A new jet/outflow maser in the nucleus of the Compton-thick AGN IRAS15480-0324

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The CT AGN sample

H_2O maser sources associated with AGN tend to show a **high column density** ($N_H > 10^{23}$ cm^{-2}) or are even **Compton-thick** ($N_H > 10^{24}$ cm^{-2}) (Braatz et al. 1997, Zhang et al. 2006, Greenhill et al. 2008, Castangia et al. 2013)

36 Compton-thick AGN

- Selection method:

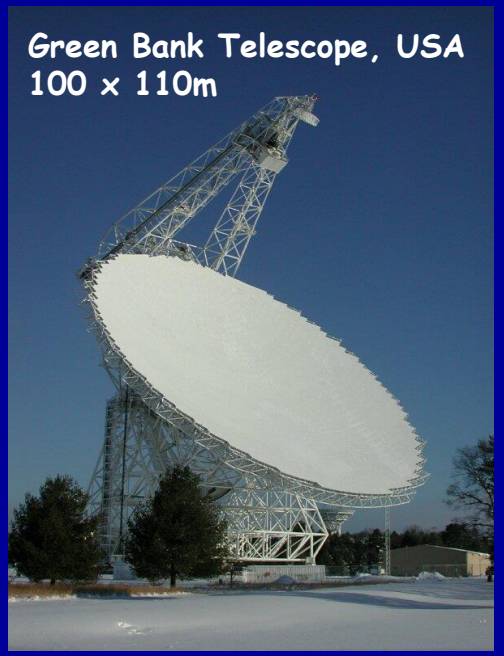
  FIR and X-ray flux and colours

  (Severgnini et al. 2012)

Maser detection rate of the entire sample: 50%!
(jet-maser sample, Henkel et al. 2005)

- 5 reobserved to improve detection threshold

  → A new water megamser

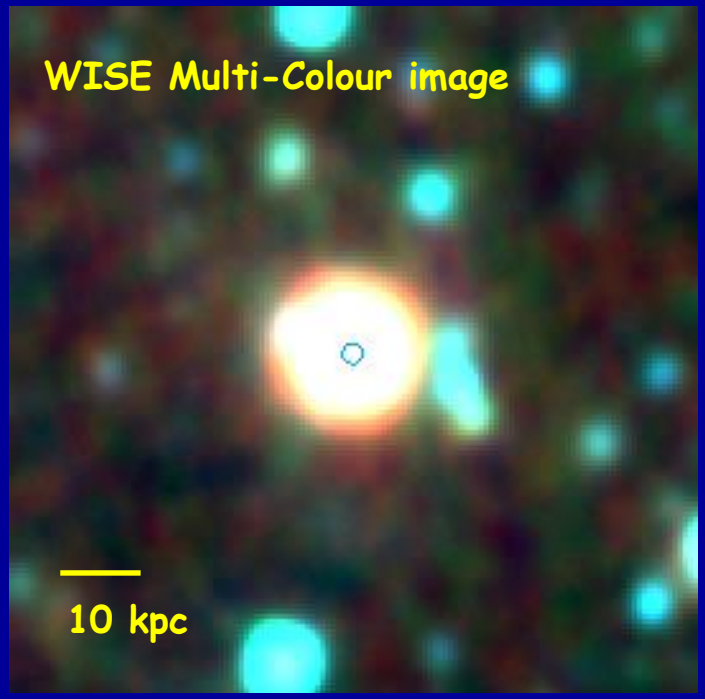


IRAS 15480-0344

A field S0 galaxy at ~130 Mpc

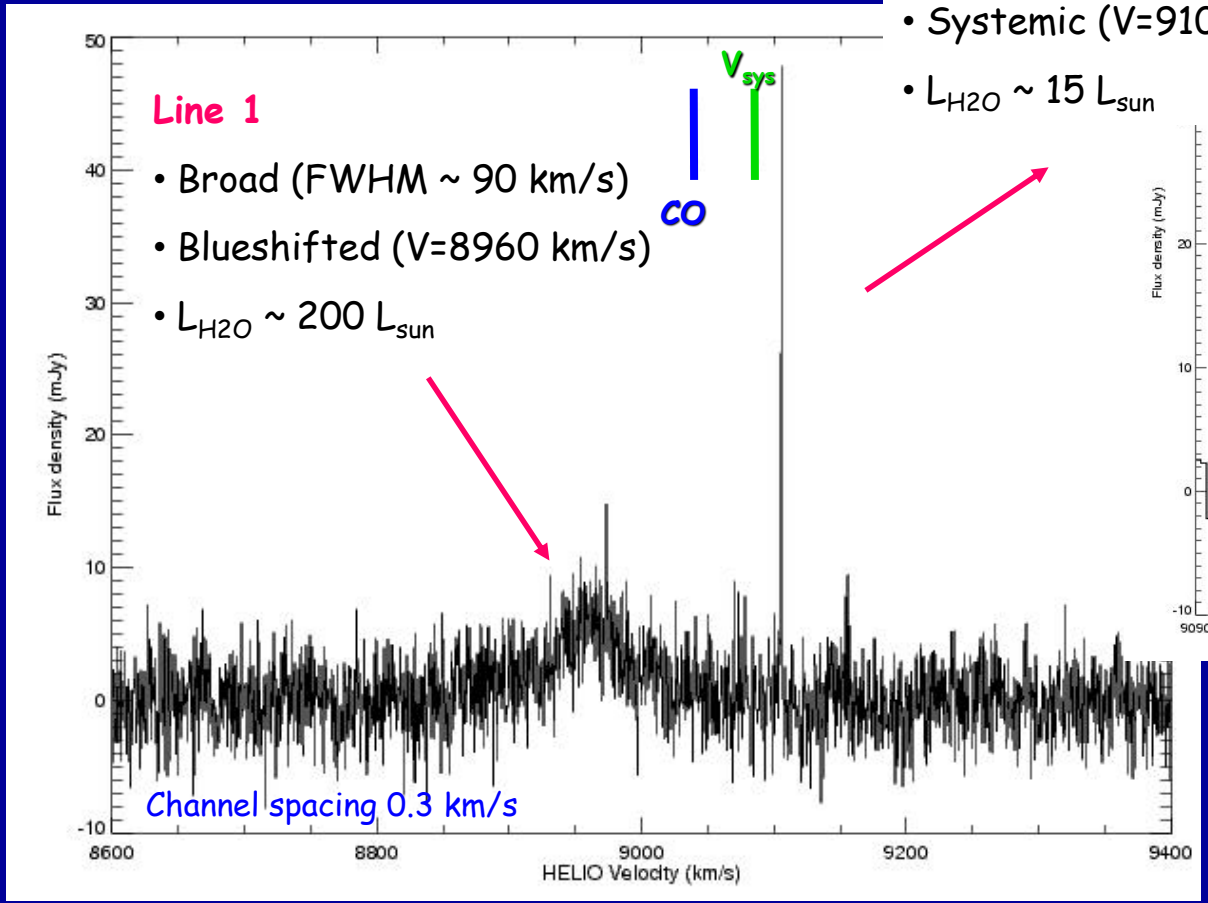
The nucleus:

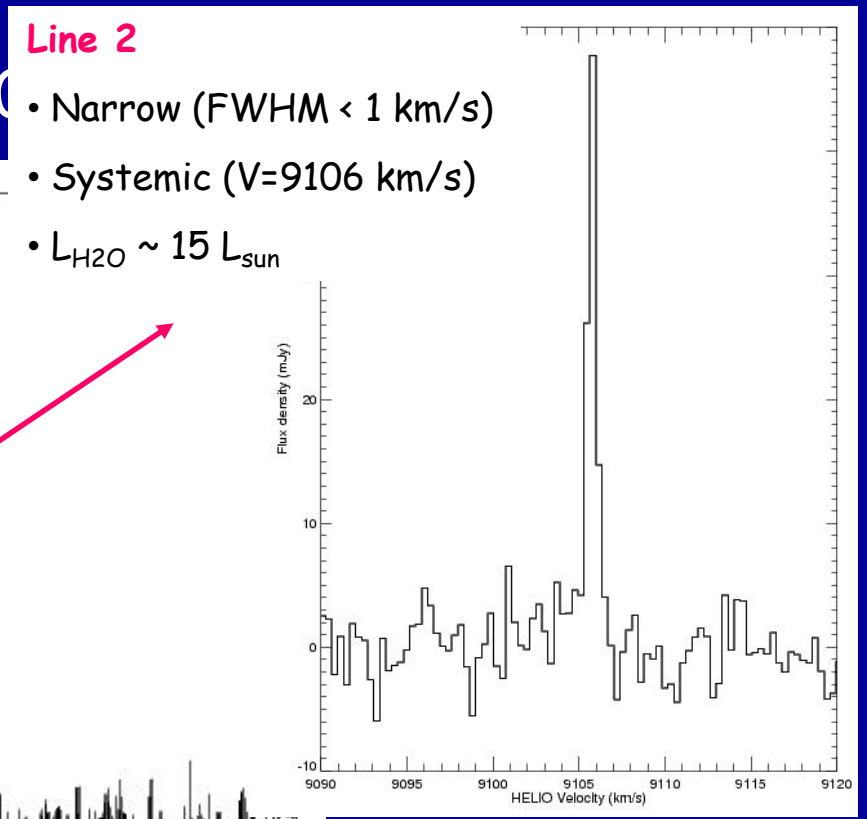
- Sy2 with broad Ha in pol. (weak)
  (Young et al. 1996)
- Unresolved radio source (VLA A, 8.4 GHz)
  Angular diameter < 60 pc
  (Schmitt et al. 2001)
- L_X=1-4x10^{43} erg s^{-1}
  (Brightman & Nandra 2011)



Single-dish observations

GBT observations, April 7, 20





(Castangia et al. 2016)

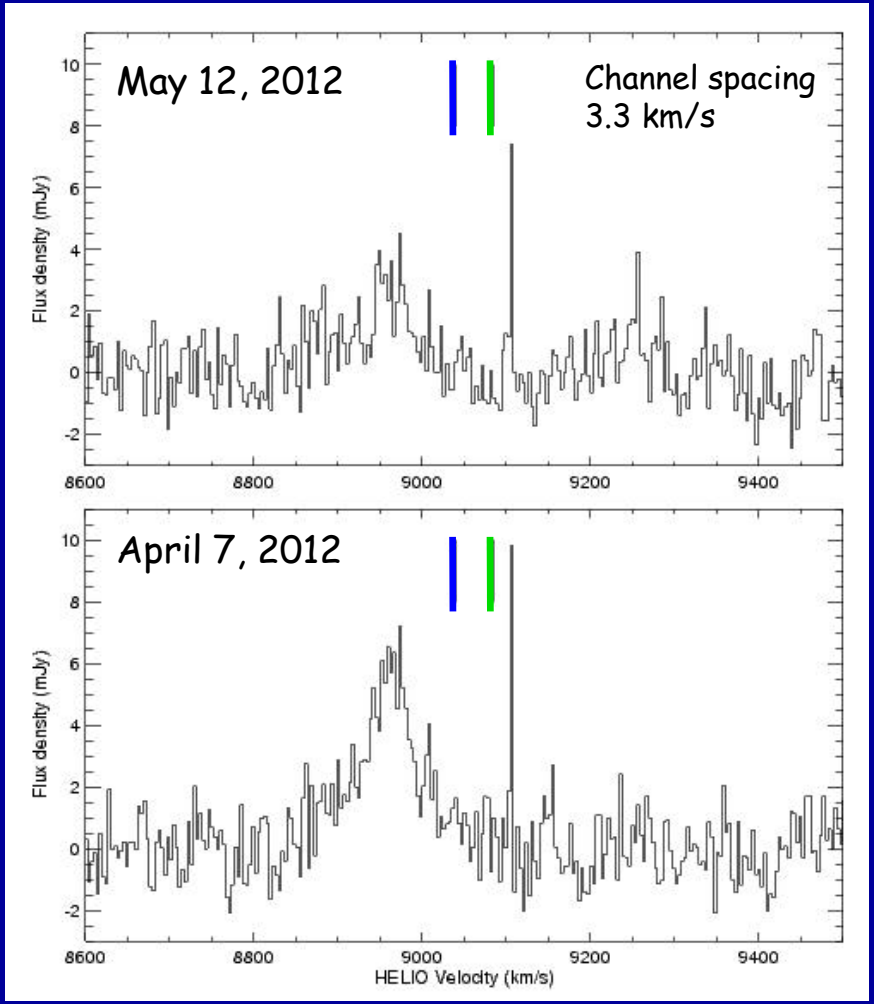
Single-dish observations

The **broad** line is **variable**:

Peak and int. flux density decreased to $\frac{1}{2}$ of their initial values in ~1 month

The properties of the **narrow** component remained relatively **constant**

(Castangia et al. 2016)



VLBI observations

Spectral line observations at K-band (ToO)

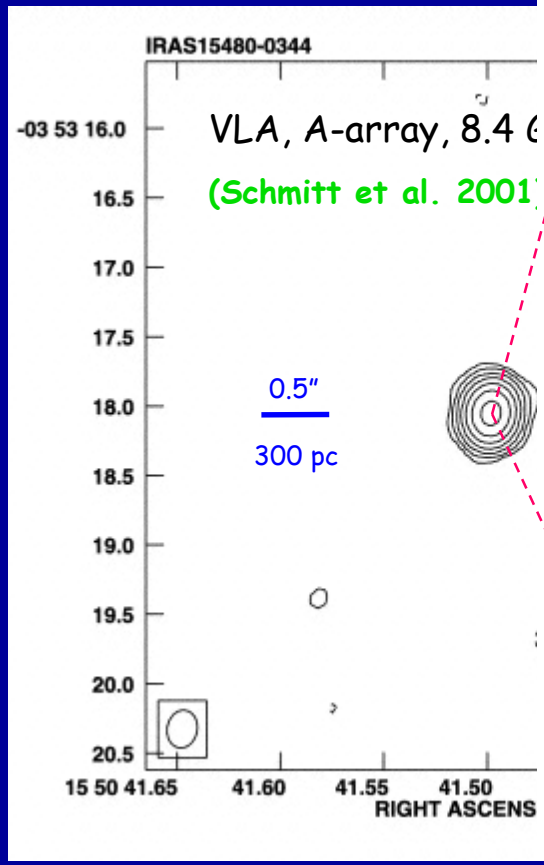
- Telescope: VLBA
- Dates: June 2 and 3, 2012 (2 x 5 hr)

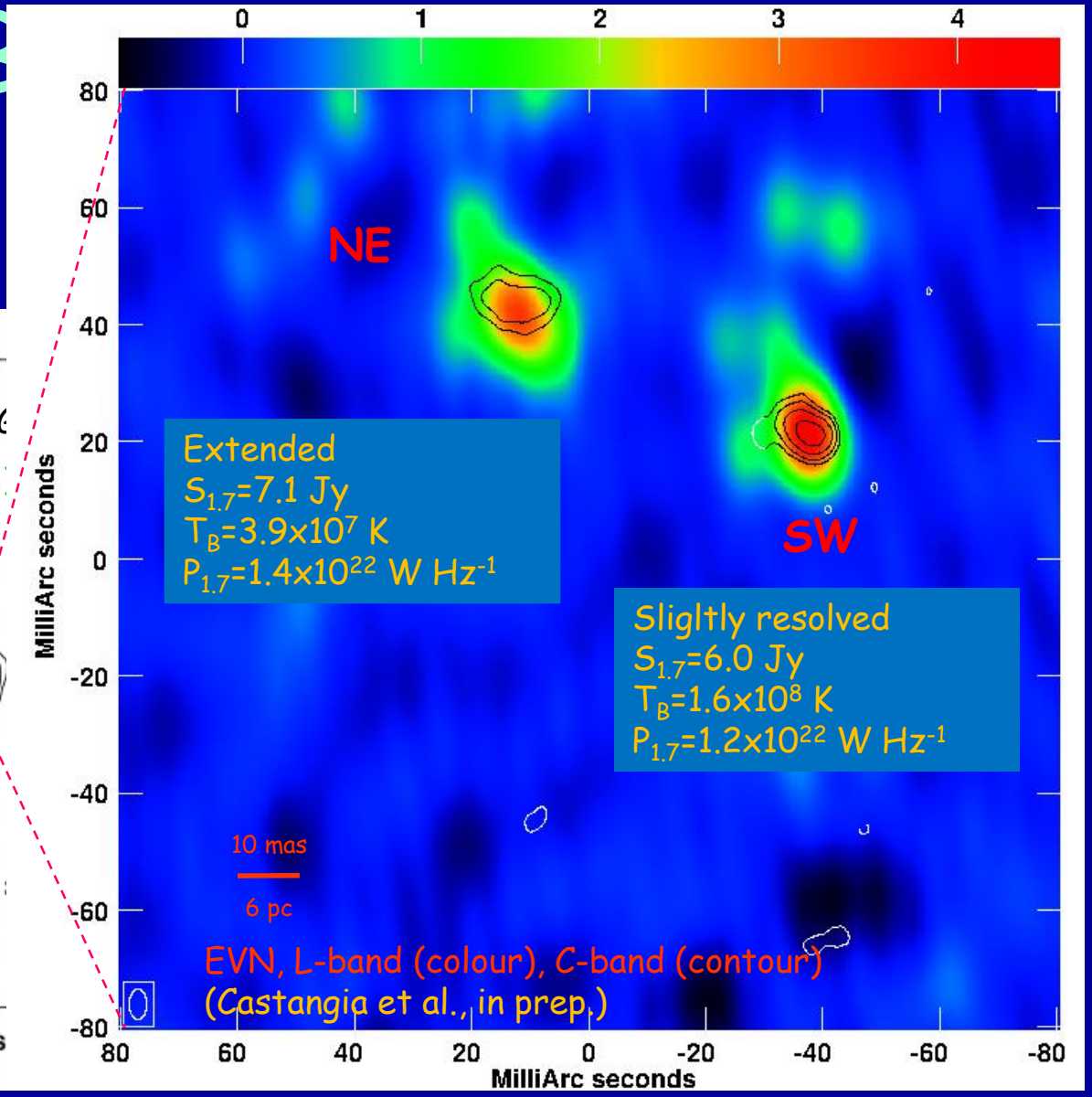
We confidently detected the narrow component at Vsys
A weak narrow feature was tentatively detected in the velocity range of the broad line
(Castangia et al. 2016)

Continuum observations at L and C-band

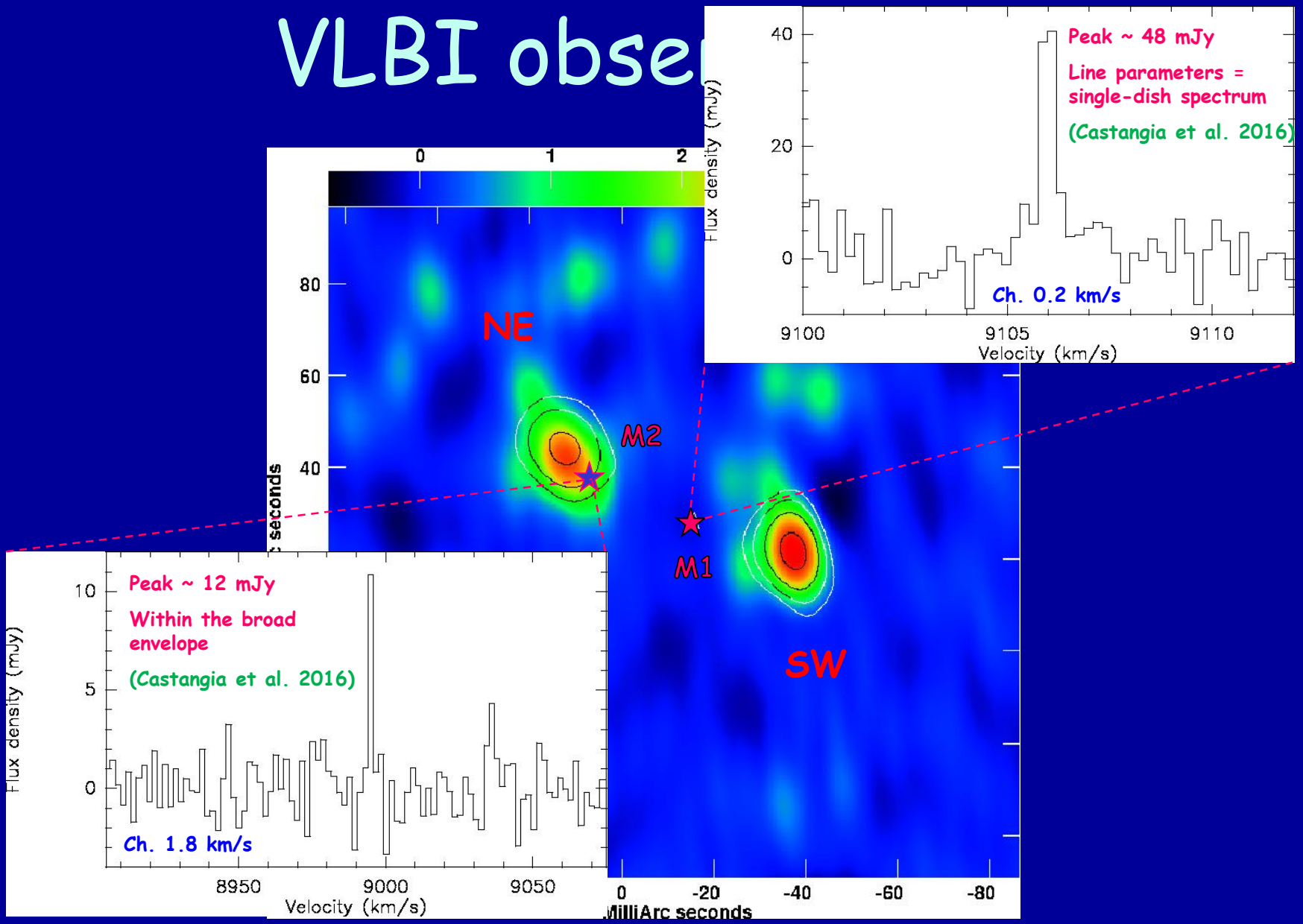
- Telescope: EVN (including the SRT at L-band)
- Dates: February 28 (L-band) and March 11 (C-band), 2015 (6 hr each)
- Bands: 8 x 16 MHz IFs
- Correlation: 32 ch per IF and pol.

VLB


IRAS15480-0344
VLA, A-array, 8.4 G
(Schmitt et al. 2001)
0.5″
300 pc
-03 53 16.0
16.5
17.0
17.5
18.0
18.5
19.0
19.5
20.0
20.5
15 50 41.65
41.60
41.55
41.50
RIGHT ASCENS


0
1
2
3
4
NE
SW
Extended
$S_{1.7}$=7.1 Jy
T_B=3.9x10^7 K
$P_{1.7}$=1.4x10^{22} W Hz^{-1}
Sligltly resolved
$S_{1.7}$=6.0 Jy
T_B=1.6x10^8 K
$P_{1.7}$=1.2x10^{22} W Hz^{-1}
10 mas
6 pc
EVN, L-band (colour), C-band (contour)
(Castangia et al., in prep.)
MilliArc seconds
80
60
40
20
0
-20
-40
-60
-80
MilliArc seconds

VLBI obse


Peak ~ 48 mJy
Line parameters = single-dish spectrum
(Castangia et al. 2016)
Ch. 0.2 km/s
Flux density (mJy)
Velocity (km/s)
NE
M2
M1
SW
Peak ~ 12 mJy
Within the broad envelope
(Castangia et al. 2016)
Ch. 1.8 km/s
MilliArc seconds

Investigating the obscured nucleus of IRAS 1548-0344

Radio continuum emission

- Total VLBI flux at 1.7 GHz is **~30%** of the NVSS flux

  → continuum emission resolved at VLBI scales

  common in Seyfert galaxies **(see e.g. Panessa & Giroletti 2013)**

- L_5=8.6x10^{38} erg s^{-1} at VLBI scales
- P_5 exceed 10^{22} W Hz^{-1}

  comparable to that of brightest Seyferts

  (e.g. IC5063; Morganti et al. 2007)

- Log R_X intermediate between radio loud and quiet AGN

Investigating the obscured nucleus of IRAS 1548-0344

Radio continuum sou

SW

Compact

$S_{1.7}$=6.0 Jy

Flat spectrum

T_B=1.6x10^8 K -> non-th

$P_{1.7}$=1.2x10^{22} W Hz^{-1}

NE

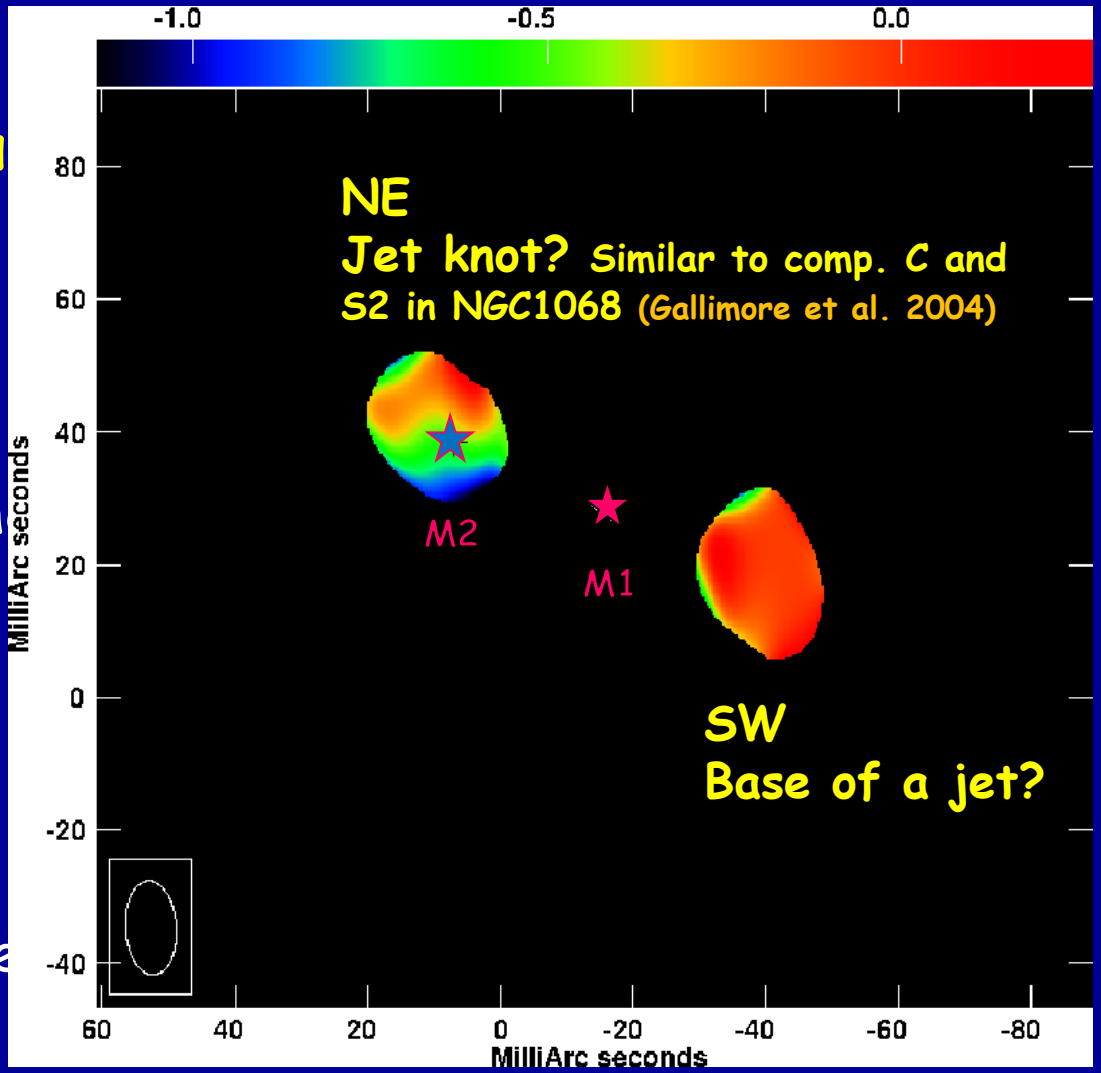
Extended

$S_{1.7}$=7.1 Jy

Steep spectrum

T_B=3.9x10^7 K -> non the

$P_{1.7}$=1.4x10^{22} W Hz^{-1}



Investigating the obscured nucleus of IRAS 1548-0344

Origin of the maser

- A slowly rotating unusually large **disk**?

  (Castangia et al. 2016)

  V_{rot} ~ 110 km s^{-1}

  R ~ 15 pc …unlikely! (typically R ≤ 1 pc)

  → maser position w.r.t the EVN sources not consistent!

  Composite origin (Castangia et al., in prep)

  broad blueshifted line → **jet** (Mrk 348, NGC1068)

  narrow systemic line → **outflow?** (disk not escluded)

Summary and future plans

- **CT AGN sample**
  - 50% maser detection rate
  - A new megamaser found
  - Statistical analysis
  - Extension of the sample
  - What about OH megamser?
- **The water megamaser in IRAS15480-0344**
  - Radio Continuum sources → jet components?
    scaled down version of more powerful radio galaxies?
  - Maser emission → Jet/outflow origin our favourite option
  - VLBI continuum observations at higher frequencies
  - Maser monitoring