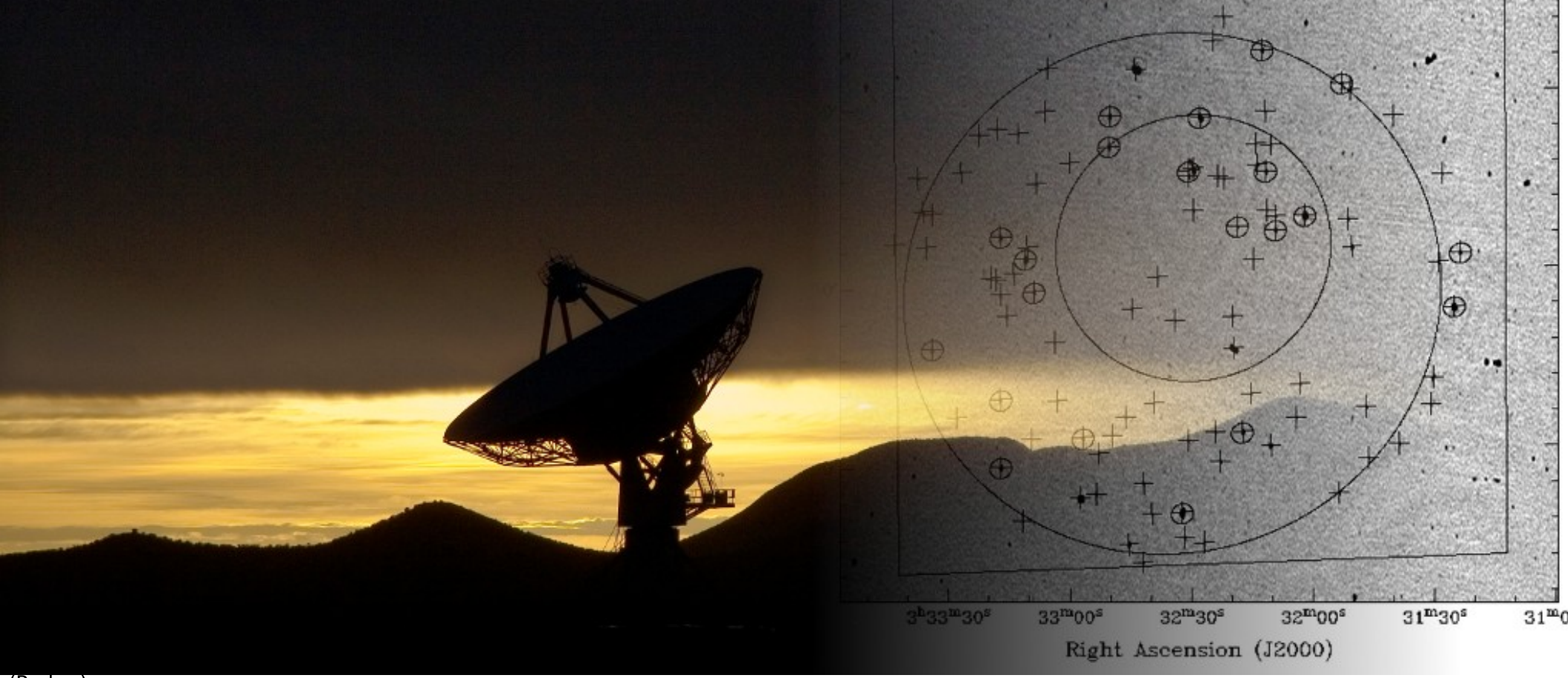


(Parker)

Finding AGN With Wide-field VLBI observations

First results from a new observational technique

22 September 2010

Enno Middelberg
Astronomisches Institut der Ruhr-Universität Bochum

Collaborators:
Alef, Bach, Brisken, Deller, Lenc, Morgan, Norris, Rottmann, Tingay

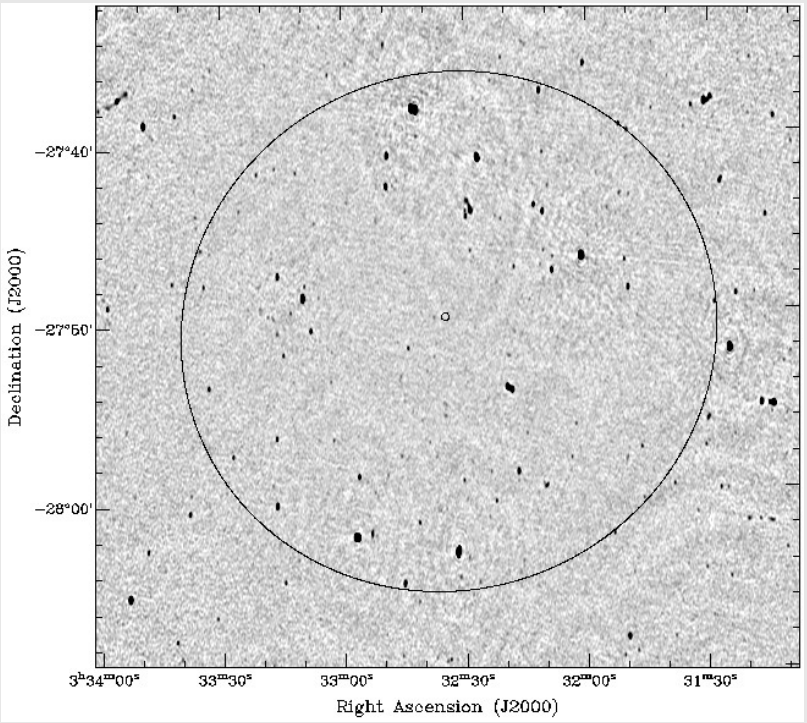
RUB

Enno Middelberg
Astronomisches Institut

Wide-field VLBI observations

Applications and problems

- VLBI surveys are expensive
- $T_B > 10^6$ K is great AGN filter (if z>~0.1)
- Long baselines
  - → high fringe rates
  - → tiny FOV
  - → no „blind“ surveys
- Workaround: higher resolution
  - → data volume >> TB/day
  - → cumbersome/impossible



Large circle: VLBA primary beams at 1.4GHz; small circle: VLBA FOV at 1.4GHz

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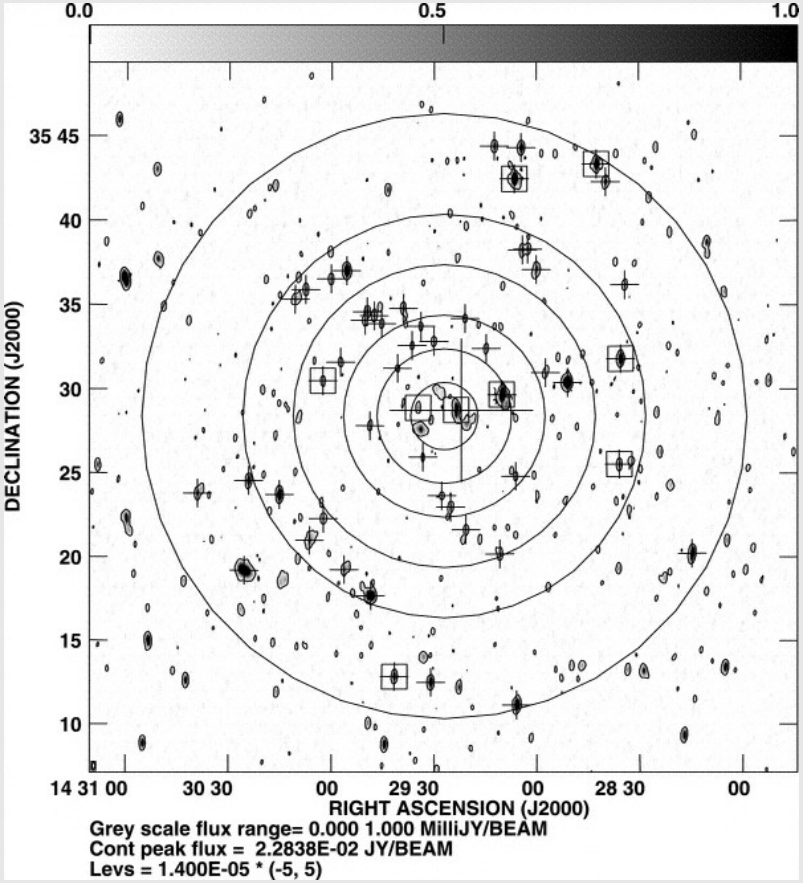
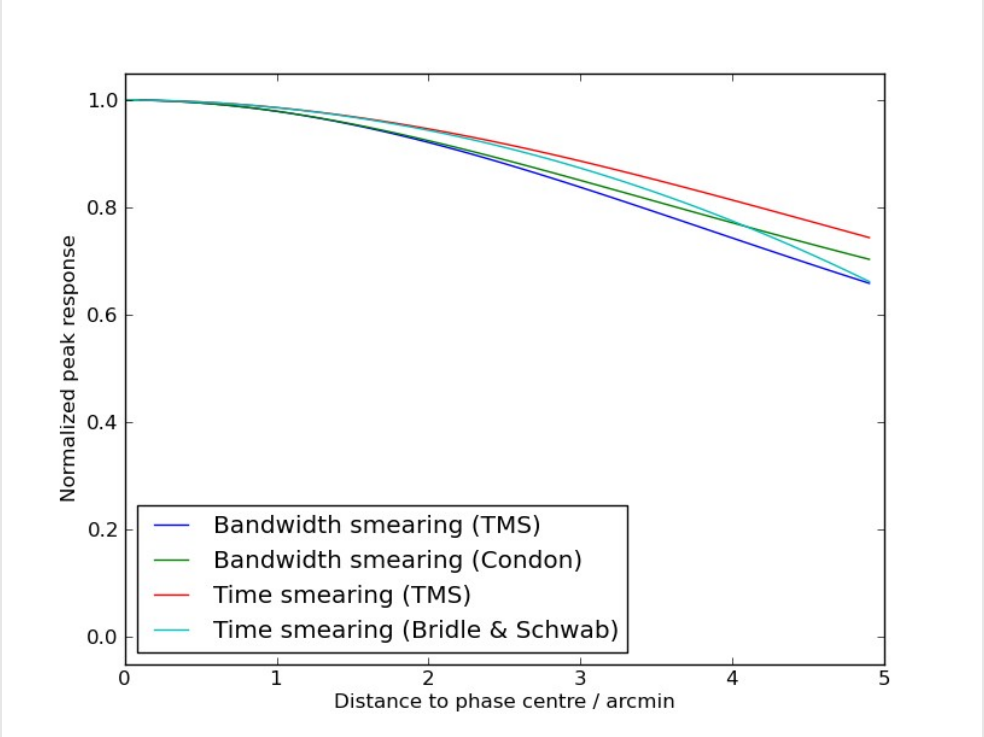
Wide-field VLBI observations

Applications and problems



Garrett+ 2005: 1024 channels, 0.5s integrations (120GB of data), FOV of few arcmin



Averaging losses on 5000km baseline with 64kHz channels and 0.5s integrations (as in Garrett+ 2005)

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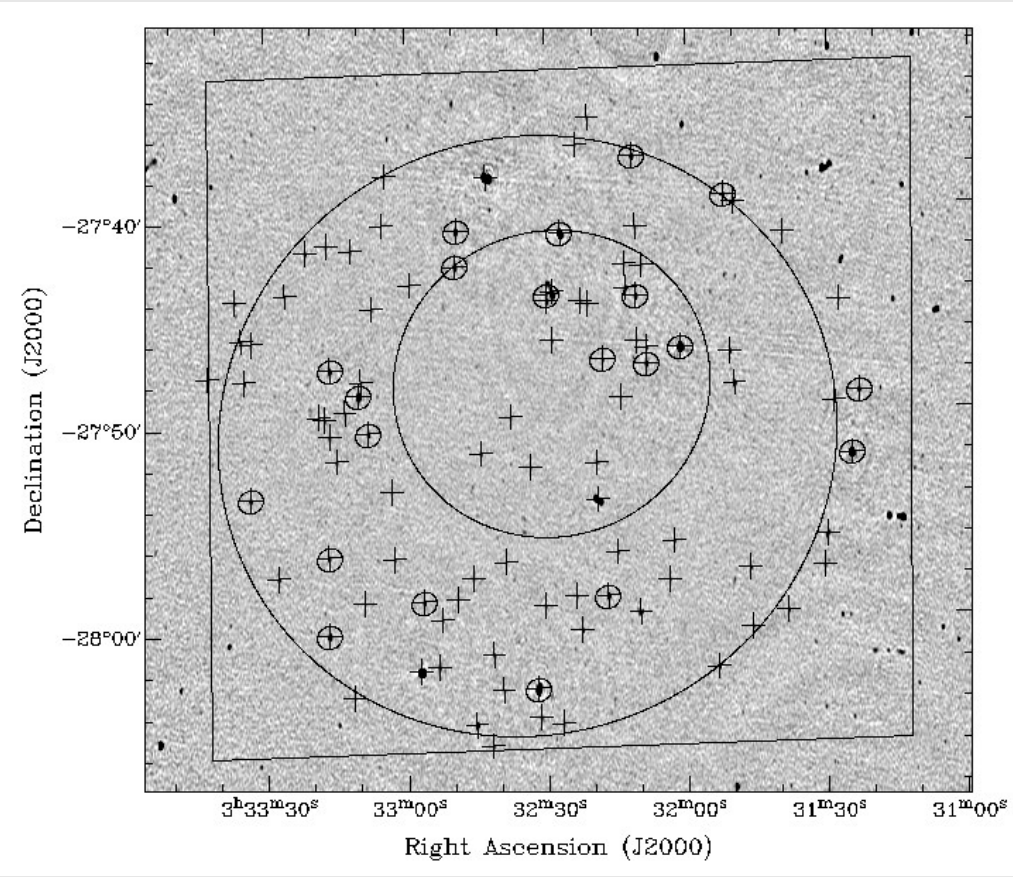
Wide-field VLBI observations

New methods: multiple phase centres in DiFX2

(Deller+ 2010, in prep)

- Fourier transform data
- Calculate delay towards N phase centres
- Phase-rotate spectra
- Correlate and average
- Result: N normal VLBI data sets



Radio sources from Norris+ (2006) indicated with pluses, large circle is VLBA FWHM at 1.4GHz, small circle is CDFS (Luo+ 2008), rectangle is ECDFS (Lehmer+ 2005)

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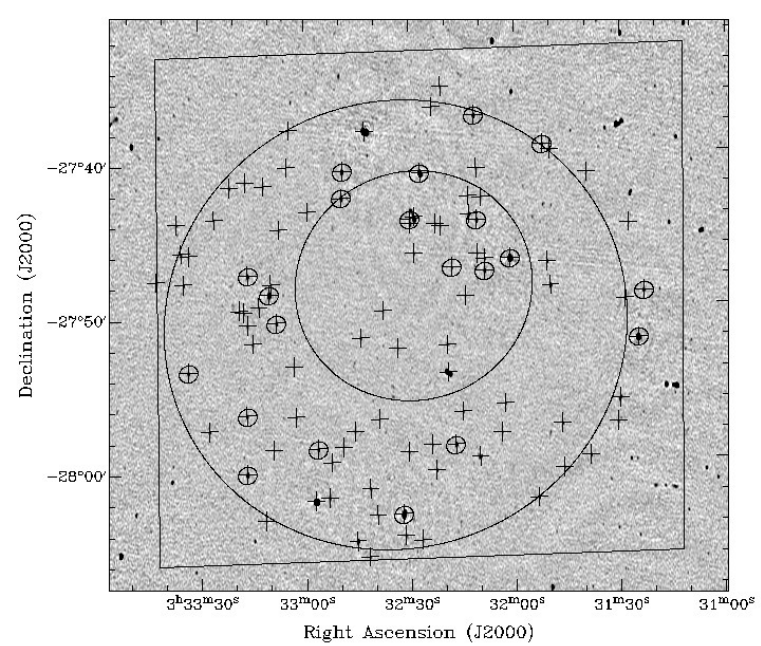
Wide-field VLBI observations

The pilot project – observations

(Middelberg+ 2010, submitted)

- CDFS observed at 1.4GHz in July 2007
- Expected sensitivity 50μJy – 100μJy
- Batch-calibration – thank you, ParselTongue
- First project to use multi-phase centre capability of DiFX2, with N=96



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- Expected sensitivity 50μJy – 100μJy
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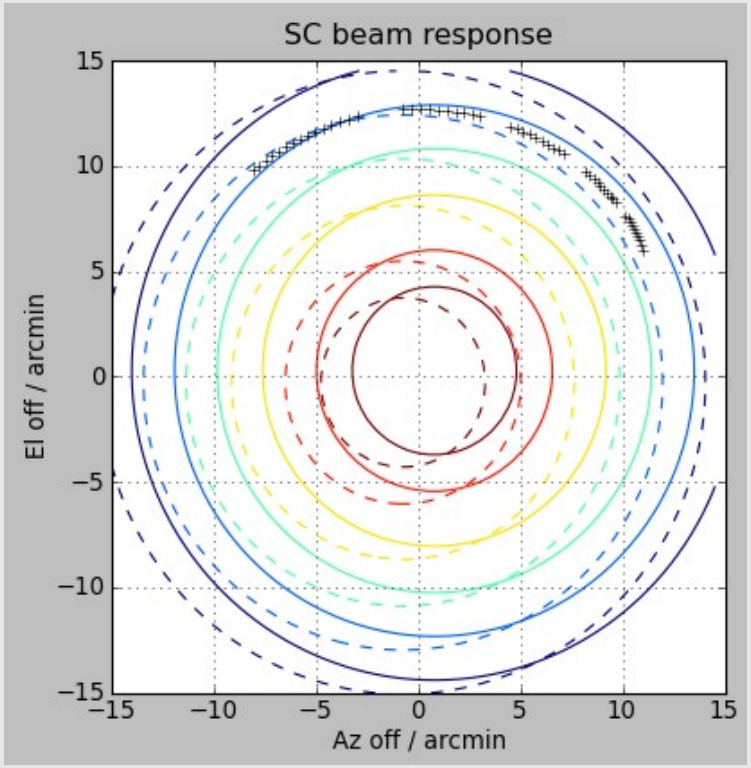
- First project to use multi-phase centre capability of DiFX2, with N=96
- Primary beam correction scheme developed

Does not require equal telescopes → EVN



Contours: RCP and LCP beams of the VLBA antenna at St Croix; crosses: path of off-axis source during the observations

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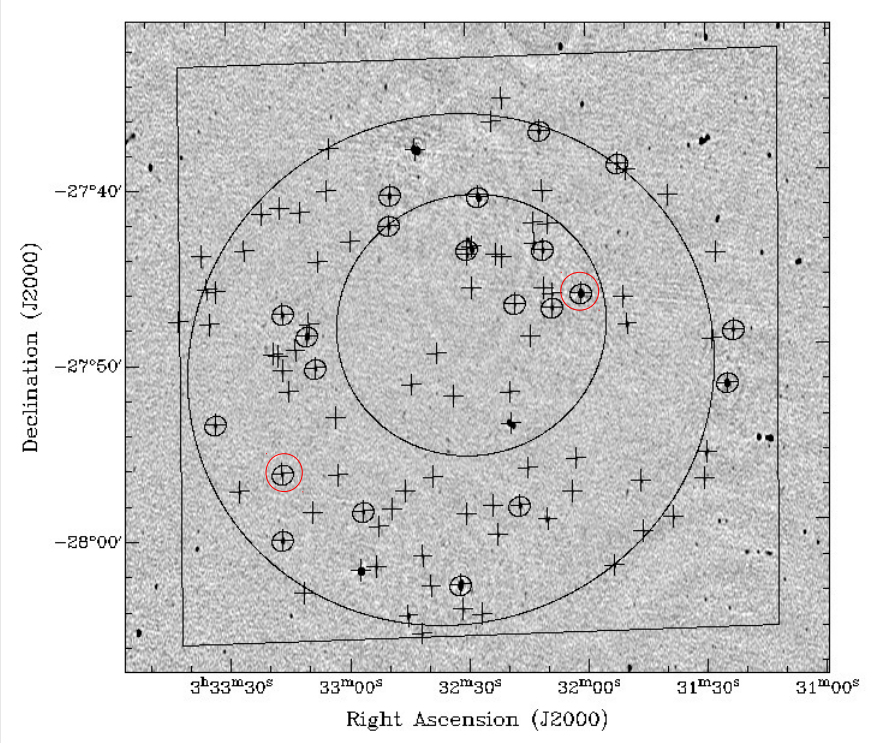
Wide-field VLBI observations

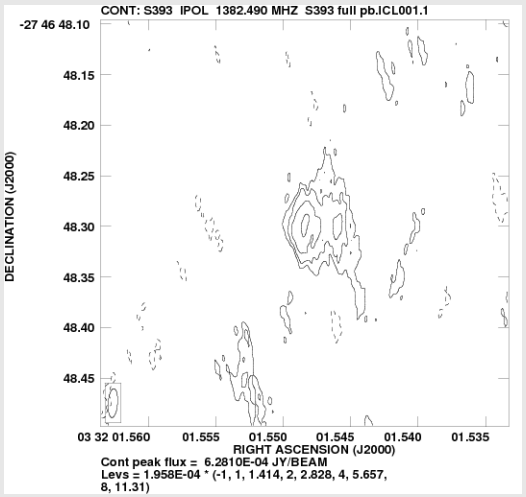
The pilot project – results

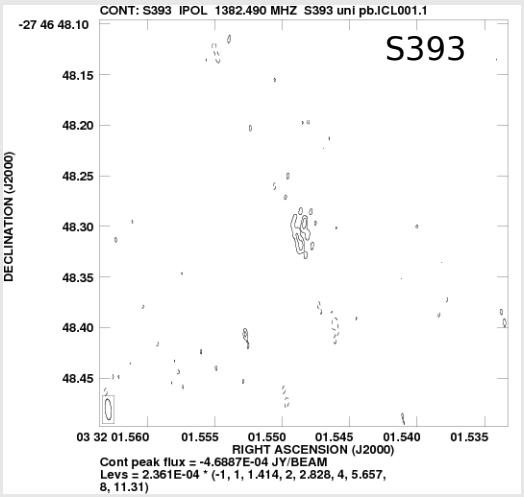
(Middelberg+ 2010, submitted)

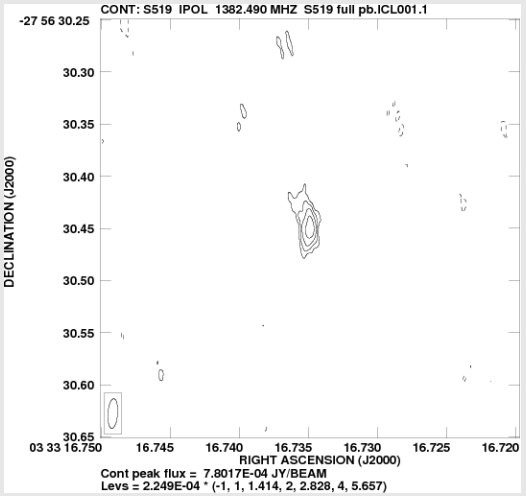


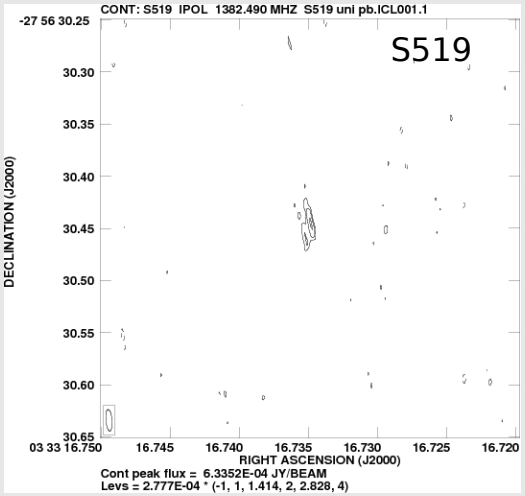
Target S393: z=1.07, S_{ATCA}=49.1mJy, S_{VLBI}=2.5mJy

Target S519: z=0.69, S_{ATCA}=0.9mJy, S_{VLBI}=1.1mJy









Left: natural weighting, right: uniform weighting

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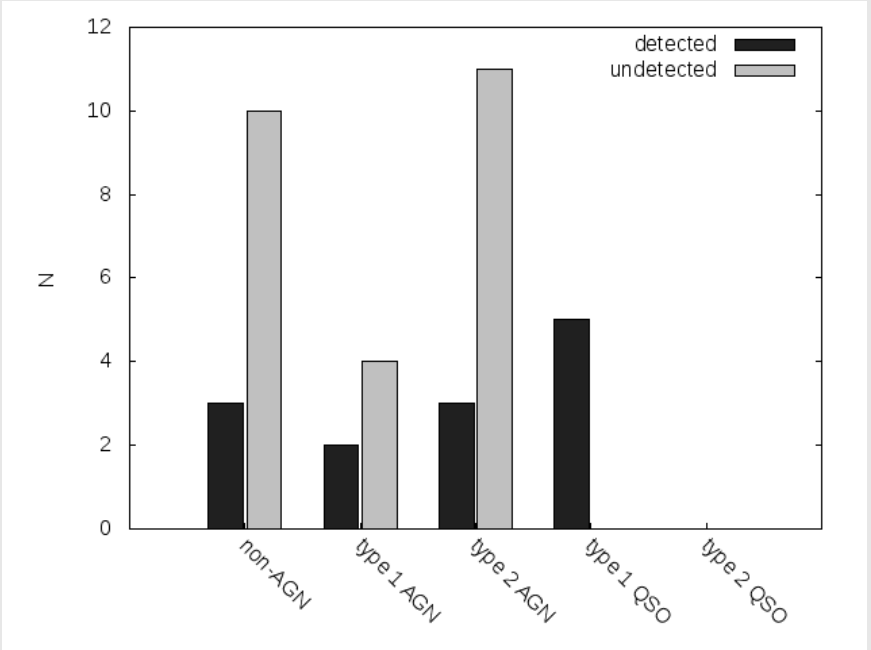
Wide-field VLBI observations

The pilot project – Summary

(Middelberg+ 2010, submitted)



- Detected 21% of sources (=AGN)
- Identified 8 previously unknown AGN
- Every X-ray type 1 QSO is detected
- 1 starburst/elliptical galaxy detected
- 1 potential radio SN
- Wide-field VLBI now practical and easy

  (but see Morgan+ 2010 and Wucknitz+ for a different approach)
- Next step: Lockman Hole East (Ibar+ 2009), use mosaicing of three pointings

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Wide-field VLBI observations

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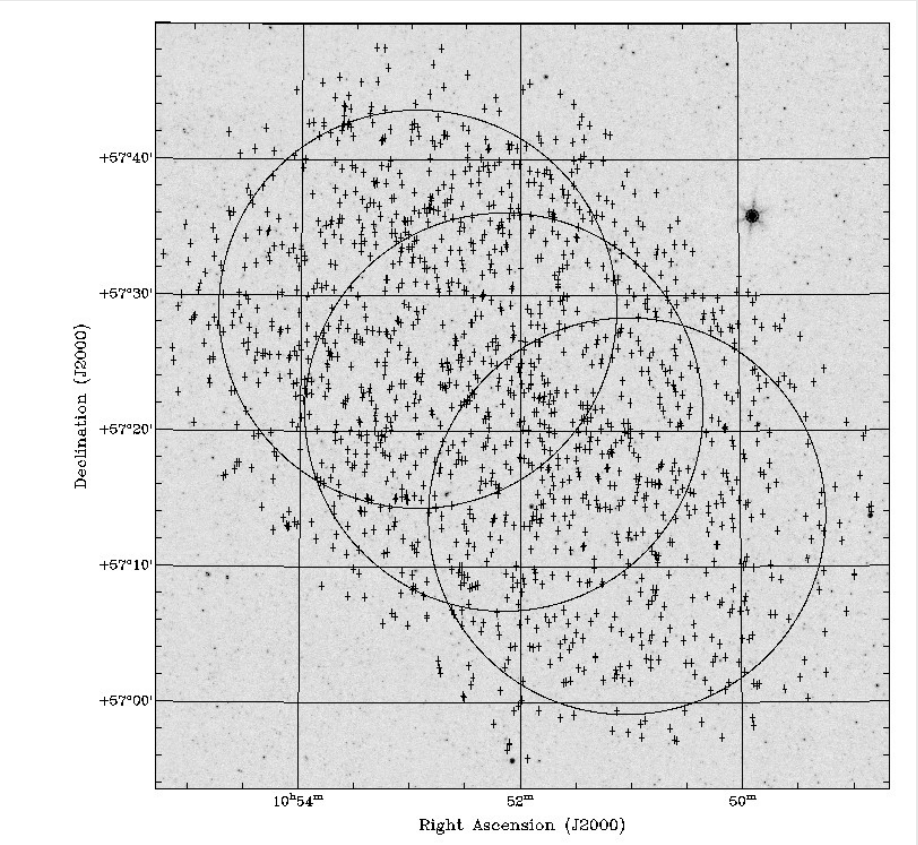

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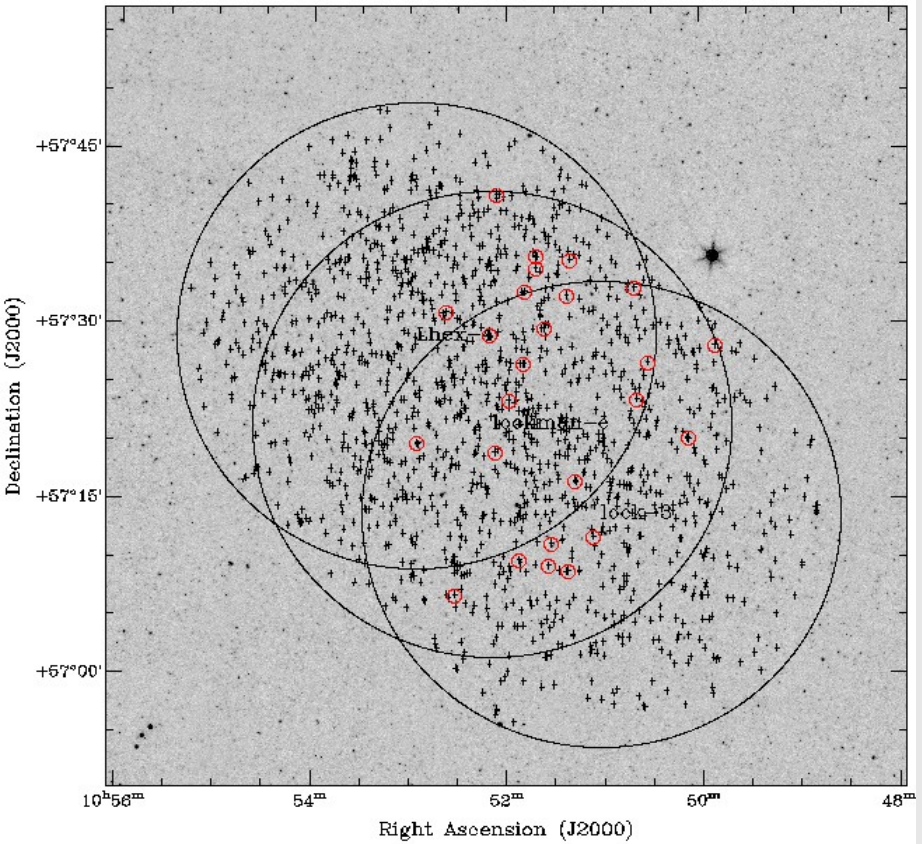
Wide-field VLBI observations

Last week's result: bm332b

(Middelberg+ 2010, not even in prep)

- bm332b: 12h @ 512Mbps
- 347 targets
- Phase-referencing only
- 28 targets with SNR>7
- Brightest has SNR=88



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- *Wide-field VLBI:*

  Astonishing new capabilities,

  easy to use!