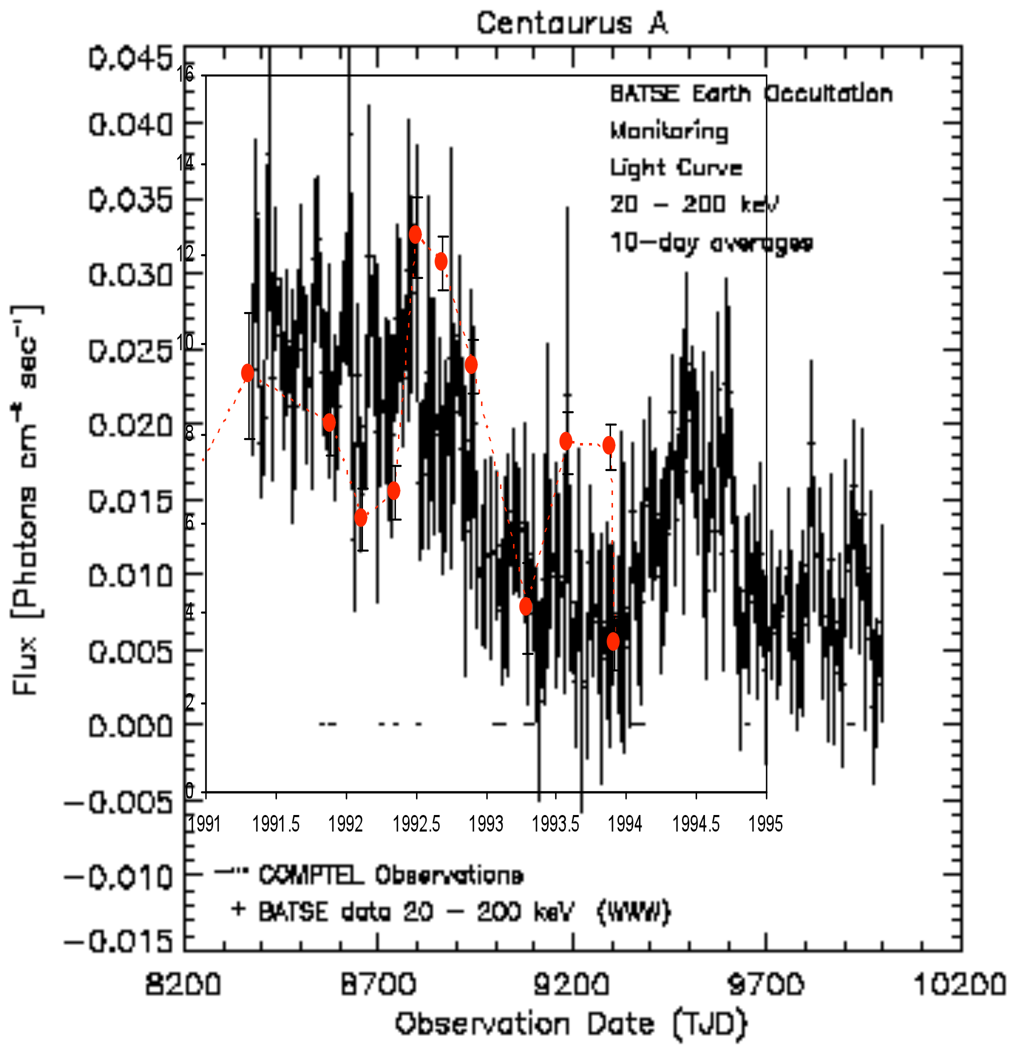
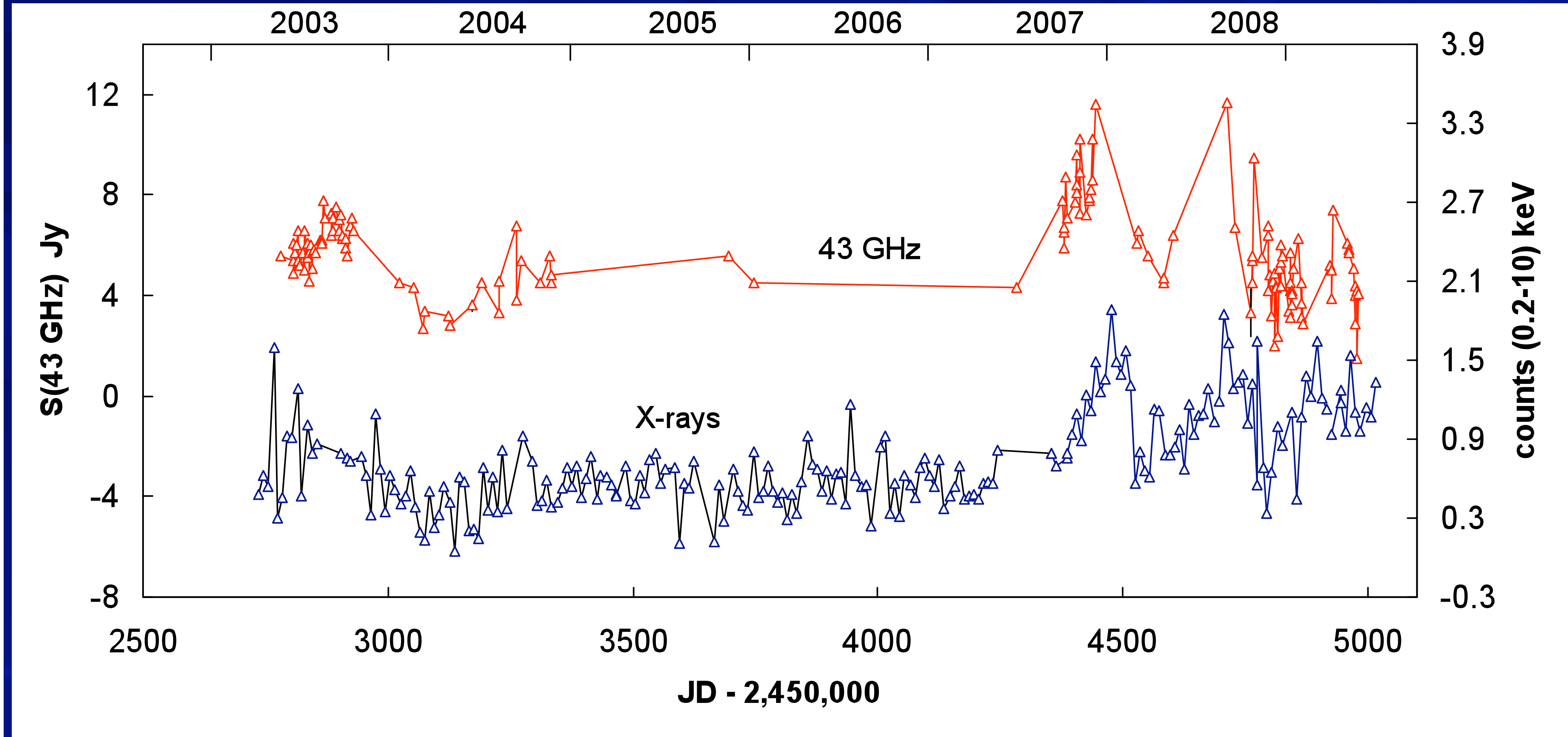


Fig. 5. Light curve of Centaurus A in the energy band 20 - 200 keV as observed by BATSE covering Phases I to IV/Cycle 4 in the years 1991 to 1995 (BATSE public data (WWW)). The data have been averaged over 10-day intervals. The 15 COMPTEL observation periods are indicated at the 0.0 flux level.

(Steinle et al. 1998)

BATSE and COMPTEL 1991-1995

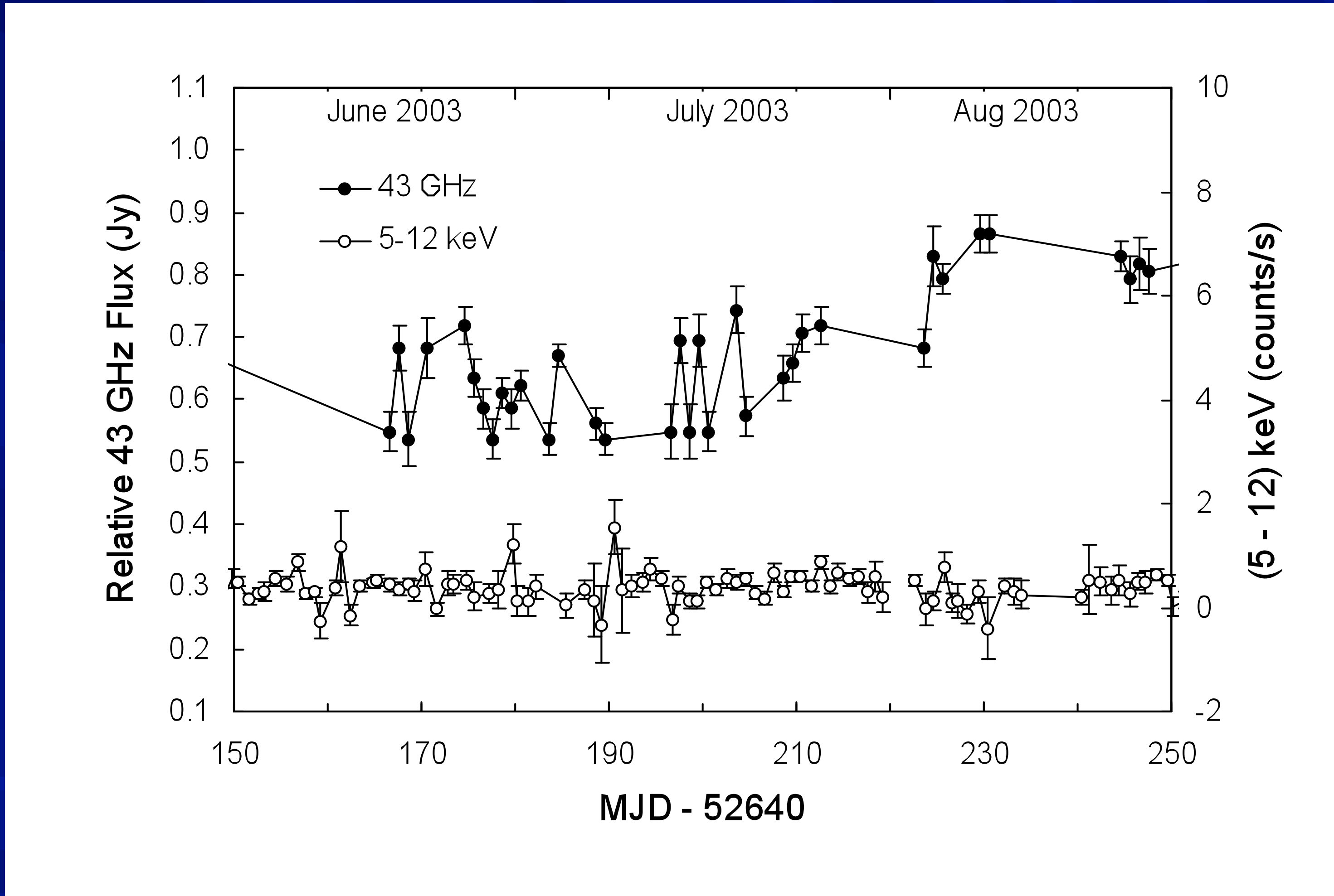
New Results



X-rays: ASM/RXTE, (10 day bins)

43 GHz: delayed by 40 days

Short term variability



No correlation between radio and ASM X-rays

Possible interpretation of rapid variability: eclipses

Size of the emitting regiom: limited by the Compton catastrophe

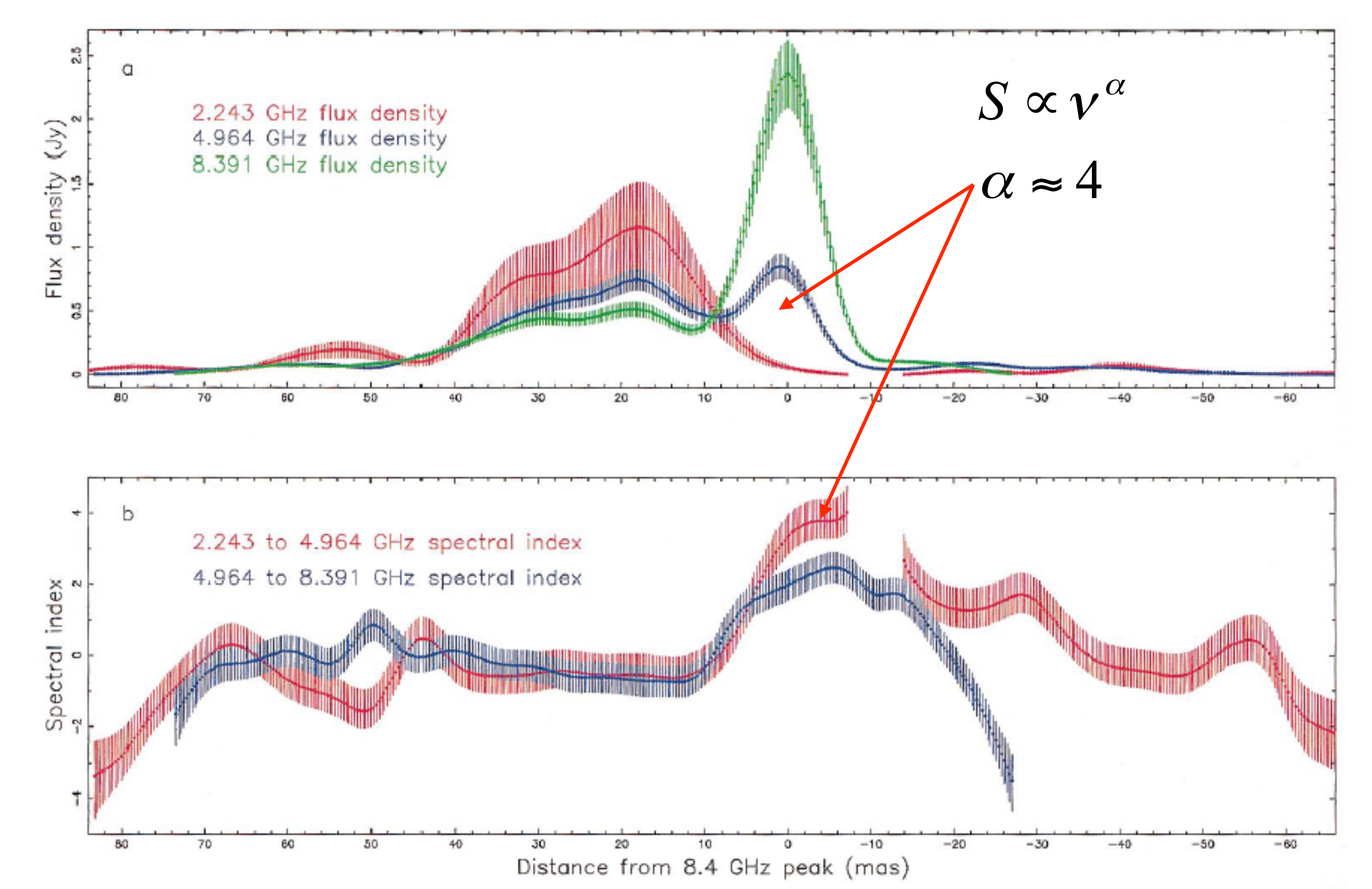
$$S_\nu(\mathrm{Jy}) = 9.6\times10^{-14}\nu^2 T_B\left(\frac{R}{D}\right)^2 \qquad T_B = 10^{12}\ \mathrm{K}$$

$R = 7.7\times10^{14}\ \mathrm{cm}$ cloud?

velocity $\upsilon \approx \frac{R}{t} \approx 0.4c$

source is moving, cloud is at rest!

Absorption mechanism: bremsstrahlung (Tingay et al. 2001)



Assume free-free absorption at 43 GHz

$$\tau = 2\times10^{-23}\,\frac{n^2}{T^{3/2}}\frac{c^2}{\nu^2}g_{ff}(\nu)2R = 1$$

$T = 10^4$ K

$R = 10^{15}$ cm

$n = 4.5\times10^6$ cm^{-3}

$N_H = 4.5\times10^{21}$ cm^{-2}

absorbs radio

1/5 of the column density necessary to absorb X-rays

Conclusions

There is a correlation between radio and (2-10 keV) X-ray variability for large amplitudes and timescales with a delay of about 40 days.

This result favors the scenario in which the emission is synchrotron radiation of a source that becomes optically thin as it expands.

Fermi observations and their correlation with other wavelength will help define the SED and maybe the actual physical processes responsable for the emission.

Conclusions

On short timescales and amplitudes the correlation between radio and X-rays does not seem to hold, radio variability can be due to bremsstrahlung absorption by ionized clouds, where the cluds are fixed but the emission region behind them changes.

MORE FREQUENT SINGLE DISH AND VLBI OBSERVATIONS AT HIGHER FRQUENCIES ARE NECESSARY!!!!!