

OH in nearby (and not so nearby) galaxies

The *other* emission line(s)

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The point

- Why are we interested in OH anyway?
 - surely HI can solve the Universe?
- A nearby laboratory: M82
 - some recent results
- Other systems: a survey of nearby galaxies
 - in the next few years
- Further afield: OH megamasers
 - ASKAP (Baan, this meeting)

Why is **OH** interesting?

- Pointer to star formation, locally and in more distant starburst/ULIRGs
- HI maps show the atomic gas distribution – what about molecular gas?
 - lots of plans for HI surveys – get OH as well
 - can be mapped at same resolution with the same instruments as HI
- See both absorption and emission
- Four lines at L-band:
 - 1665/1667 MHz main lines: starformation, HII regions, SNRs
 - 1612/1720 MHz satellite lines: usually SNRs
- In more distant galaxies, OH mega/gigamasers
 - often associated with mergers
 - statistics, luminosity/number evolution?

M82: the prototypical starburst galaxy

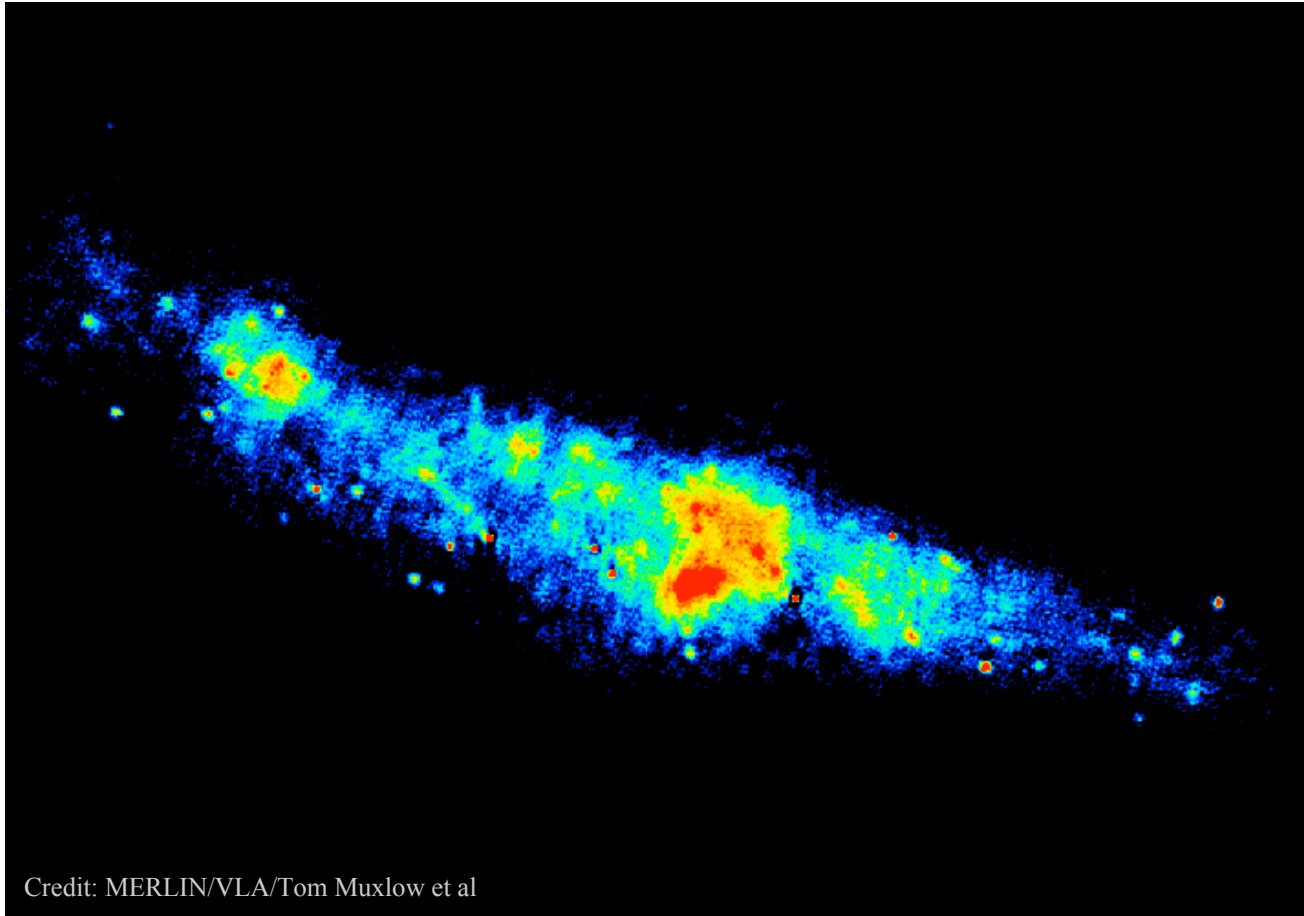
- Starburst: interaction with M81
- Strong radio continuum emission
 - extended emission
 - HII regions, SNRs (VLBI monitoring: Fenech et al 2009)
 - transients (e.g. SN2008iz Brunthaler et al)
- Distribution of neutral hydrogen - atomic gas
- OH observations – molecular gas
- Strong absorption + numerous maser spots
 - associations?
 - velocity distribution?

The **M82** starburst



Credit: X-ray (blue): NASA/CXC/JHU/D.Strickland; Optical (green, orange):
NASA/ESA/STScI/AURA/The Hubble Heritage Team; IR (red): NASA/JPL-Caltech/Univ. of
AZ/C. Engelbracht

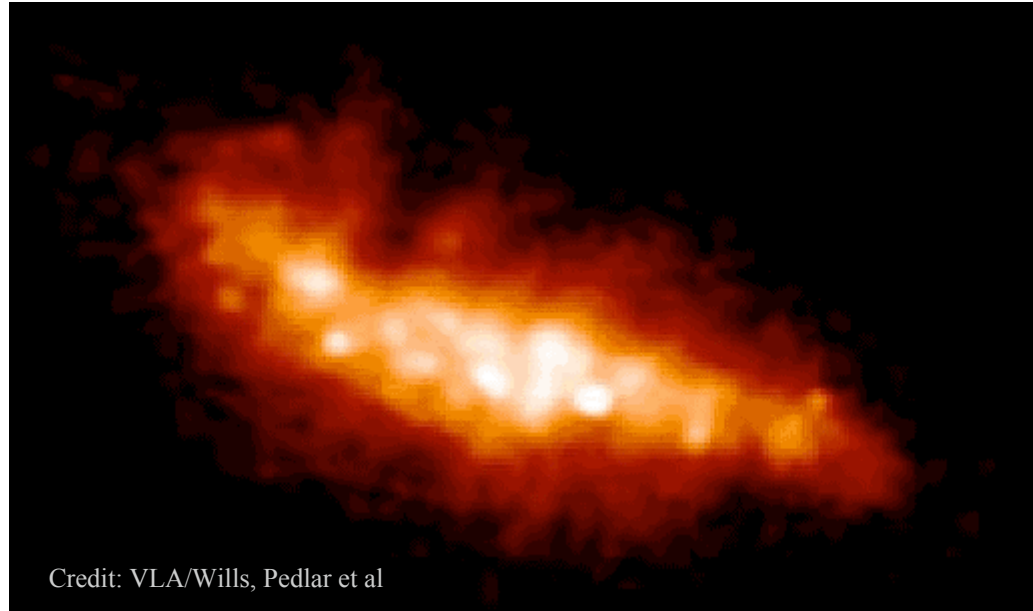
Radio sources in the central kiloparsec



Combined
MERLIN/VLA
observations
of M82 at 5GHz

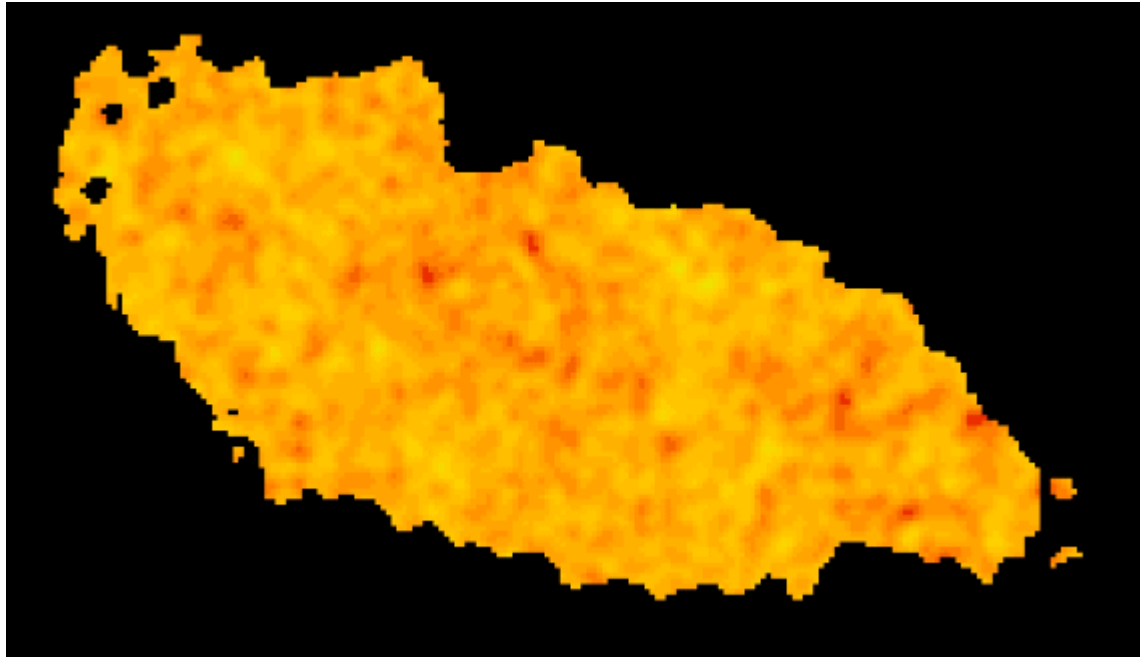
2008iz + new
transient

Neutral hydrogen in the central kiloparsec



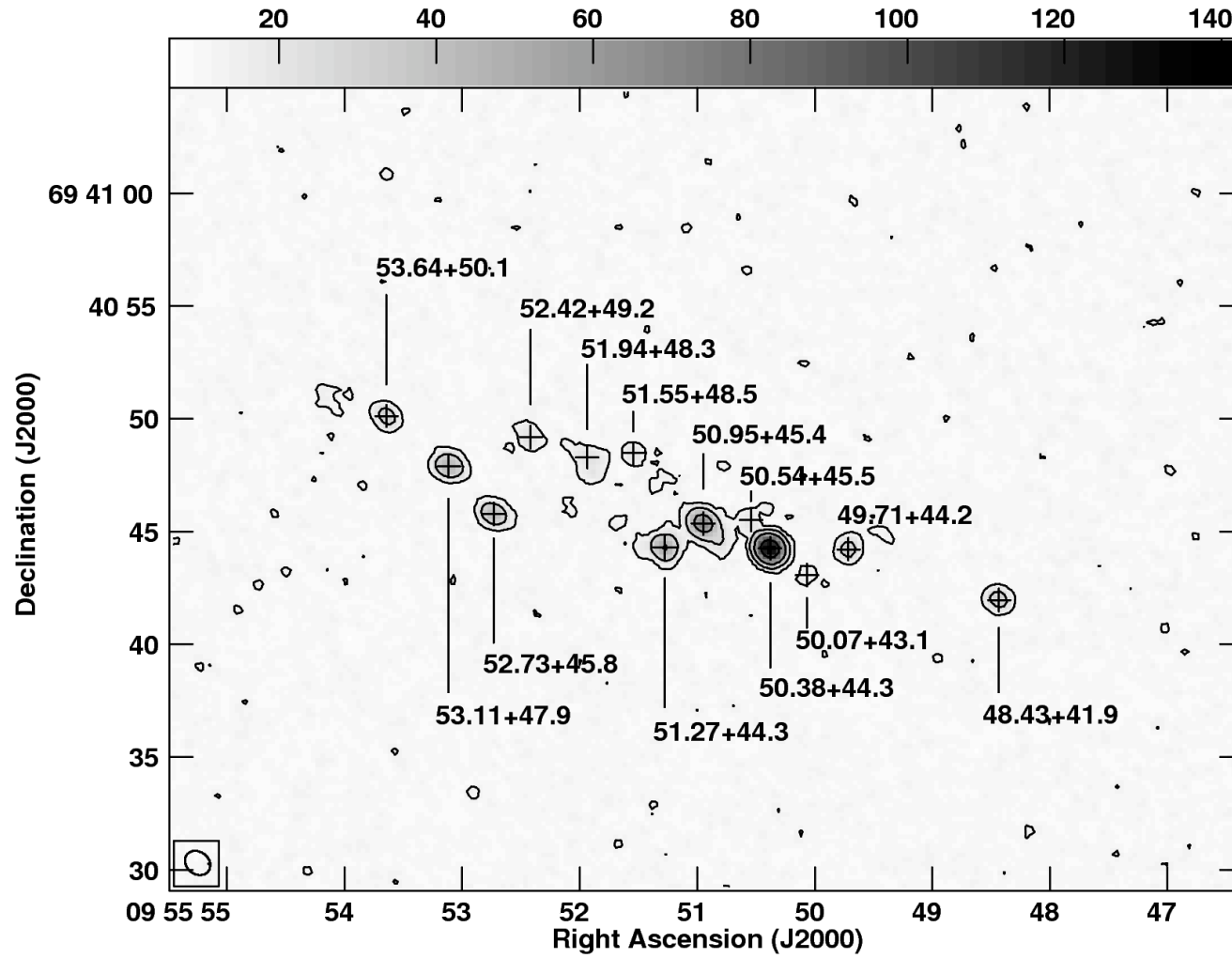
VLA observations
of M82 at 1.4GHz

OH absorption and emission in the central kiloparsec

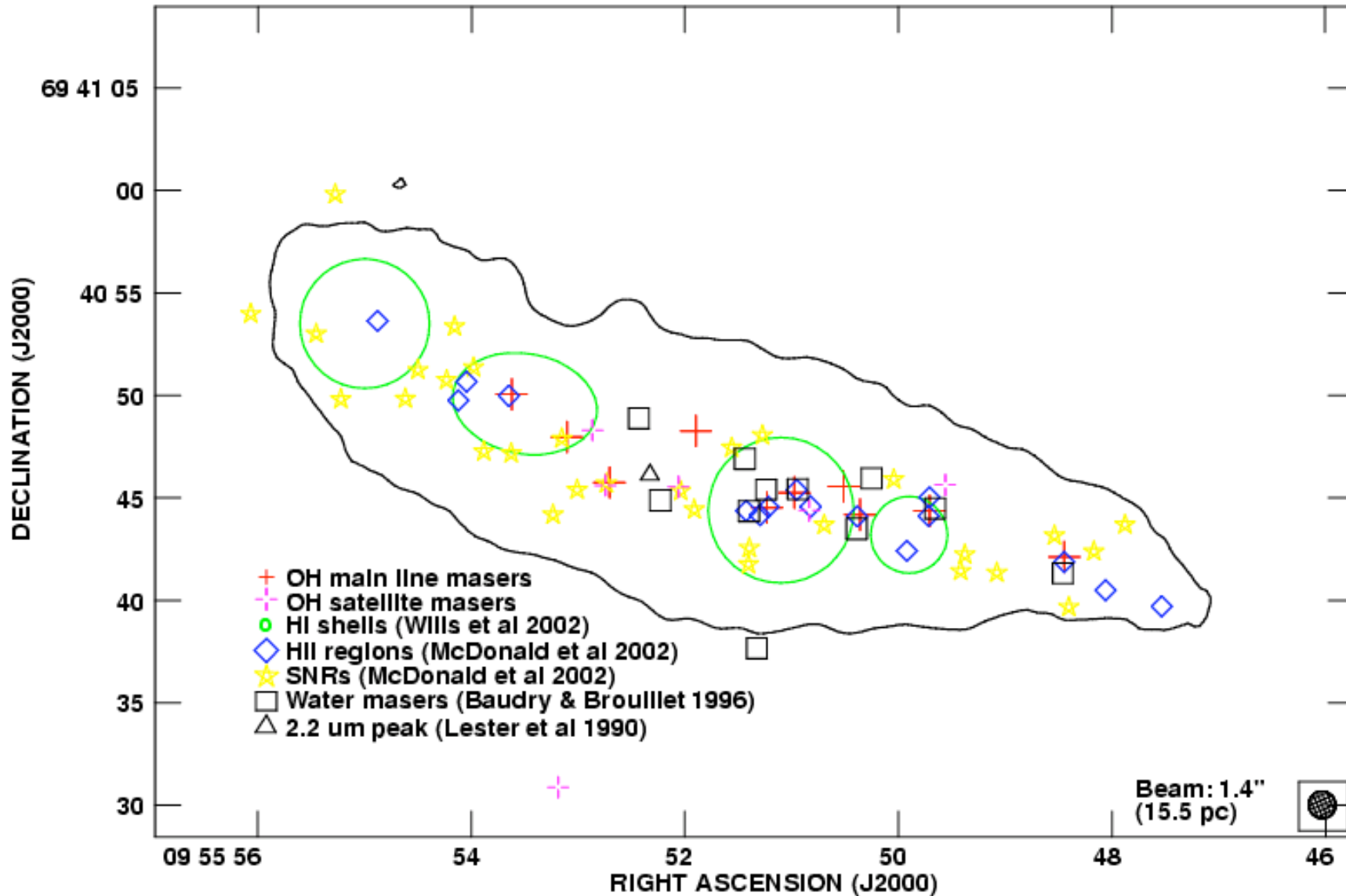


VLA observations
of M82 at 1.6GHz

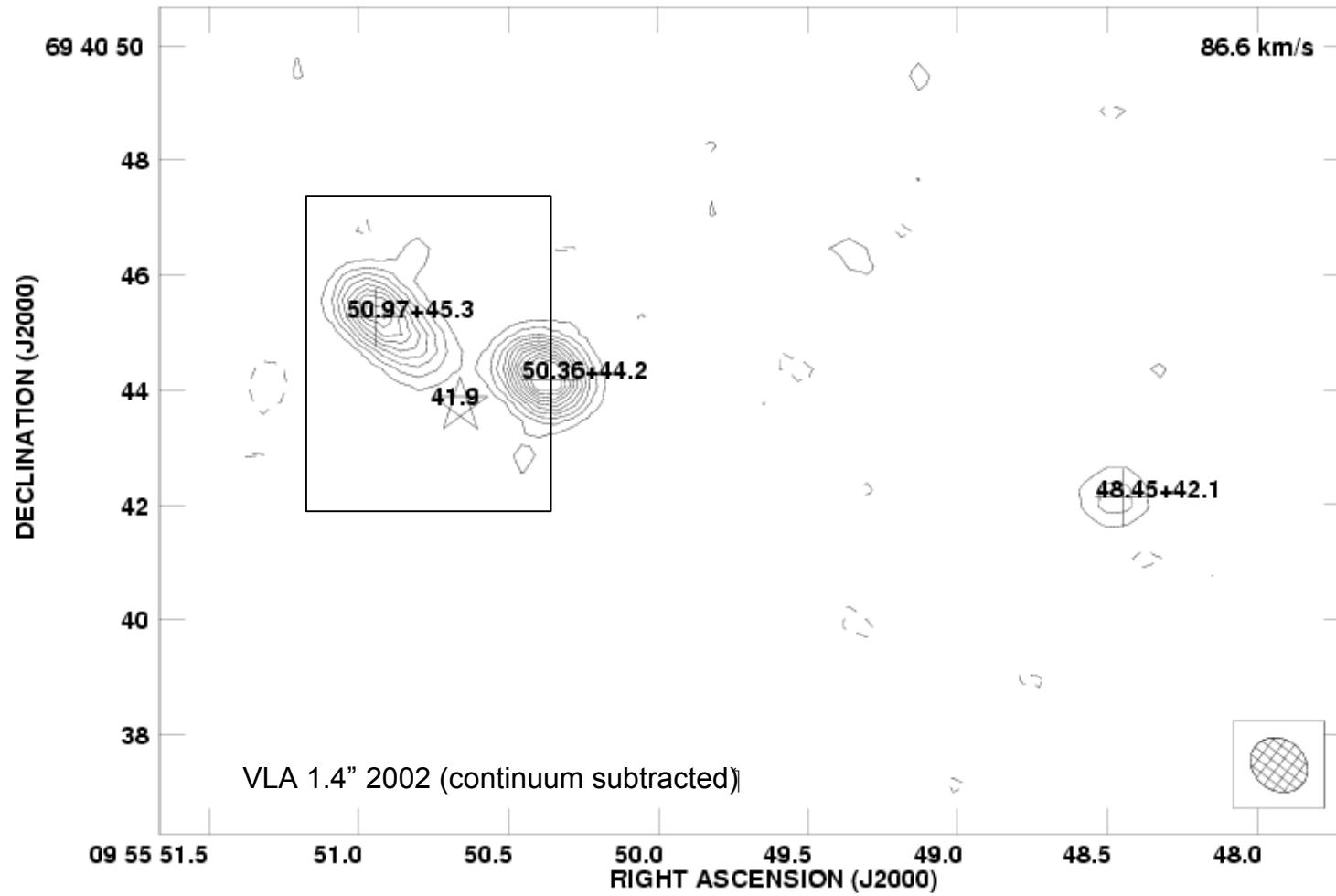
OH main line masers in M82



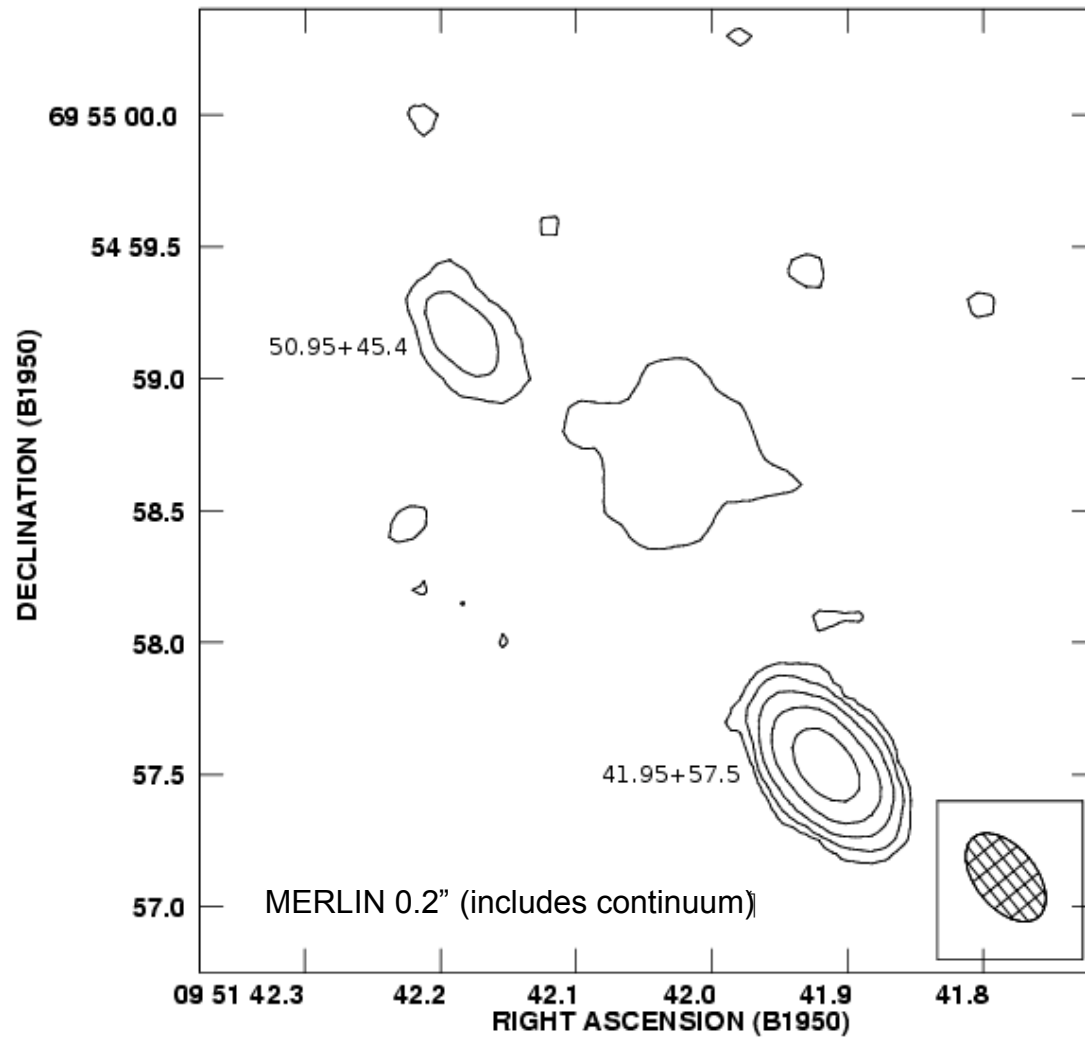
Spatial distribution - c.f. continuum sources



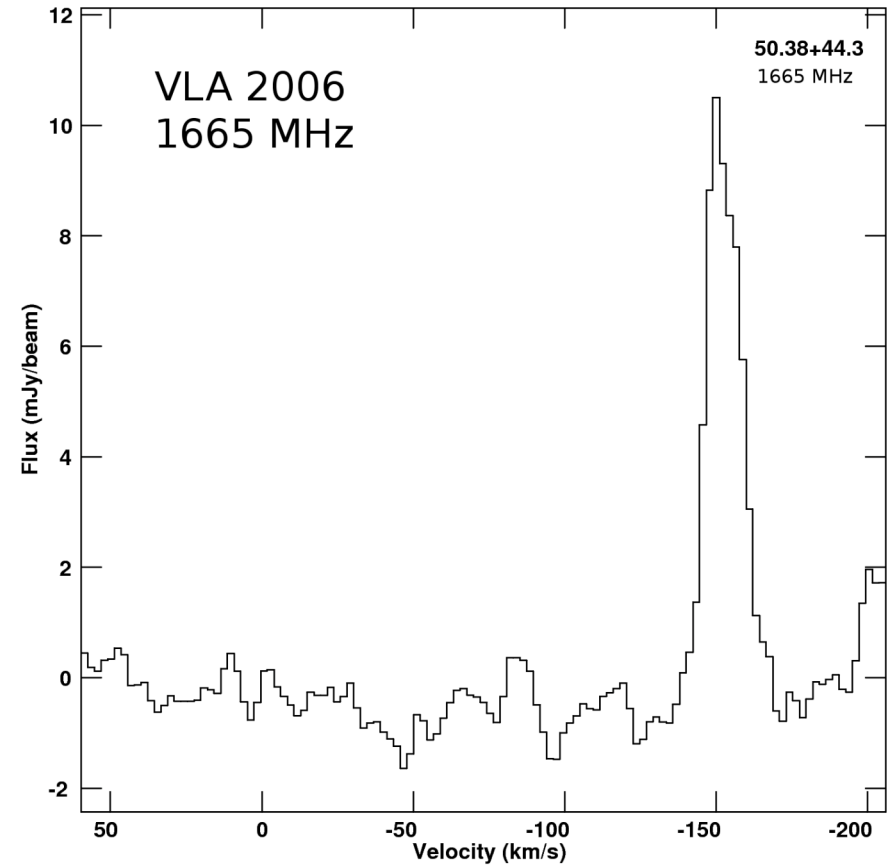
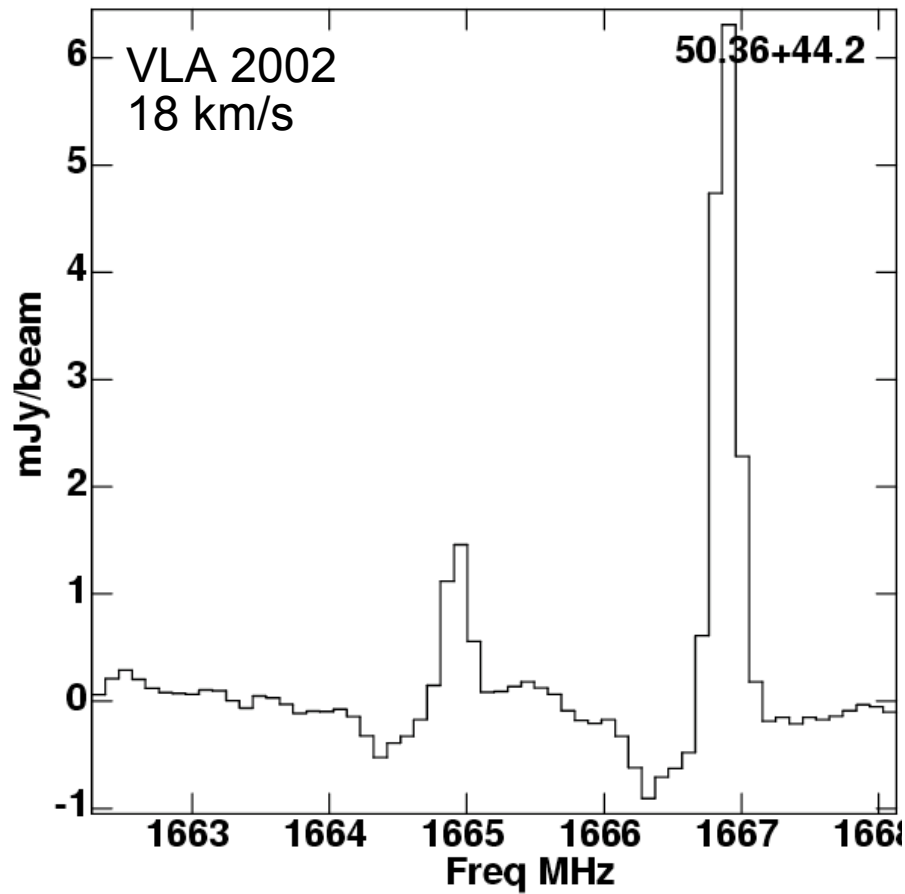
Spatial resolution?



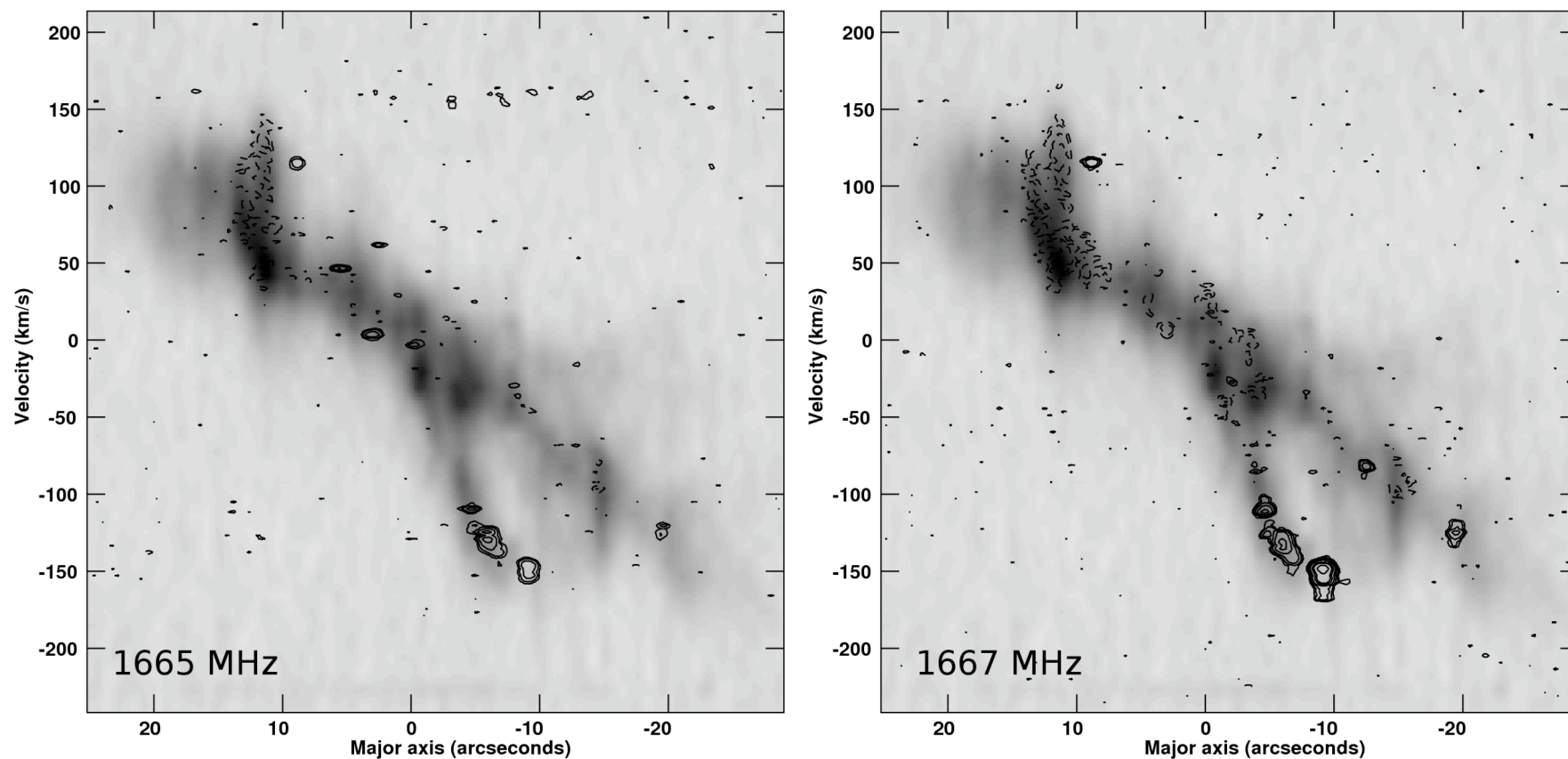
Spatial resolution?



Some spectra: **50.38+44.3** – the brightest source



Velocity distribution – c.f. atomic gas

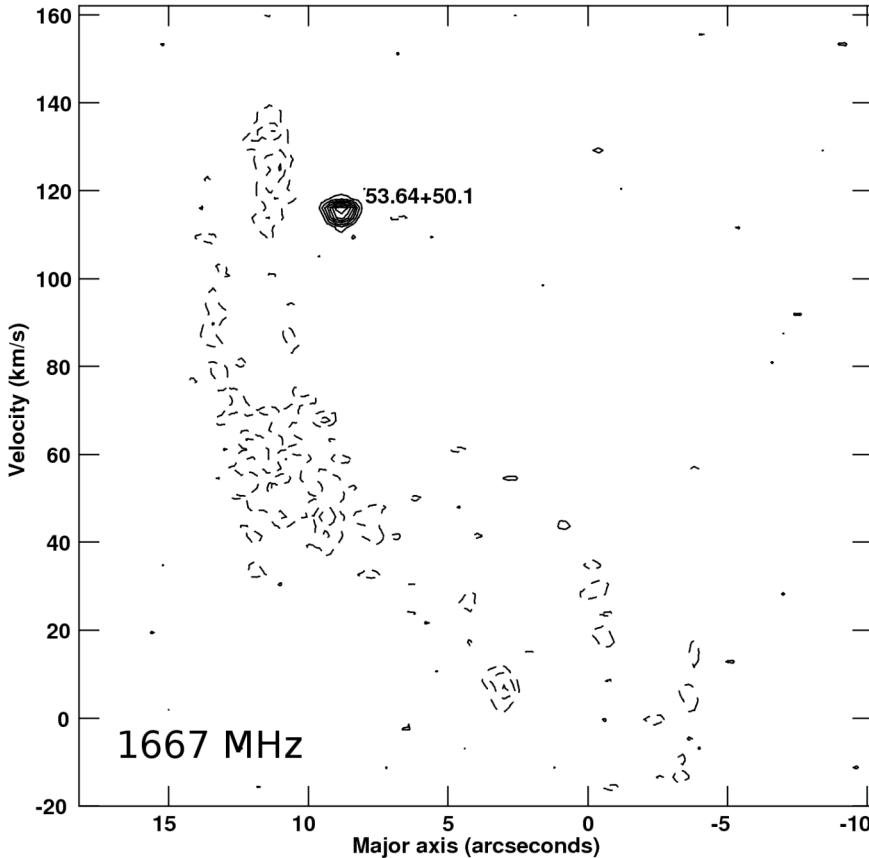
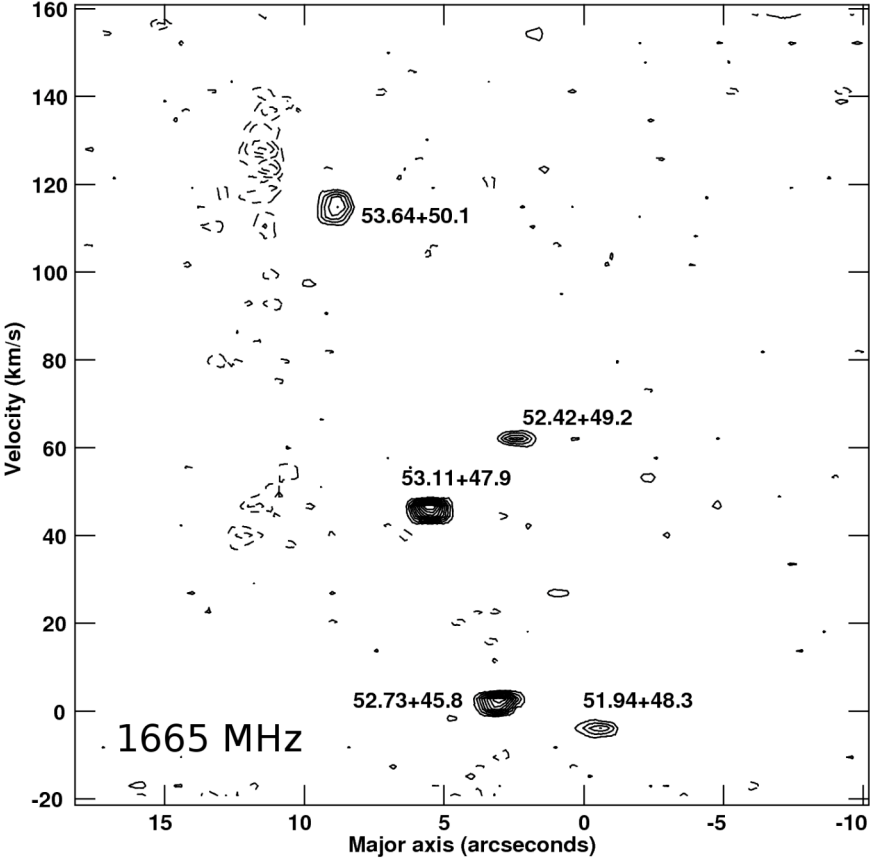


contours: VLA 2006 data (-4, -2, -1, 1, 2, 4, 8, 16, 32) x 1.5 mJy/beam

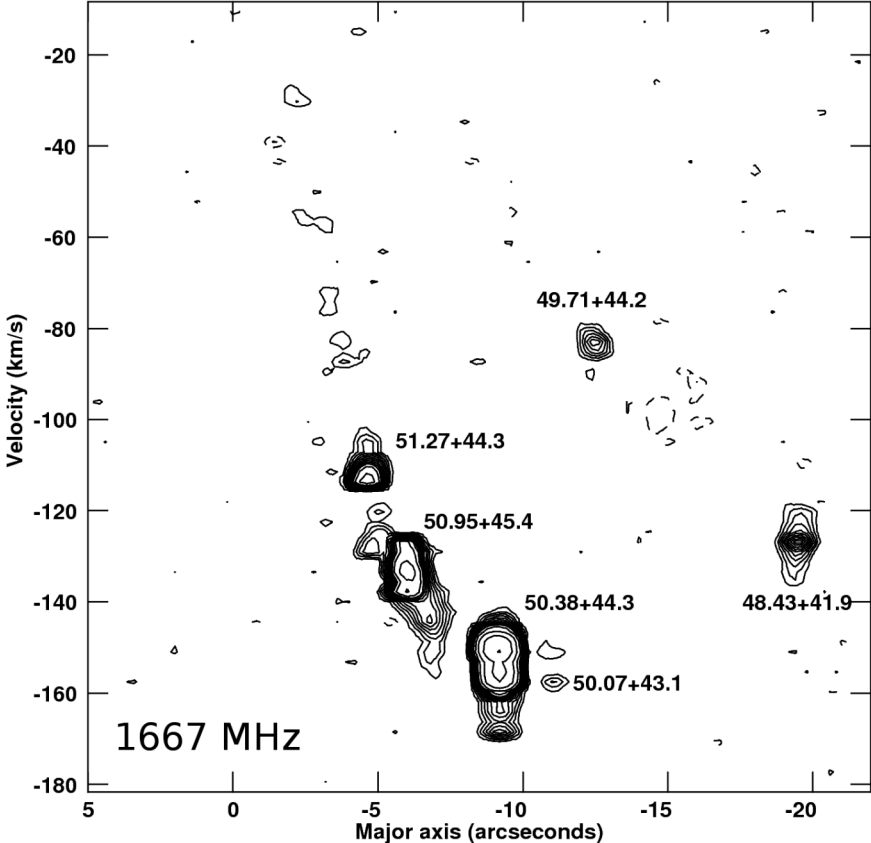
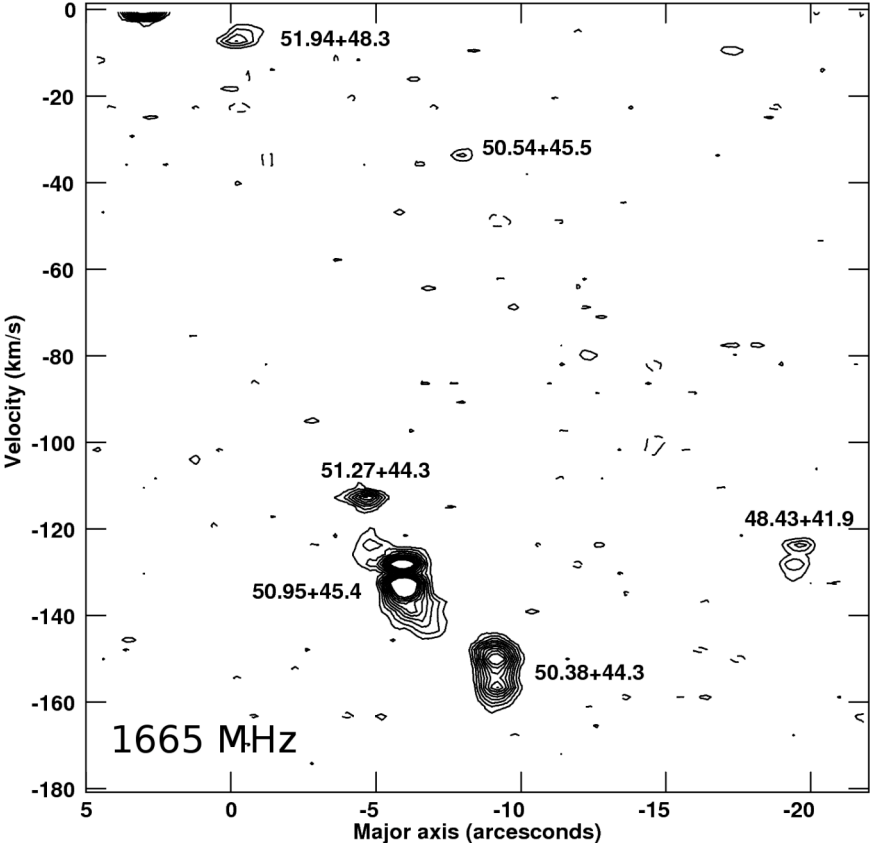
greyscale: VLA HI data from Wills et al (2000)

Velocities are relative to the systemic velocity of M82

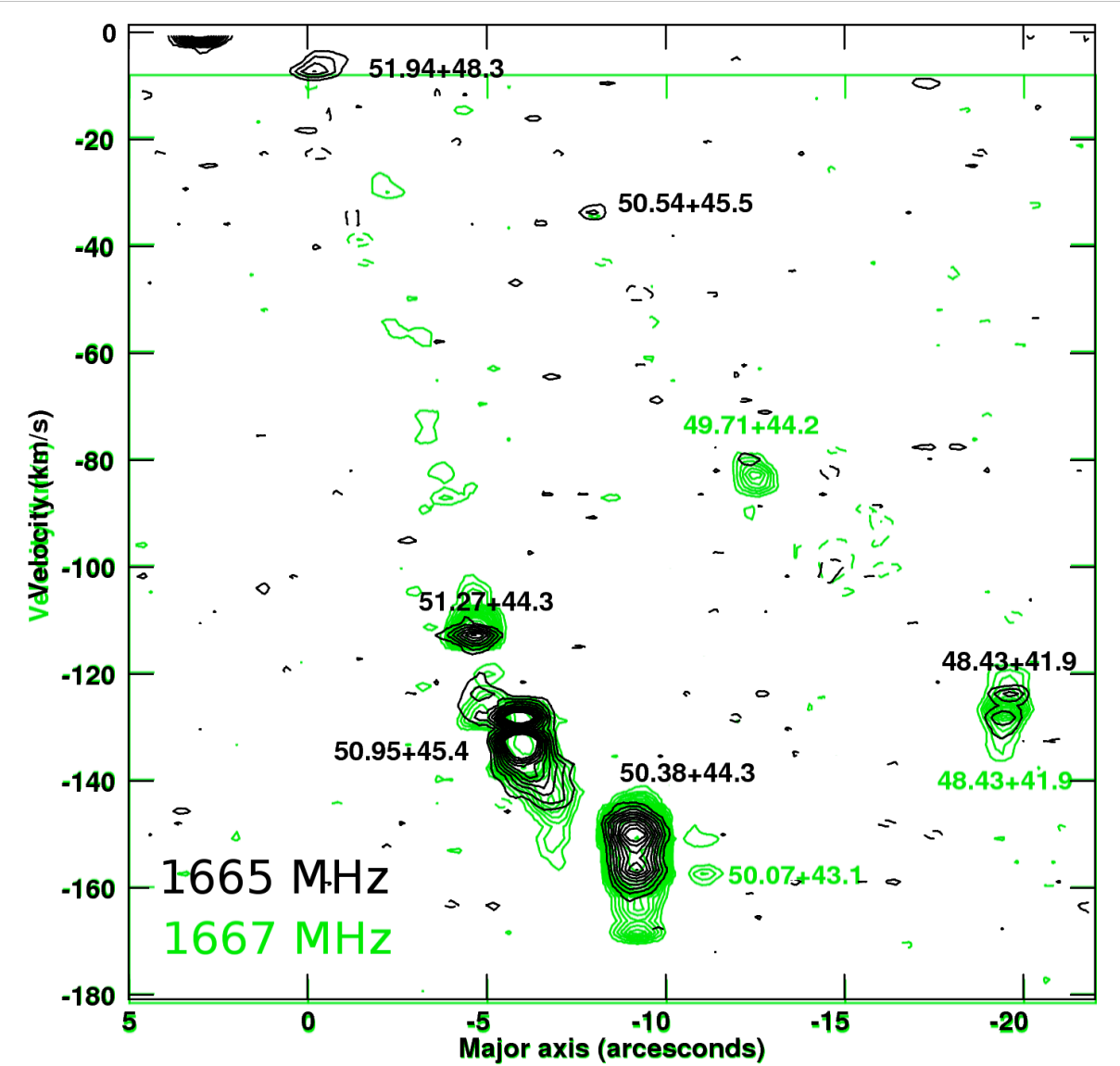
Velocity distribution



Velocity distribution



Velocity distribution



Other nearby systems

- Only have one really good lab – our galaxy
- Can see kilomasers in a few nearby galaxies
- Further than the local group we are limited to mega/gigamasers
- Next generation radio telescopes – step forward in capability
 - OH surveys can be carried out “for free” by HI line surveys
 - **BUT** problems of mis-identifications
- Two upcoming surveys...

Legacy e-MERLIN Multi-band Imaging of Nearby Galaxies (PIs: Beswick &McHardy)

- “The aim of this project is to observe a large sample of nearby galaxies with sub-arcsecond angular resolution at microJy sensitivities. Such observations will allow us to study a very wide range of astrophysical phenomena, such as supernovae and their remnants, HII regions, potentially extragalactic X-ray binaries, ULX source, planetary nebular, AGN and jets and much more.”
- Shallow tier: 280 galaxies out to 100 Mpc (from Palomar sample)
- Deep tier: 6 galaxies with particularly good ancillary data
- All observed at both L and C-band
- Much of this is continuum science BUT:
 - new e-MERLIN correlator provides **very** flexible line capabilities
 - survey kinematics with OH (and HI) at the same time
- Many new 'laboratories' to study and compare

ASKAP OH Megamasers survey (PI: Roy)

- Survey OH megamaser (gigamaser) population out to $z=1.38$ with ASKAP
- Trace high-IR luminosity galaxies, merger systems
 - luminosity/number evolution?
- Previous surveys mostly targeted strong-IR sources
 - this will be a blind, unbiased survey
 - does orientation have an effect?
- In parallel with planned HI surveys, BUT
 - confusion with lower-redshift HI likely – need redshifts

Summary

- In M82, the molecular OH gas shows similar distribution to HI
 - including blue arc which aligns with pv slope seen in [NeII]
- OH masers (mostly) coincident with known continuum features
 - unknown whether these associations are physical or just l.o.s.
- Some show significant velocity structure
 - especially in the blue arc (although still unresolved spatially)

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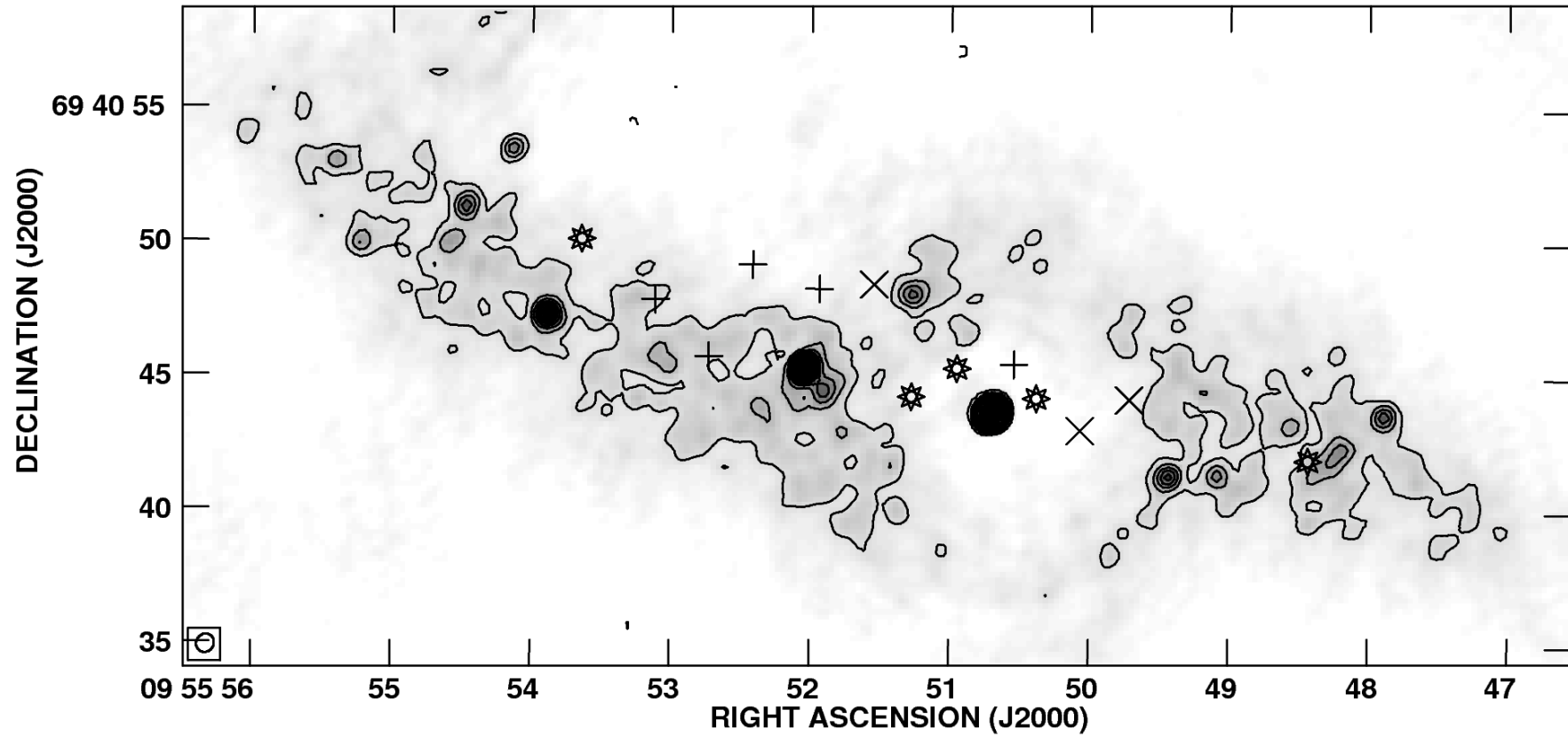
Summary

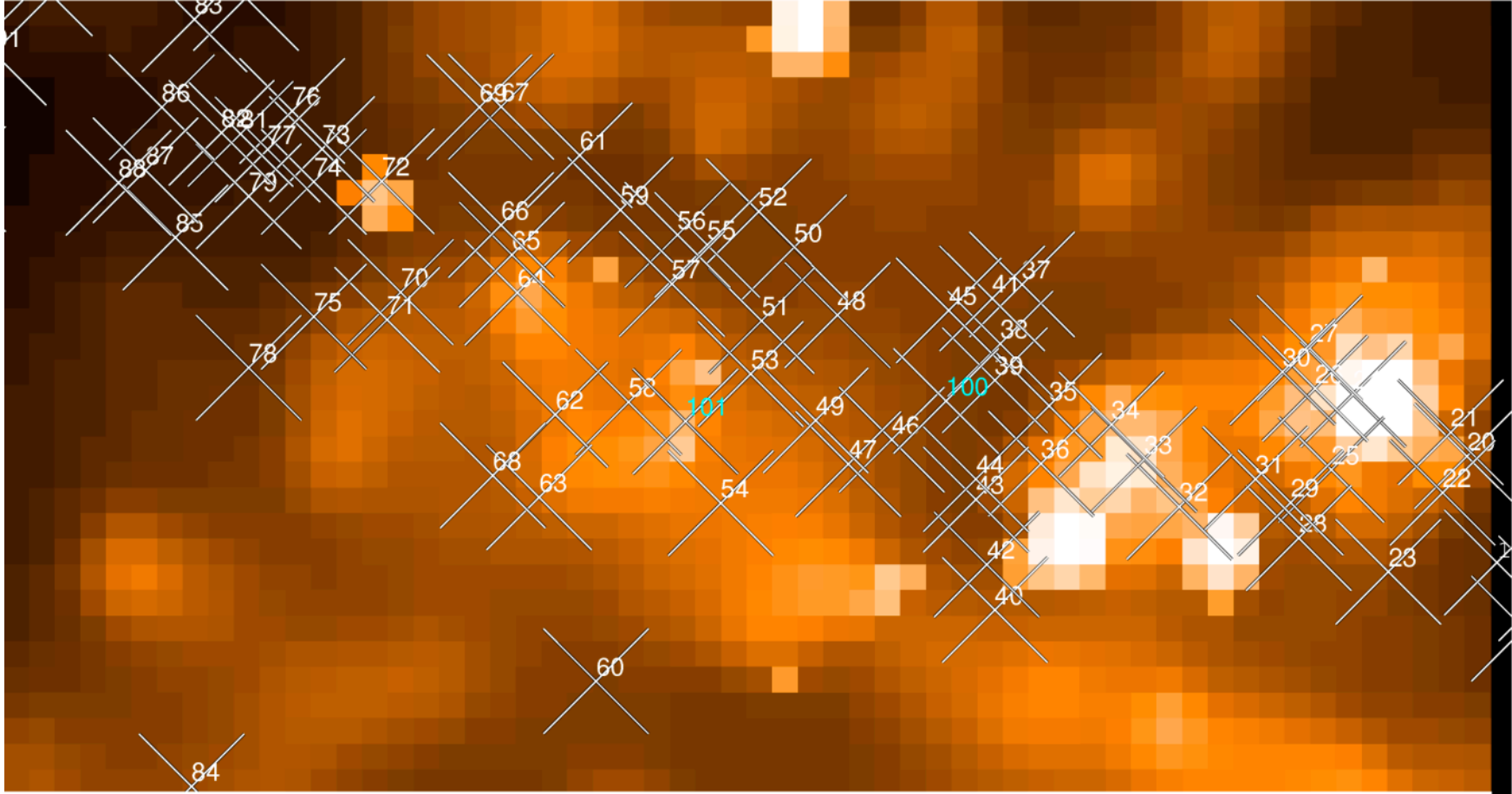
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And finally....

- HI is not the only useful line!

Ionised gas





Starlink GAIA::Skycat
Mez

M82-2.fits
9:55:50.779 69:40:40.66 J2000

dferrech

Jun 04, 2009 at 16:27:11