Imaging compact SNR, supernovae, and AGN emission in M82 and M81

Brief progress report on project LC0_026

Lofar status meeting
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E. Varenius, J. Conway, A. Deller, N. Jackson, I. Marti-Vidal, F. Batejat, O. Wucknitz, R. Beswick, B. Adebahr, K. Chyzy

Outline

- Summary of project LC0_026
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- Some science goals and current leads
- Image of M82 with remote stations at 151MHz
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- Image of M82 with MERLIN at 408MHz
- Future work in progress

Summary of project LC0_026

- HBA observations of M81 and M82, March & April 2013, including Core, Remote and International stations.
- 7 Int. stations were OK: 4 in Germany, 1 in France, Sweden and UK.
- 16 hours of data taken, 10 hours calibrated and imaged
- Three simultaneous beams:
  M82, M81 (0.5deg), J0958+6533 (4deg)
- Single beam obs. of 3C196 for 2.5 min once every hour to allow phasing up of the core.
- 2 freq. blocks of 16MHz each centered on 110MHz and 151 MHz. Only upper 16MHz at 151MHz calibrated and imaged.

Calibration strategy

- **Average** to 10s, 1ch/sb (NDPPP). For speed.
- **Phase up the core stations**, using BBS and NDPPP here at Onsala.
  - Derive and apply phase solutions once every hour using data for 3C196.
  - Sum all core stations, then remove data for individual core stations.
- **Convert to cirular polarisation** (mscorpol.py) and export to UVFITS.
- **Load data into AIPS** for J0958+6533, M81 and M82.
- **Find delay and rate corrections** using J0958, ≈700mJy. (FRING in AIPS).
- **Set flux scale** by Amp&Phase selfcal on J0958 (CALIB in AIPS).
- **Copy** delay, rate, amp and phase corrections **to M81, 4 degrees away.**
- **Refine phase calibration on M81,** point source as model. (CALIB in AIPS).
- **Transfer M81 calibration to M82,** 0.5degrees away from M81.
- **Export to** Measurement Set and load into **CASA** (size≈3GB).
- **Image M82** using CLEAN with Multi-Frequency Synthesis in CASA 3.4.

- Note: No selfcal was done on M82.

Some science goals and current leads

- The low luminosity AGN M81* was predicted to be around 50mJy. Seems to be about 155mJy.
- Supernova SN2008iz in M82 was predicted to be 140mJy. We see nothing. Might be due to foreground free-free absorption.
- Compare with MERLIN 408MHz map of M82 from 1994 and look for objects with very steep spectra. Seems both similar and different. Differences most likely due to foreground free-free absorption.

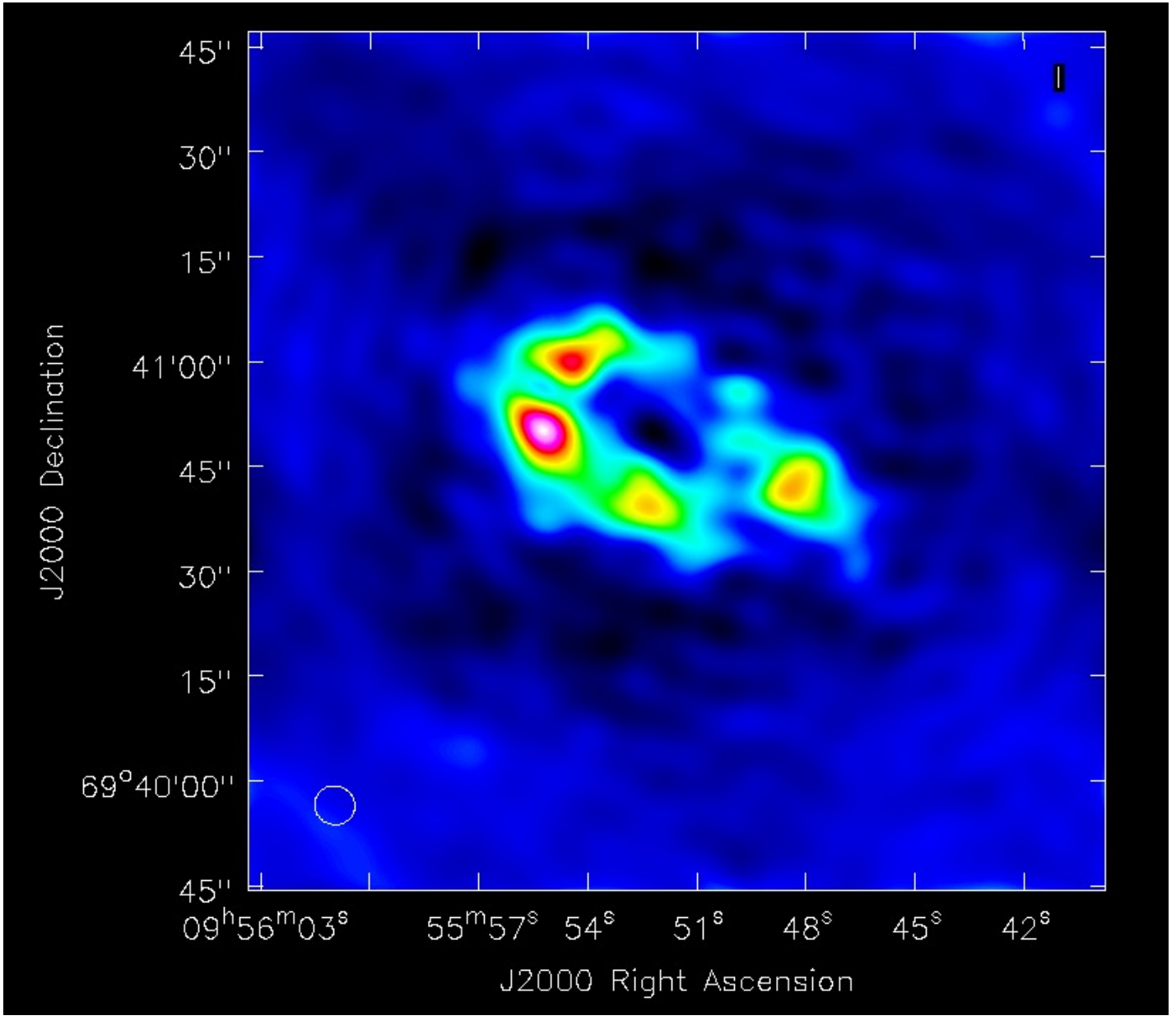
M82 with Remote stations and phased up core at 151 MHz

RMS noise=9.6mJy/beam

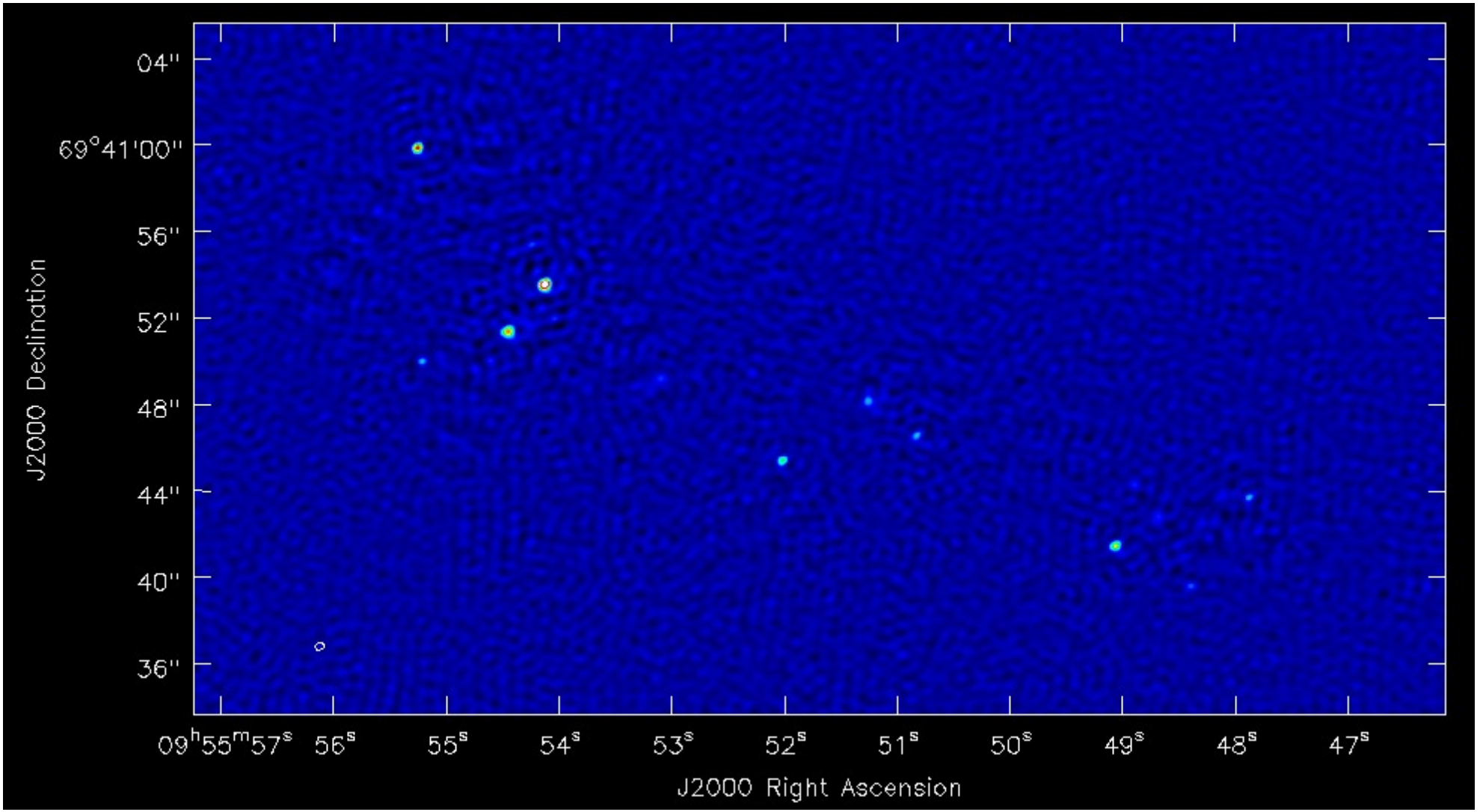
Resolution=5.8x5.5 arcsec

Max=166mJy/beam

Min=-36mJy



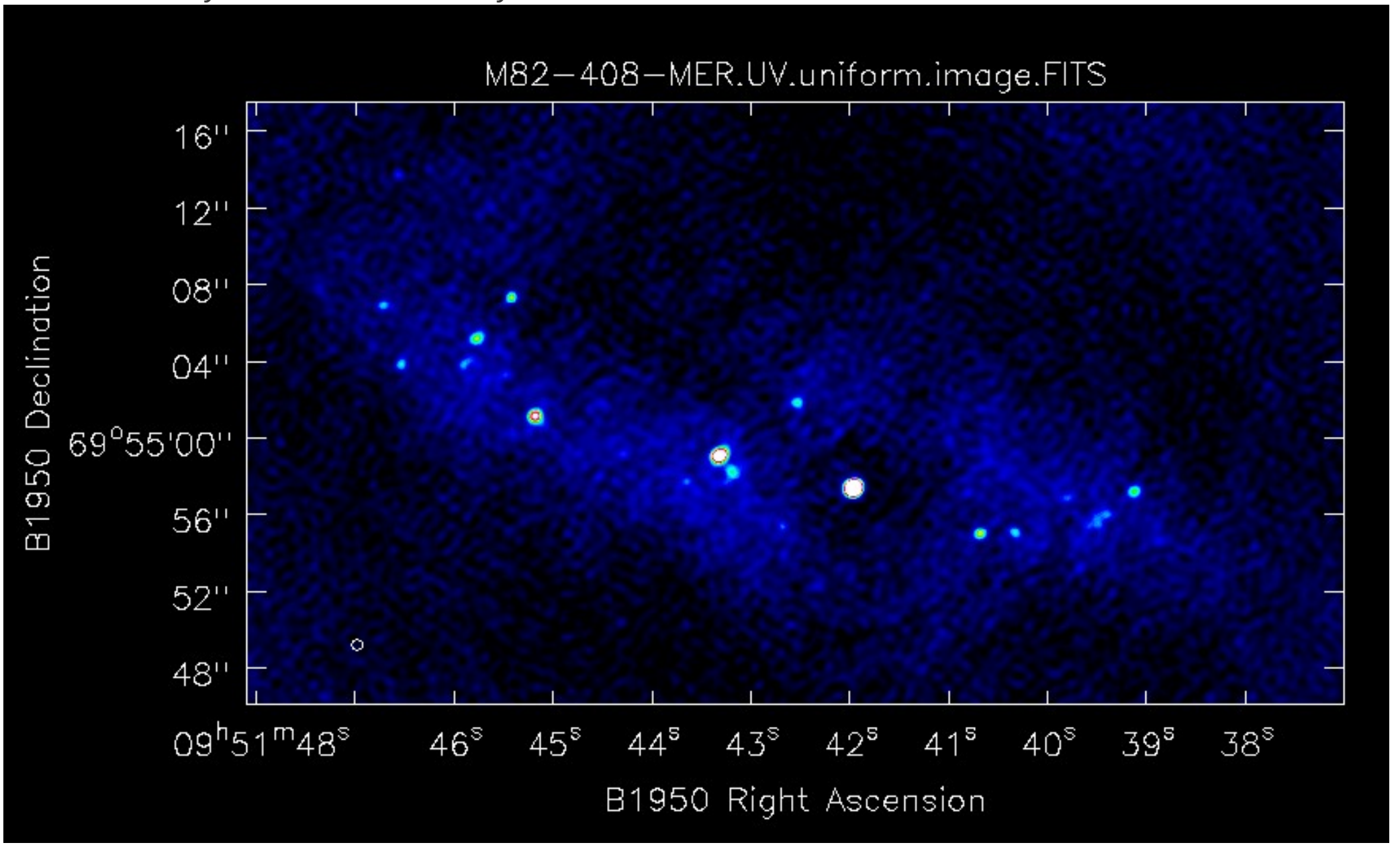
M82 with Int. stations and phased up core at 151 MHz



RMS noise=0.28mJy/beam. **Resolution**=0.42x0.34 arcsec.
Max=19.6mJy/beam, **Min**=-2.4mJy/beam.

MERLIN at 408MHz, from 1994

RMS noise=0.57mJy/beam, **Resolution=**0.55x0.50arcsec
Max=94.8mJy/beam, Min=-2.7mJy/beam



Future work

- Refine amplitude calibration by checking flux of J0958+6533 in MSSS.
- Include remaining 6 hours of data.
- Include lower 16MHz at 110MHz.
- Phase-up only a part of the core to make sure primary beam is not affecting edges of M82.
- Try phase self calibration on M82.
- Make combined image with all baselines: international + remote.