The Twin Features in NGC 1275

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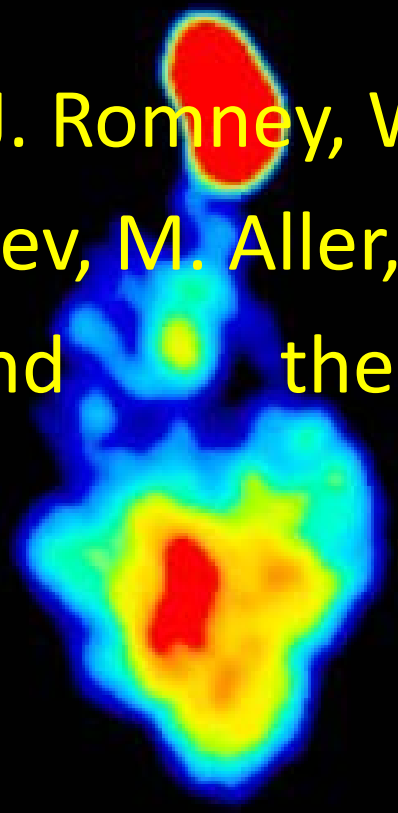
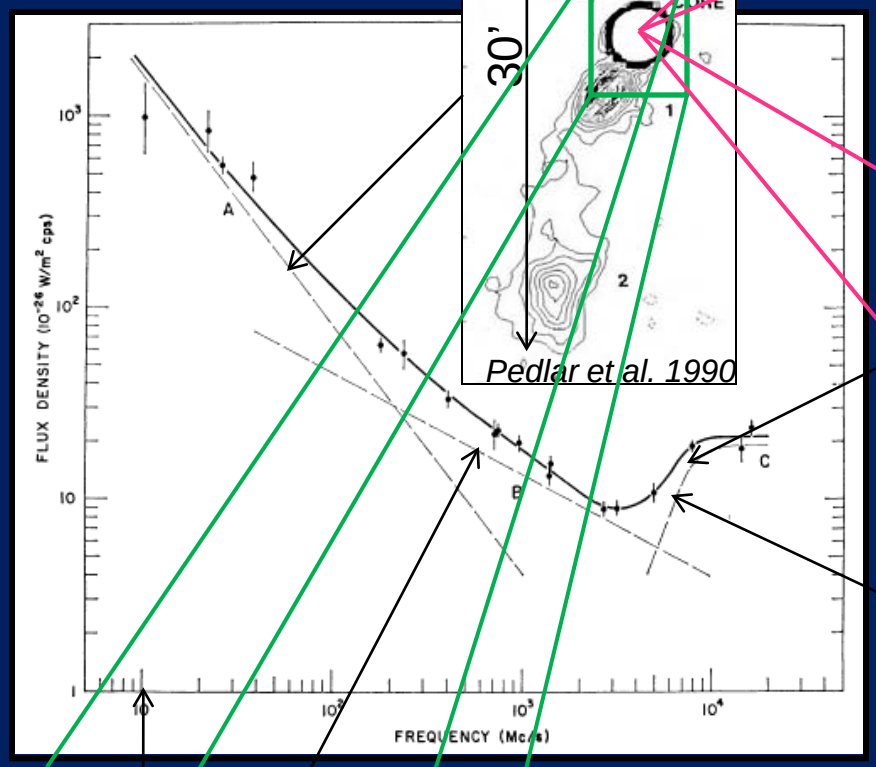


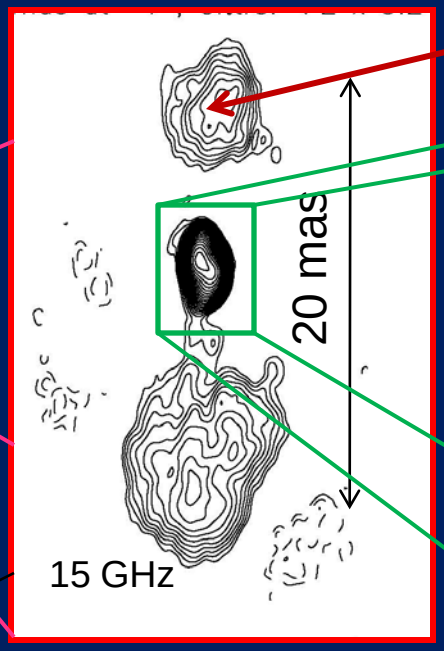
NGC 1275 – aka 3C 84

- Perseus A
  - Sydney: Mills, 1952
  - Jodrell Bank: Handbury-Brown & Hazzard, 1952
  - Cambridge, Ryle et al. 1954 (RSE 03.02)
- NGC 1275: Baade & Minkowski (1954)
- Seyfert Galaxy: Carl Seyfert (1943)
  - Not typical Seyfert: P~10^{26} W/Hz
  - AGN not SF
- 2.8 cm US Network +EVN (1972-1995)
- 2 cm
  - VLBA full tracks (1995-2000)
  - MOJAVE (2000-2010)
    - 1 mas = 0.35 pc
    - 1 mas/yr = 1.2c

NGC	1950 R.A.	1950 Dec.	Type	m_{total}	$m_{nucl.}$	Spect.	Modulus	No. of Plates
1068	$2^h40.1$	− 0° 14	Sb	10.0	13.0	G3	26^m0	17
1275	3 15.6	+41 18	E:	13.0	15.5	G3	30.0	4
3516	11 3.4	+72 50	Sa	12.2	13.7	G2:	28.5	6
4051	12 0.6	+44 48	Sb	11.7	14.0	G2	26.0	4
4151	12 8.0	+39 41	Sb	11.2	12.0	G2	26.0	12
7469	23 0.7	+ 8 36	Sa	13.0	14.3:	G0:	29.8	2



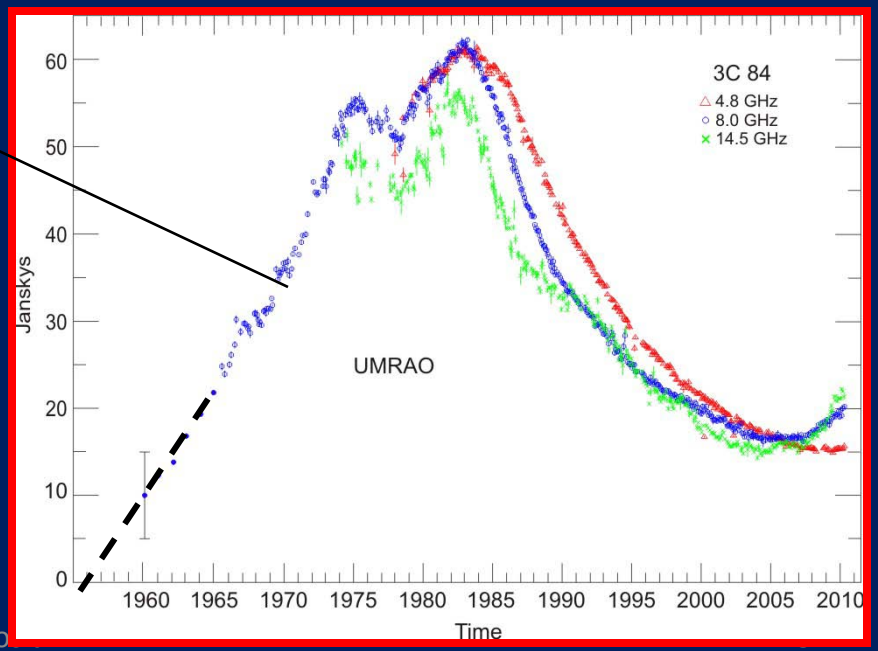
Pedlar et al. 1990



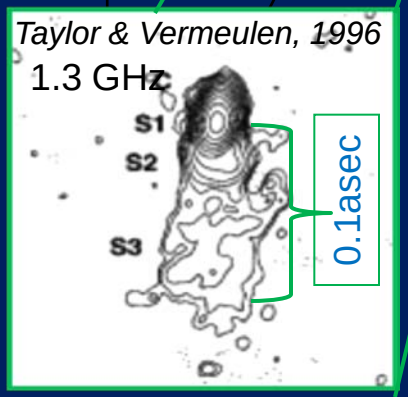
FFA

Walker et al. , 2000

Dhawan et al 1998



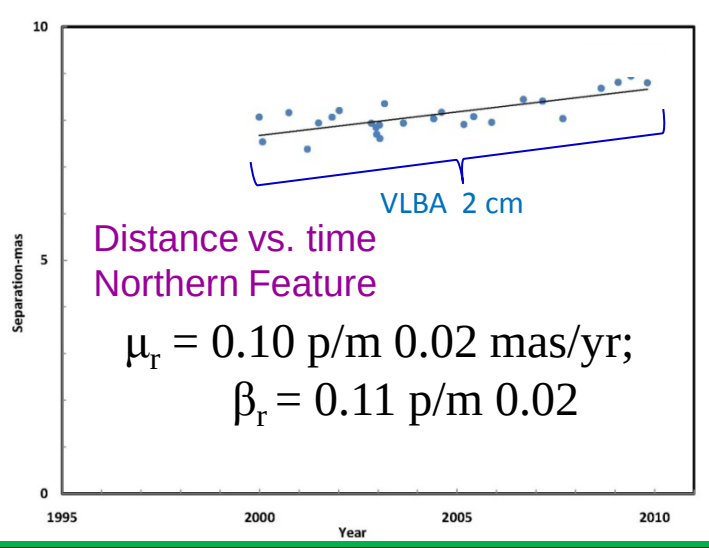
Taylor & Vermeulen, 1996

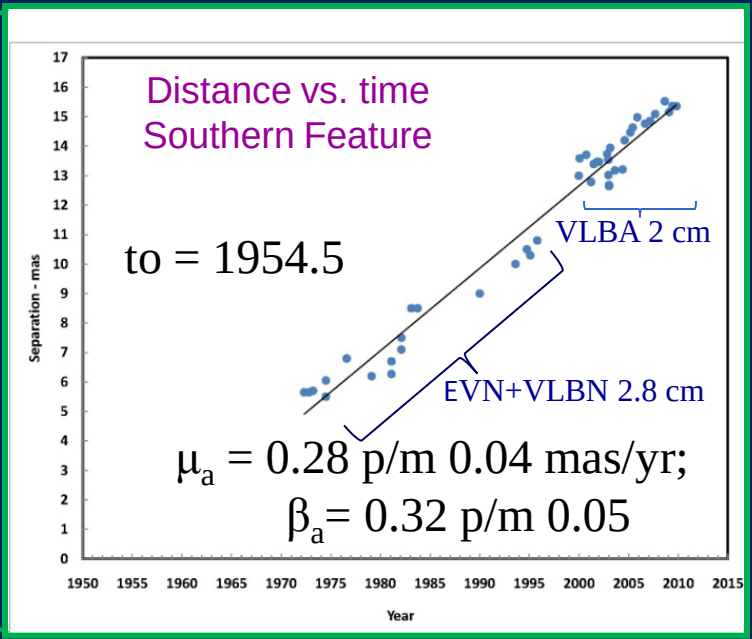


MOJAVE
2.8 cm
VLBA

βr

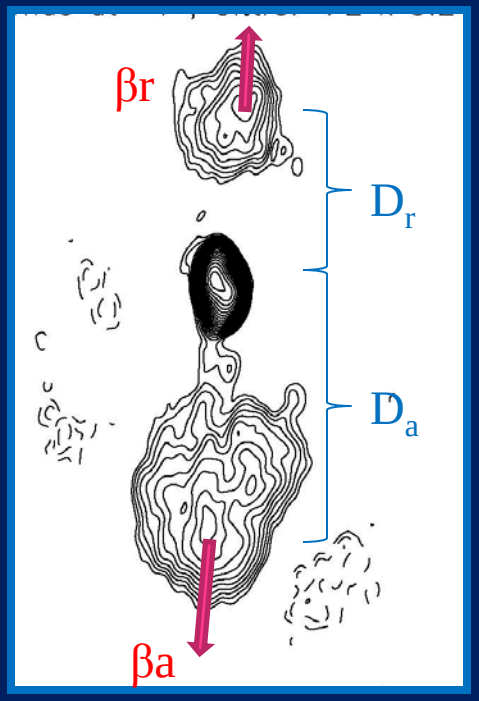
βa





$$\beta_a = \beta \sin\theta / (1 - \beta \cos\theta)$$

$$\beta_r = \beta \sin\theta / (1 + \beta \cos\theta)$$



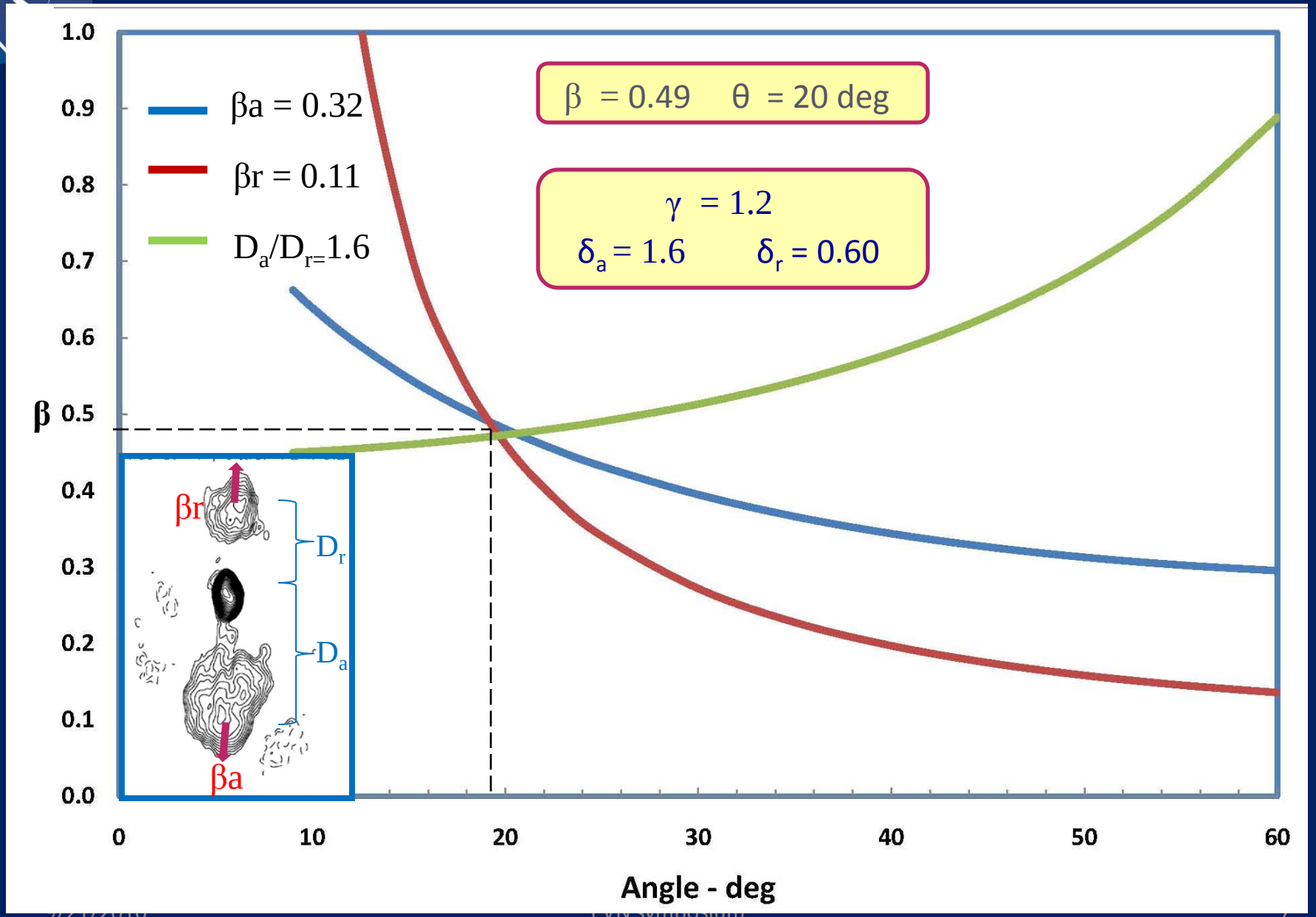
$$D_a/D_r = (1 + \beta \cos\theta)/(1 - \beta \cos\theta)$$

Kinematics

If ejection is symmetric

- both components move in opposite directions
- both move with same speed
- both components were ejected at the same time
- both components move through same environment

Then β & θ are completely defined by the observations


βa = 0.32
βr = 0.11
Da/Dr=1.6
β = 0.49 θ = 20 deg
γ = 1.2
δa = 1.6 δr = 0.60
β
Angle - deg
βr
βa
Dr
Da
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60

Luminosity considerations

$$L/L_o = \delta^{\alpha+p}$$

$2 < p < 3; \alpha \sim 0$

$$L/L_o = 1.6^{2.5} \sim 3$$

$$L_o \sim 10^{26}\ \mathrm{W/Hz}$$

Summary

- At least 3 ejections from AGN
  - ~ 1965
  - ~ 1955
  - 10^2 to 10^3 years ago
- 3C 84 is powerful AGN : P= 10^{26} W/Hz
- 3C 84 jet speed increases with distance and is only mildly relativistic
  - $0.05 < \beta < 0.5$
  - $\delta \sim 1.6$
- Motion is close to the line of sight (20 deg)
  - Not a mis-oriented BL Lac jet
  - Possibly precesing nozzle
  - Southern lobe not characteristic of typical jets and more like lobe of radio galaxies
- Relation to superluminal jets of other powerful radio sources is unclear
  - Possible spine-sheath configuration as in M87