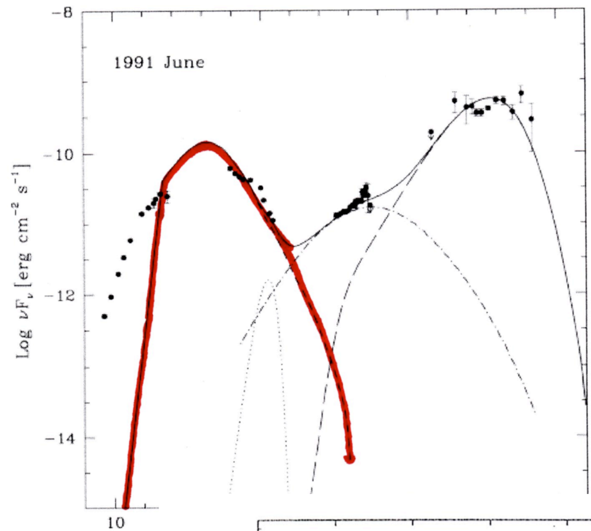
Millimeter monitoring,

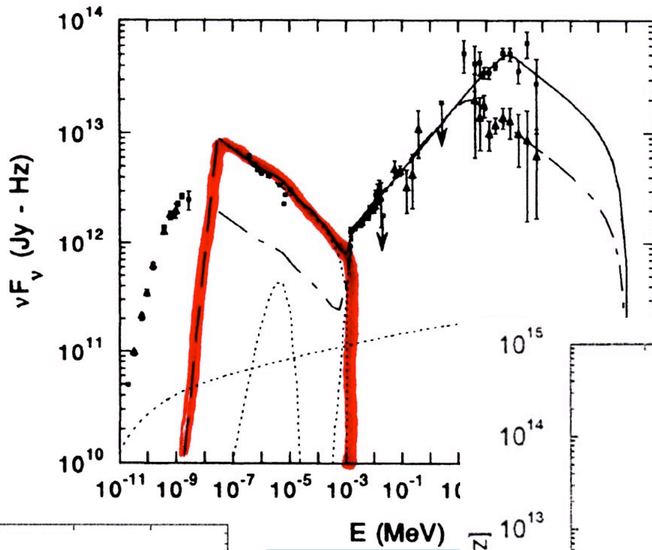
or,

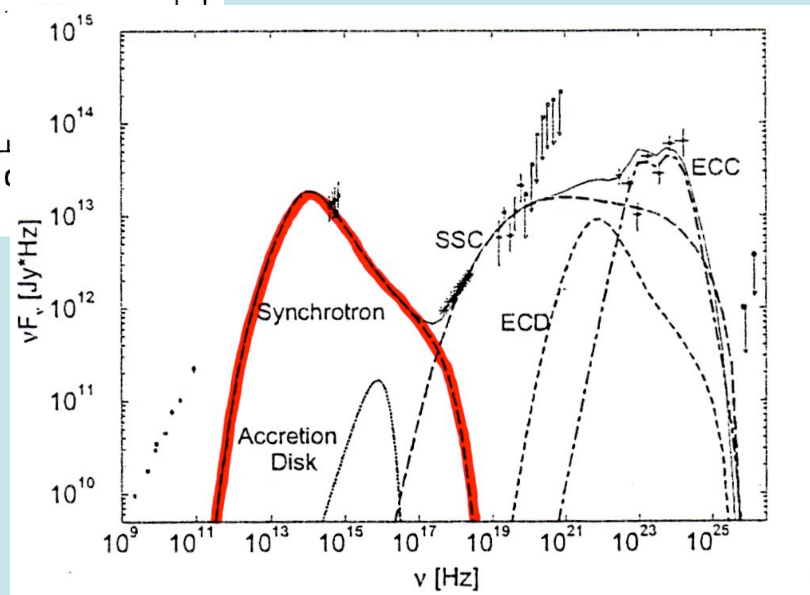
the trouble with AGN and gamma-rays

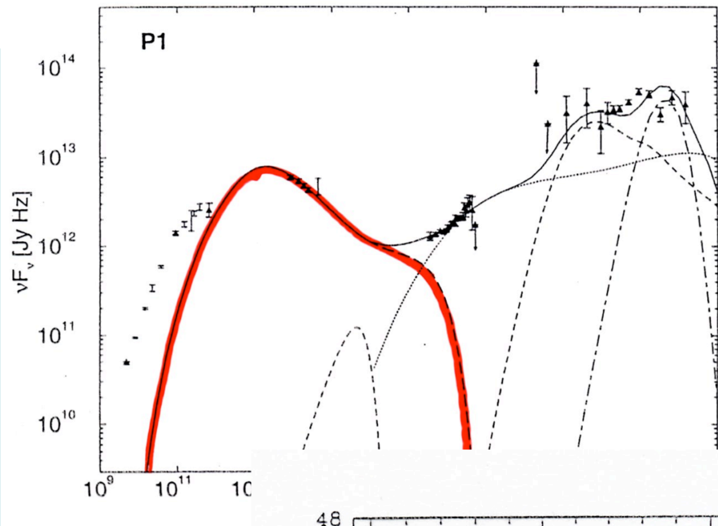
Esko Valtaoja
Tuorla Observatory, U.Turku
Metsähovi Radio Observatory, Helsinki U. of Technology
FINLAND
esko.valtaoja@utu.fi

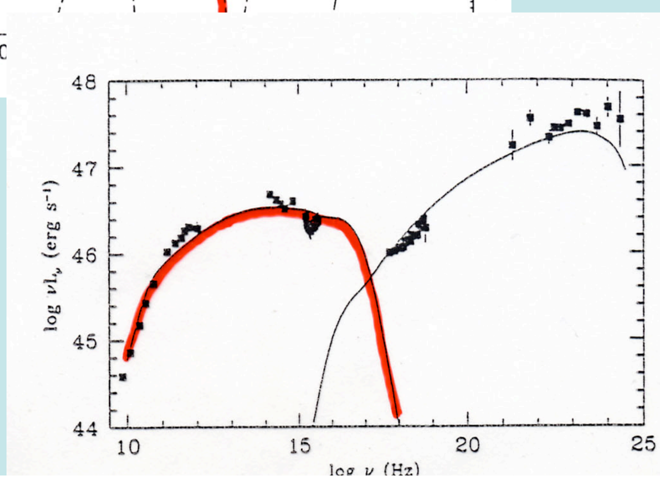
Six times 3C 279, June 1991

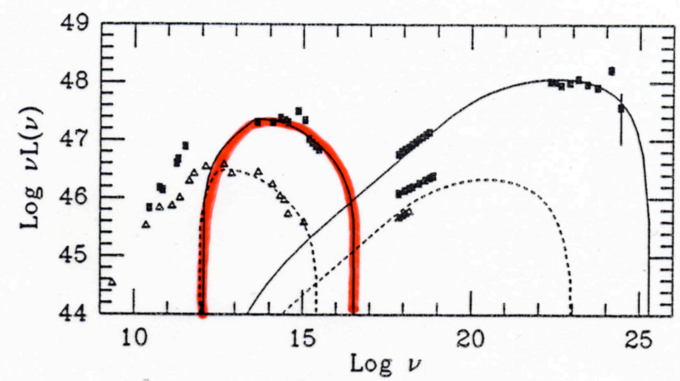










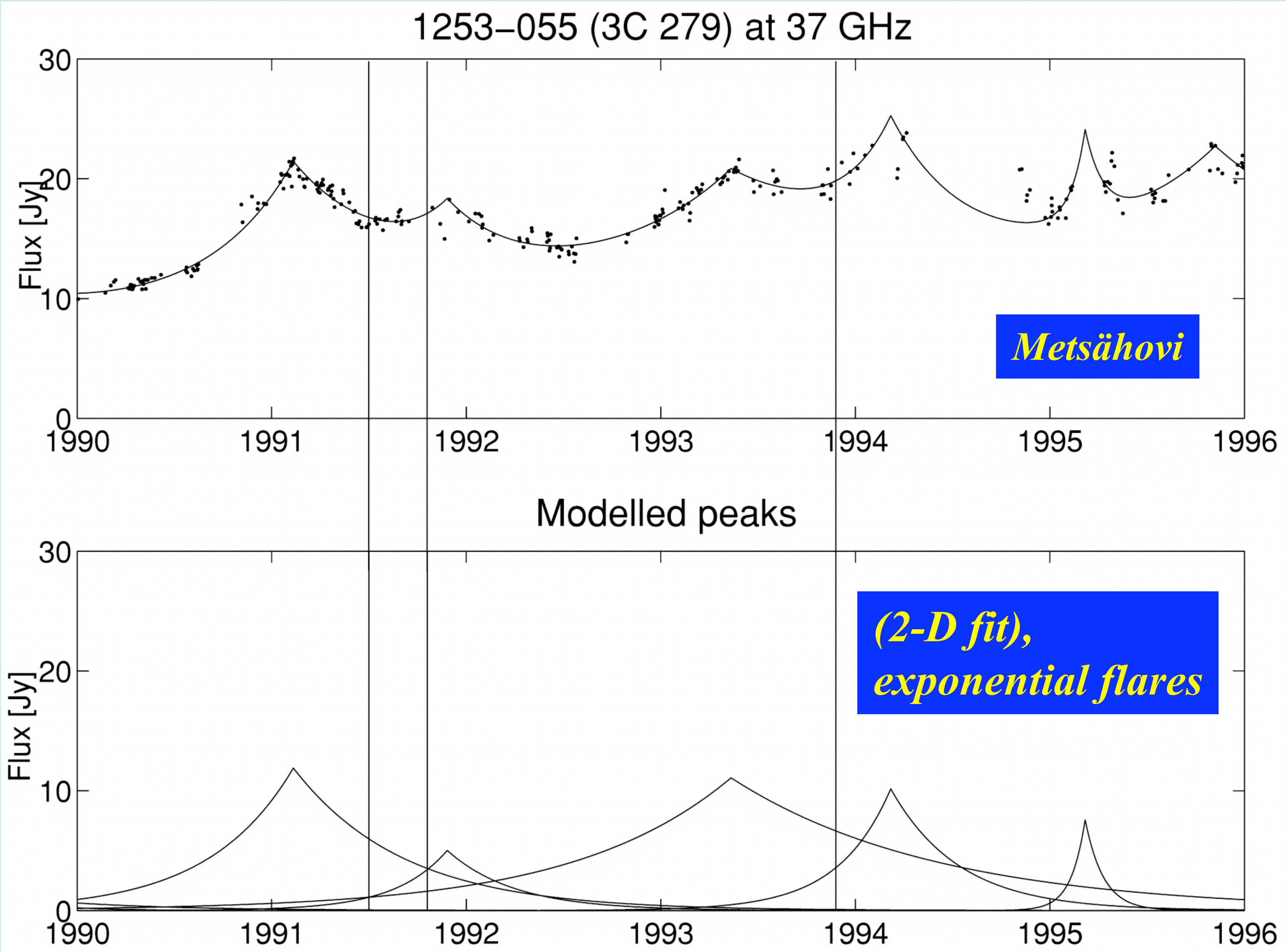


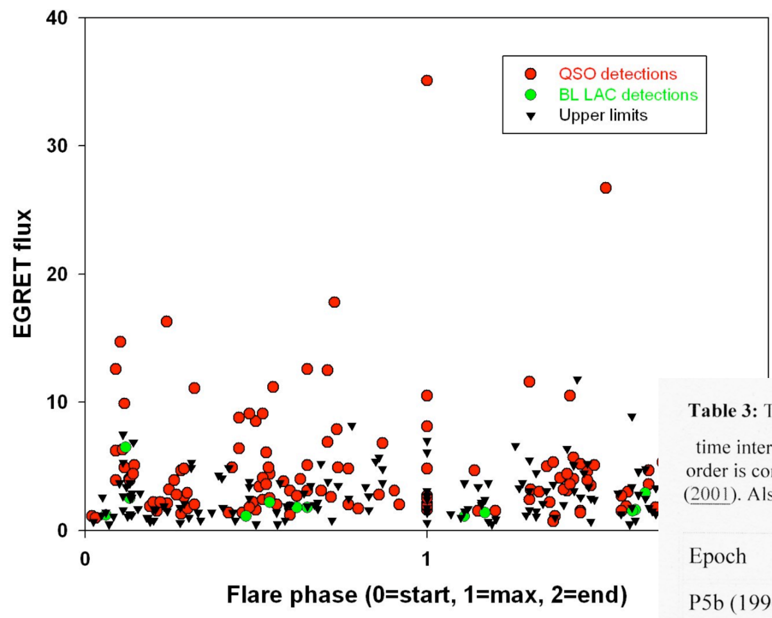
- **theoretical synchrotron spectra with little (no) connection to reality**

- **snapshots with no temporal framework or constraints**

- **(mainly) one-zone model spectra, in disagreement with the basic shocked jet framework**

WHAT CAN mm-MONITORING DO? 1) Movie, not a snapshot: synchrotron and strong gamma flaring in 3C 279 [Lähteenmäki & Valtaoja, Ap. J. 590, 95 (2003)]





P = 99,9 %

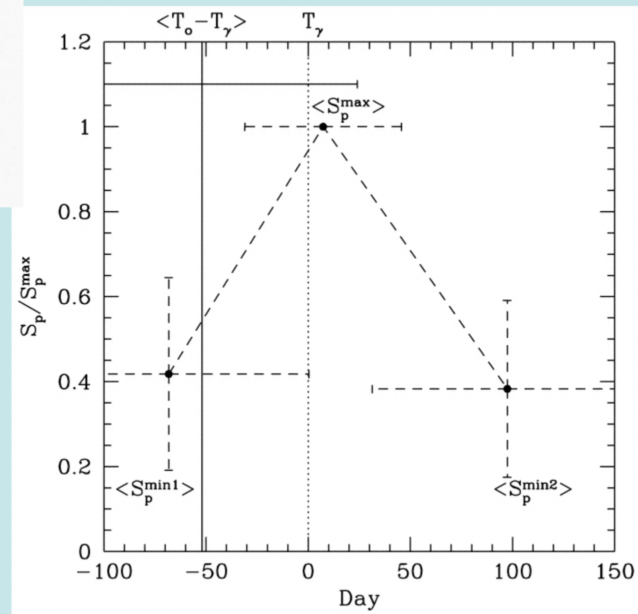
***EGRET vs continuum sample*: radio flare starts before gamma flare** **[Valtaoja & Teräsranta 1995; Lähteenmäki & Valtaoja 2003]**

Table 3: The EGRET epochs ordered by increasing Δt_{obs} [years], the time interval since the start of the last outburst as derived here. This order is compared to the gamma-ray state adopted from Hartman et al. (2001). Also an estimate of the distance, L, of these shock components from the apex of the jet is given (see text).

Epoch	Shock No.	Δt_{obs}	gamma-ray state	L [pc]
P5b (1996.092)	10	0.006	very large flare	0.12
P8 (1999.070)	15	0.195	high	3.88
P5a (1996.063)	9	0.206	high	4.10
P1 (1991.47)	3	0.225	high	4.48
P3a (1993.858)	6	0.288	moderate	5.74
P6b (1997.470)	12	0.328	moderate	6.53
P3b (1993.979)	6	0.409	moderate	8.15
P2 (1993.004)	4	0.49	low	9.76
P6a (1997.010)	10	0.924	low	18.41
P4 (1994.970)	7	0.99	low	19.72

P = 99,98%

***3C 279*: the more distant the shock, the weaker the gamma flare** **[Lindfors et al. 2006]**



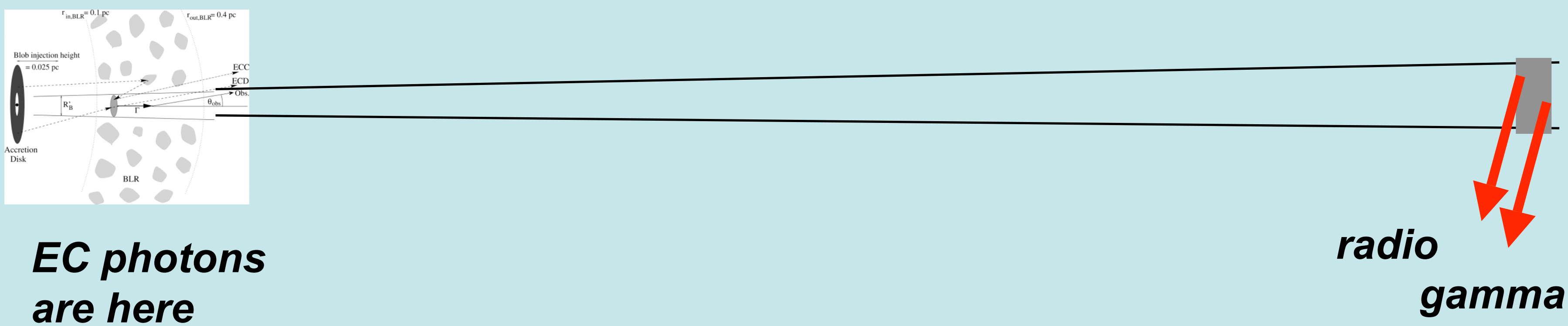
***EGRET vs VLBI sample*: new component emerges before gamma flare** **[Jorstad et al. 2001]**

P = 99,999%

<u>All Continuum + VLBI data vs EGRET:</u>

strong gamma radiation comes from shocks on the average 2 months old (observer's frame) = several parsecs down the jet

[Jorstad et al. 2001; Lähteenmäki & Valtaoja 2003]

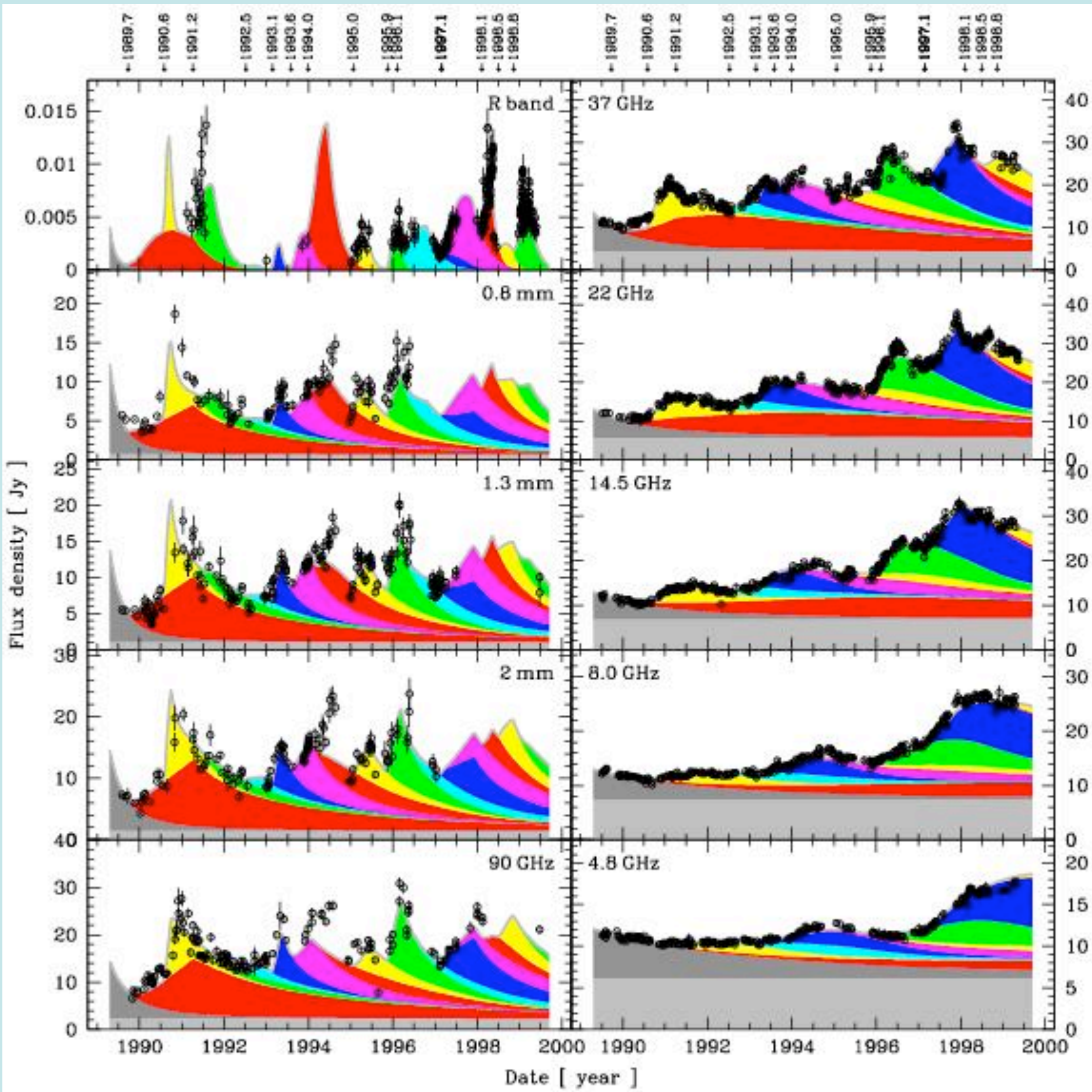


External Compton fails.

WHAT CAN mm-MONITORING DO? ***2)*** ***Identify and separate the jet and the shock components in the sources at any given time***

[Lindfors et al., A&A 456, 895 (2006)]

3C 279

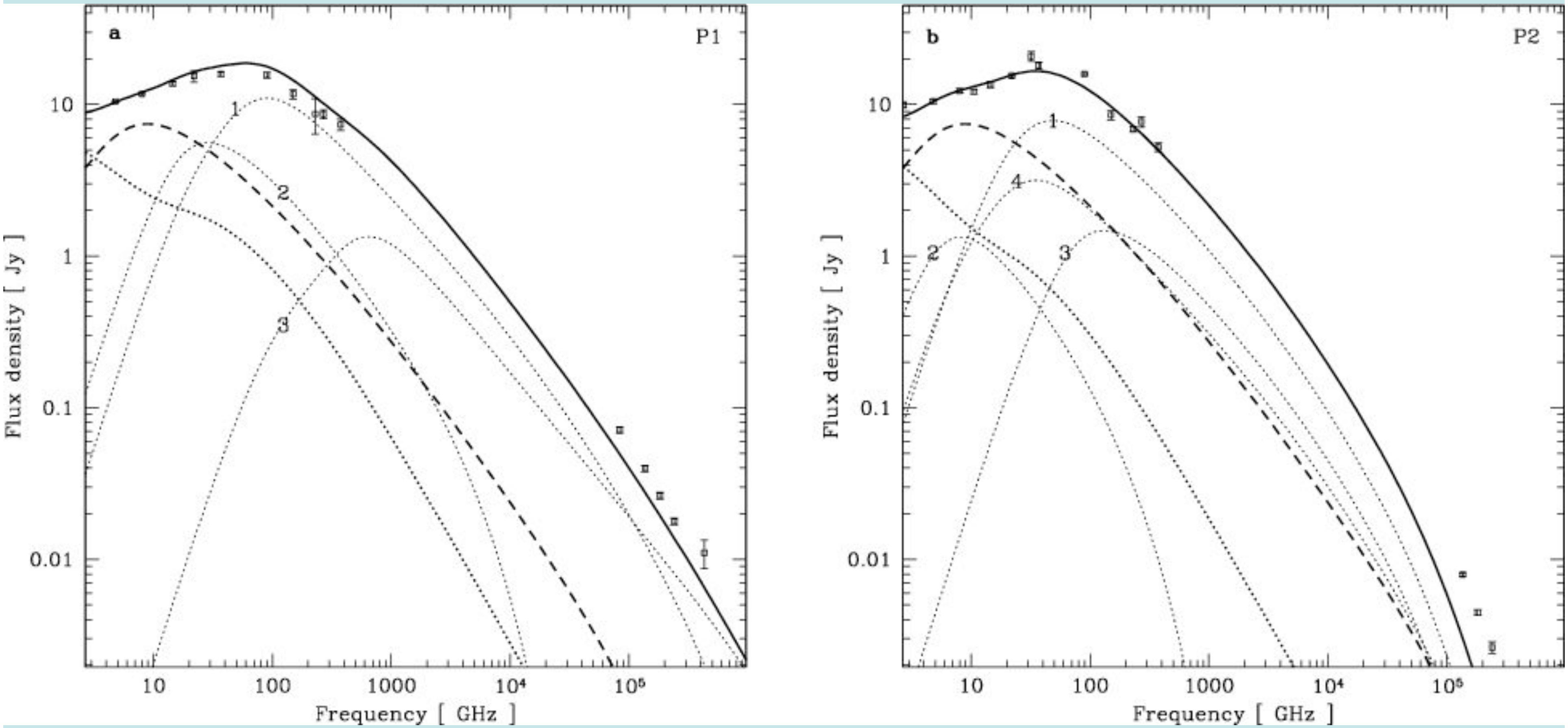


19 frequencies

Michigan
Metsähovi
SEST
IRAM
JCMT
KVA
NOT
Perugia
Torino
+
literature data

3C 279 during the first 2 EGRET epochs:

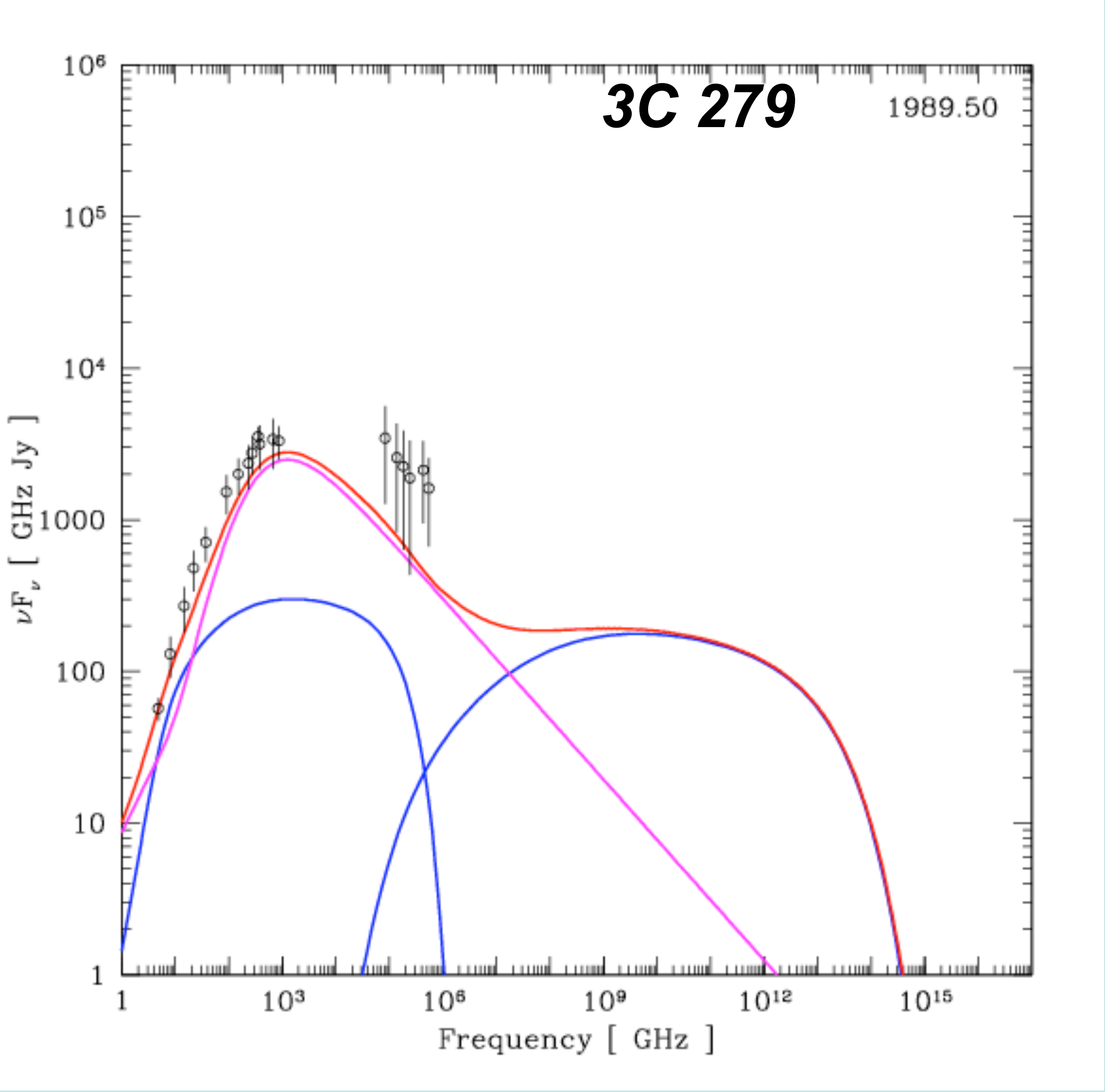
the true jet and shock synchrotron components revealed (Lindfors, Valtaoja & Türler, A&A 440, 845 (2005)



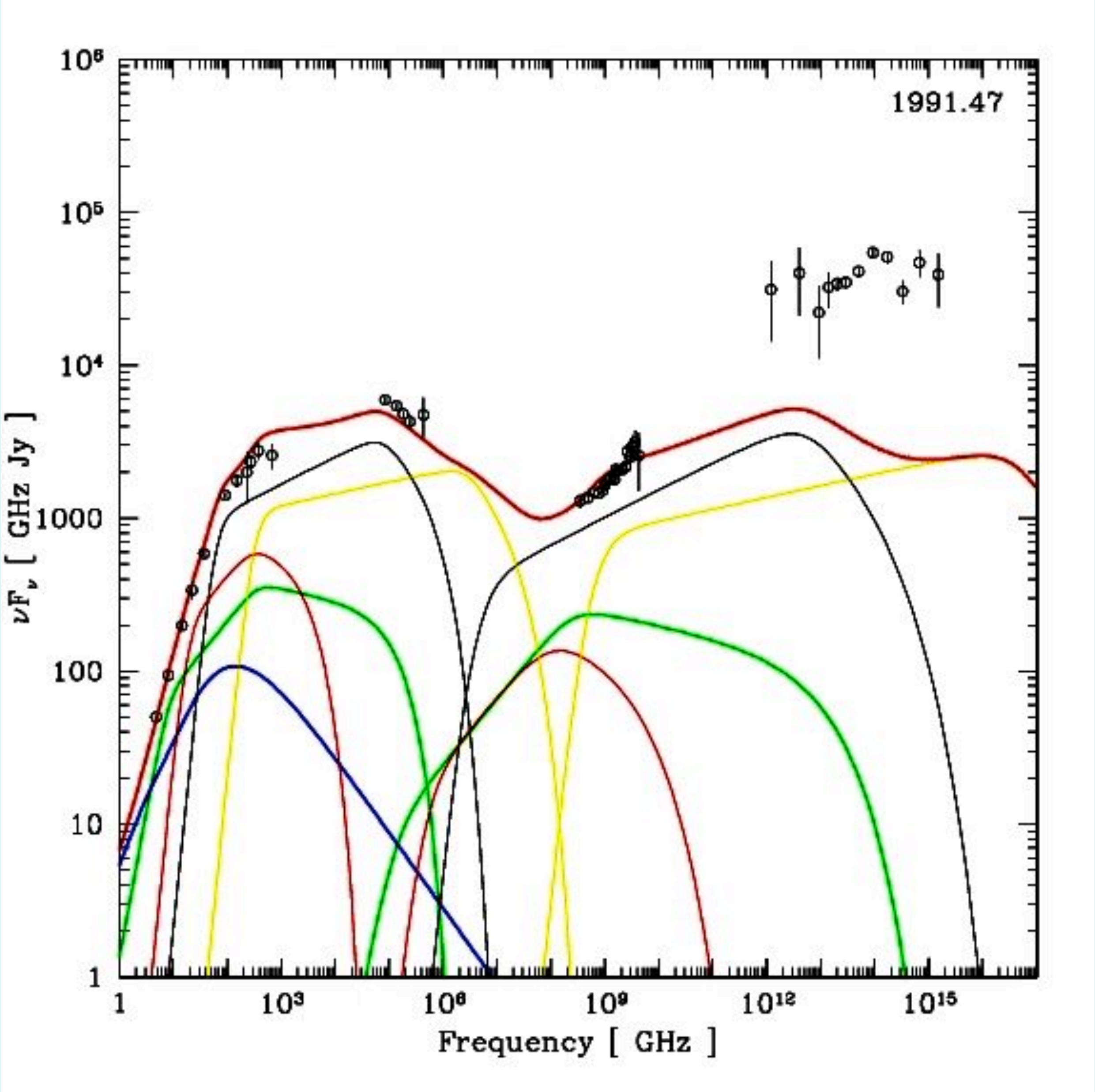
***Assumptions**: Marscher & Gear shocked jet model*

***Numerical code**: Türler and Lindfors (3-D fit to all mf data)*

SYNCHROTRON COMPONENTS + your favorite model
→ INVERSE COMPTON COMPONENT



3C 279, June 1991: ***Synchrotron-self-Compton also fails.***
(Lindfors, Valtaoja & Türler, A&A 2005)

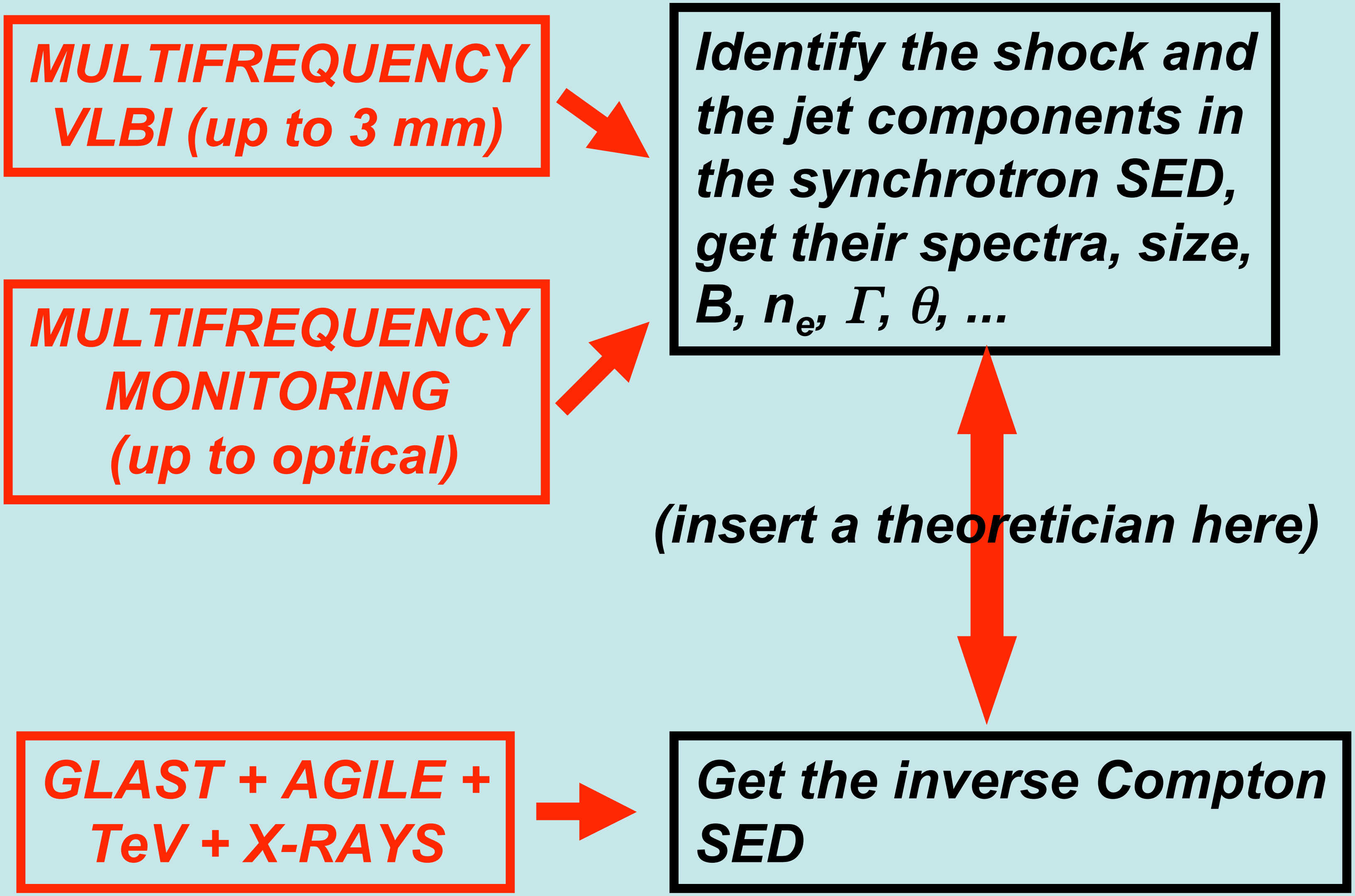


WHAT NEXT?

- SSC and EC both fail for 3C 279 at least
- improved SSC calculations ?
- mirror Compton from dust etc.?
- internal shocks?

something crucial is missing...

GLAST + multifrequency/VLBI monitoring


MULTIFREQUENCY VLBI (up to 3 mm)
MULTIFREQUENCY MONITORING (up to optical)
GLAST + AGILE + TeV + X-RAYS
Identify the shock and the jet components in the synchrotron SED, get their spectra, size, B, n_e, Γ, θ, ...
(insert a theoretician here)
Get the inverse Compton SED