Radio flux density monitoring: recent MERLIN results

Andy Biggs
(Joint Institute for VLBI in Europe)

Monitoring in the radio

- Radio monitoring has some advantages over the optical
  - High and consistent resolution
  - No extinction due to dust
  - No microlensing (?)
  - 24 hour per day observing
  - 365 day a year observing
- 1998-2000 were good years for radio time delay determinations
  - PKS 1830-211 (Lovell et al. 1998)
  - JVAS B0218+357 (Biggs et al. 1999)
  - CLASS 1608+656 (Fassnacht et al. 1999)
  - QSO 0957+561 (Haarsma et al. 1999)
  - CLASS 1600+434 (Koopmans et al. 2000)

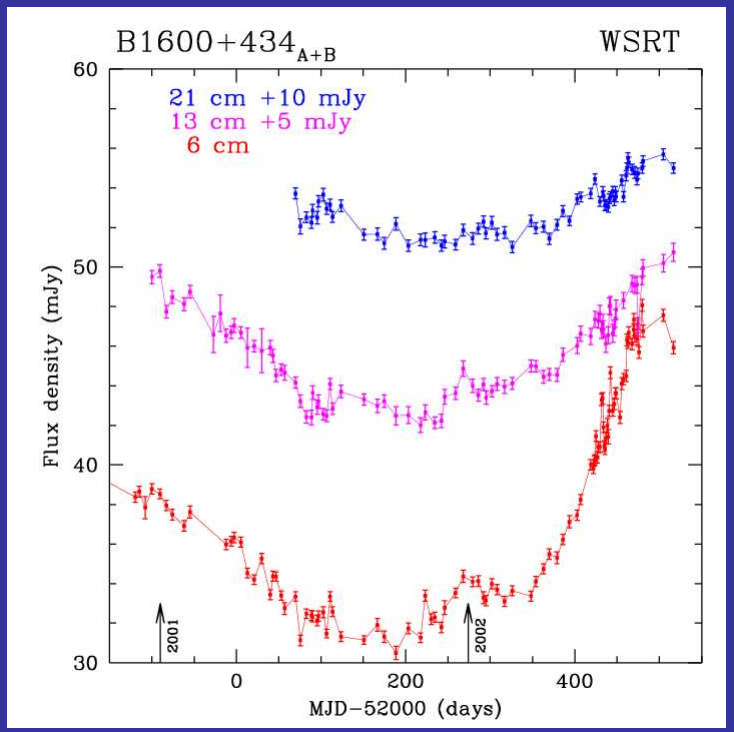
What has happened since 2000?

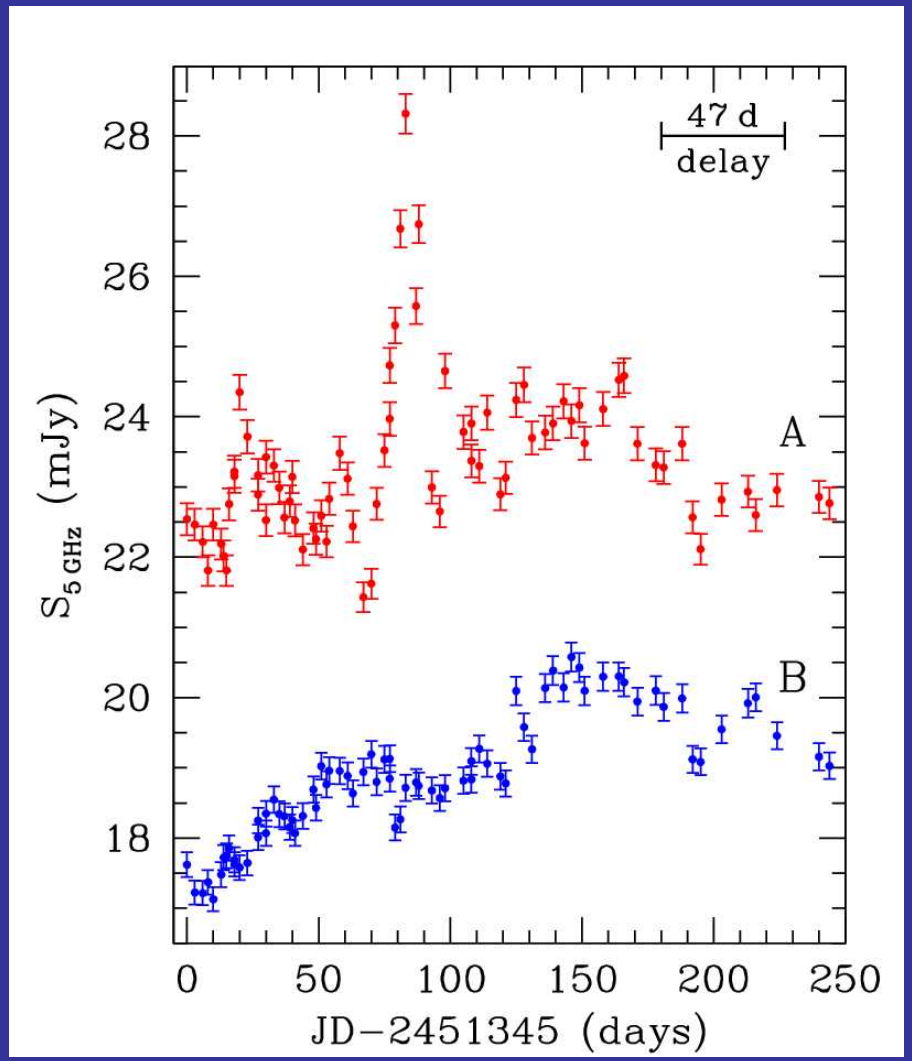
- Only one radio time delay since 2000
  - JVAS 1422+231 (Patnaik & Narasimha 2001)
- Most JVAS/CLASS lenses checked for variability
  - Results have been disappointing (images don't vary)
  - Fassnacht talk
- Southern lenses as well
  - e.g. PMN J1838-3427 (Winn et al. 2004)
- Extrinsic variability detected in CLASS 1600+434
  - Koopmans & de Bruyn 2000
  - Microlensing or scintillation or both?
- Largest systematic search has been MERLIN "Key Project"

Extrinsic variability in 1600+434

Right: VLA monitoring revealed uncorrelated variability in A and B – probably microlensing

Below: total flux has been monitored with the WSRT at 6, 13 and 21 cm



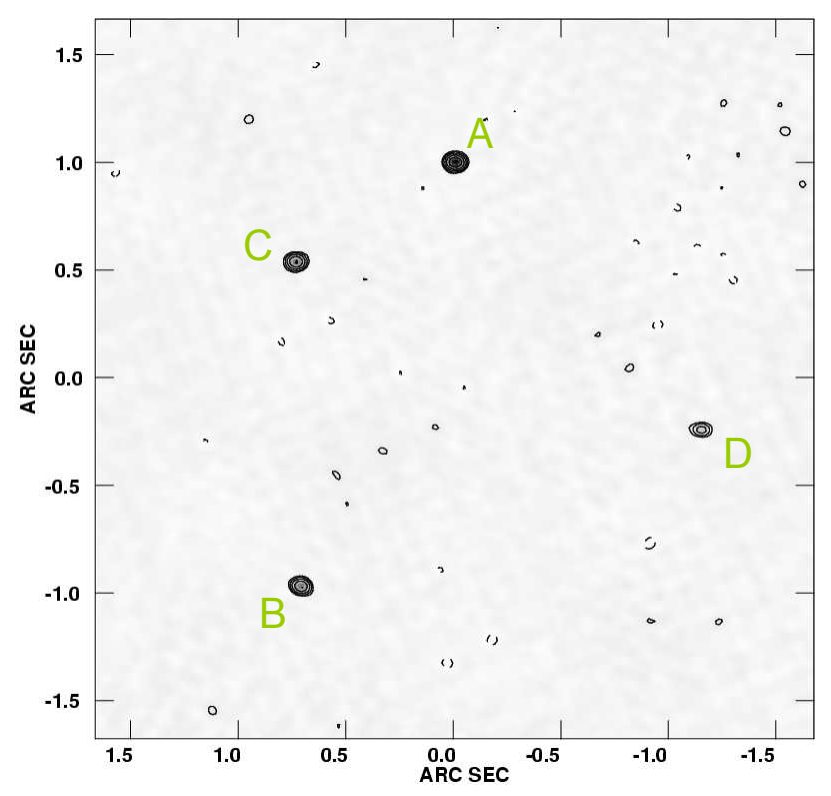


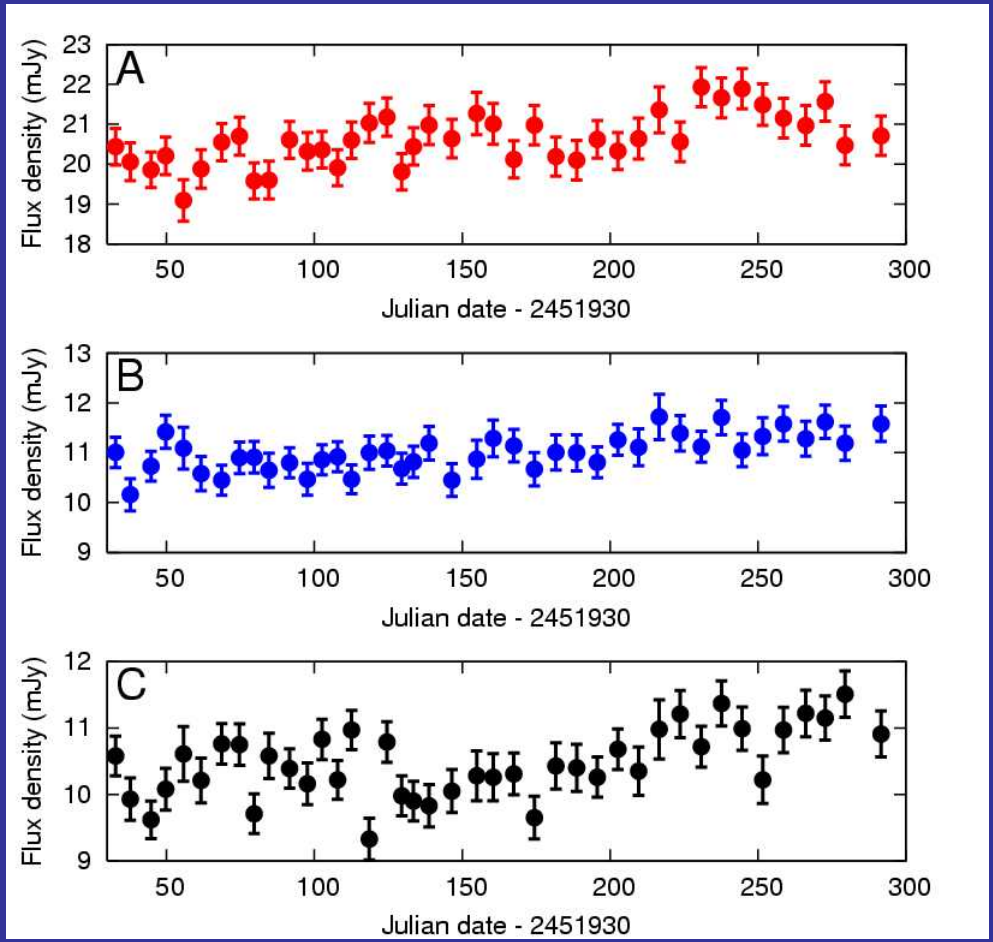
Work by L. Koopmans & G. de Bruyn

MERLIN “Key Project”

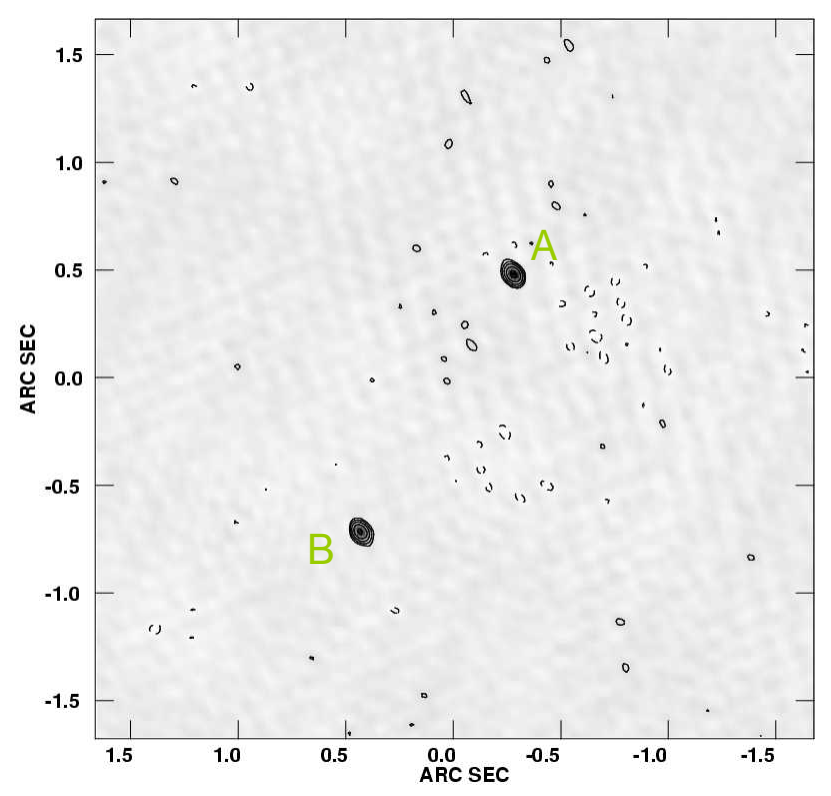
- Monitored 8 JVAS/CLASS lens systems at 5 GHz
  - 0128+437
  - 0712+472
  - 1359+154
  - 1422+231
  - 1555+375
  - 1600+434
  - 1608+656
  - 2045+265
- February – November of 2001 (41 epochs)
- Main goal of project was to detect microlensing
- Results are preliminary
  - More work needed to better quantify flux density uncertainties
  - Assume 2% accuracy for the present
  - Flux ratios should be more reliable (Koopmans et al., 2003)

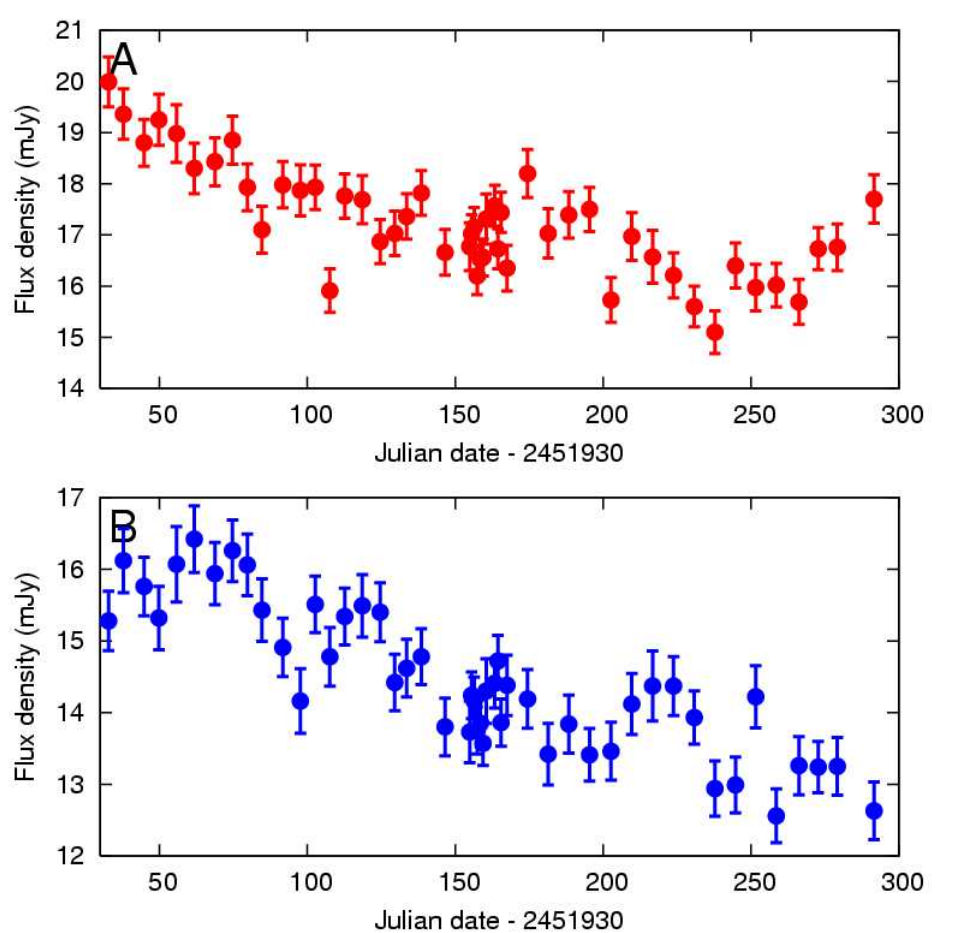
1608+656


A
B
C
D
ARC SEC
ARC SEC
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5

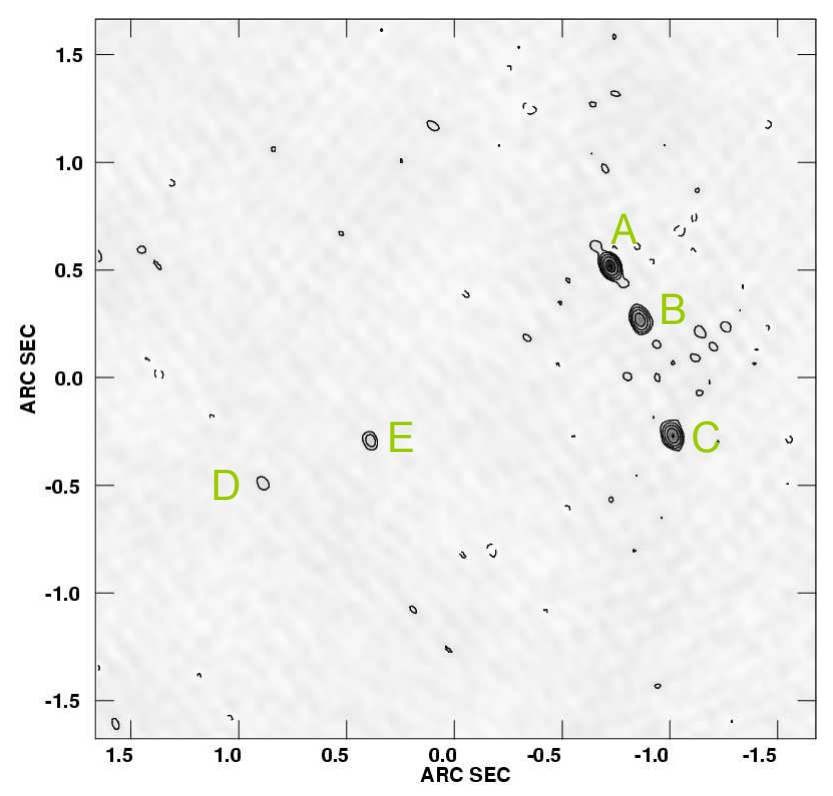

A
B
C
Flux density (mJy)
Julian date - 2451930
50
100
150
200
250
300

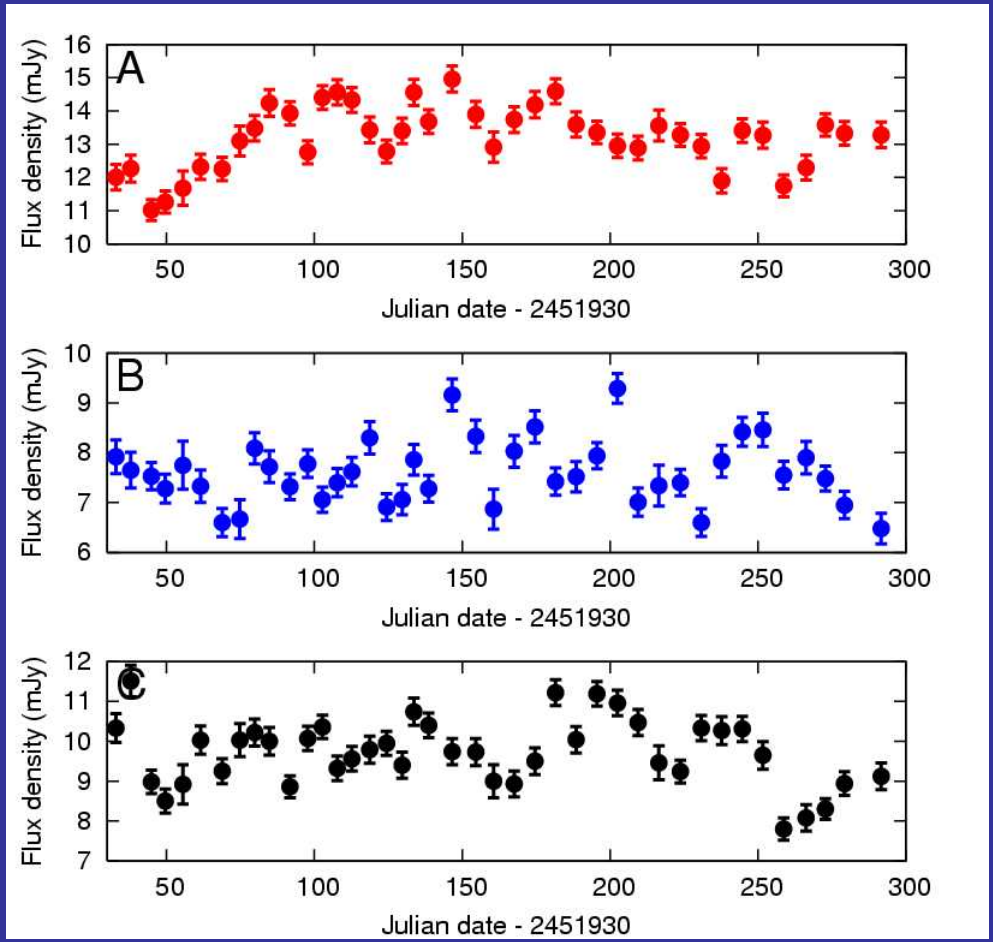
1600+434


A
B
ARC SEC
ARC SEC
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5

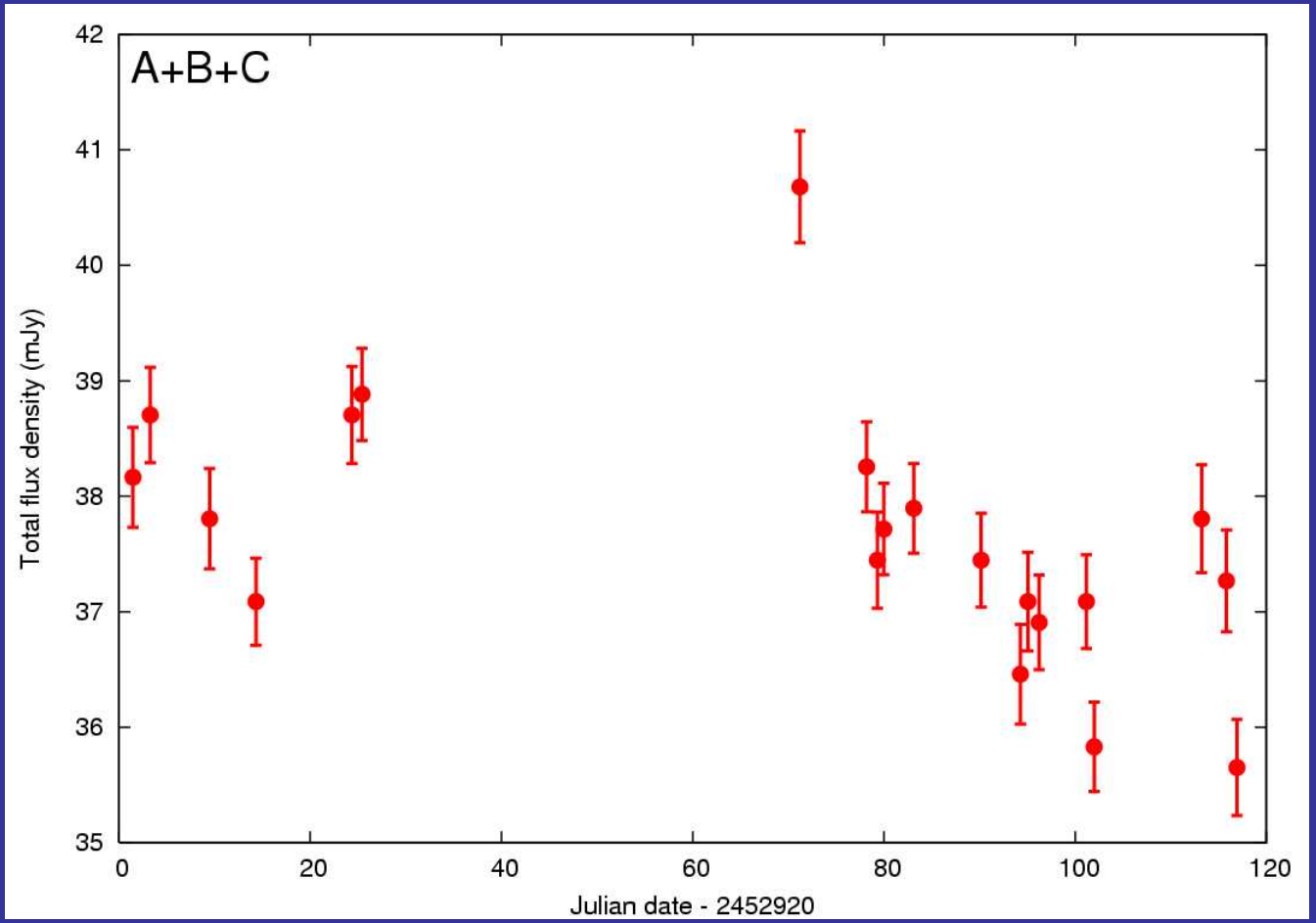

A
B
Flux density (mJy)
Julian date - 2451930
21
20
19
18
17
16
15
14
13
12
50
100
150
200
250
300

2045+265


A
B
C
D
E
ARC SEC
ARC SEC
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5


A
B
C
Flux density (mJy)
Julian date - 2451930
50
100
150
200
250
300

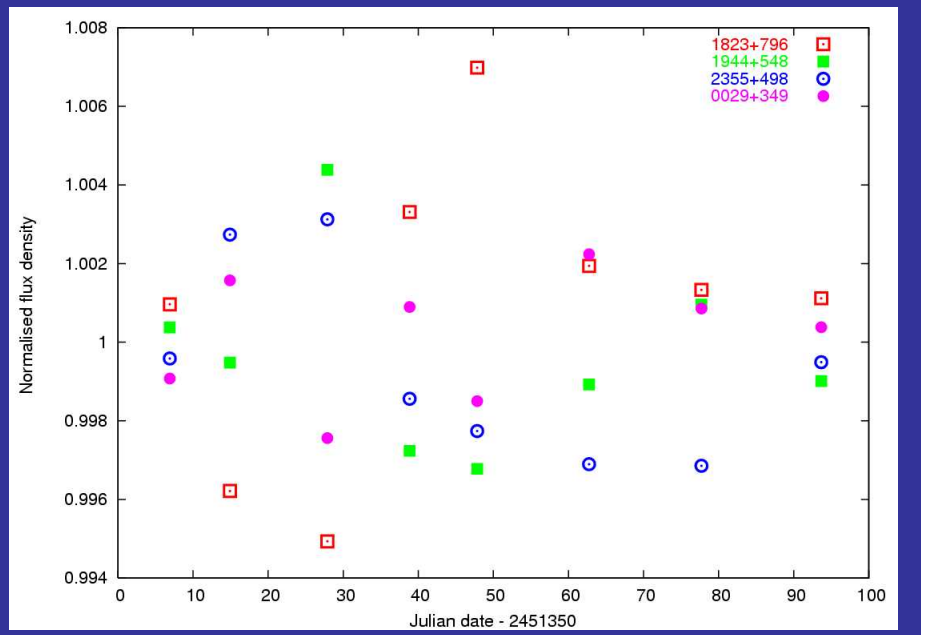
WSRT follow-up of 2045+265 (5 GHz)



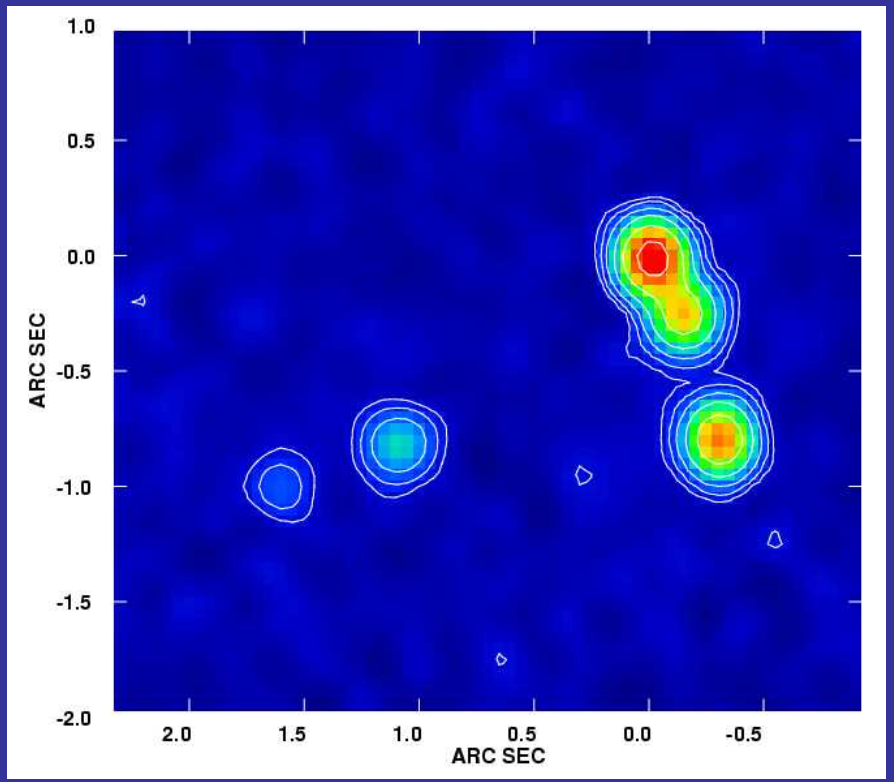
Error bars = thermal noise combined with 1% of flux density

VLA archival data of 2045+265 (8.4 GHz)

Flux calibrator stability

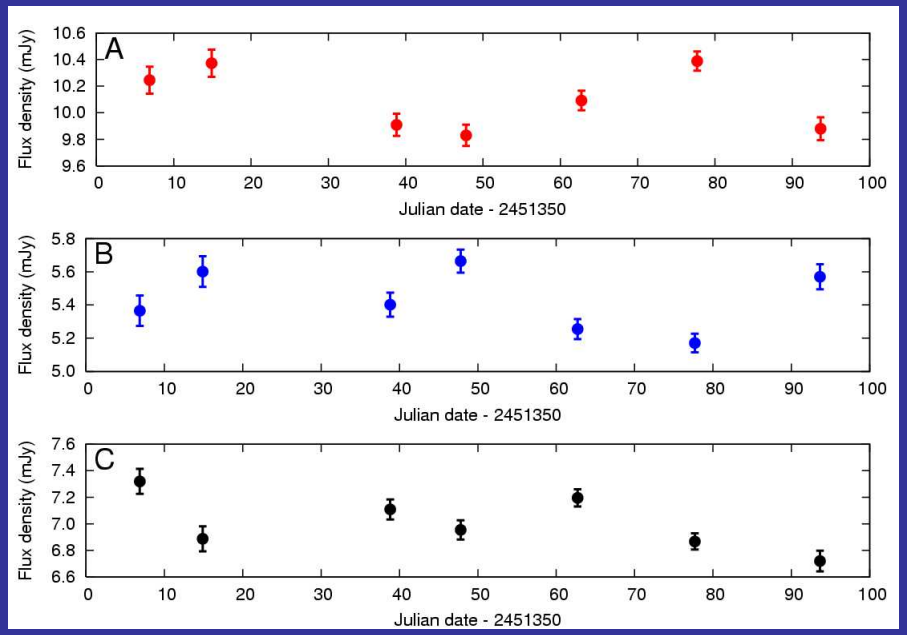


VLA map of 2045+265

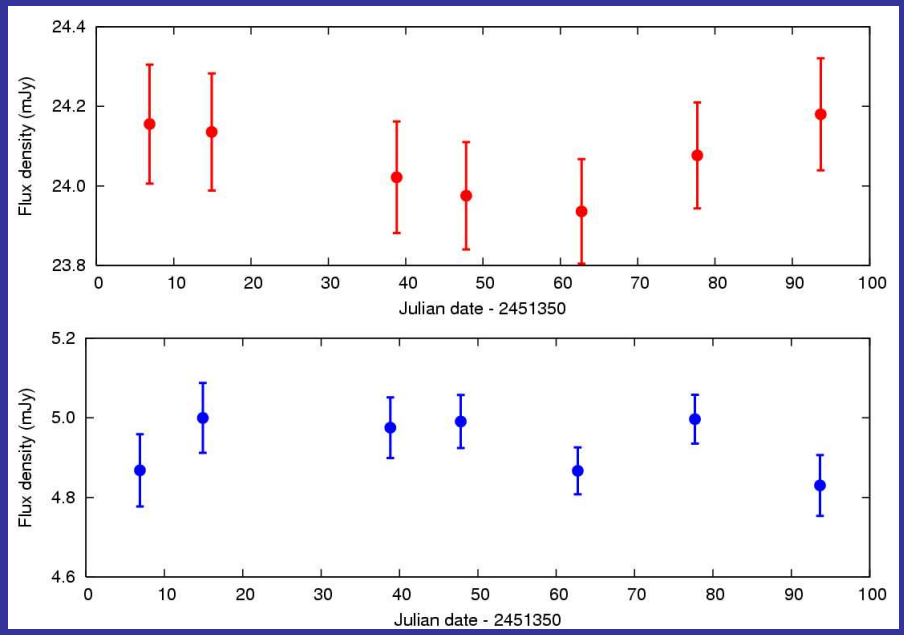


VLA archival data of 2045+265

2045+265



2319+051



Error bars = thermal noise combined with 0.5% of flux density

Summary

- 2 lenses show significant variability with MERLIN
  - 1600+434
    - Mainly intrinsic variability
    - Some evidence for extrinsic effects
  - 2045+265
    - Clearest detection of extrinsic variability
    - WSRT and VLA support MERLIN results
    - Low Galactic latitude (–10°) argues in favour of Galactic scintillation
    - Cygnus superbubble lies close to 2045 line of sight
- No clear detections of microlensing effects seen in MERLIN data
- Radio time delay success is now lagging behind optical
  - Why don't the radio sources vary?
  - Many appear to have low-frequency turnovers
  - How can the radio community deliver more time delays?