EVN observations of the lens system B0128+437

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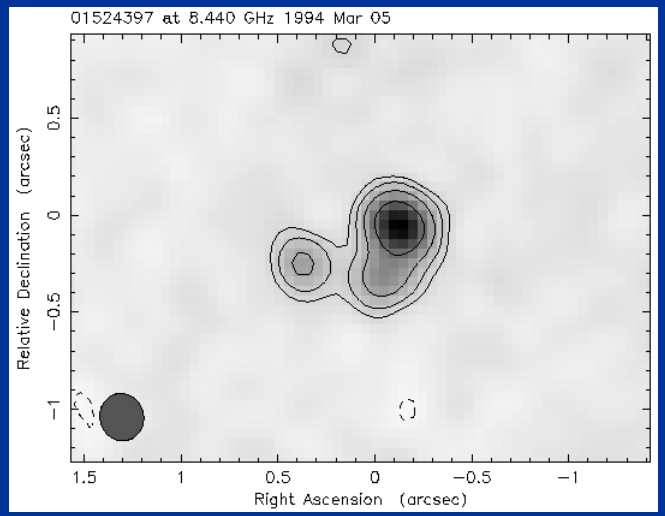
Introduction

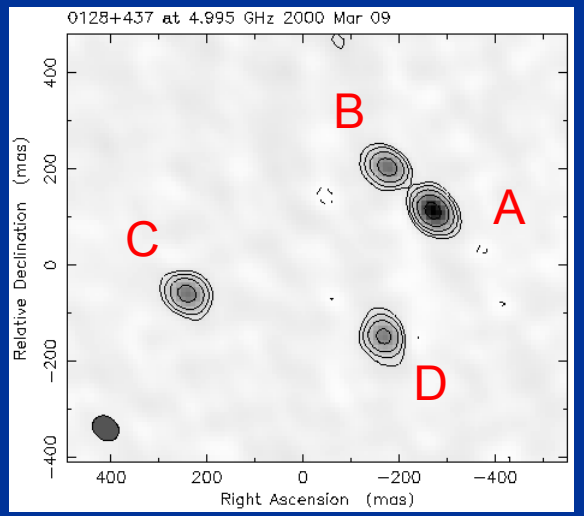
- G. lenses are powerful astronomical tools
  - Cosmology – H_0, Ω_m, Ω_λ
  - Galaxy mass, mass distribution
  - Astrophysics
    - Magnetic fields
    - Ionised gas
    - Dust
    - Absorption lines
- Scatter-broadening seen in many systems

CLASS B0128+437

- One of 22 lenses found in JVAS/CLASS
- Four images
- Maximum separation = 540mas (small!)
- Each image resolved by VLBI (rare!)

VLA
8.4 GHz

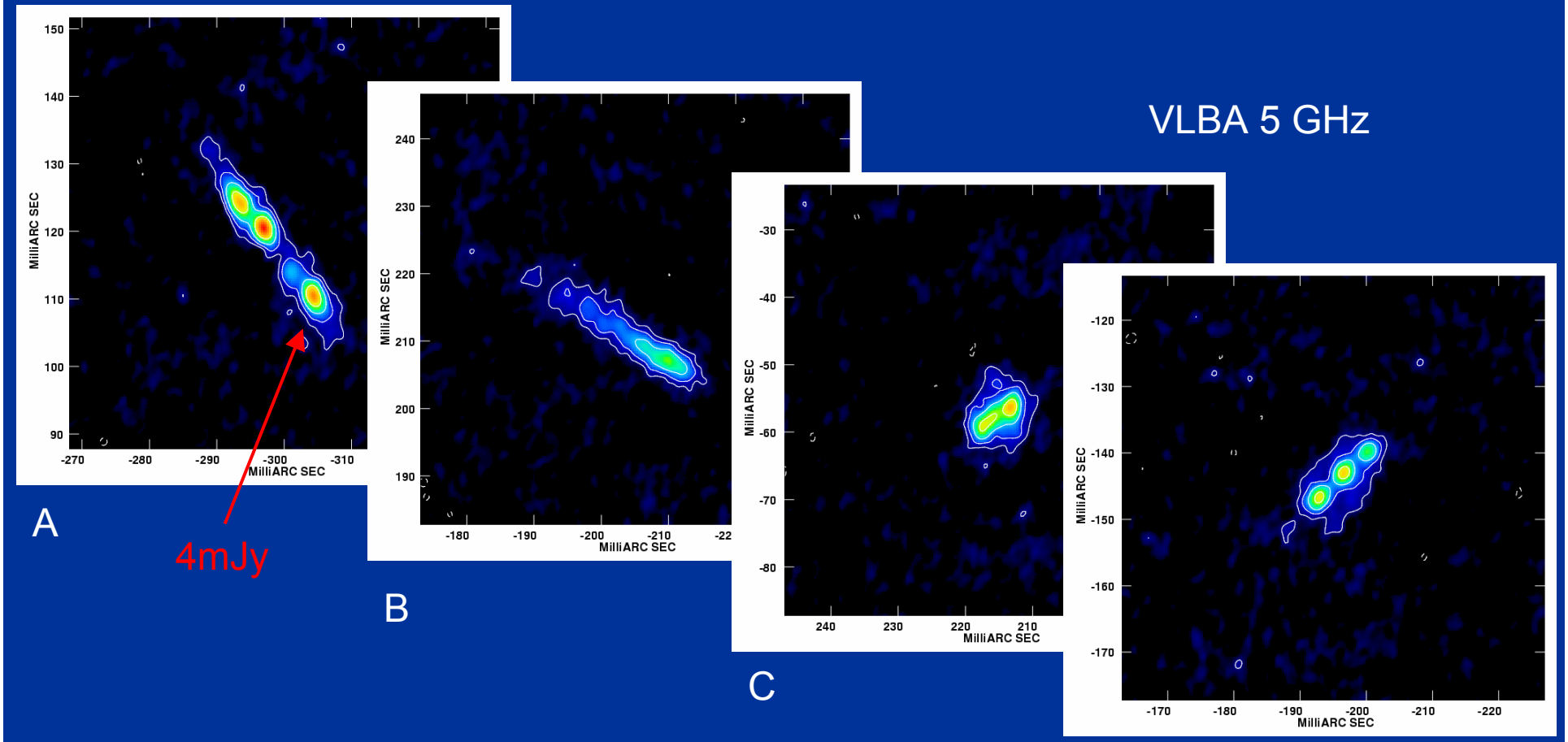




MERLIN
5 GHz

Phillips et al. 2000

VLBI source structure



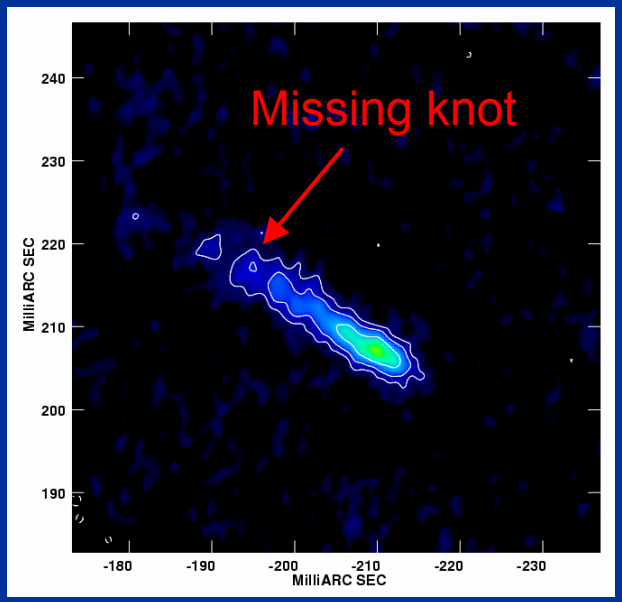
- Source has <u>three</u> ‘knots’
- None seen in image B!
- Surface brightness of B lower than the rest

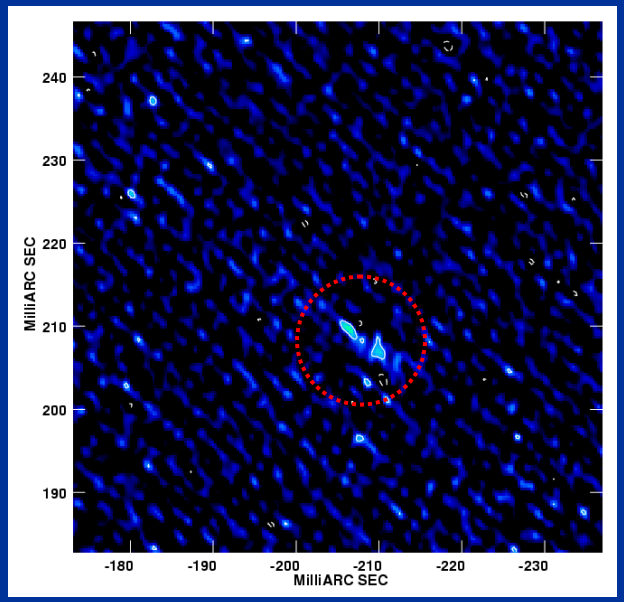
Biggs et al. 2004

Cause of distortion

- Image B is probably scatter-broadened
  - More flux detected with ‘Natural’ weighting
- The scattering is spatially dependent
  - Brightest knot undetected

‘Natural’

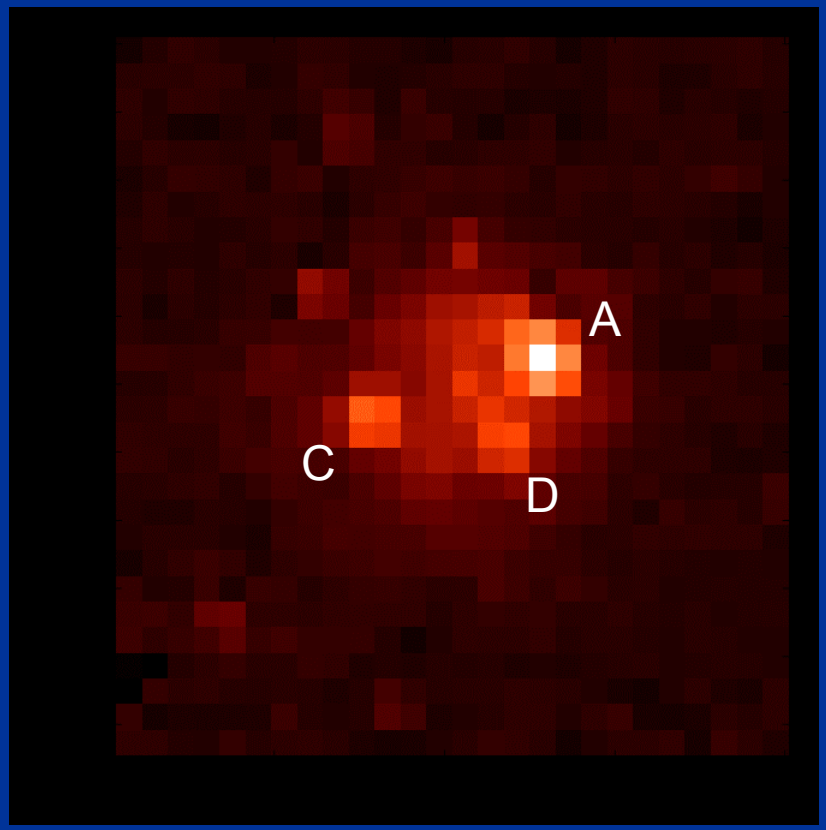




‘Uniform’

HST *H*-band imaging

- Image B not seen with NICMOS
- Dust associated with gas in lens galaxy



PI: Kochanek

EVN observations

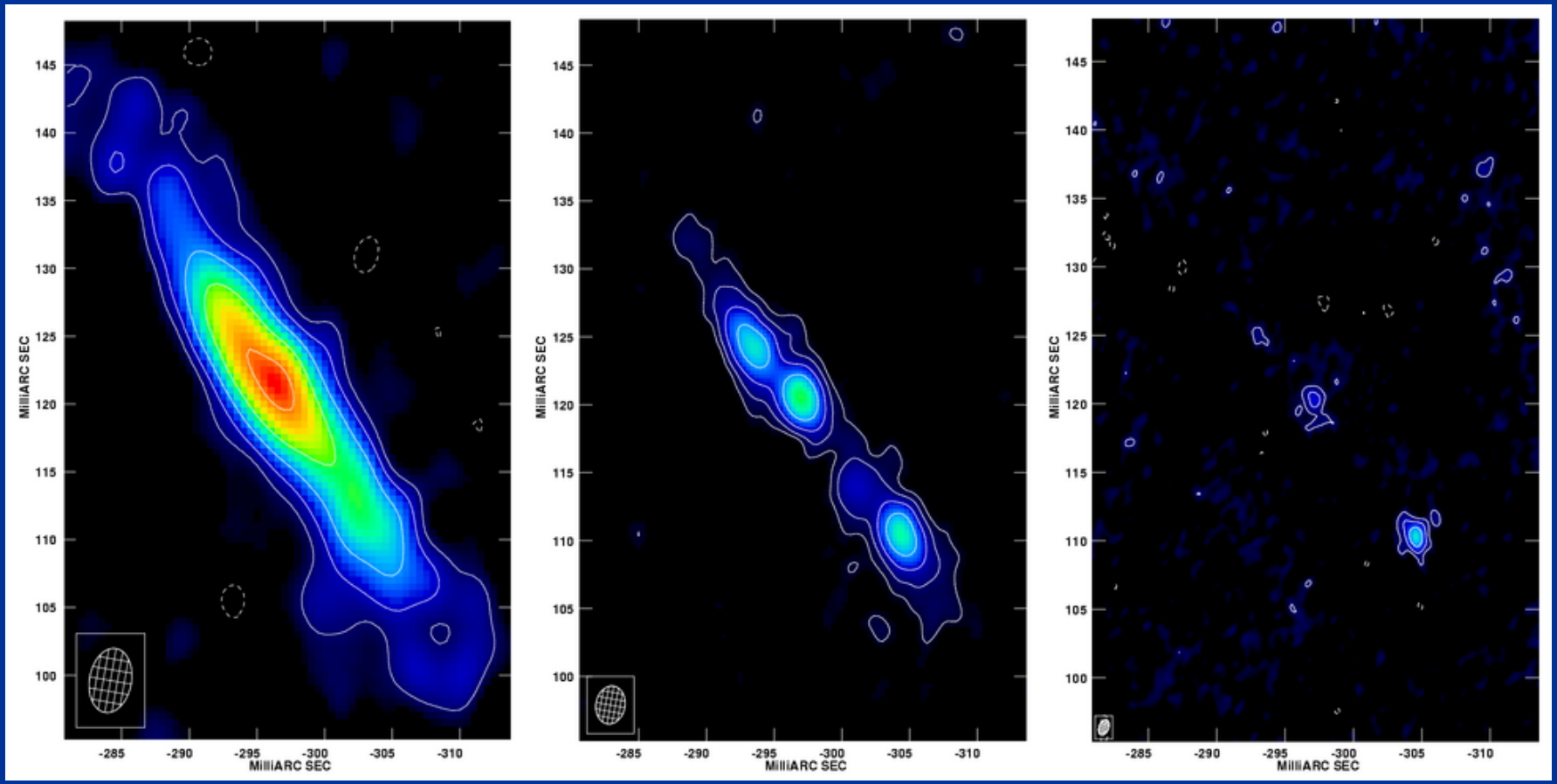
- 0128 observed with EVN at 1.4 GHz
  - Western EVN + Urumqi
- Source brightest at this frequency
  - Gigahertz Peaked Spectrum (GPS)
- Images get much larger with frequency
  - Modelling constraints

VLBA (+Effelsberg)

2.3 GHz

5 GHz

8.4 GHz



Biggs et al. 2004

EVN observations

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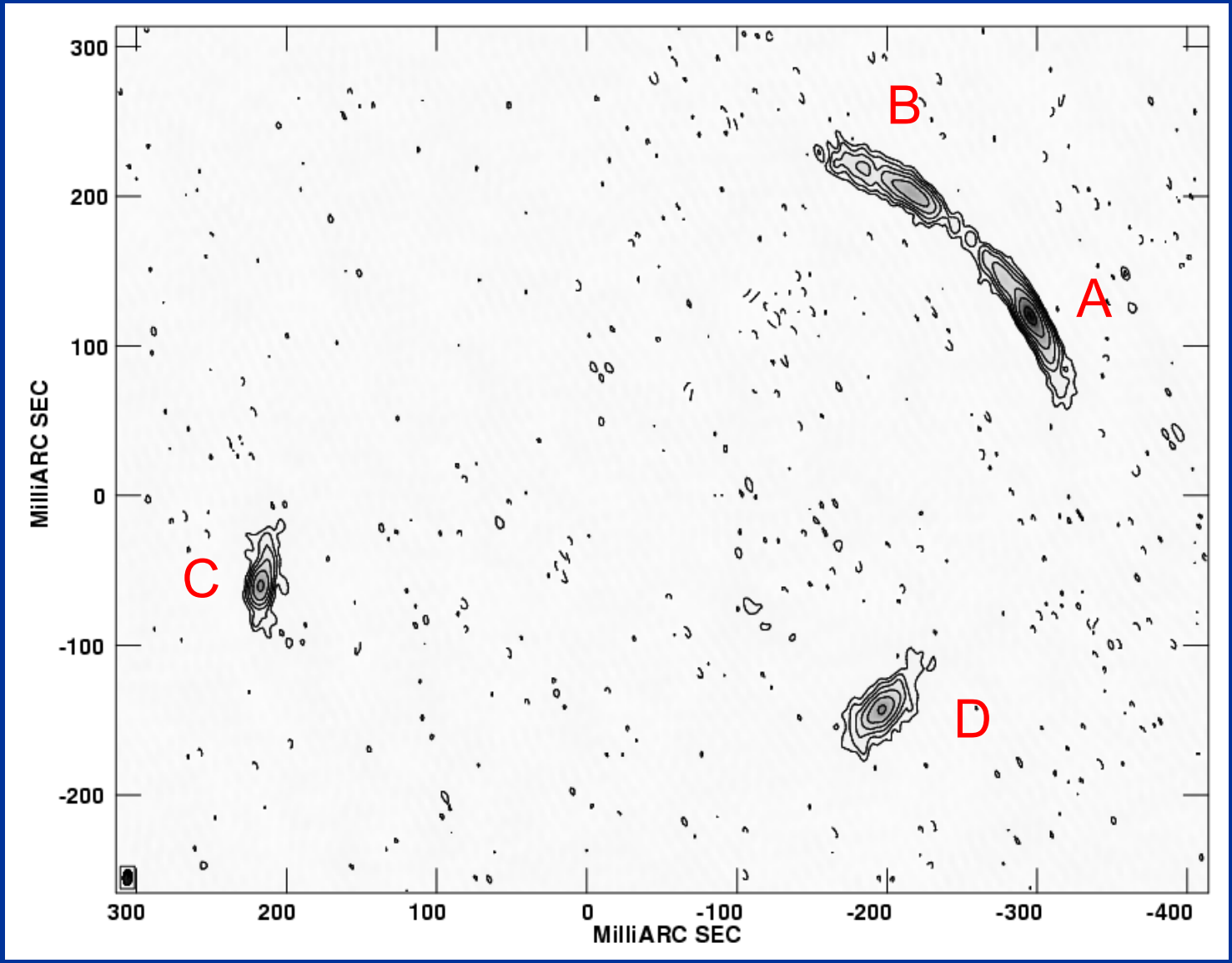
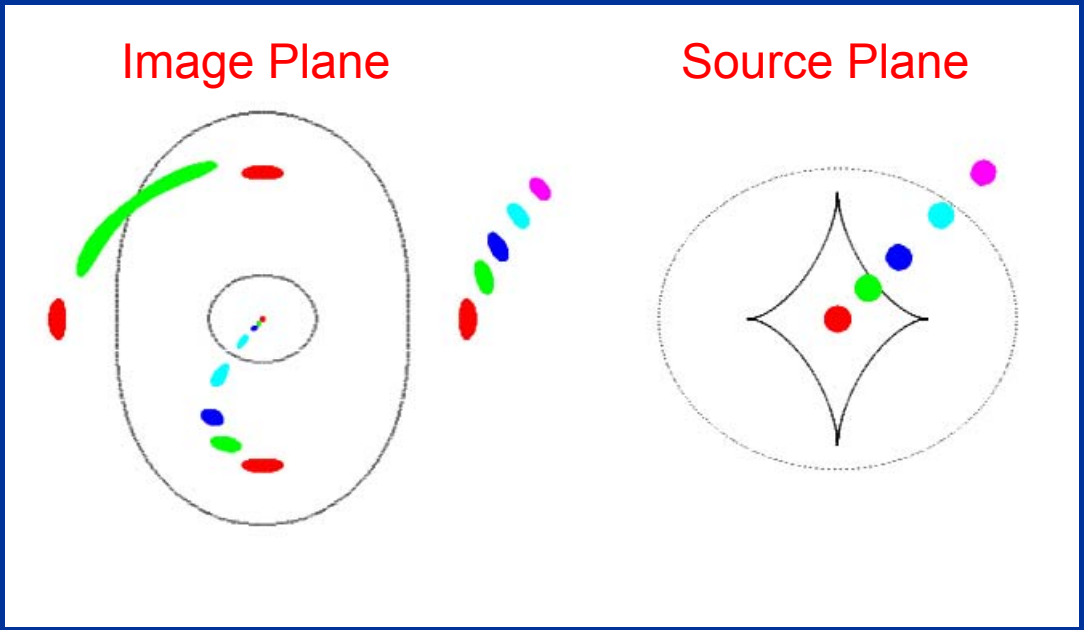
  - Modelling constraints
- New frequency
  - Scattering varies as λ^2

B0128+437 at 1.4 GHz



Lens mass modelling

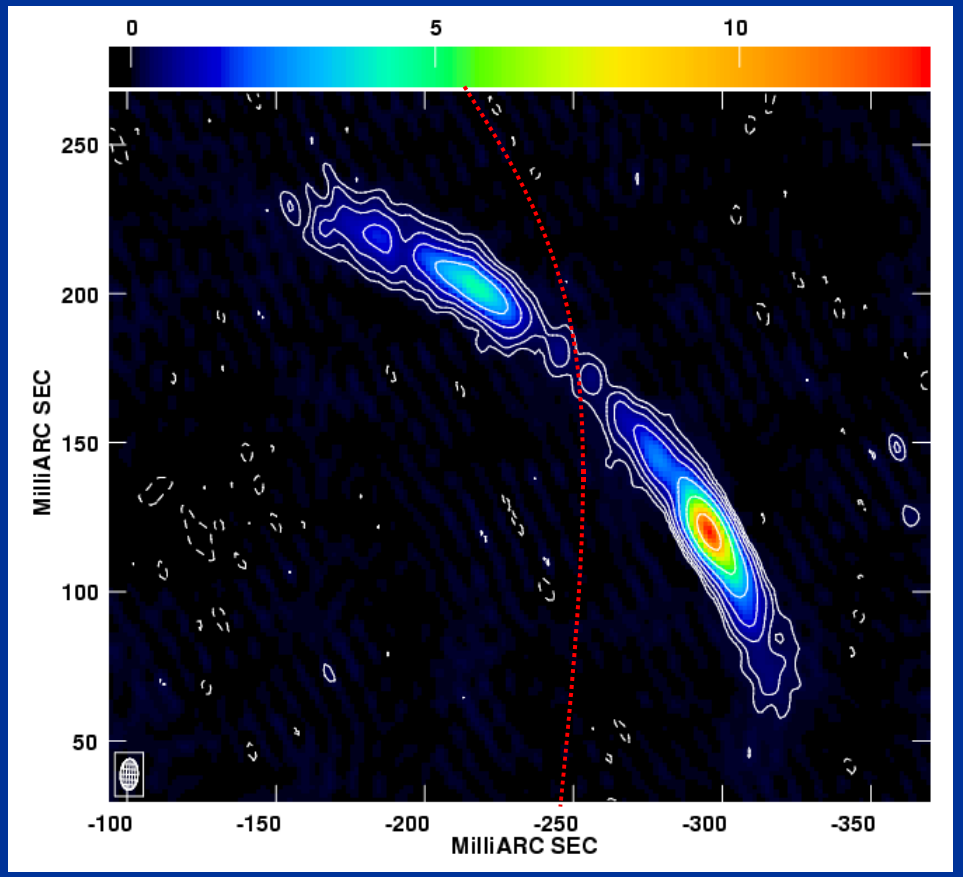
- Images are created on critical curve
  - Magnification very high
  - Sensitive to galaxy mass model parameters



Lens mass modelling

- Images merge due to larger source size
- Paired components seen between A and B

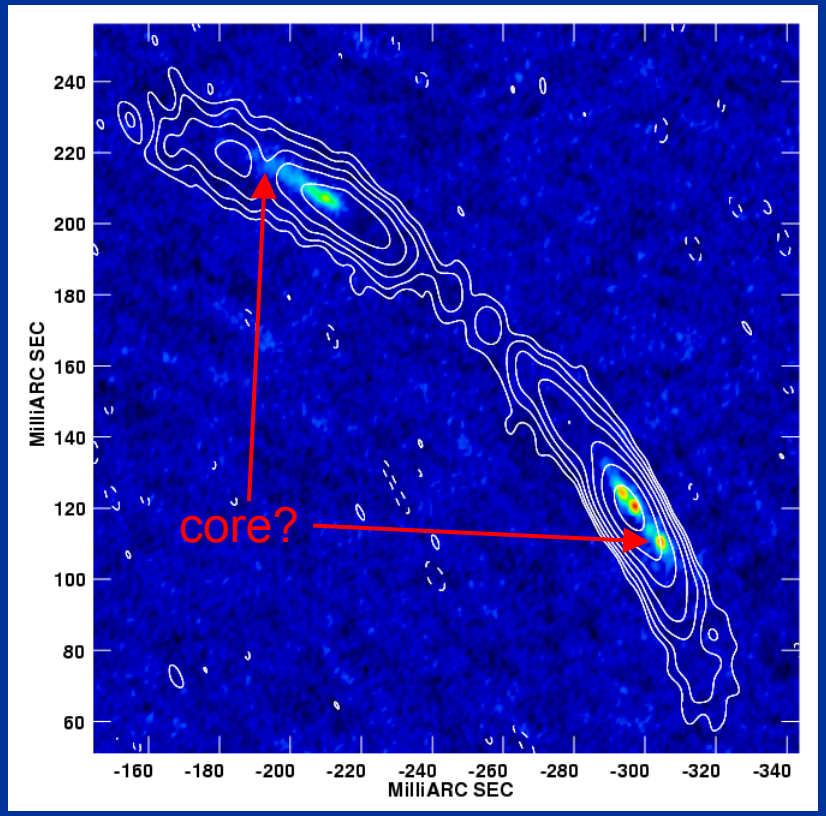
- Path of critical curve tightly constrained
- Intrinsically very faint part of source
- Extended emission can be LensCleaned



Scatter-broadening

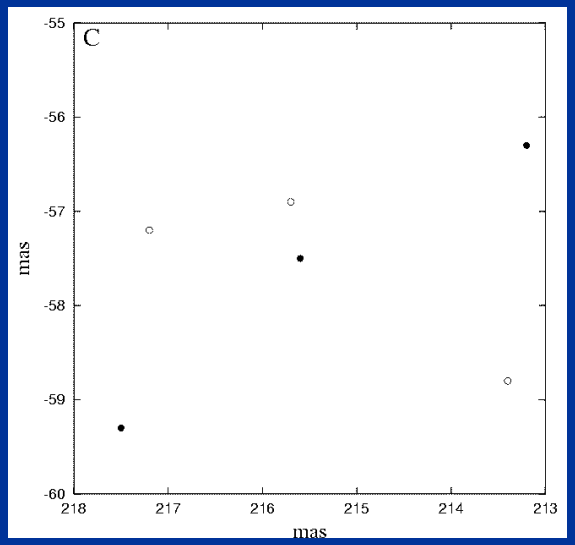
- Surface brightness lowest in B
- A prominent ‘hole’ is visible

- All observations were phase-referenced
- Hole corresponds to missing ‘core’ component
- Scattering parameter can be added to LensClean

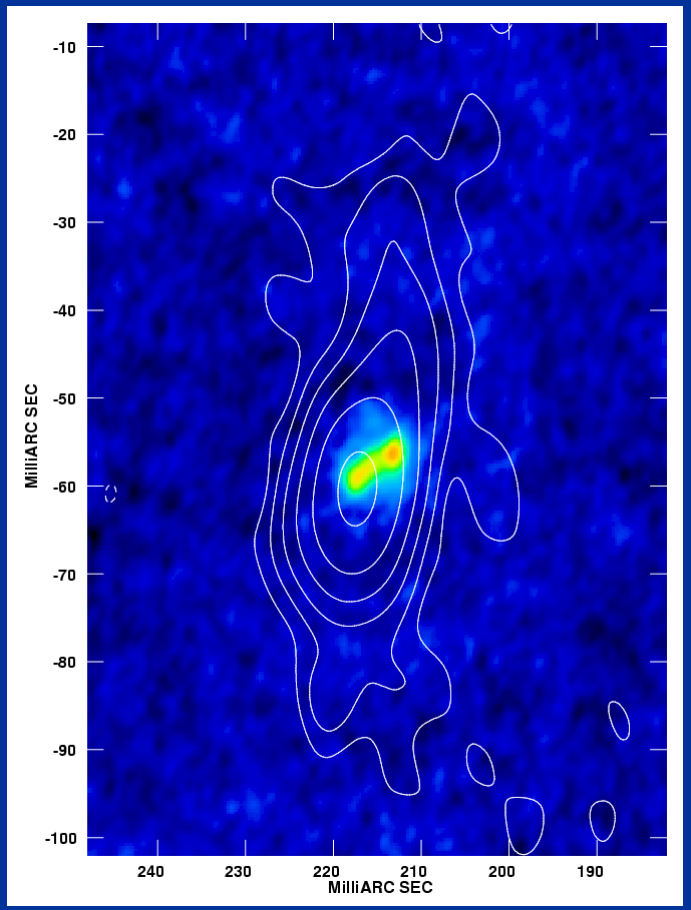


Lens substructure

- Axis of C different at low and high ν
- Can't model 5-GHz positions



- observed
- model



- Rotated by substructure?
- Probably tangentially stretched

Summary and future work

- Image B is scatter-broadened
- Scatterer lies in ISM of the lensing galaxy
- EVN 1.4-GHz data:
  - Provide new model constraints
  - Resolve scattering in image B
- For the future:
  - LensClean of EVN data
  - 15-GHz VLBI may detect missing core in B
  - Search for HI absorption at lens redshift