13th EUROPEAN VLBI NETWORK SYMPOSIUM

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MULTY FACE UNITY

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We studied fine structure of objects:

1. The star formation regions: Orion KL, W 3 OH
2. The nearest objects – whirlwinds.
3. The active nucleus of galaxies: 3C 84, 3C 273, M 87, 3C 454.3, Cyg A, 1803+784, NGC 4258

The structures and kinematics are similar.

ORION KL – H_2O Mega maser emission, *0.5 AU/mas*

Disk S-form, ϕ ~ 30 AU visible of the edge

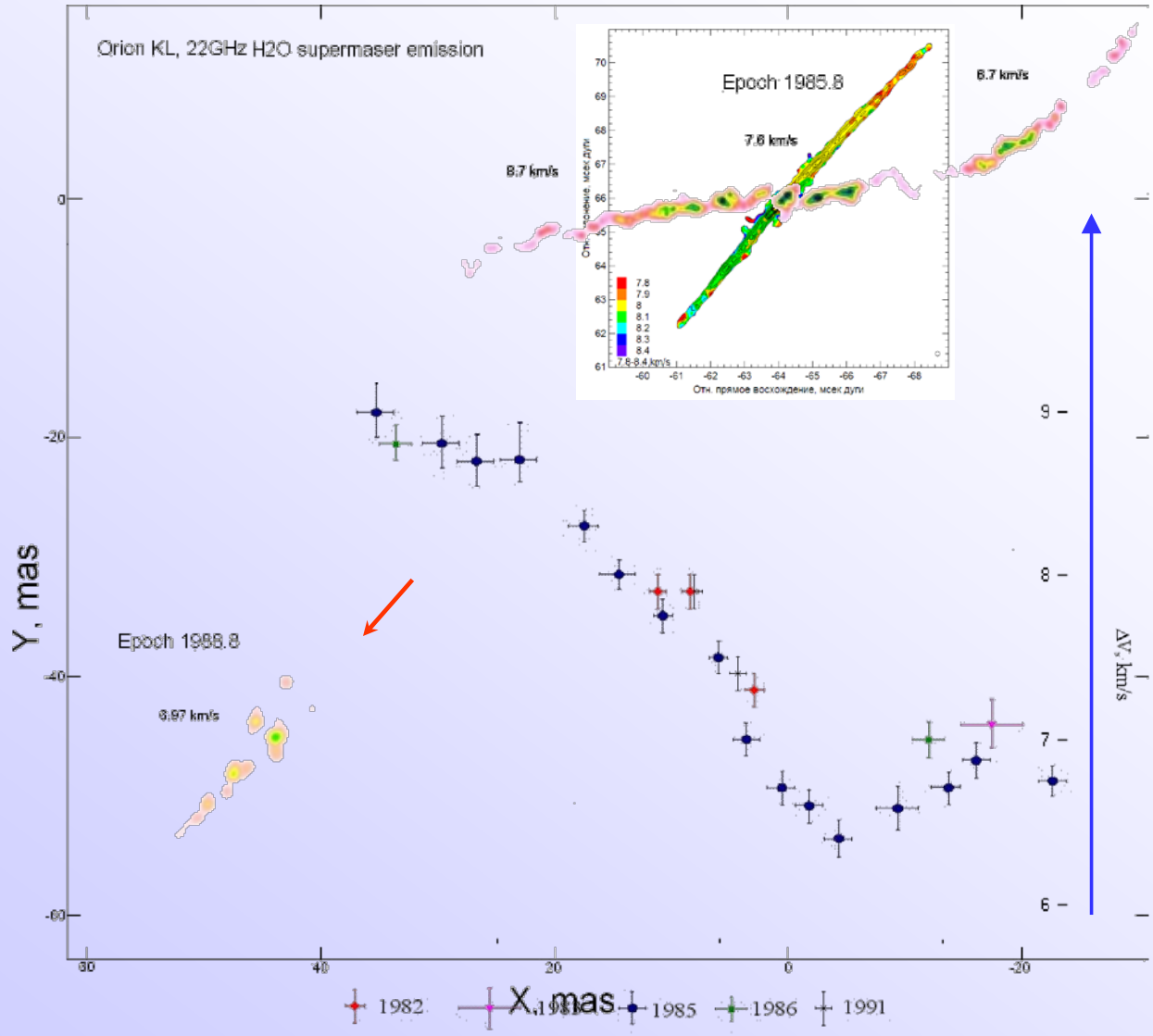
Compact components are tangential direction of arms.

The disk rigid body rotation, $T_{rot} \approx 170$ yr

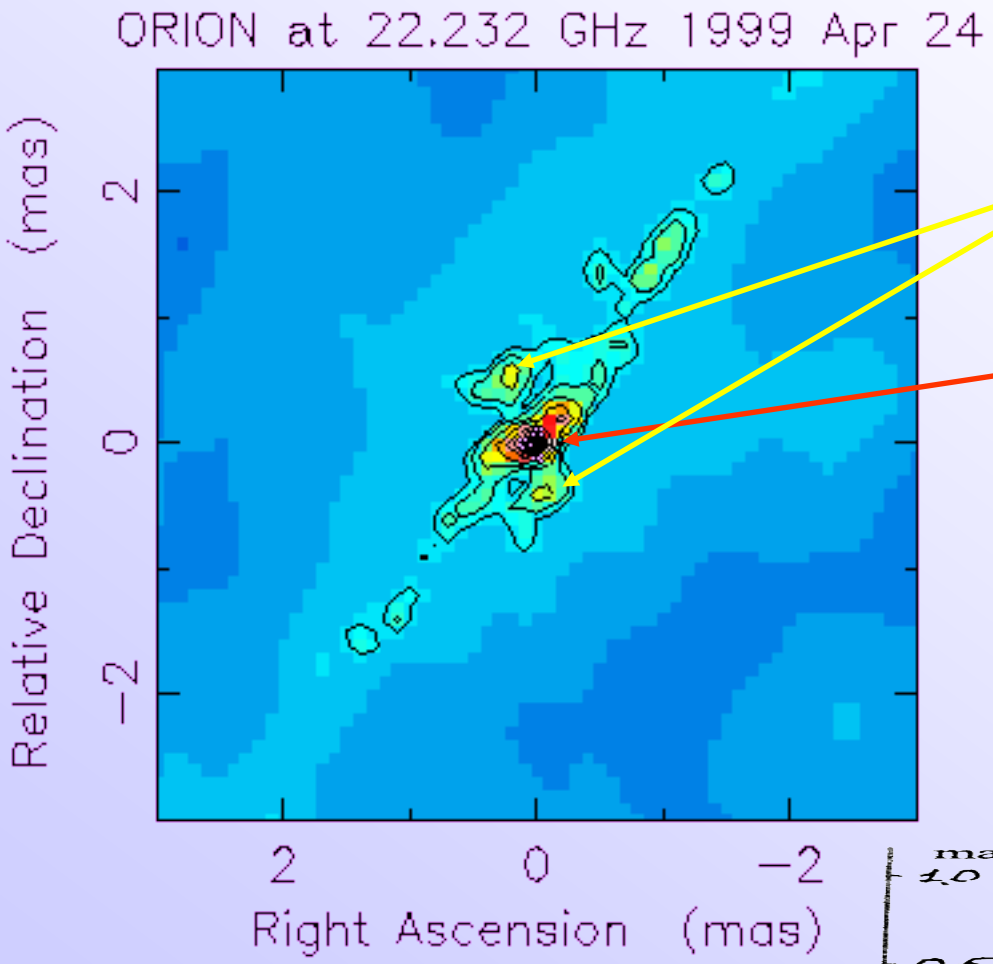
Bipolar outflow

R ≥ 7 AU
Keplerian movement

M< 0.01 M_{sun}



STRUCTURE of the CORE



Low velocity nozzle

ϕ = 0.45 AU, $T_b \approx 10^{13}$ K

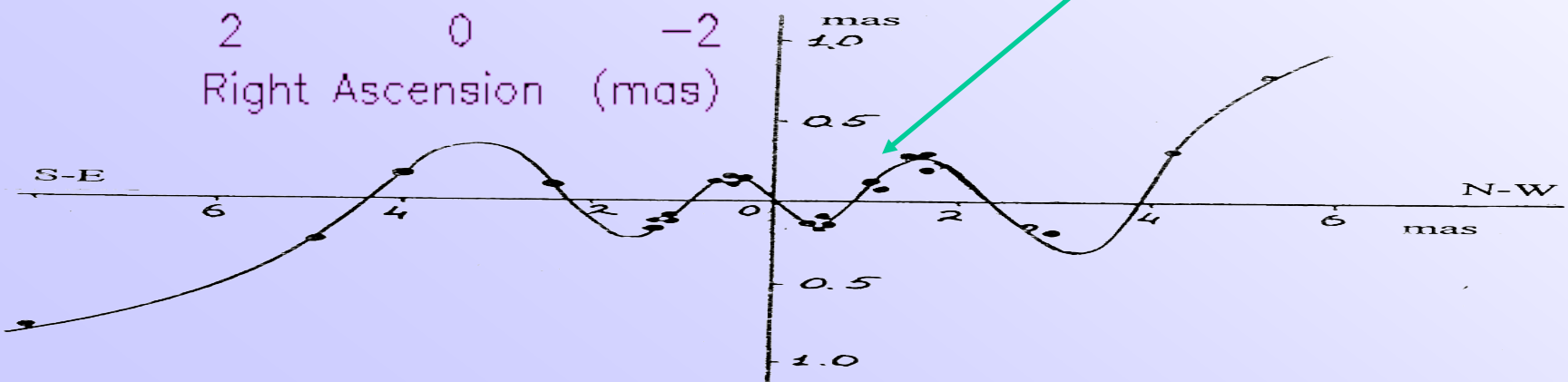
High velocity ejector

$T_b = 10^{17}$ K

•Helix structure

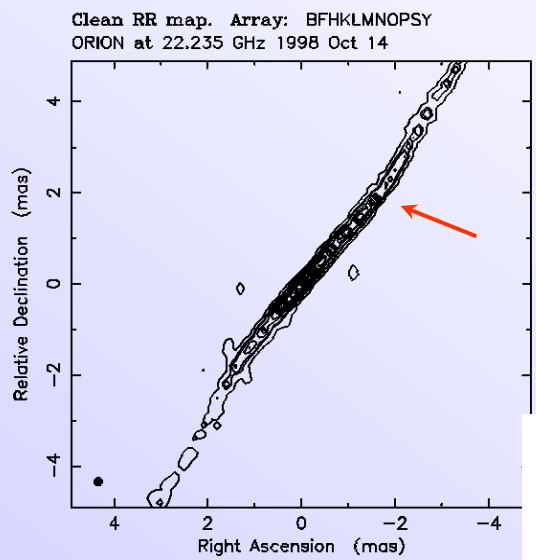
Precession period T ~ 10 yr

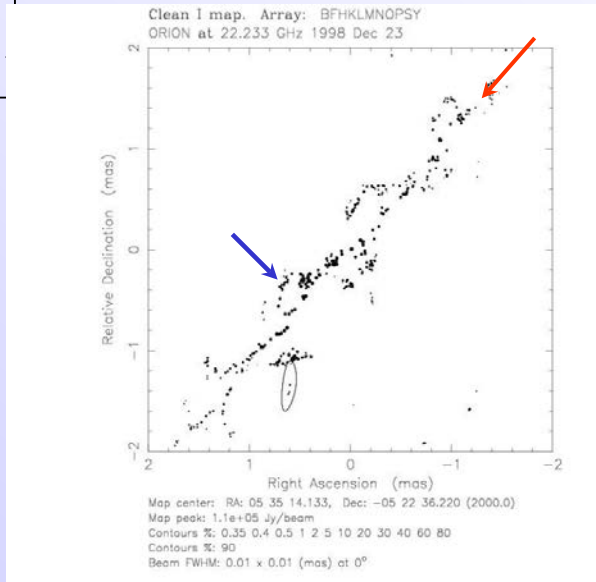
Precession angle ~16°

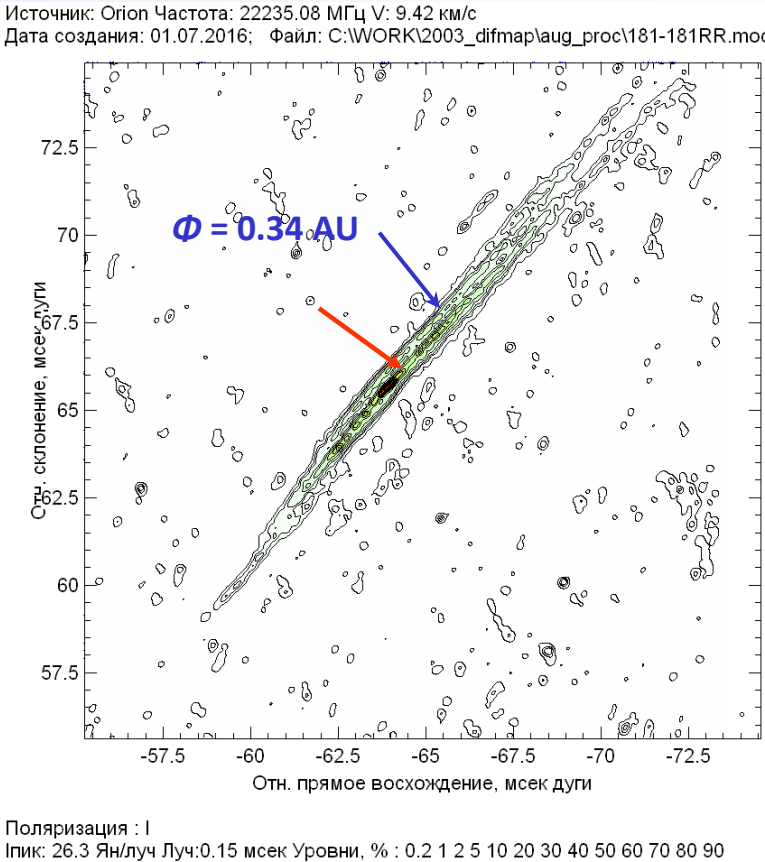


BIPOLAR OUTFLOW

LOW & HIGH velocity jets







Orion KL

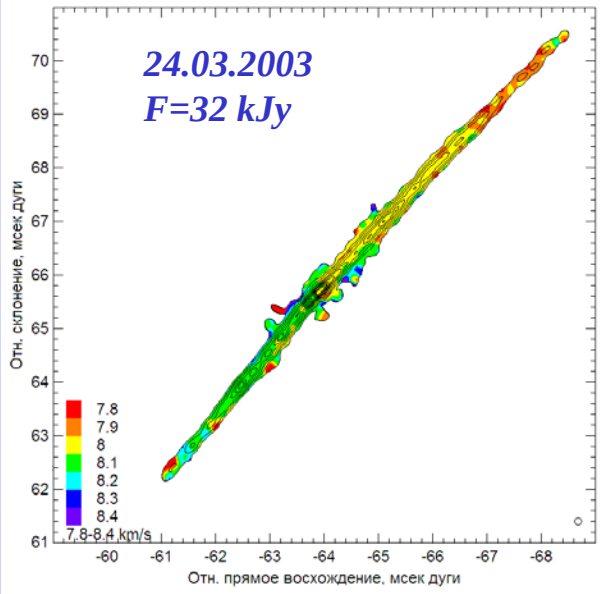
The bipolar outflow

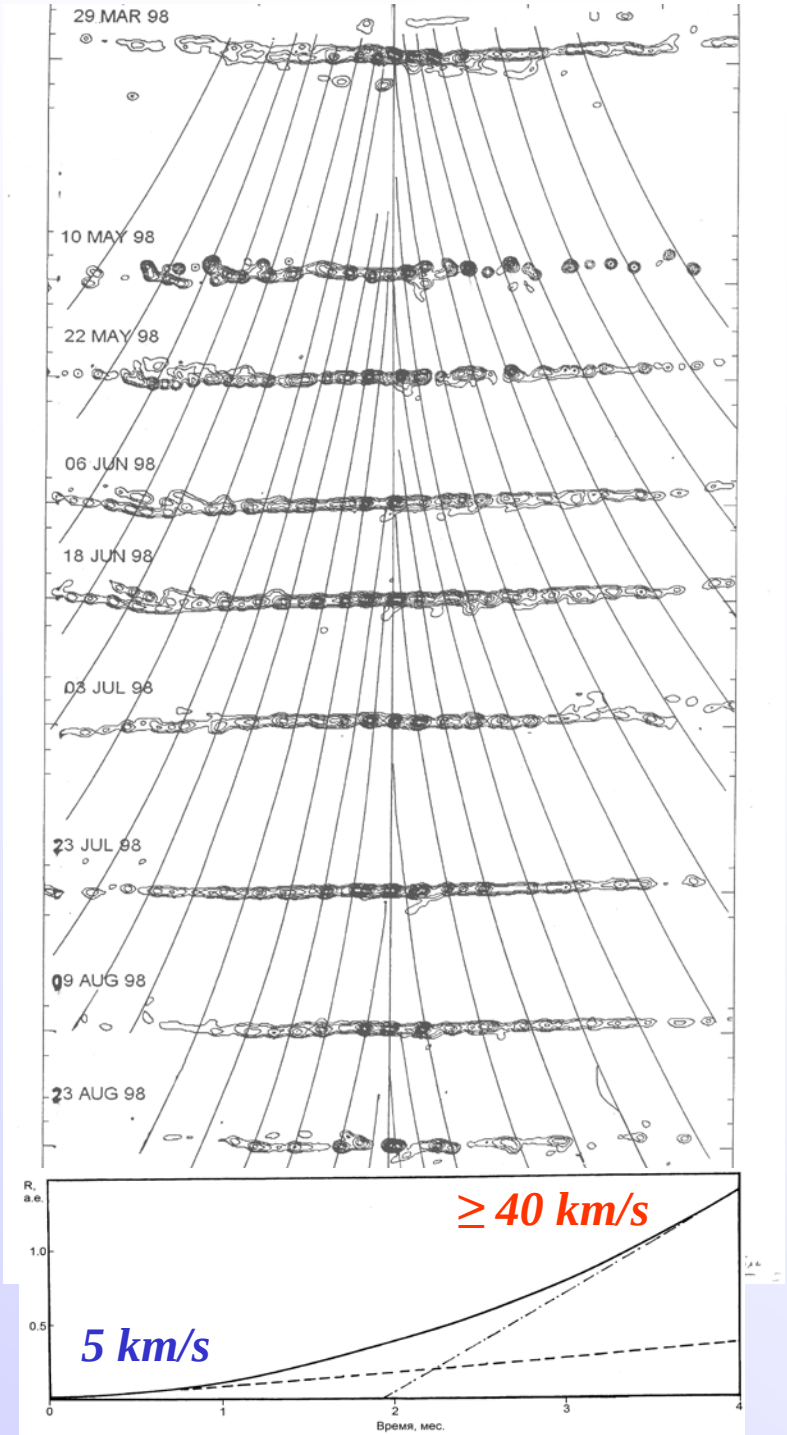
Epoch 1998 yr.

**** The collimation and acceleration - interaction with surrounding medium.***

**** Ejection velocity*** **v ~ 5 km/s**

****An acceleration*** **=> v ≥ 40 km/s at 2 AU.**





Whirlwind

High* & *low

velocity jet

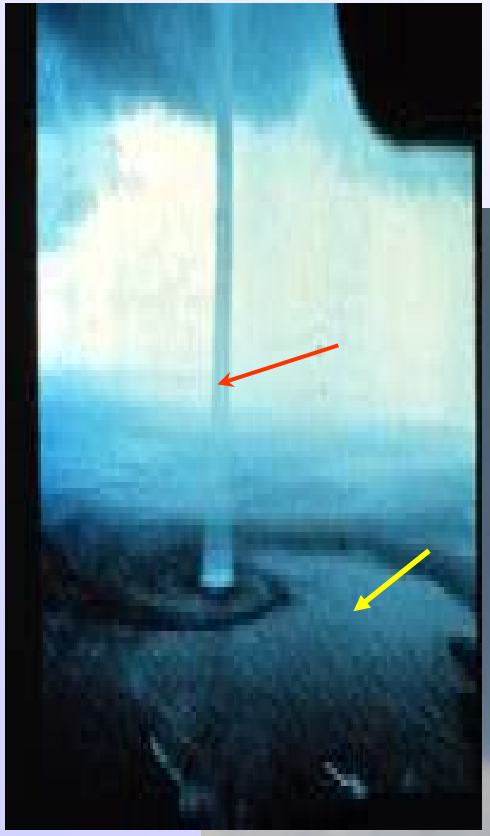


рис.1 d

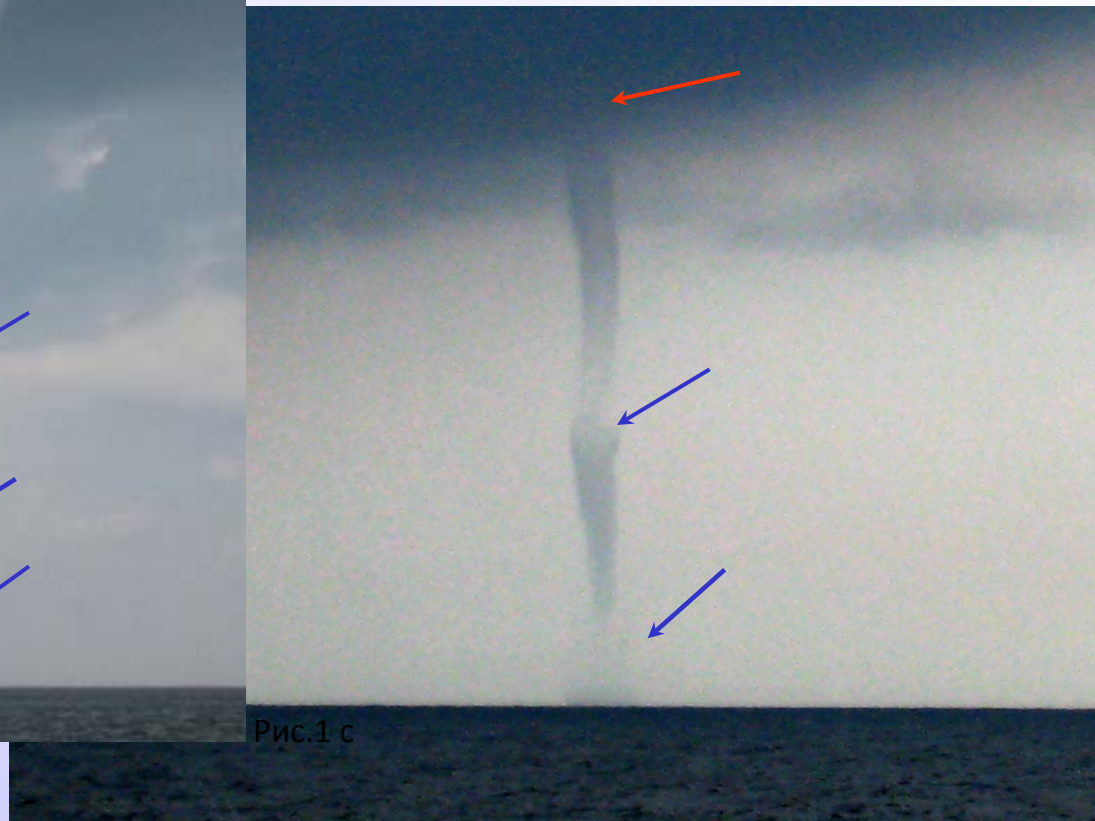


Рис.1 c

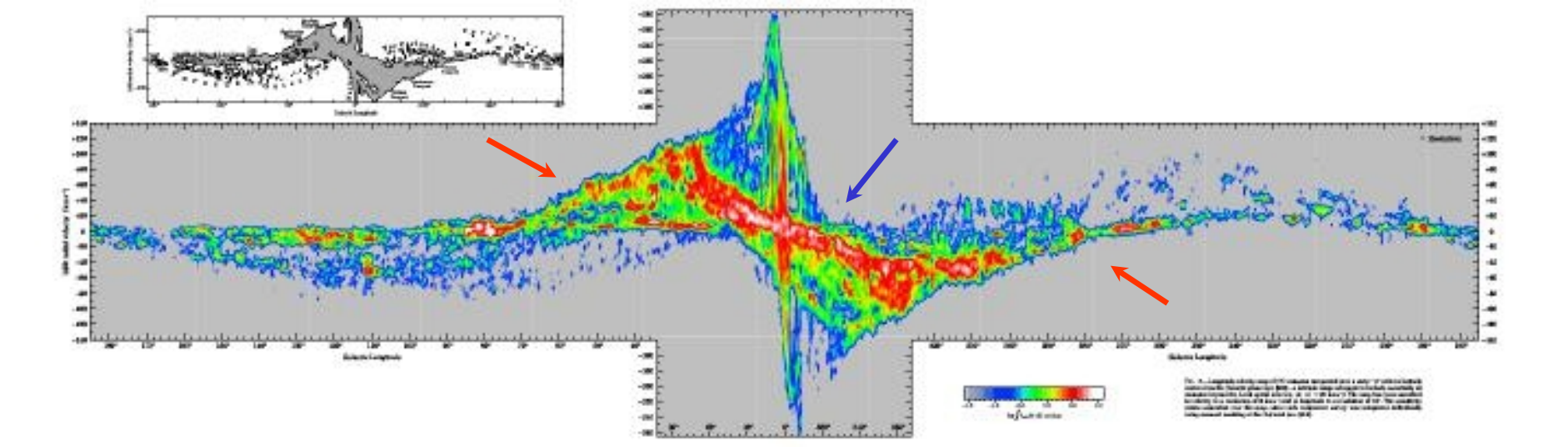
Conclusion.

Movement of matter – unstable => formation of whirlwind – anti centrifuge:

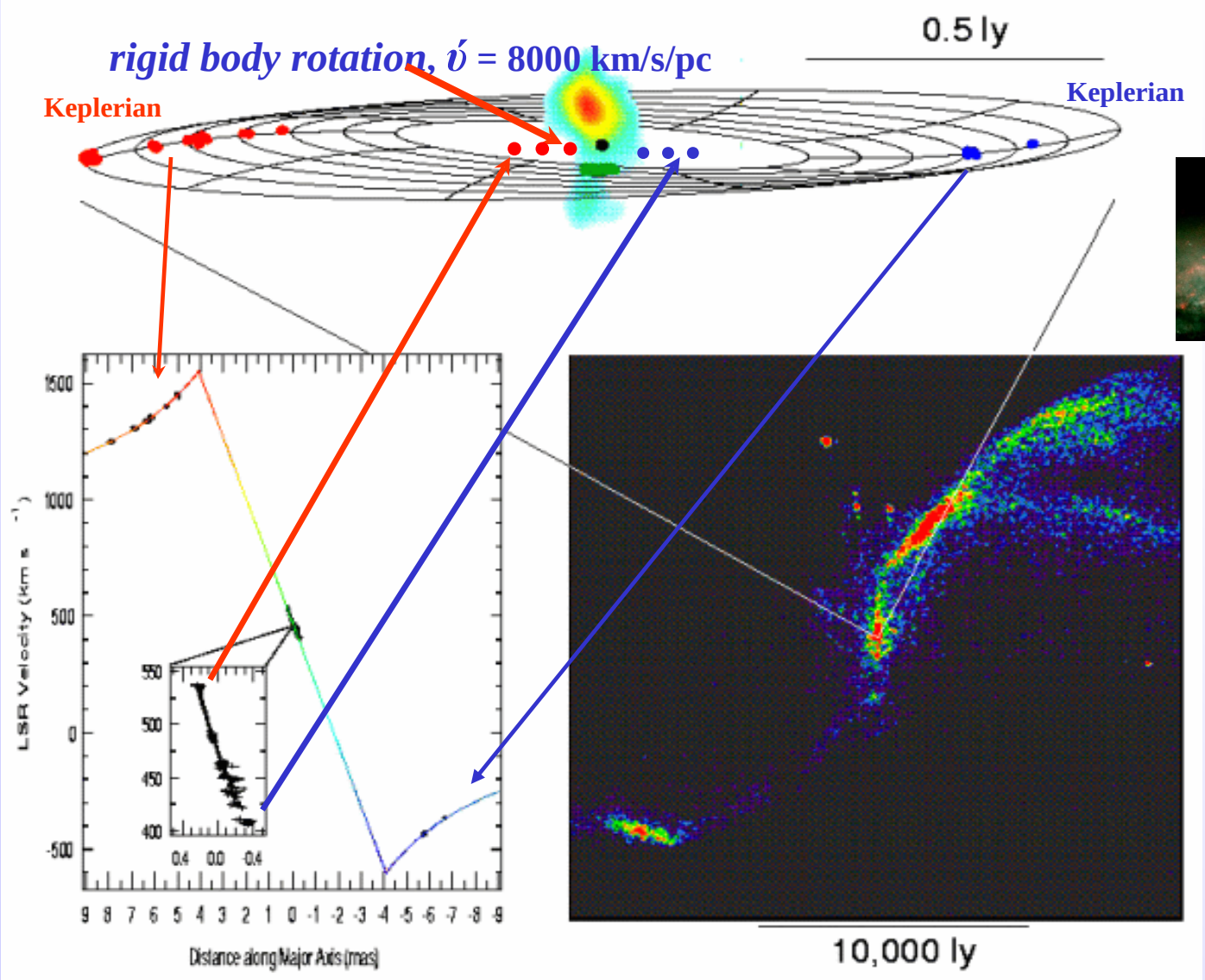
- **Surrounding matter is accreting to "disk" and flowing along arm to a center.**
- **An extra angular momentum carries of by rotated bipolar outflow.**
- **"The disk" - rigid body rotation.**
- **The acceleration and collimation of the outflow – interaction with surrounding matter.**
- **A surplus of the matter is falling at the forming central body.**
- **Gravity field of the body stabilized the process.**

Galaxy

<u>Keplerian</u> and <u>rigid body</u> rotation disk
Bipolar outflow

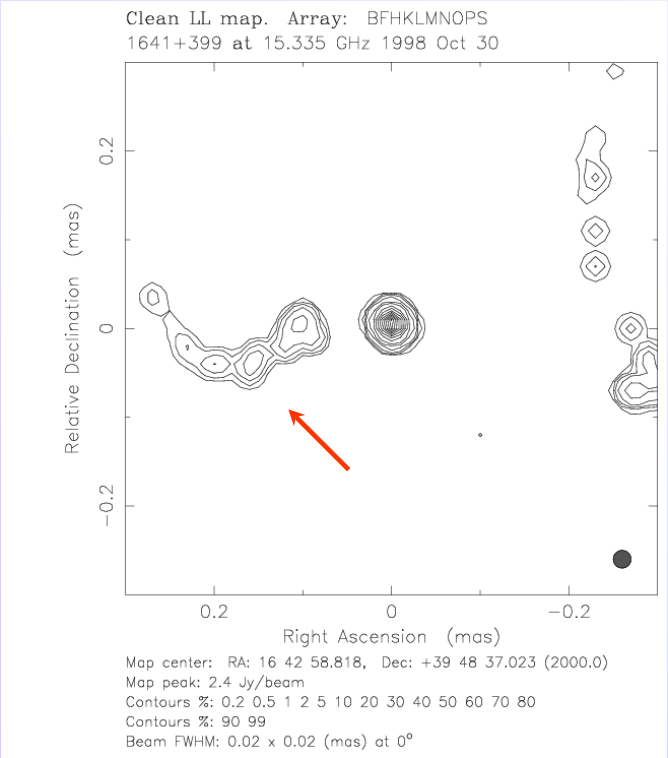


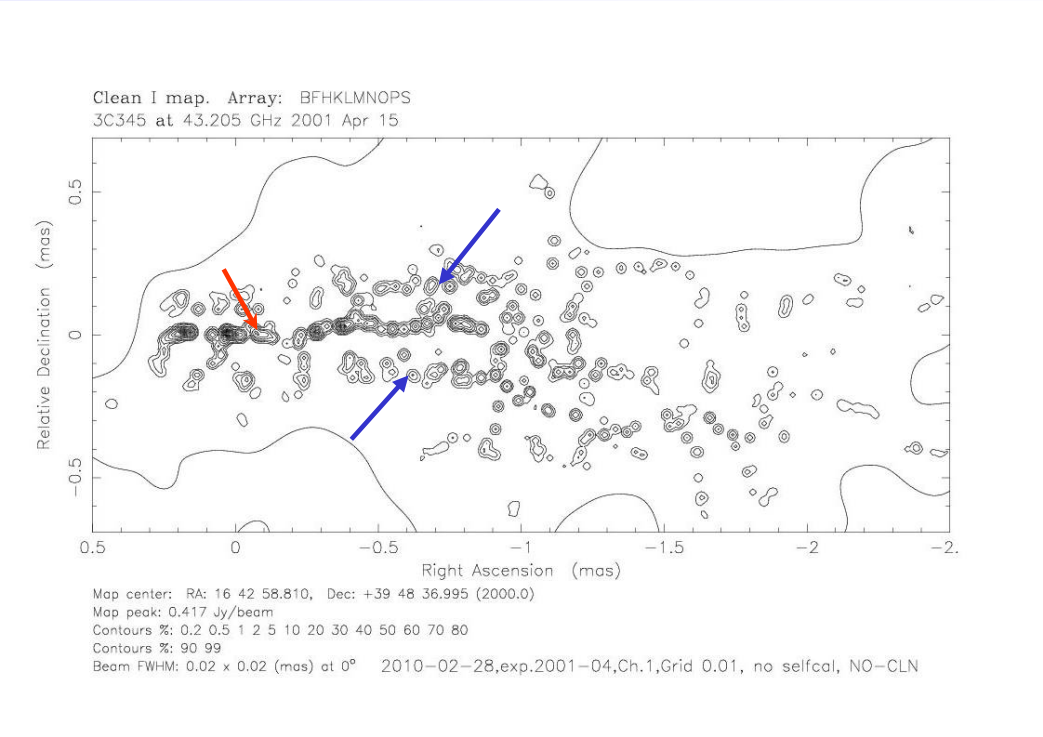
NGC 4258 *H_2O maser radiation*, (Moran et al., 1995)



V rot (R = 0.28 pc)= 770 km/s, V rot (r = 0.14 pc) = 1080 km/s, M = 10^7 M_{sun}

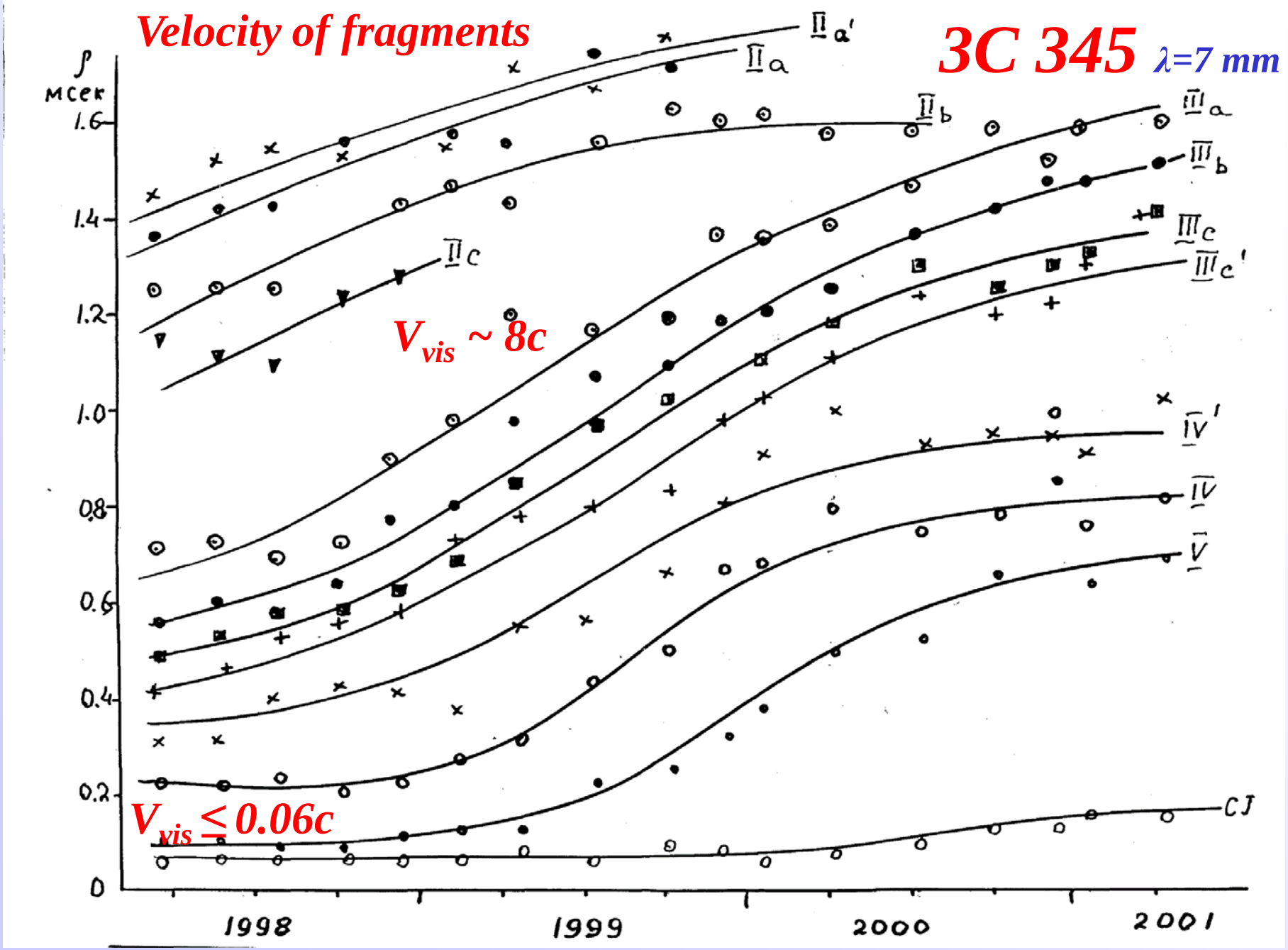
3C 345, 6.6 pc/mas

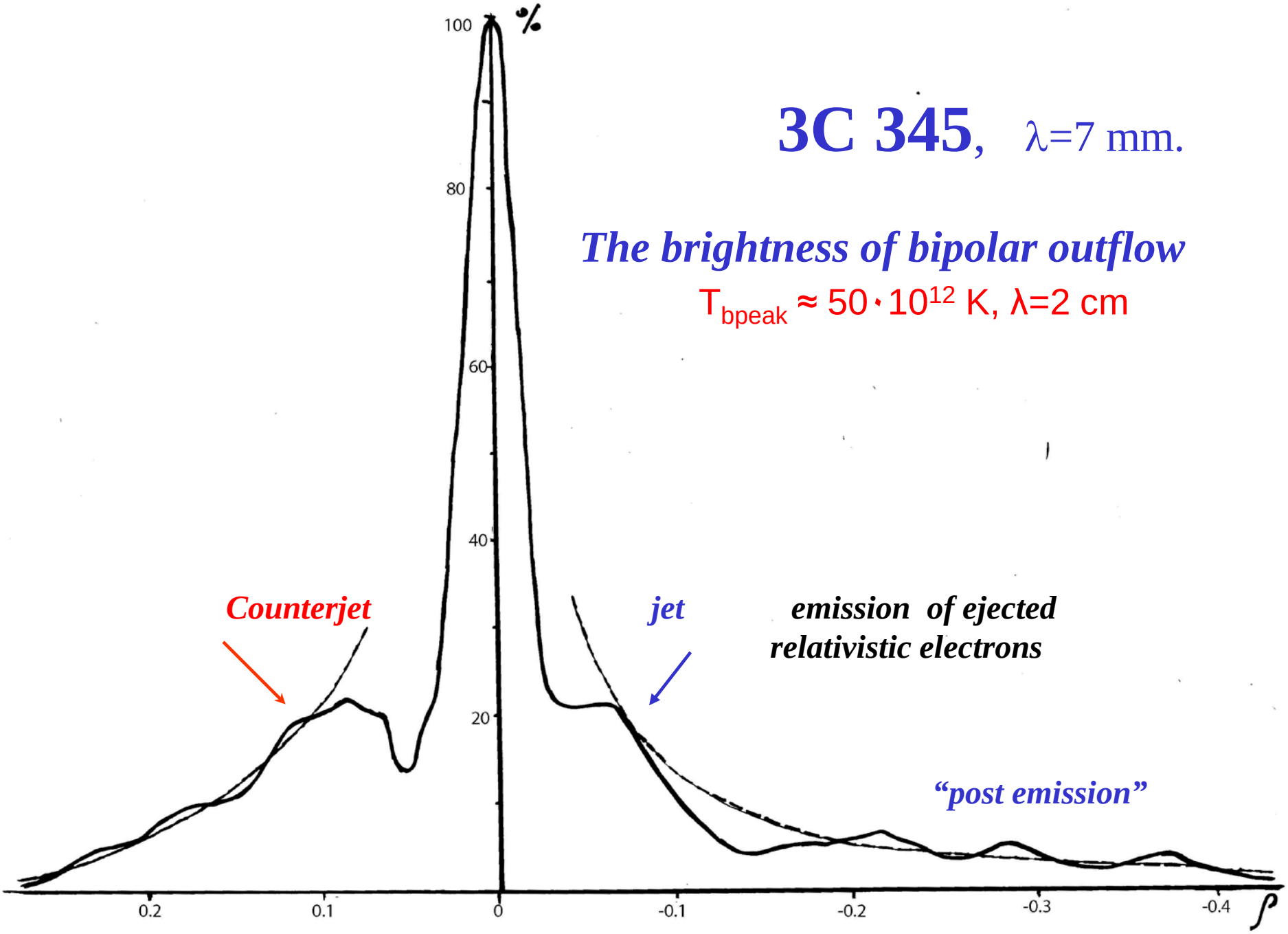




High *and* ***low*** *velocity* **bipolar** *outflow.*

The jet >> the counter jet


Velocity of fragments
3C 345 λ=7 mm
ρ
мсек
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
II a'
II a
II b
II c
III a
III b
III c
III c'
IV'
IV
V
CJ
V_vis ~ 8c
V_vis ≤ 0.06c
1998
1999
2000
2001
yr

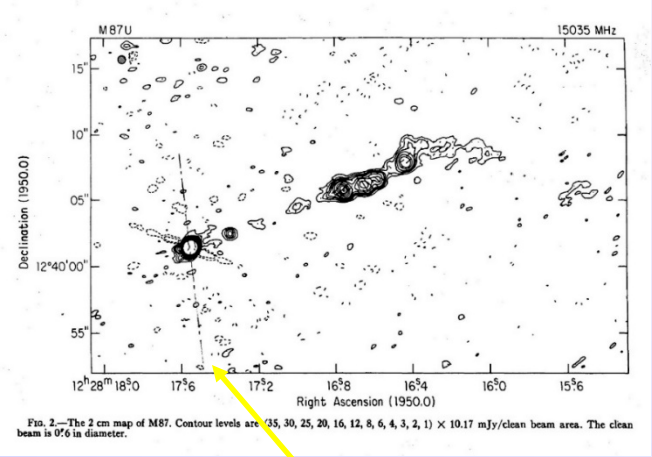


3C 345, λ=7 mm.

The brightness of bipolar outflow

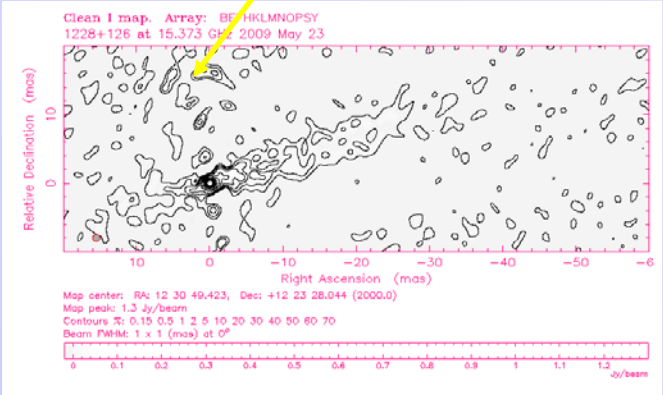
$T_{bpeak} \approx 50 \cdot 10^{12}$ K, λ=2 cm

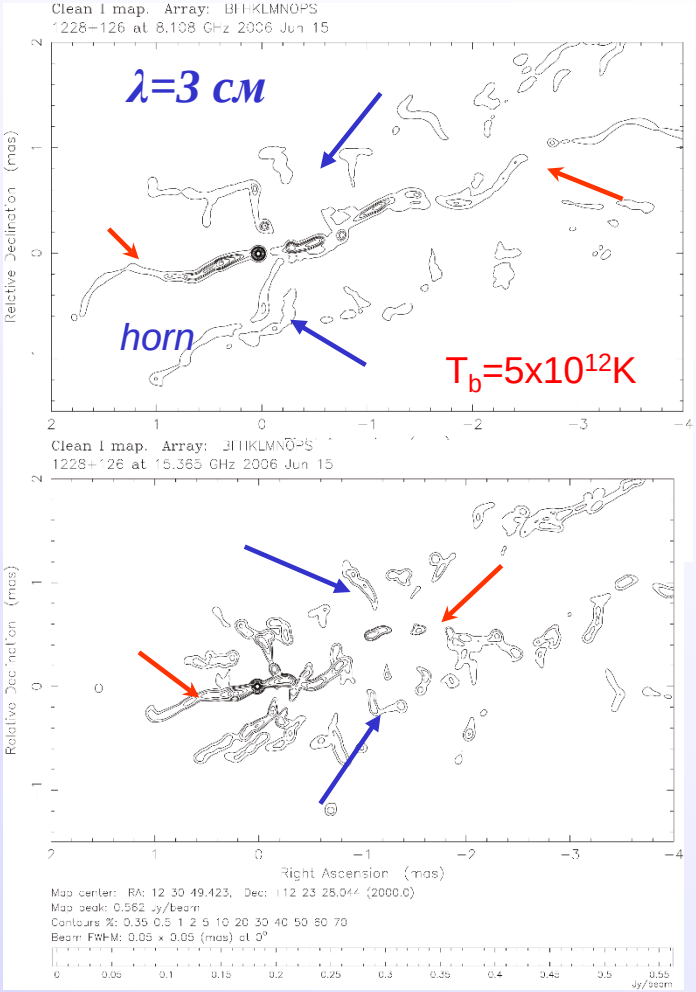
M 87 – radio galaxy, *0.078 pc/mas*



nozzles

λ=2 см

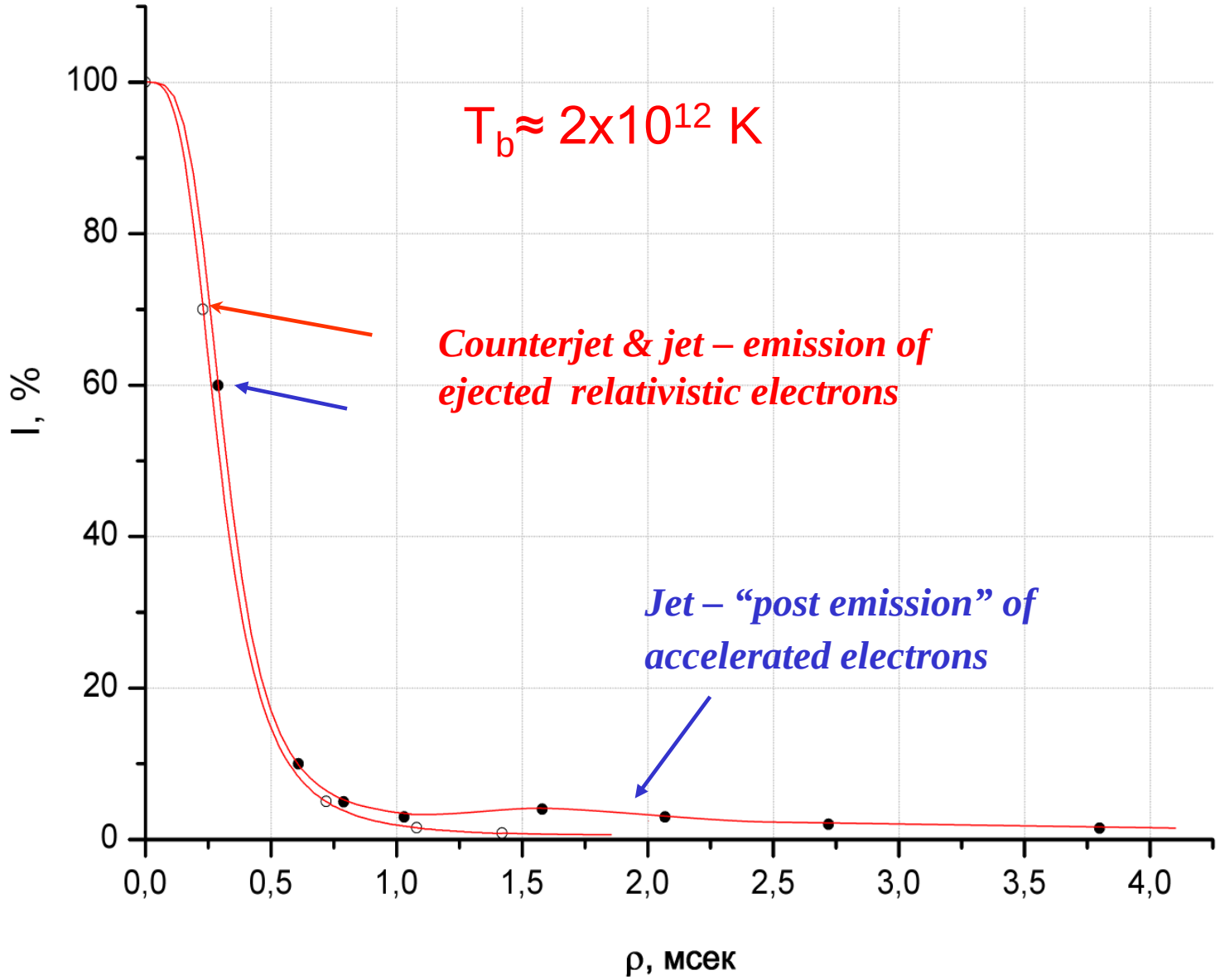


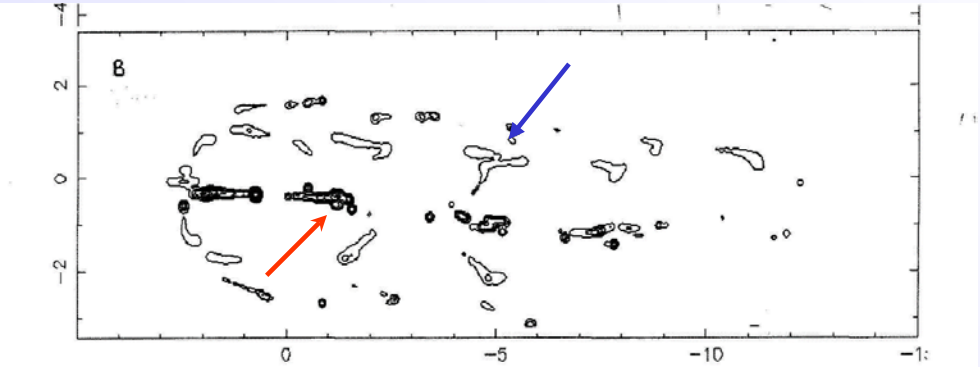


Bipolar outflow

High & Low velocity bipolar outflows. **Horn – decreasing *ϕ* of nozzle**

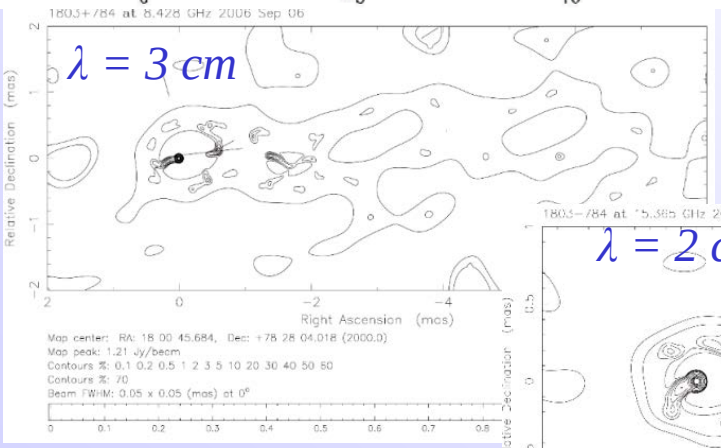
M 87 brightness of bipolar outflow, λ=2 cm

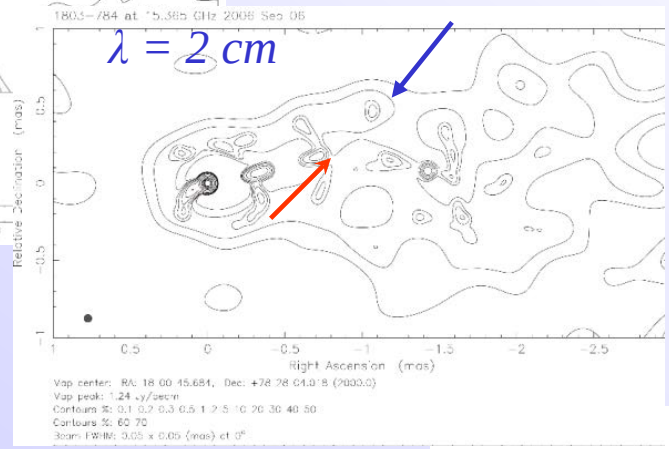


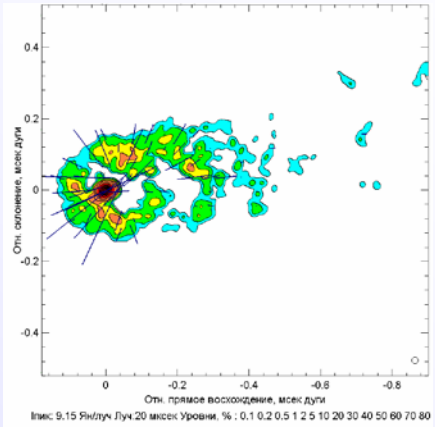


1803+784

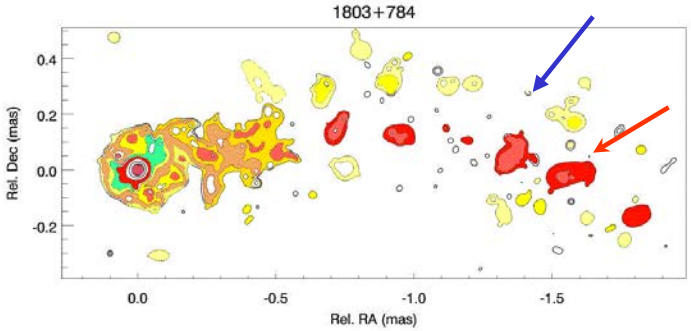
7 pc/mas







λ = 7 mm



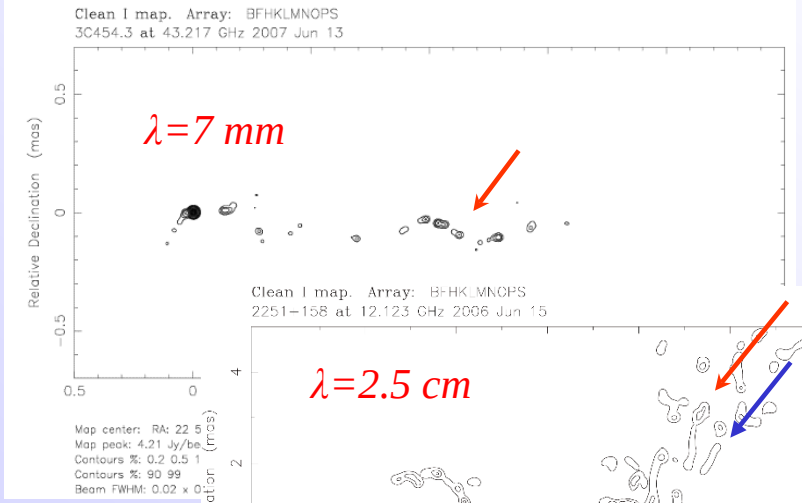
***High* & low velocity bipolar outflow**

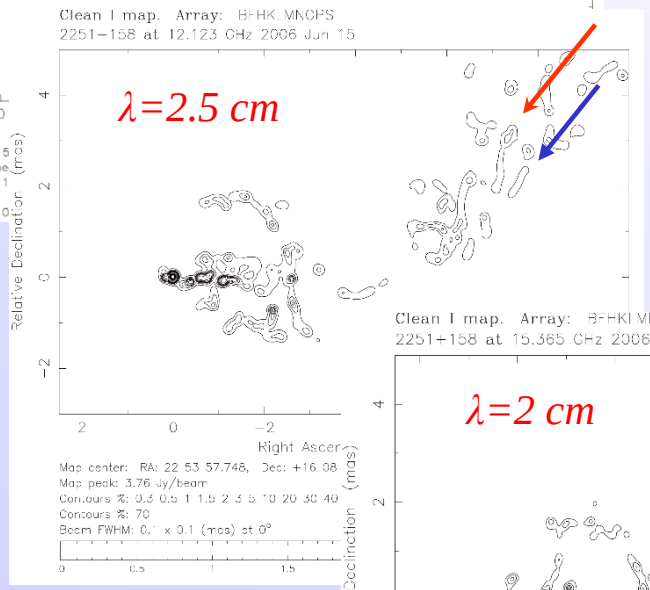
$T_b \approx 20 \times 10^{12}$ K, λ=7 mm (0.02); 18 cm (0.1 mas)

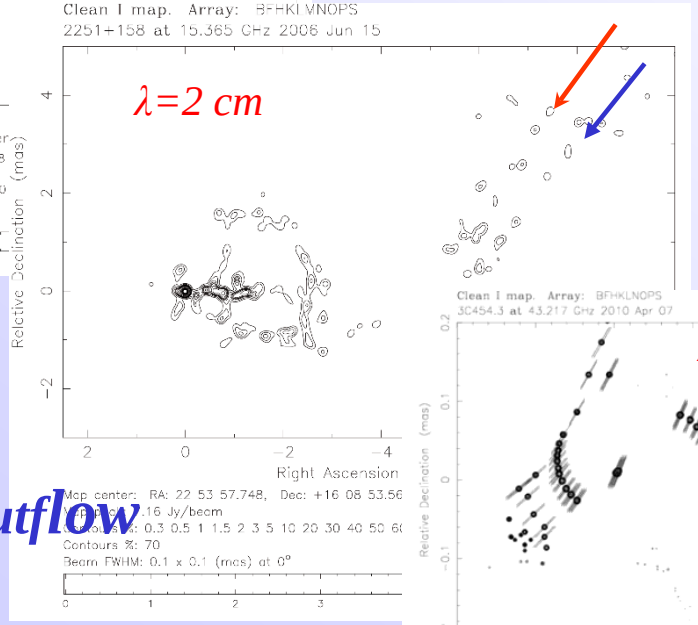
$Ø_{nozzl}$ = *0.2=>20 pc*

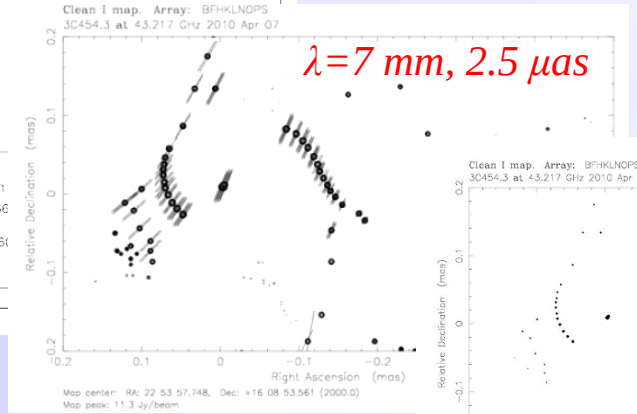
3C 454.3

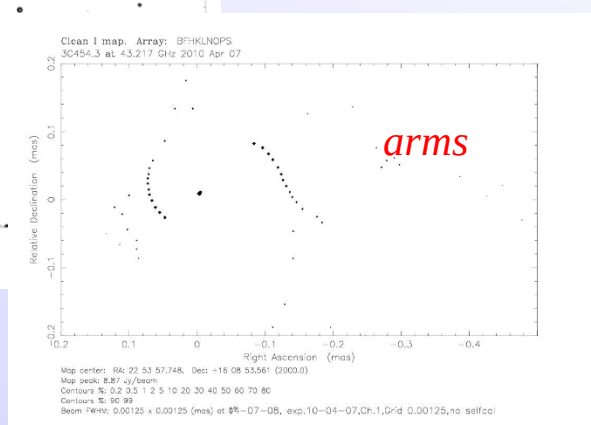
7.7 pc/mas











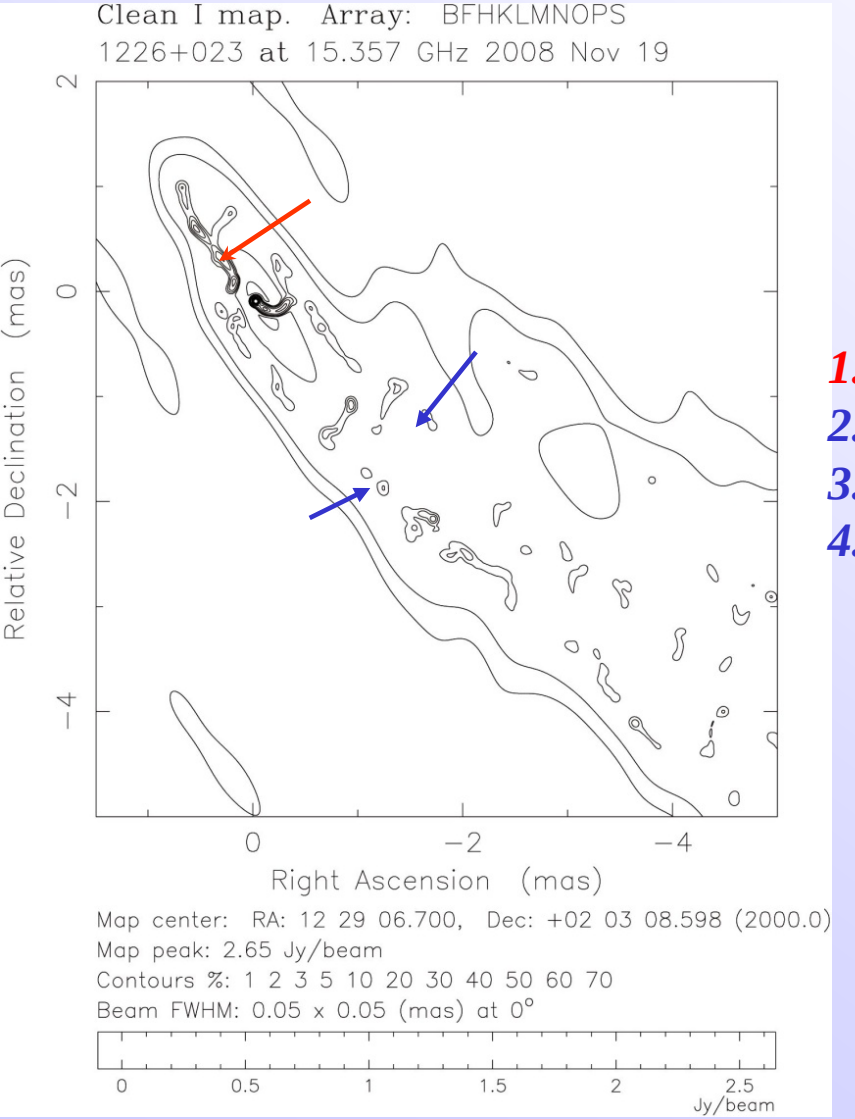
Disk

High & low velocity outflow

$T_b \geq 50 \times 10^{12}$ K

λ=7 mm φ=0.010 mas

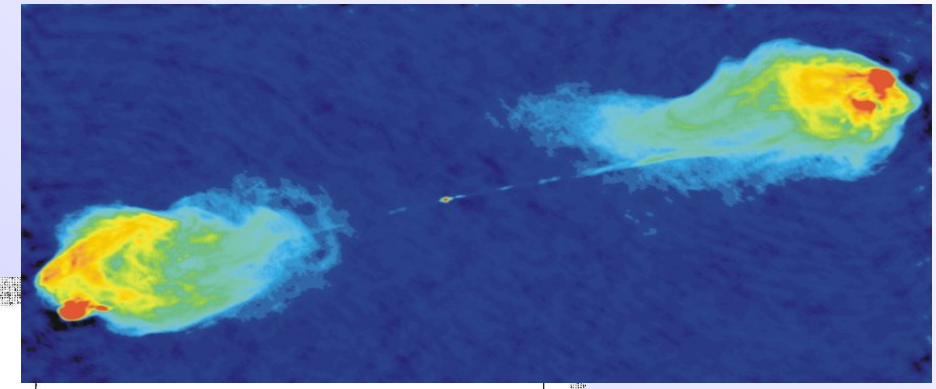
3C 273 *2.7 pc/mas* *λ=2 cm*

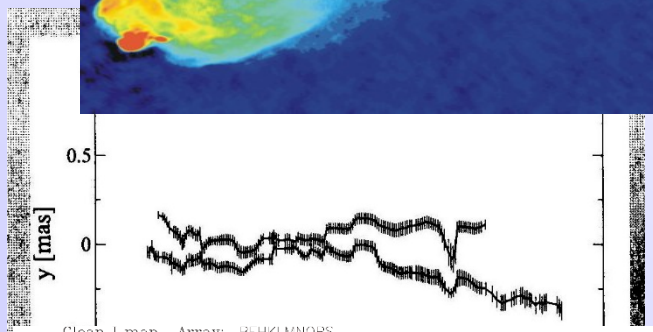


Bipolar outflow

1. ***The high velocity jet & counterjet ≤ 3 pc.***
2. ***The low velocity jet – chains of components***
3. ***The nozzle brightness $T_b = 40 \cdot 10^{12}$K, φ=20 μas.***
4. ***The jet velocity v < 0.03c.***

Cyg A, 1 pc/mas

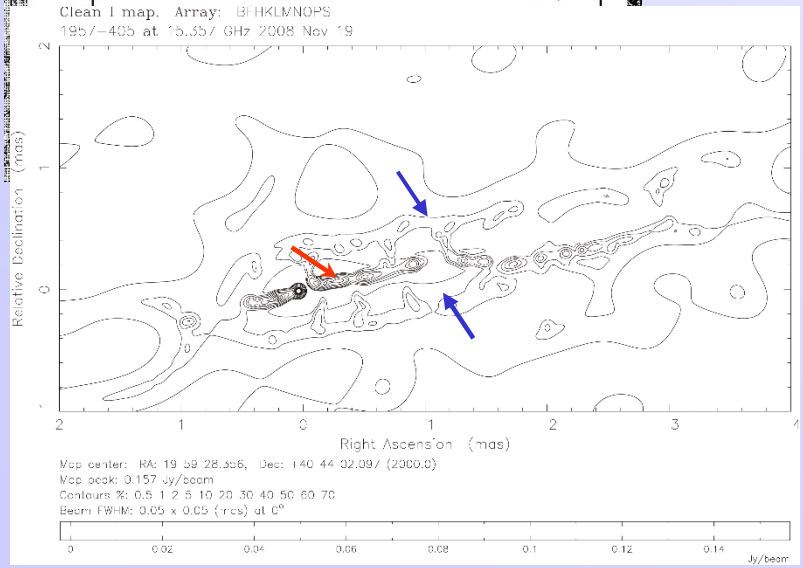




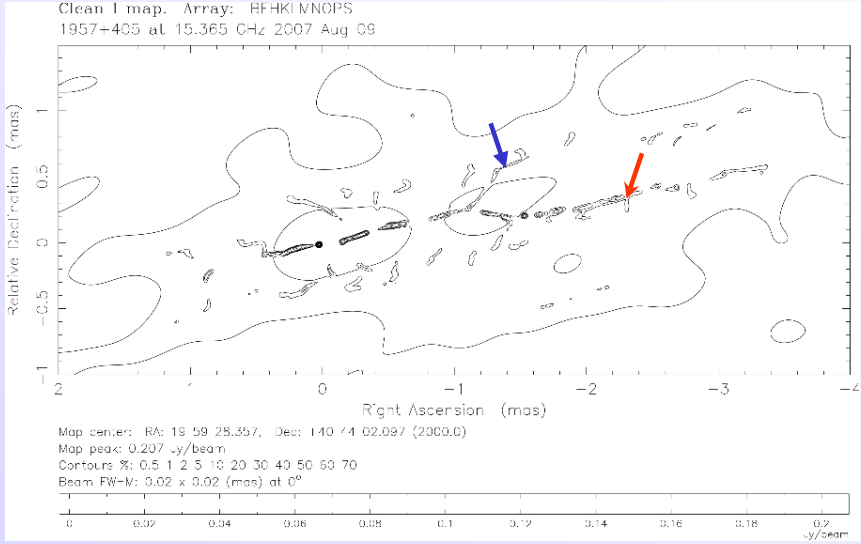
B. Boccardi,
T. Krichbaum…7 mm.

Bipolar outflow
High & low velocity

$T_b \approx 4x10^{12}$ K

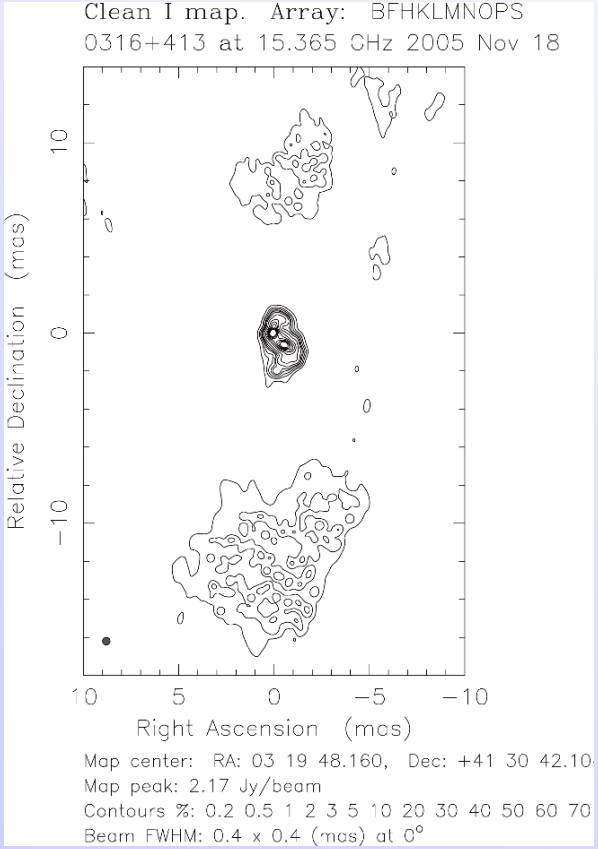


λ=2 cm



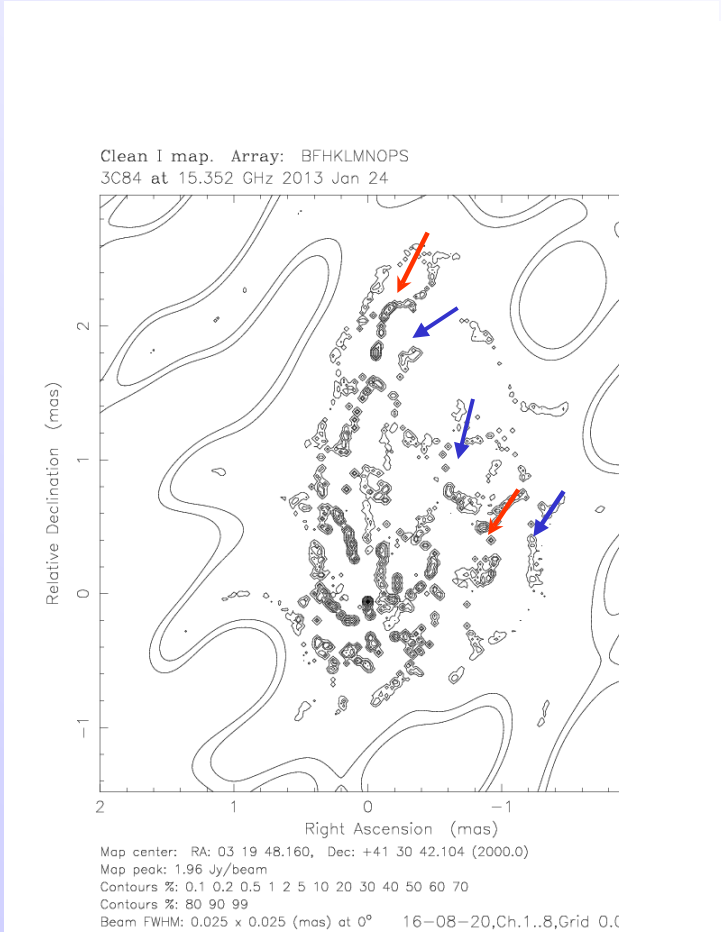
3C 84 *0.35 pc/mas*

Double system $\Delta V \approx 600$ km/s, $T \approx 5 \cdot 10^3$ yr

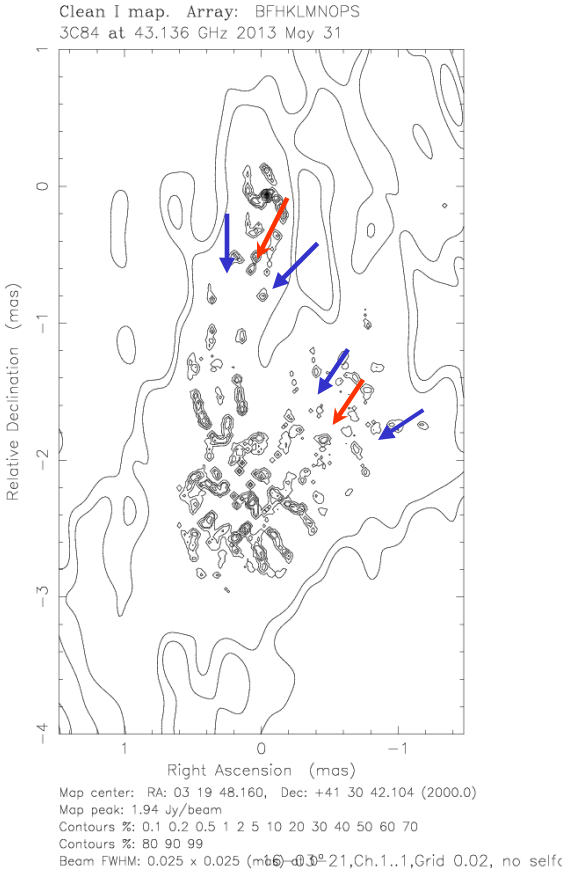


$T_b \approx 50 \times 10^{12}$ K

λ=2 cm



λ=7 mm



Parameters of AGN

Sources	T_b , 10^{12} K	∅o , pc	∅ $_{1/2/3}$ pc	V c.	L_{jet} - L_{cjet}	L_{jet}/L_{cjet}	D, Mpc	pc/mas
3C84	50//λ=2cm	0.007	0.3/0.8/1.4	-	1.1/0.3	3.5	75	0.35
3C273	45/2	0.05	2.2/6	0.06	16/3.2	5	735	2.7
M87	10/6	0.004	0.07/0.12/0.8	0.02	0.24/.01	2.4	16.75	0.078
3C454.3	150/0.7	0.003	14/40	-	20/8 -	3	5489	7.7
3C345	50/2	≤0.07	1.3/2.1	0.05	5.6/0.8	7	3473	6.63
Cyg A	4/ λ=2cm	≤0.02	0.65/1.6	-	3.5/0.8	4.3	247	1.07
1803+784	20/0.7	0.06	1.4/2.5/5	-	3.5/13-	4	4107	7.06
medium	4 -150	0.01 – 0.05	≤ 5	<0/05	-	5	-	-

Conclusion

- **AGN – *whirlwind – space tornado.***
- ***Electro conducting medium.***
- **Rotate flowers – *generation current/magnetic field***
- **Magnetic fields – *extra acceleration and collimation.***
- **Ring currents - *jet solenoids, "disk" dipole.***
- **The jet & counterjet - moving *along & opposite* of the *magnetic field of system – acceleration and deceleration.***
- **The nozzle - ejector of the relativistic *electrons* $T_b >> 10^{12}$ K.**

- ***Dedicate to 55yr VLBI & 22yr VLBA***

THANKS

Trajectory of the Zond – Venus atmosphere.

Distance $100 \cdot 10^6$ km. λ=18 cm. Accuracy 100 m (0.2 mas).

Fringe size φ=5 mas (B=8×10^3 km)