(Past,) new, and future observations of 4C31.04 and other CSOs

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Outline

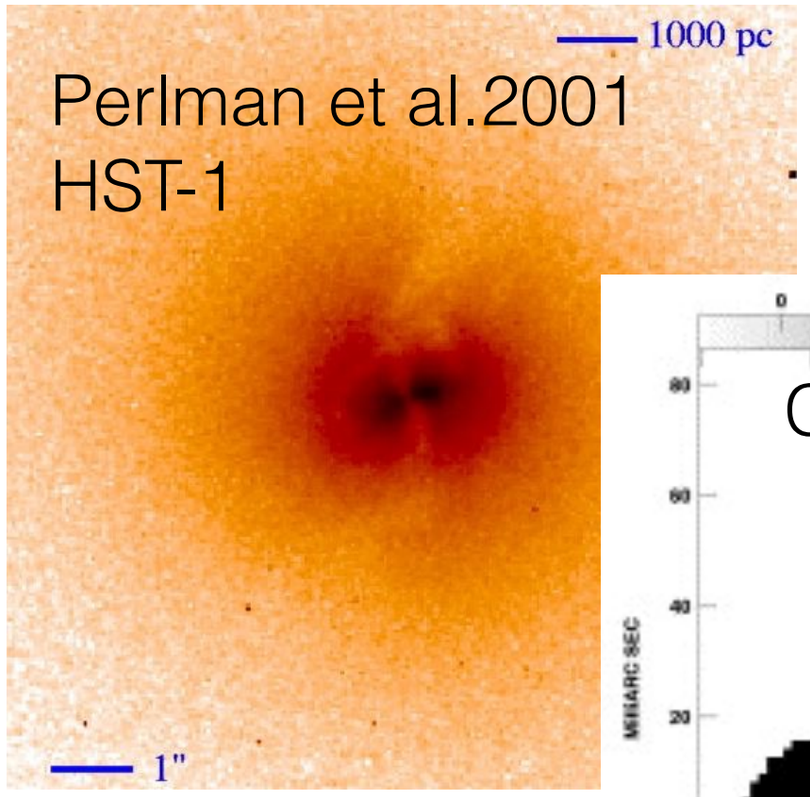
- Why 4C31.04
- Published results
- Other observations & updated results
- Future prospects on 4C31.04 and other CSOs

Why 4C31.04

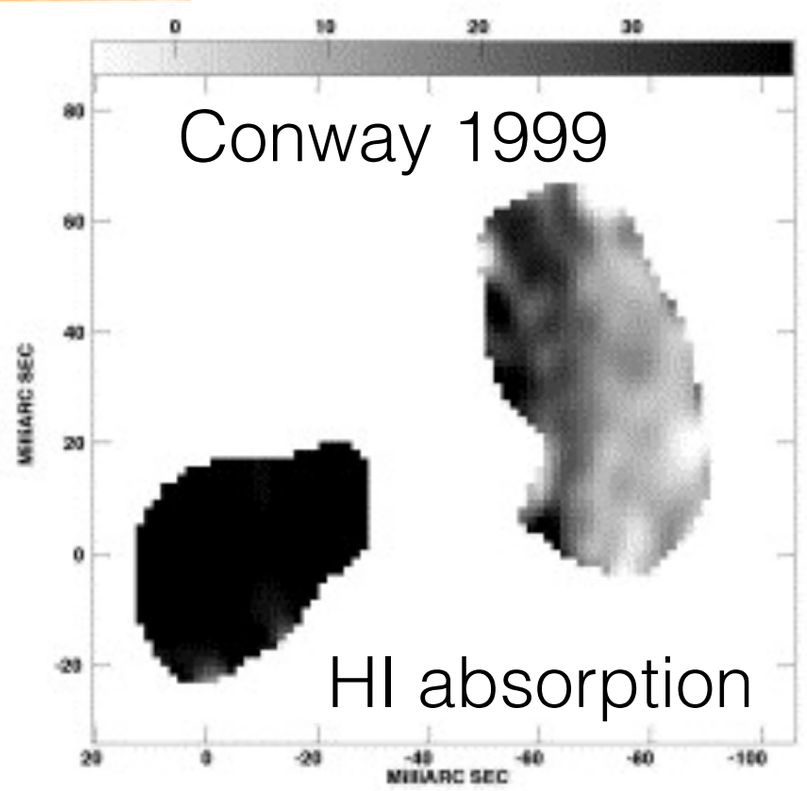
- It’s near!
- Well defined hot-spots
- Well defined core
- “Easy” to get proper motion, dynamic age
- Plenty of extended emission
- “Easy” to get spectral age
- Relatively low power: not a peculiar “monster”
- Gamma-ray detection? (closer but low luminosity)

Background

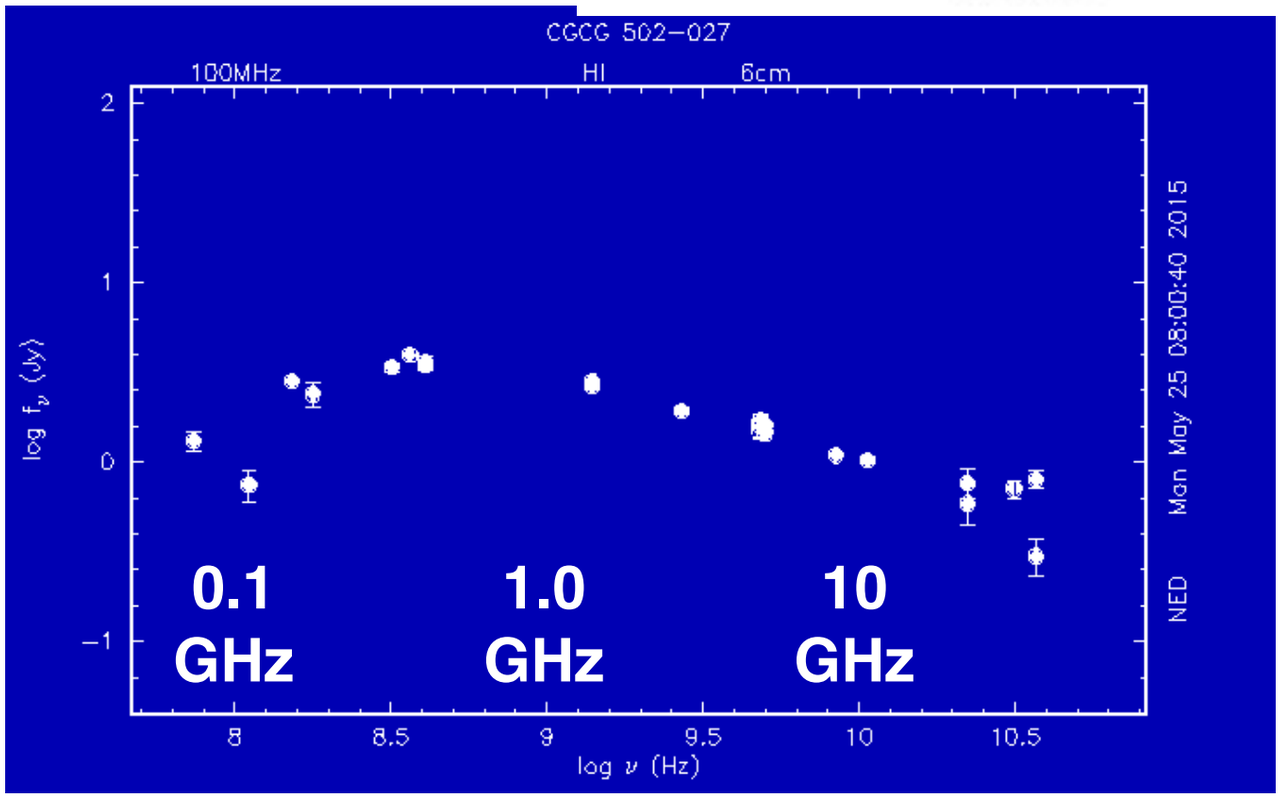
- z=0.06 (1mas/yr~4c)
- $S_{1.4}$=2.5 Jy
- $P_{1.4}$~10^{25} W Hz^{-1}
- $\alpha_{0.4\text{-}86}$=0.6
- VLBA observations in 1995 and 2000 at 5 GHz



Perlman et al.2001
HST-1

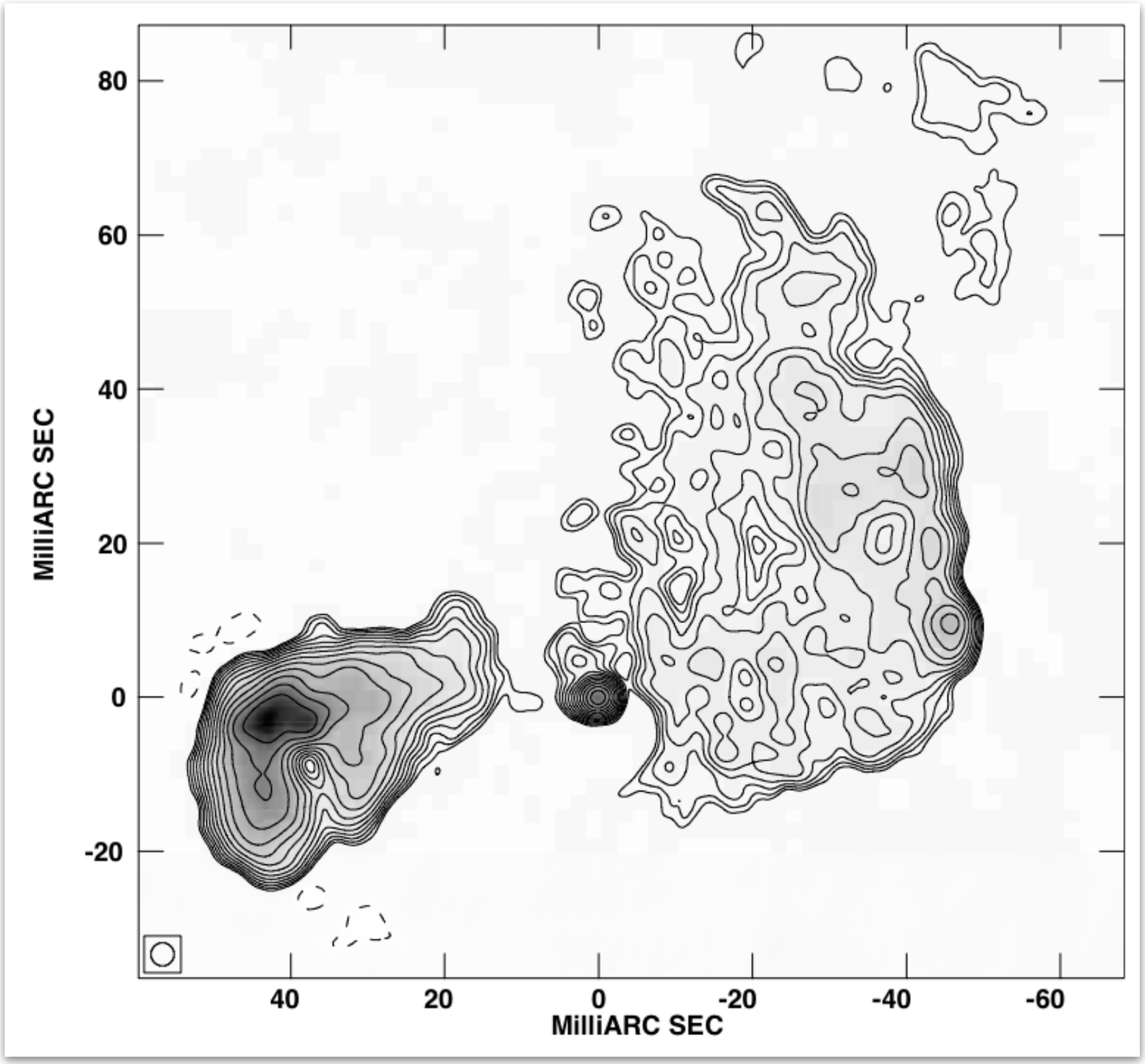


Conway 1999
HI absorption



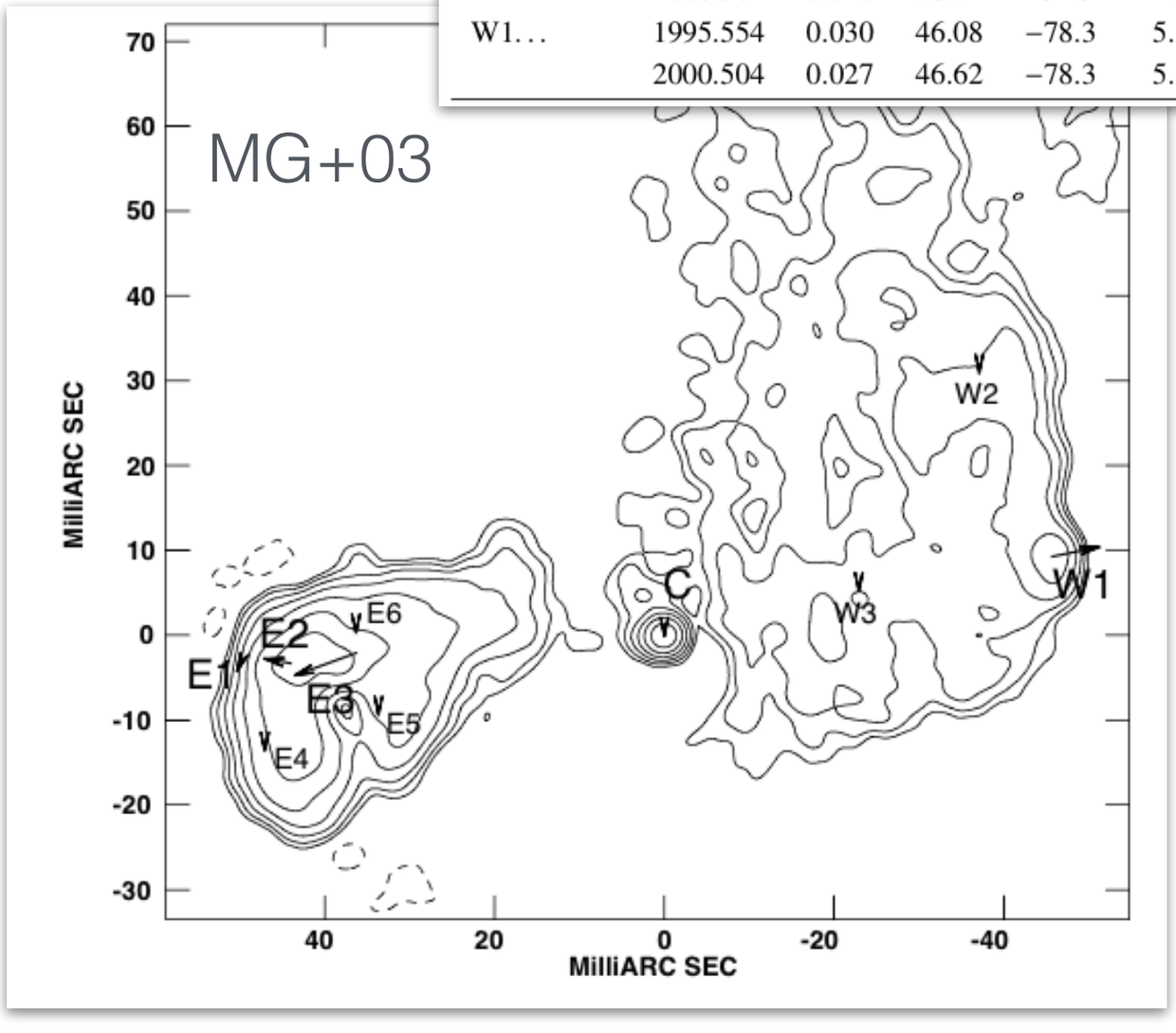
Results - the 2000 image

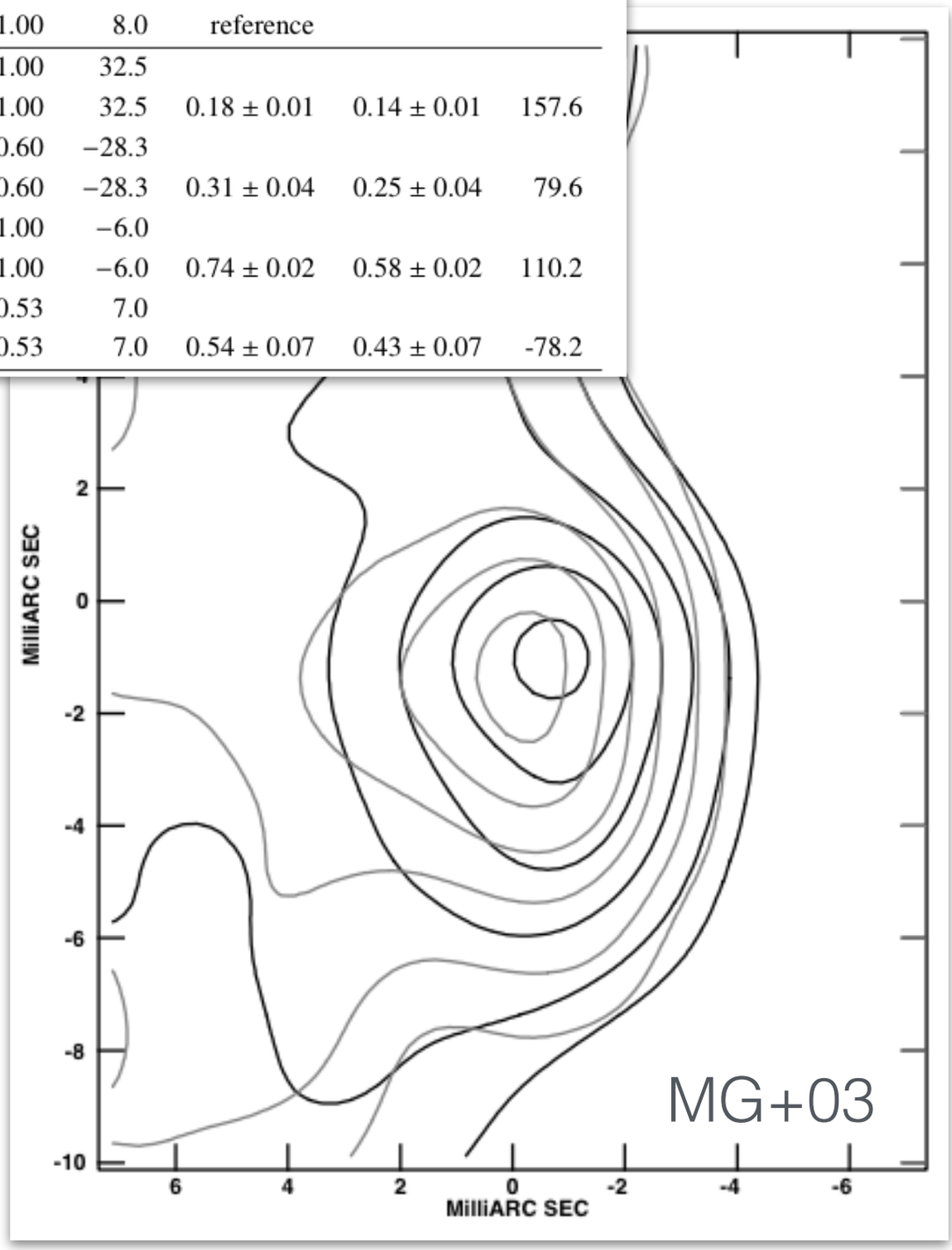
- Giroletti, M.; Giovannini, G.; Taylor, G. B.; Conway, J. E.; Lara, L.; Venturi, T. 2003 A&A (MG+03)



1995-2000 comparison

Component	Epoch	S (Jy)	r (mas)	θ (°)	a (mas)	b/a	Φ (°)	Δr (mas)	v (h_{65}^{-1} c)	PA (°)
C...	1995.554	0.020	0.0	0.0	0.81	1.00	8.0			
	2000.504	0.024	0.0	0.0	0.81	1.00	8.0	reference		
E1...	1995.554	0.013	46.74	93.7	1.60	1.00	32.5			
	2000.504	0.013	46.82	93.9	1.60	1.00	32.5	0.18 ± 0.01	0.14 ± 0.01	157.6
E2...	1995.554	0.137	42.52	93.6	7.20	0.60	−28.3			
	2000.504	0.135	42.82	93.5	7.20	0.60	−28.3	0.31 ± 0.04	0.25 ± 0.04	79.6
E3...	1995.554	0.038	37.30	94.6	2.95	1.00	−6.0			
	2000.504	0.040	38.01	94.9	2.95	1.00	−6.0	0.74 ± 0.02	0.58 ± 0.02	110.2
W1...	1995.554	0.030	46.08	−78.3	5.54	0.53	7.0			
	2000.504	0.027	46.62	−78.3	5.54	0.53	7.0	0.54 ± 0.07	0.43 ± 0.07	-78.2

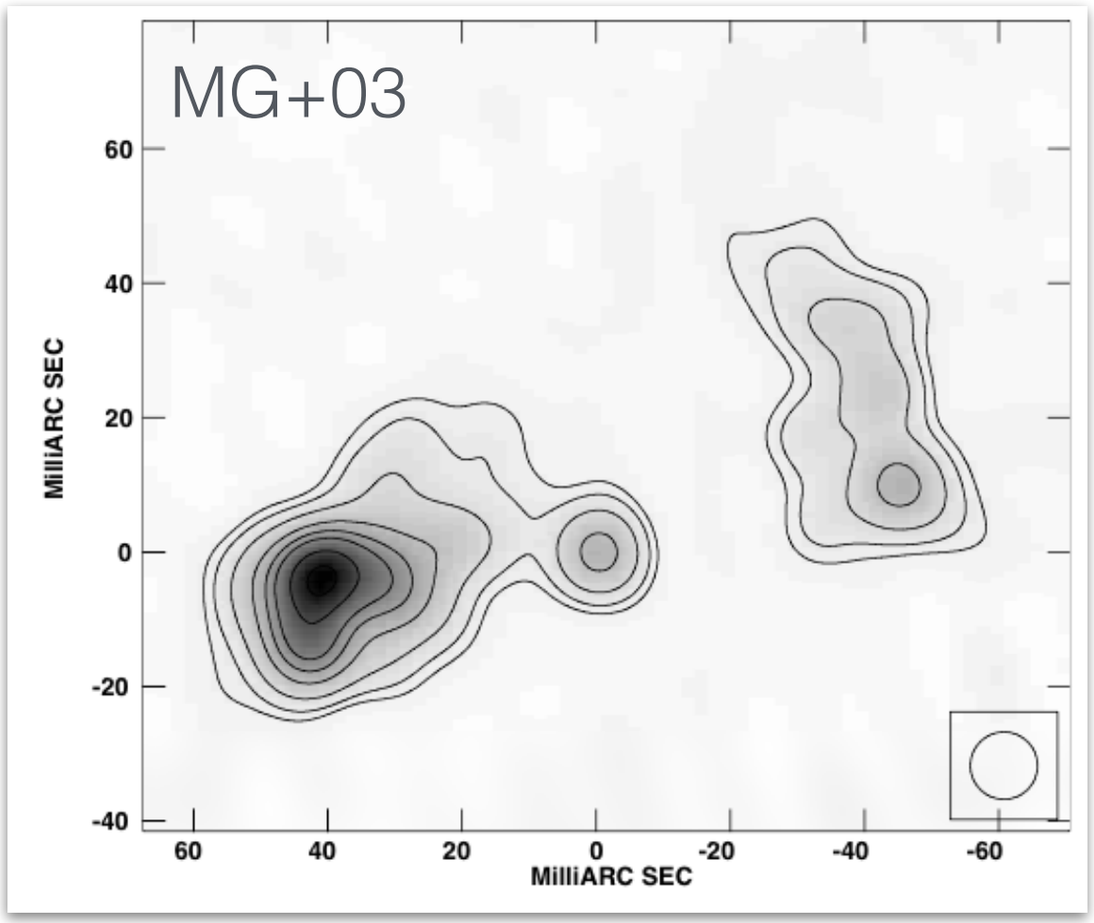


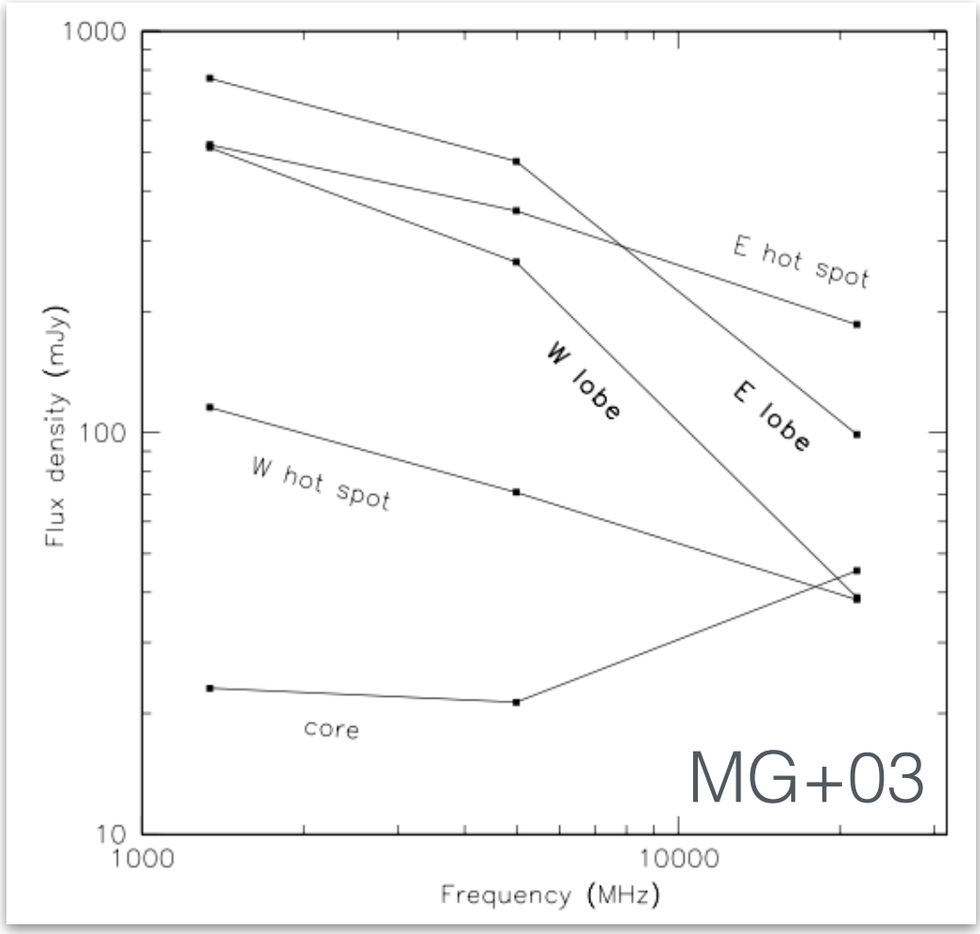


kinematic age

- average motion of (0.42 ± 0.08) mas in 5 years, or (0.085 ± 0.016) mas/yr, or (0.33 ± 0.06) h^{-1} c
- kinematic age 548 ± 100, or ~550 years
- faster jet feature in the eastern jet
- real age probably larger (lobe emission)

spectral age





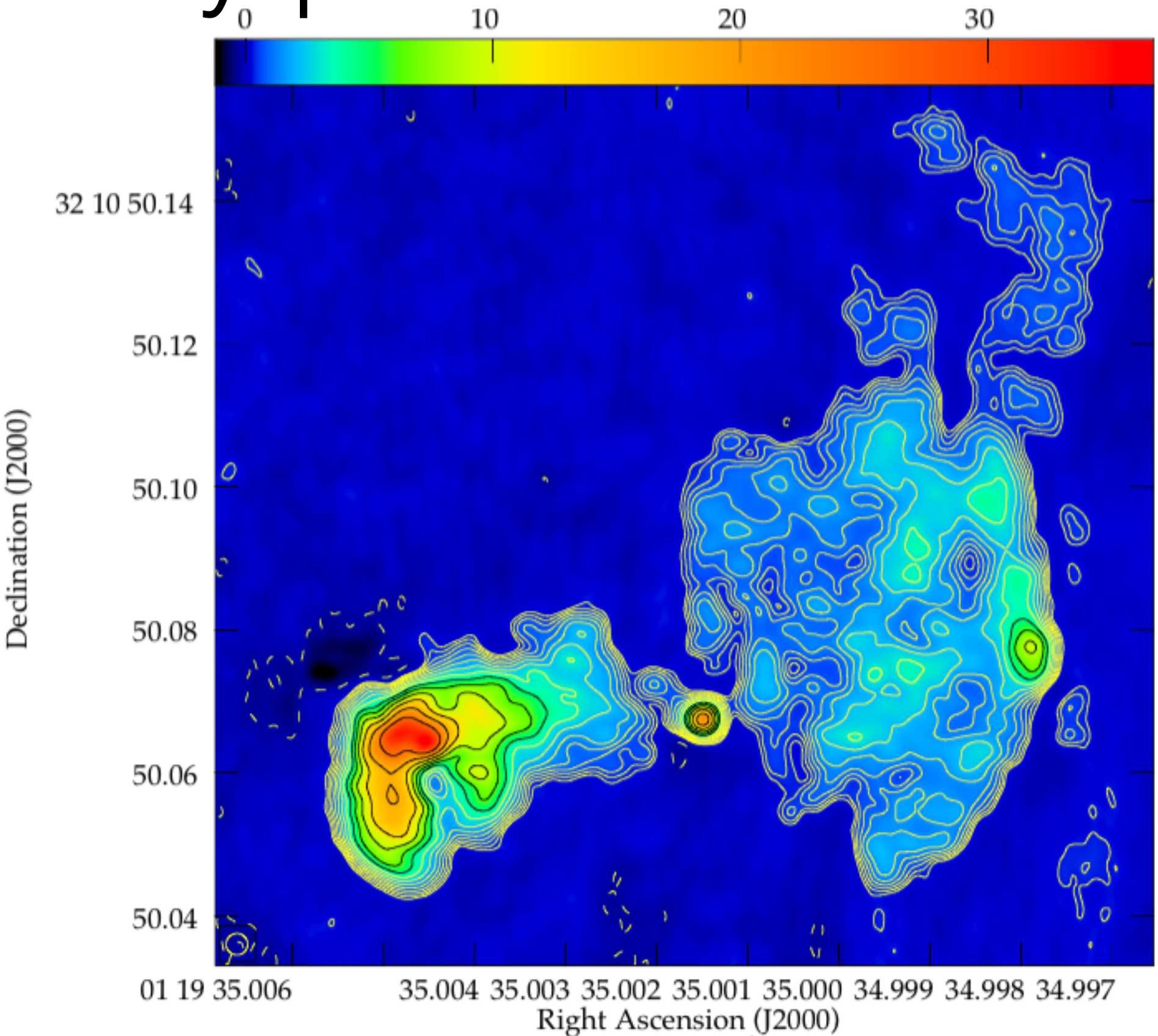
- availability of 1.3 GHz VLBA and 22 GHz MERLIN data
- inverted core, ~flat hot spots, steep and broken lobes
- equipartition magnetic field ~3-4mG ~2-3mG in E and W lobe
- estimated radiative age 3000-5000 yrs

open issues

- two-epoch, 5-yr time baseline: loose constraint on kinematic age
- core, hot-spot spectrum and variability
- more epochs, more frequencies in later years
  - 2005, 5 and 15 GHz VLBA+Y
  - 2008, 5 and 14 GHz VLBA

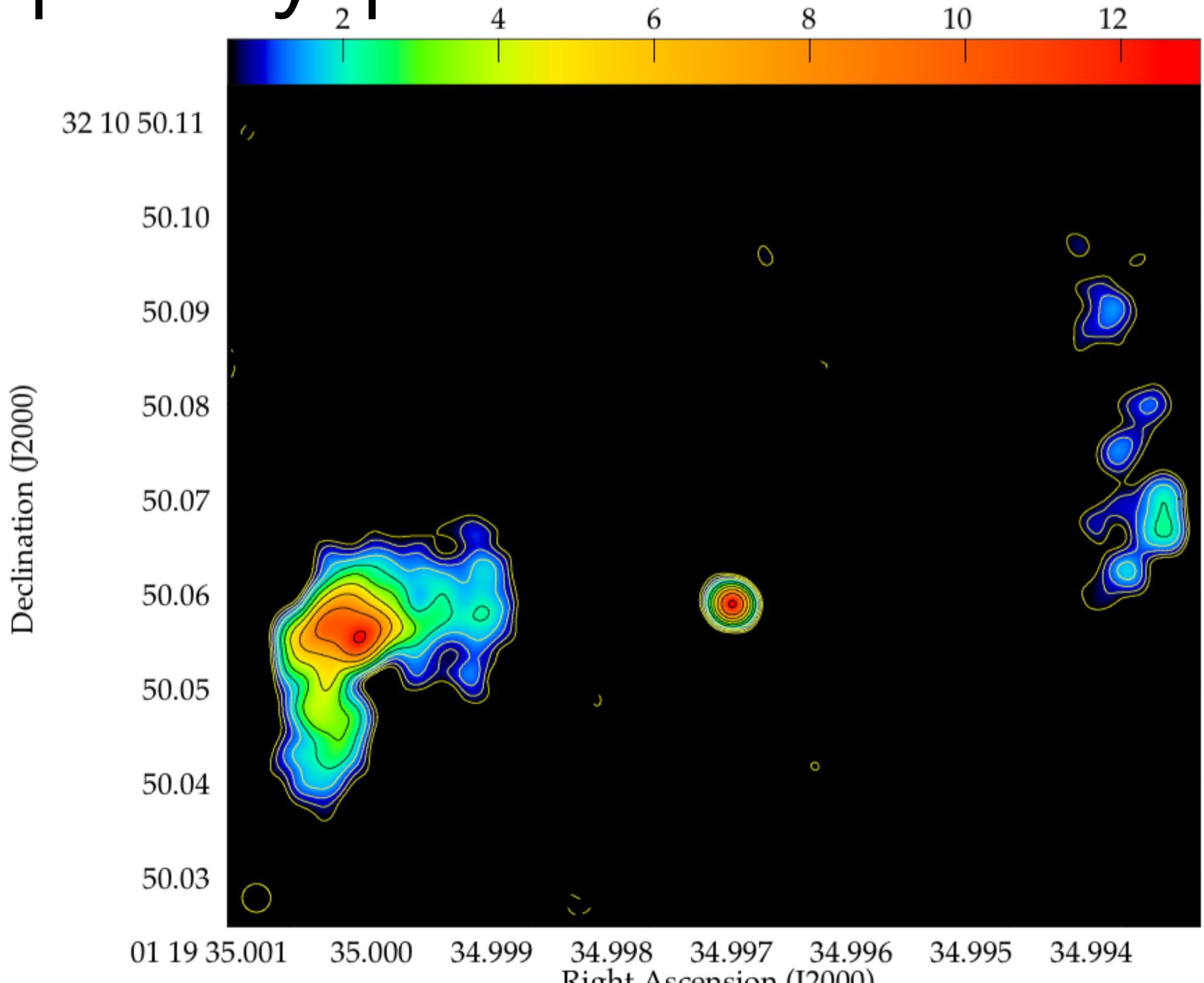
more pretty pictures…

- VLBA+Y1
- 5 GHz
- 2005 Jul



more pretty pictures…

- VLBA
- 14GHz
- 2008 Feb



but not really pretty results

- largest motion is for western hotspot, but towards north

- eastern jet is also moving, but only in inner part

- no convincing overall advance motion revealed: previous kinematic age estimate probably is a lower limit

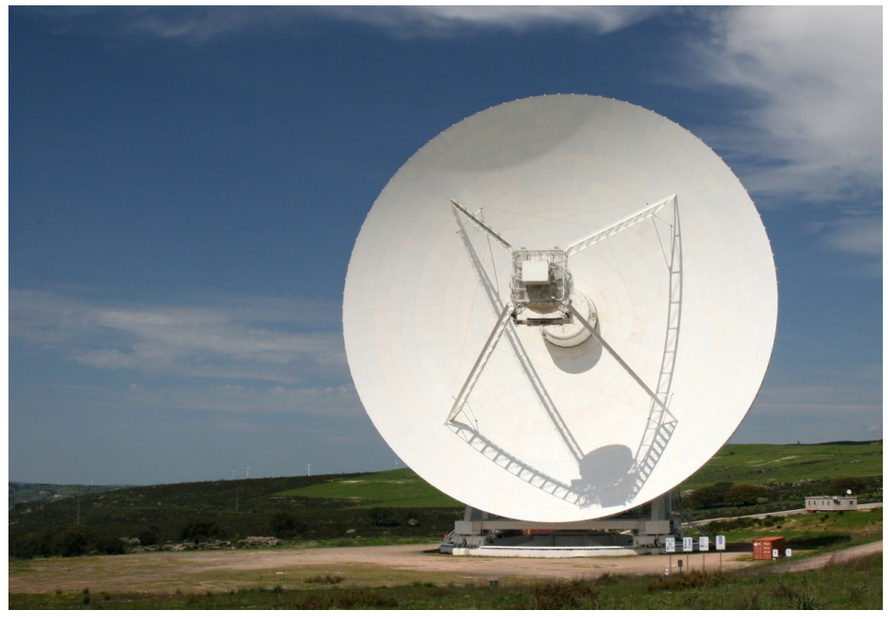
- spectral features confirmed, but lobe mostly resolved out

room for improvement

- no phase referencing: core proper motion issue
- recent datasets, but still only 32MHz total bandwidth
- 8 GHz probably ideal band to probe break frequency in spatially resolved images
- complex source: still possible to play with model fit…

general outlook

- over the last decade
  - bandwidth from 32-64 MHz now up to 256 MHz, with prospects for ~GHz
  - many new and large additions to EVN (Sardinia and Tianma), plus more dishes for (u,v)-coverage
  - brand new multi-frequency KVN, East Asia VLBI



- in the near- mid-term future
  - African VLBI Network… SKA

CSO outlook

- start to look for most compact and youngest radio sources with high frequency VLBI
  - cores and hot spots have flat-flattish spectra
- start to look for faint extended emission and try to estimate spectral age (eg in the 4-8 GHz band)
- will polarisation start to be detectable? or what limits can we put? connection to gas distribution?

Summary

- kinematic/spectral age ~1000-5000 yrs
- complex evolution
- looking forward to future work