High-resolution imaging of SNR IC443 and W44 with the Sardinia Radio Telescope

E. Egron (INAF/OAC, Italy)

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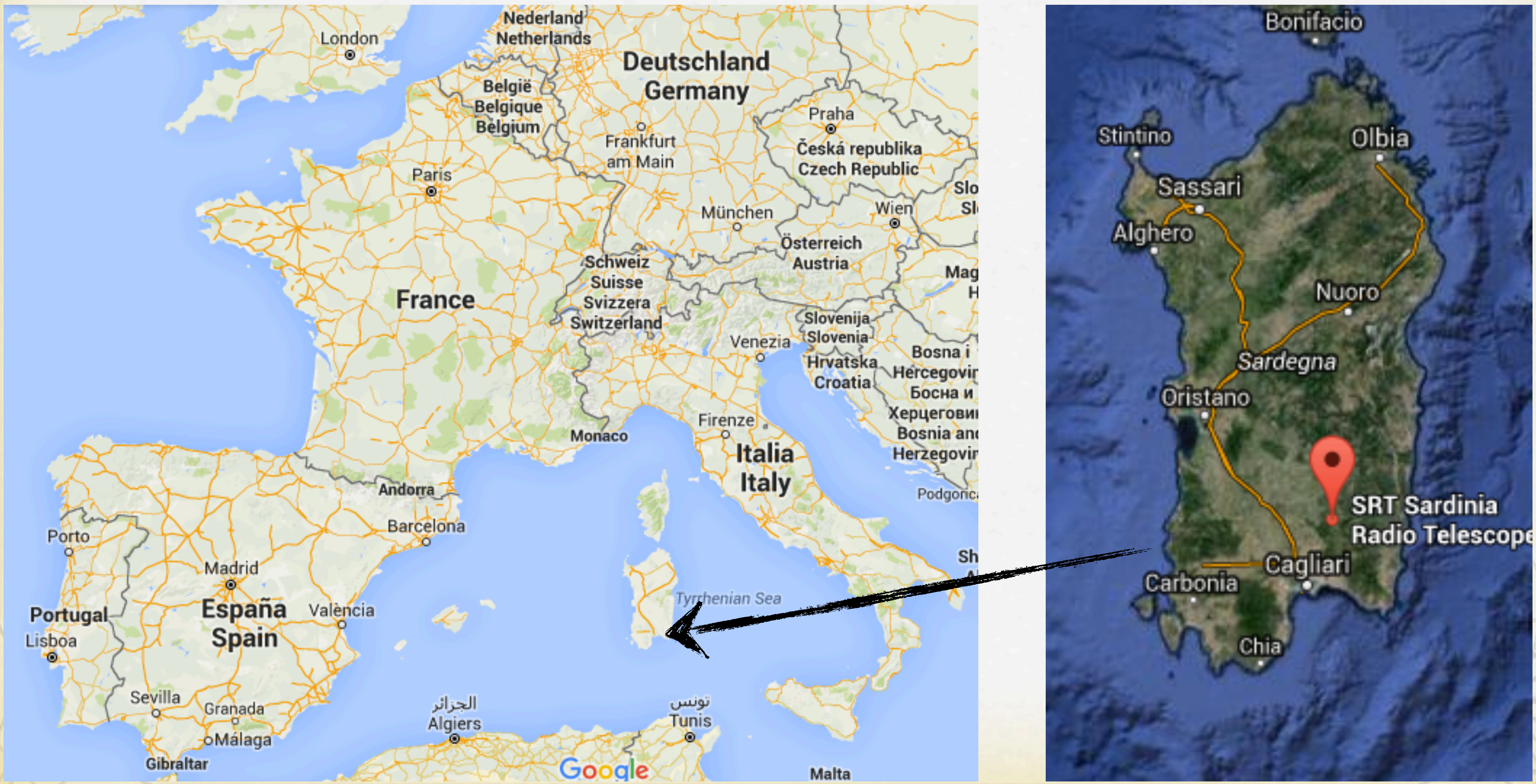
SRT Sardinia Radio Telescope

INAF ISTITUTO NAZIONALE DI ASTROFISICA NATIONAL INSTITUTE FOR ASTROPHYSICS

SRT Location

San Basilio, Sardinia

Lat. 39°29'34"N - Long. 9°14'42" E, 700 m.a.s.l.



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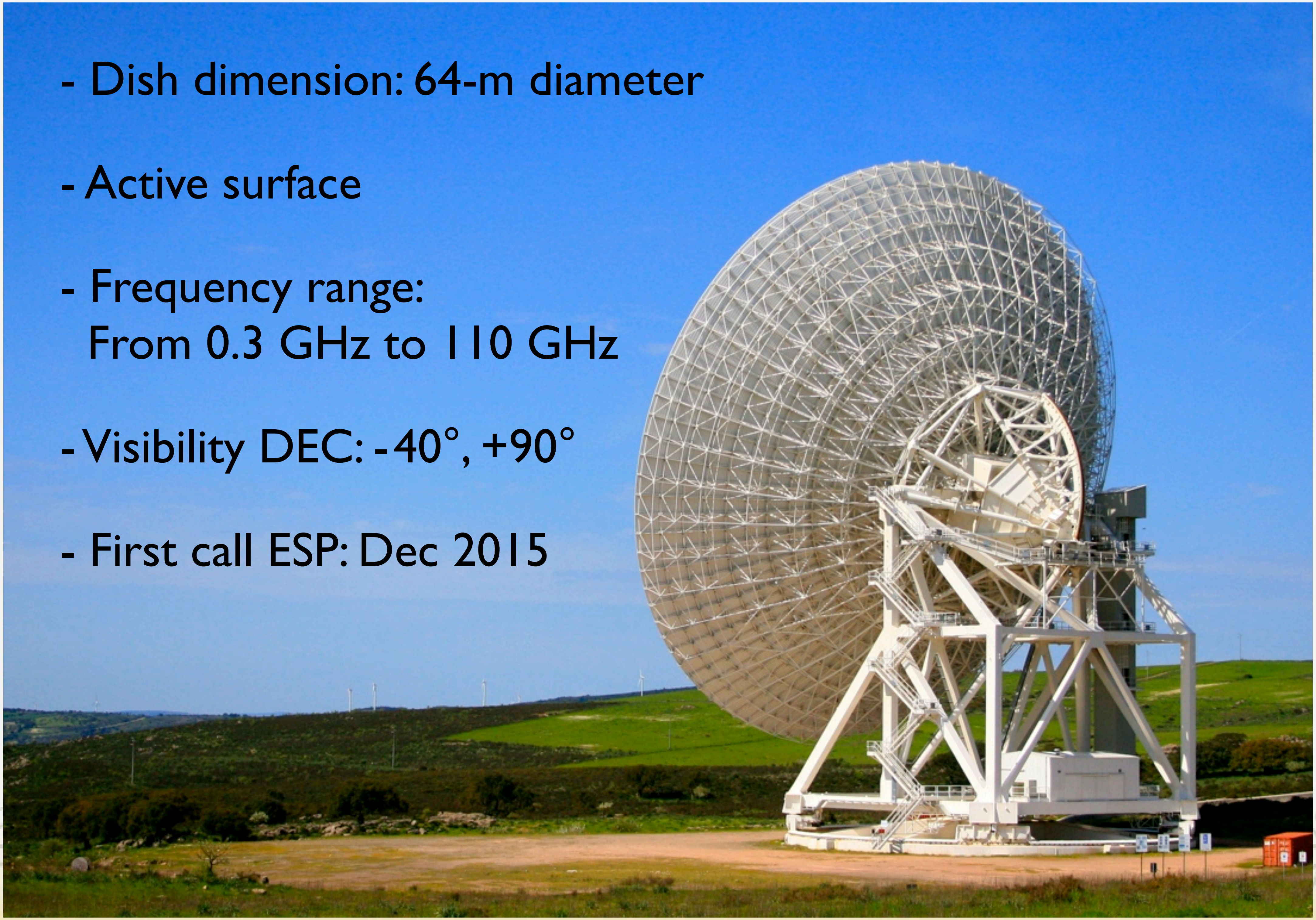
A few words about SRT



- Dish dimension: 64-m diameter
- Active surface
- Frequency range:
  From 0.3 GHz to 110 GHz
- Visibility DEC: -40°, +90°
- First call ESP: Dec 2015

Radio observations of SNRs

* High-resolution maps of SNRs are lacking > 5 GHz

* Single dish and interferometry are complementary

* SRT maps of W44 and IC443 at 1.5 GHz, 7 GHz and 21.4 GHz

AIMS => to have precise measurements on flux density

=> to better understand the spectral index of SNRs

A. Pellizzoni's talk
S. Loru's poster

SRT observations

* On-The-Fly maps
* Beam oversampling

} Pixel size about 1/4 HPBW

* Automatic RFI rejection
* Automatic baseline subtraction

} Single Dish Imager (SDI software)

=> Accurate flux density measurements and flux errors

W44 flux at 1.4 GHz ?

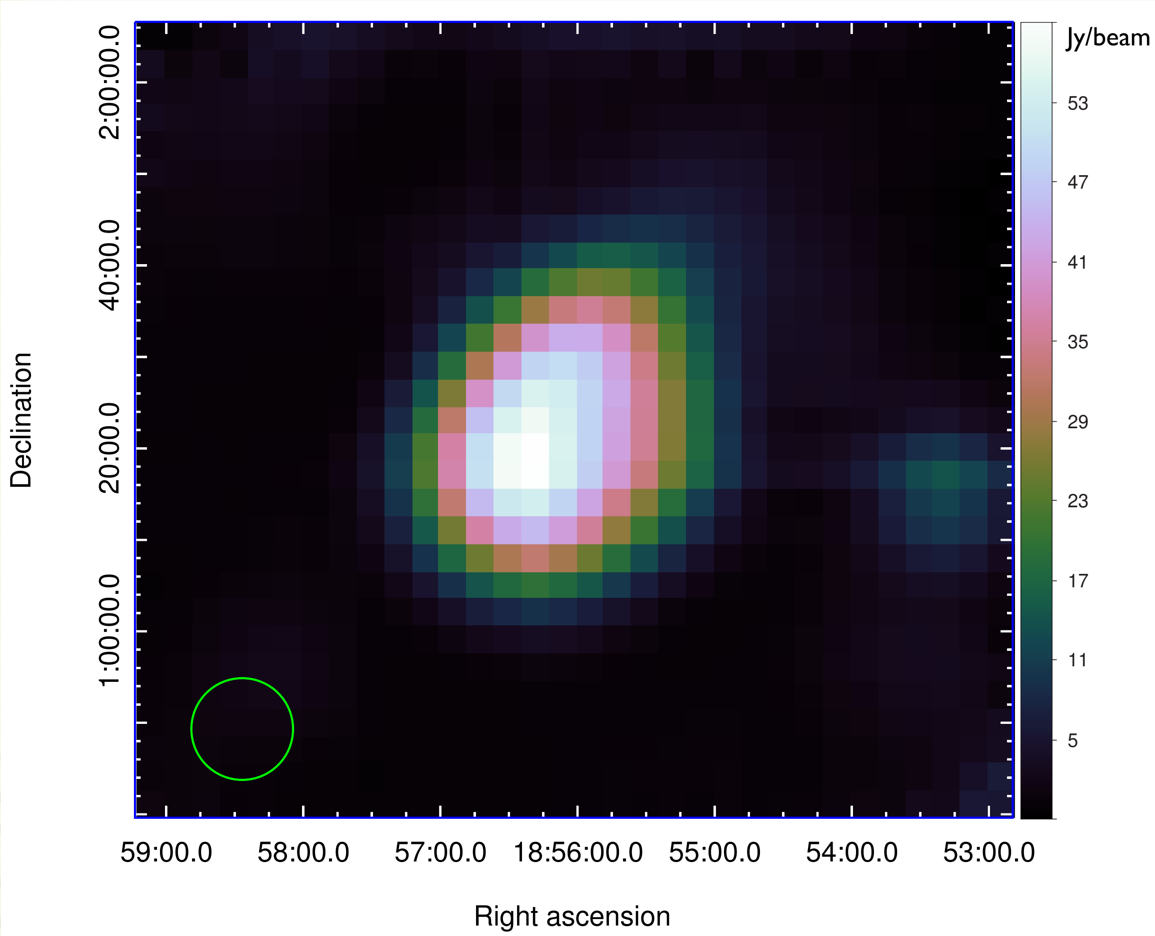
* Discrepancies in the literature (see Castelletti et al. 2007)

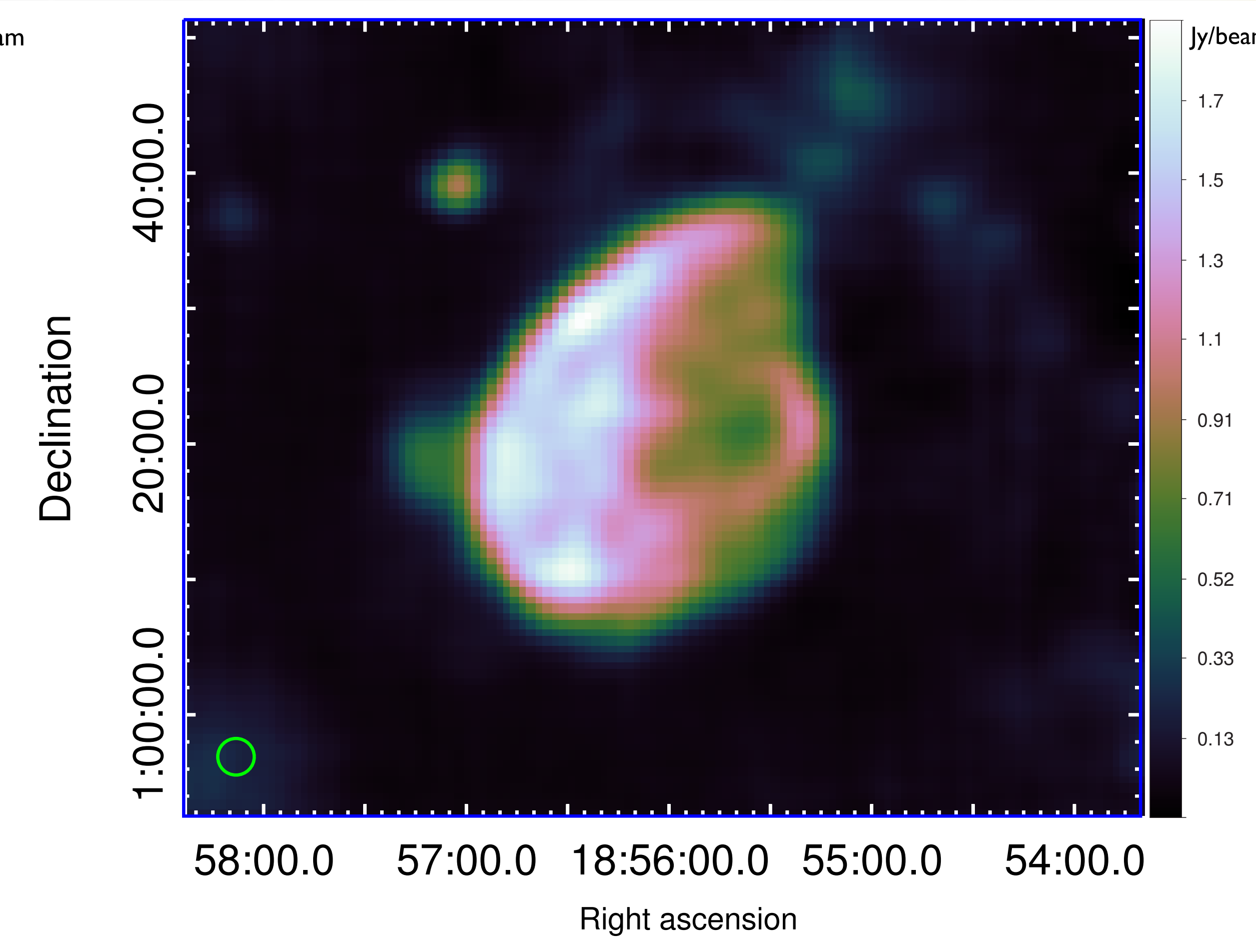
Frequency (MHz)	Scaled flux density (Jy)	References
1390.....	173 ± 35	Westerhout (1958)
1400.....	188 ± 23	Pauliny-Toth et al. (1966)
1400.....	173 ± 26	Kellermann et al. (1969)
1410.....	236 ± 47	Scheuer (1963)
1410.....	236 ± 35	Beard & Kerr (1969)
1414.....	274.7 ± 0. 4	Altenhoff et al. (1970)
1420.....	180 ± 36[c]	Leslie (1960)
1442.....	210 ± 20	Giacani et al. (1997)
1442.....	300 ± 7	Castelletti et al. (2007)

W44 at 1.5 and 7 GHz with SRT

F = 214 +/- 6 Jy
beam: 11.1’
14 maps of 1.6°x1.4°
eff time: 4h10
rms = 81 mJy/beam

F = 96 +/- 5 Jy
beam: 2.7’
7 maps of 1.2°x1.0°
eff time: 6h50
rms = 7 mJy/beam





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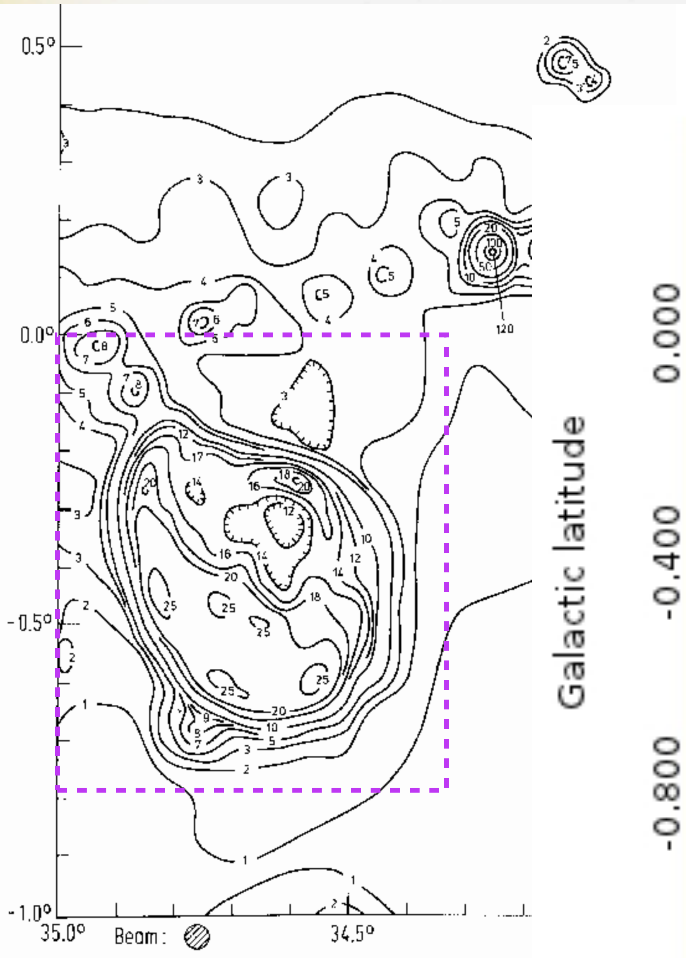
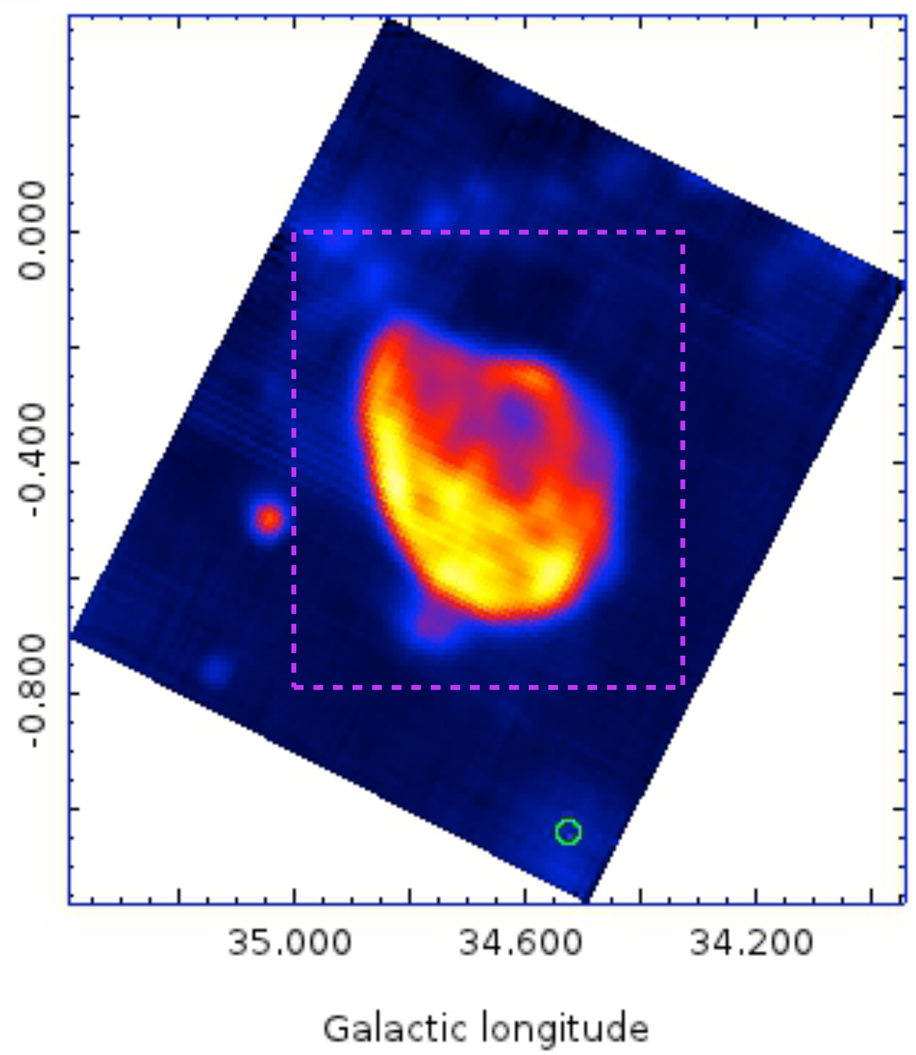
SRT: **1550........** **214 +/- 6 Jy** Egron et al. (submitted to MNRAS)

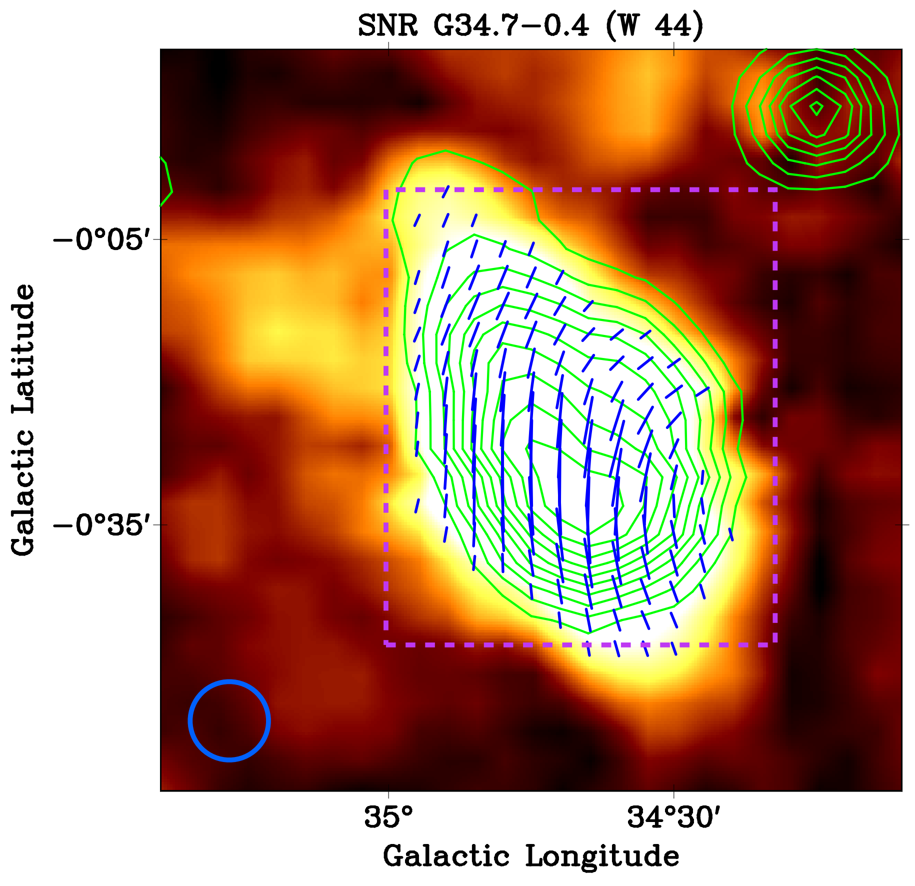
Single-dish observations of W44

* Effelsberg at 4.9 GHz (beam: 2.6')
* SRT at 7 GHz (beam: 2.7')
* Urumqi at 4.8 GHz (beam: 9.5')



Altenhoff et al. 1979



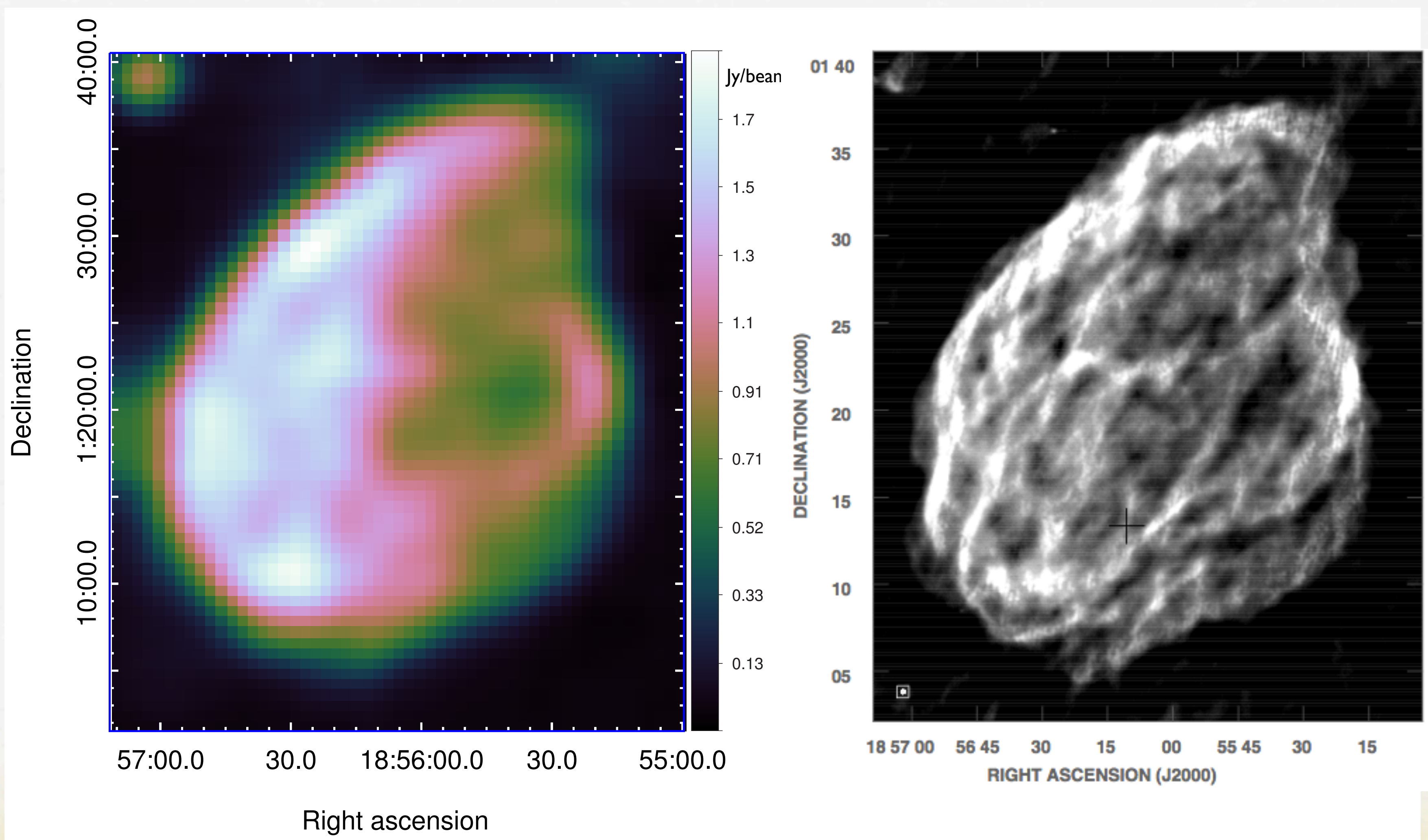


Sun et al. 2011

SRT and VLA maps of W44

* Advantage VLA => great details in the morphology
  (see Castelletti et al. 2007: obs at 324 MHz)

* Advantage SRT => accurate flux measurements at 1.5 and 7 GHz

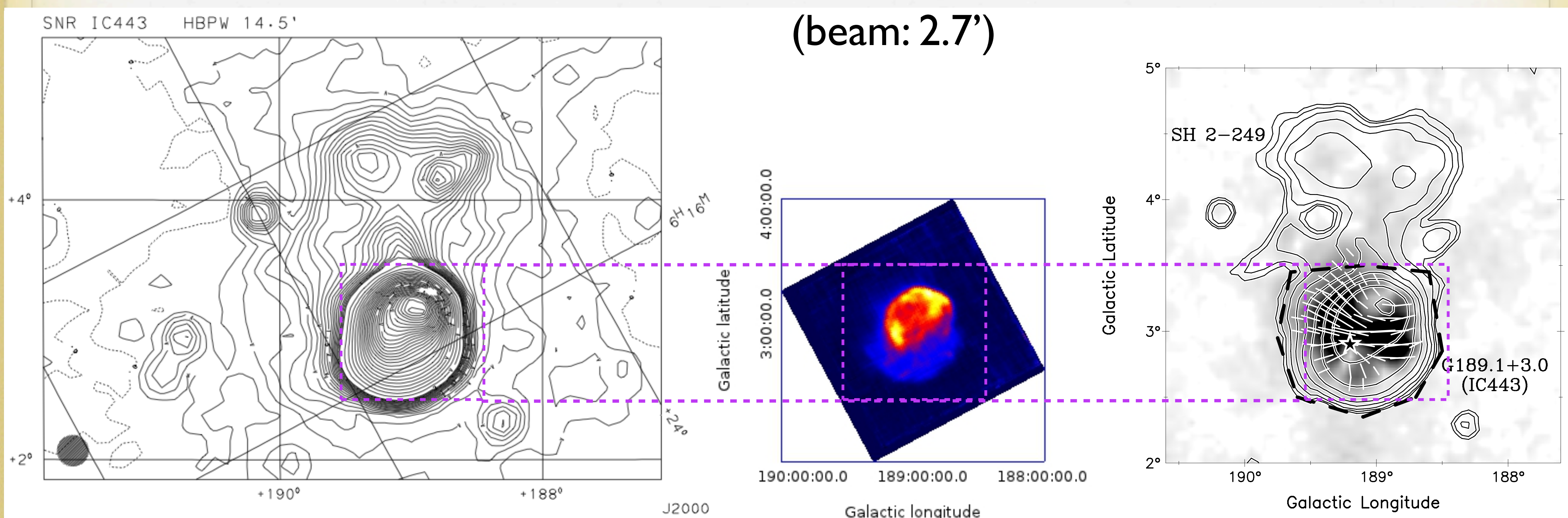


Single-dish observations of IC443

* Effelsberg at 868 MHz (beam: 14.5')

* SRT at 7 GHz (beam: 2.7')

* Urumqi at 5 GHz (beam:9.5')



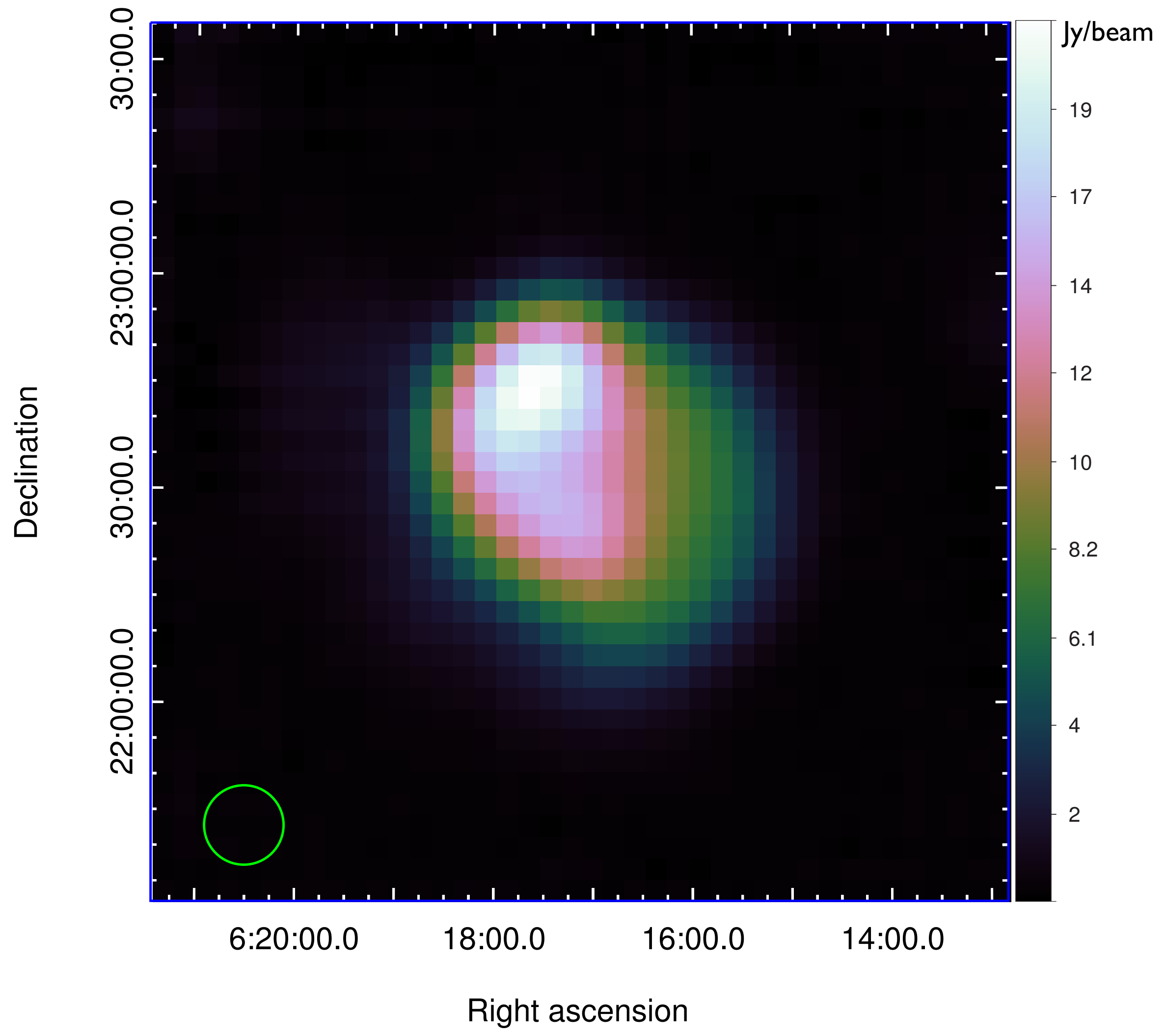
(Reich et al. 2003)

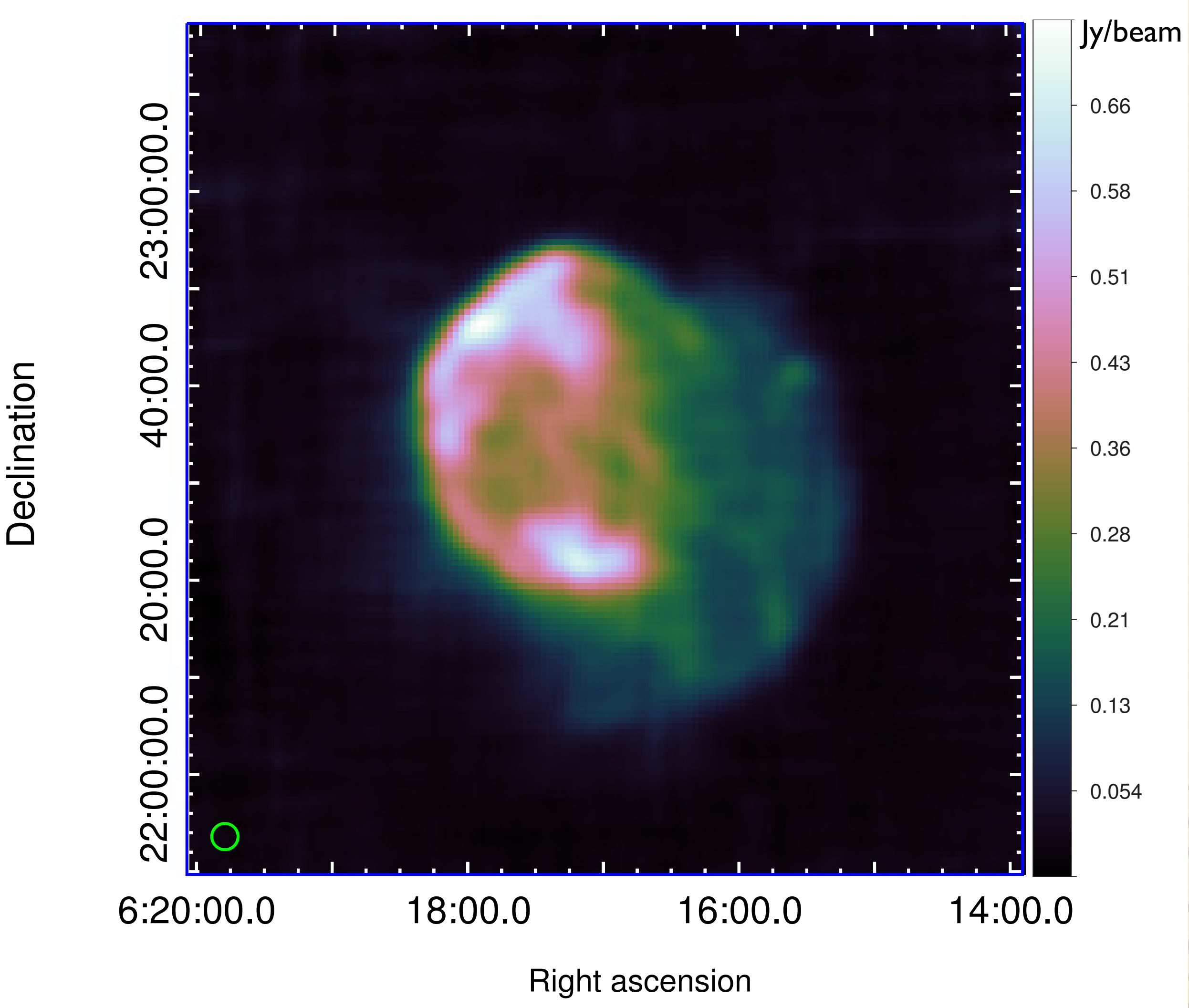
(Gao et al. 2011)

IC443 at 1.5 and 7 GHz with SRT

F = 131 +/- 4 Jy
beam: 11.1’
13.5 maps of 2°x2°
eff time: 7h15
rms = 76 mJy/beam

F = 69 +/- 3 Jy
beam: 2.7’
3 maps of 1.5°x1.5°
eff time: 5h30
rms = 20 mJy/beam





IC443 at 1.5 and 7 GHz with SRT

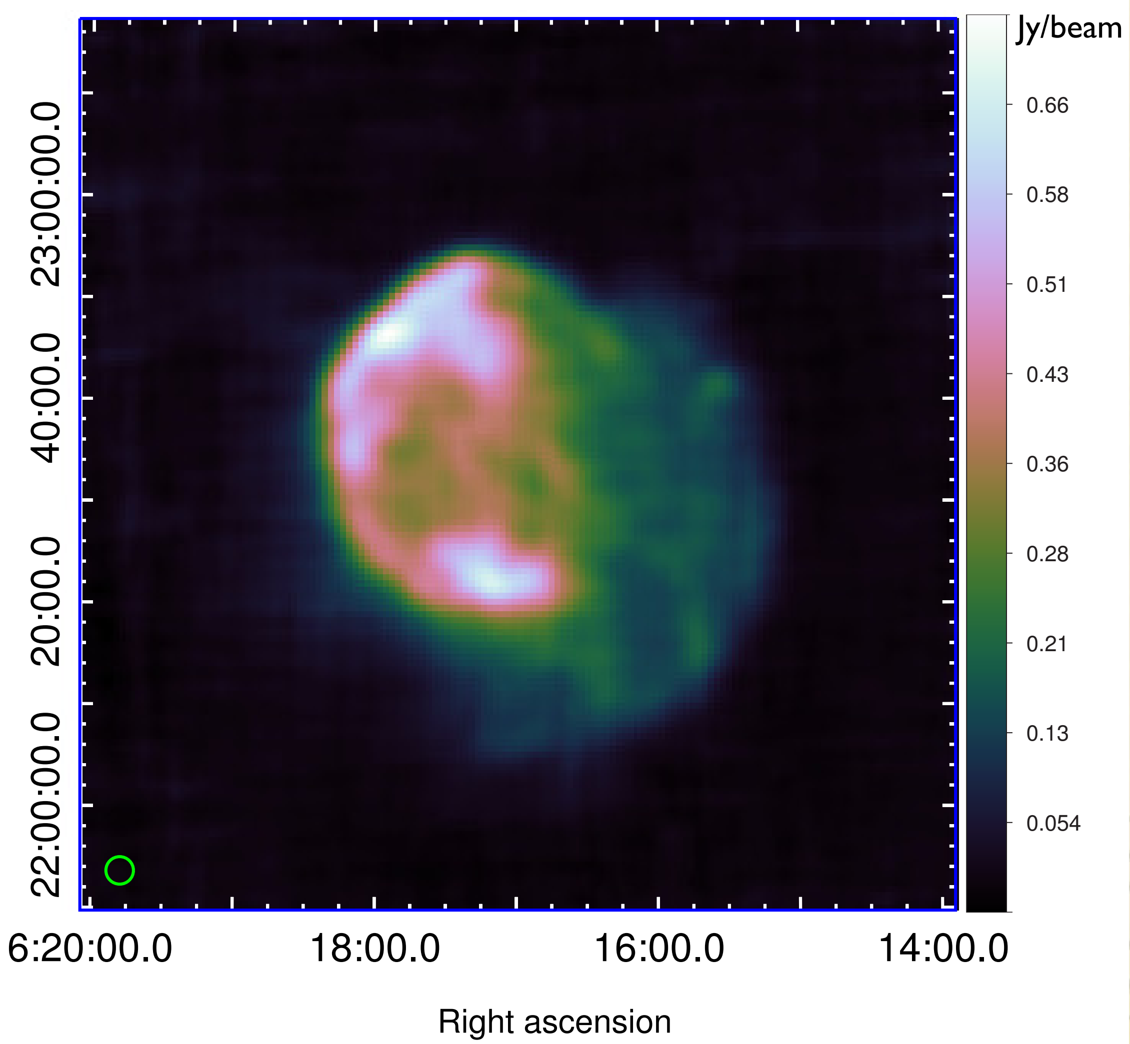
F = 131 +/- 4 Jy at 1.5 GHz

comparison with flux values at 1.4 GHz

	Frequency (MHz)	Scaled flux density (Jy)	References
	1390.....	177 ± 15	Westerhout (1958)
	1400.....	170 ± 20[c]	Hogg (1964)
=>	1400.....	146 ± 18	Wanner (1961)
=>	1410.....	131 ± 13	Milne & Hill (1969)
=>	1419.....	130 ± 13	Green (1986)
	1420.....	160 ± 16[c]	Hagen et al. (1955)
=>	1420.....	138 ± 15	Hill (1972)

Extract from Castelletti et al. 2011

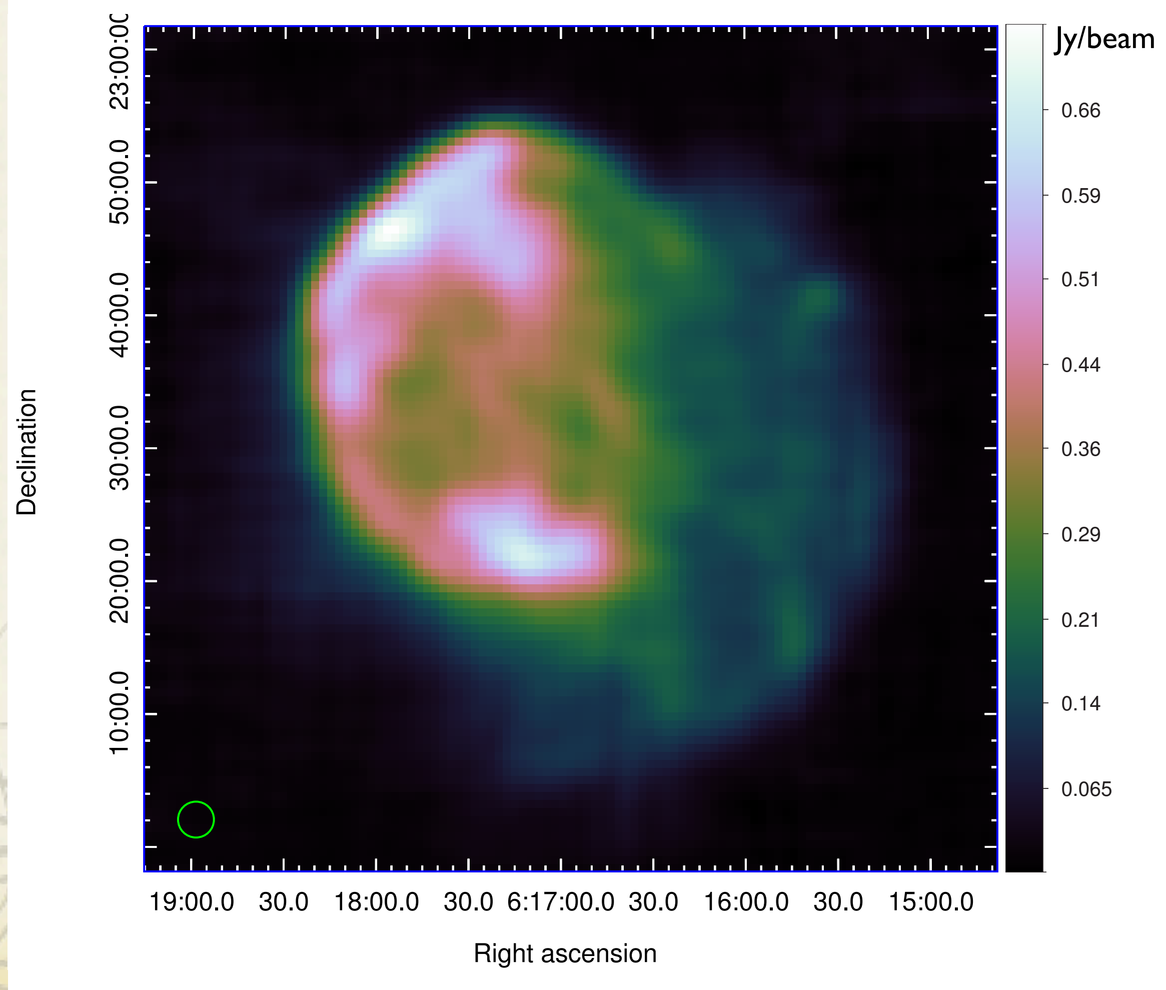
F = 69 +/- 3 Jy at 7 GHz
consistent with Dickel 1971
F = 70 +/- 15 Jy
at 6.6 GHz

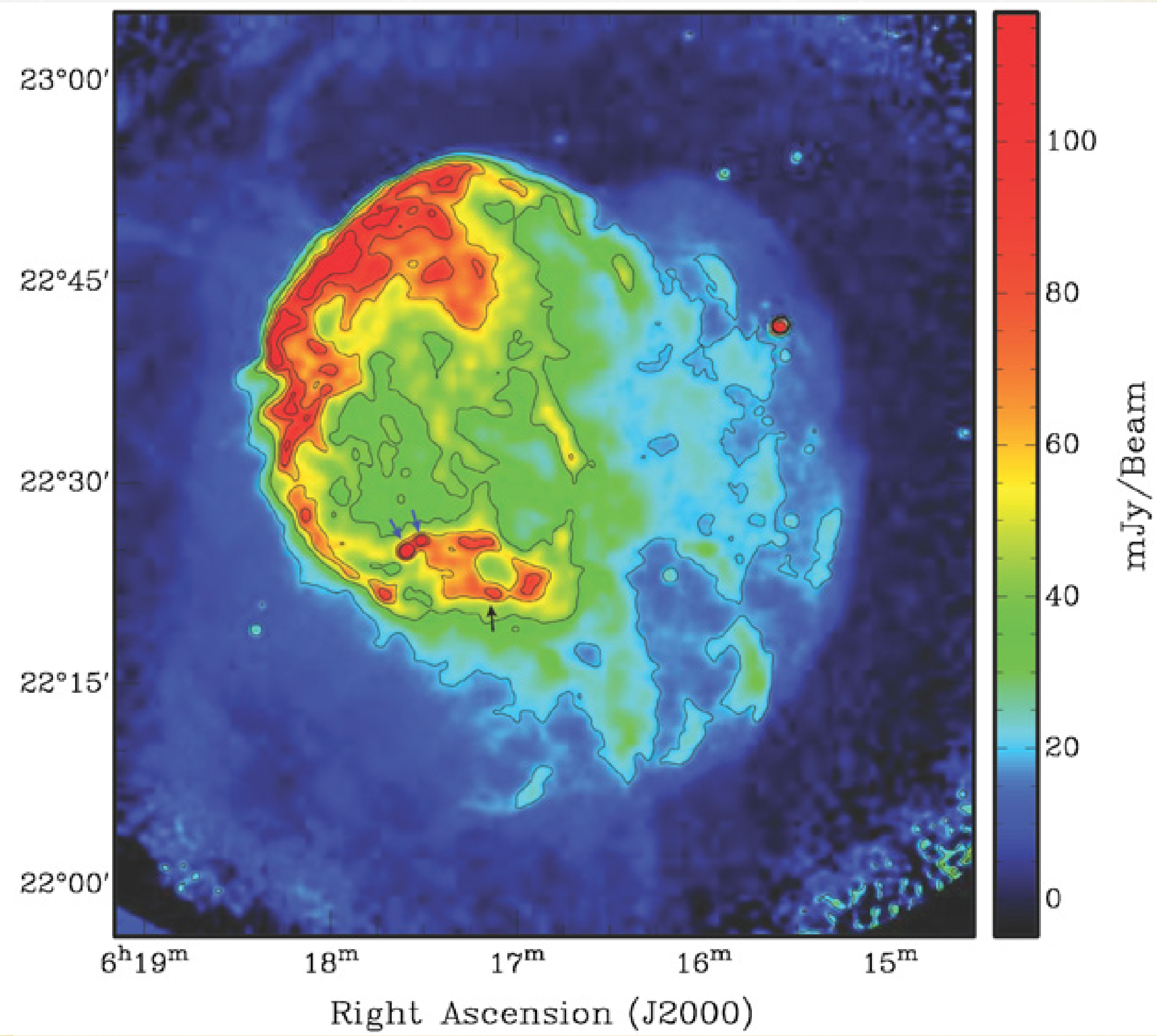


SRT versus VLA/Arecibo

* Flux density at 1.5 and 7 GHz consistent with the literature

* Comparison of SRT map at 7 GHz with VLA and Arecibo at 1.4 GHz (Lee +2008)

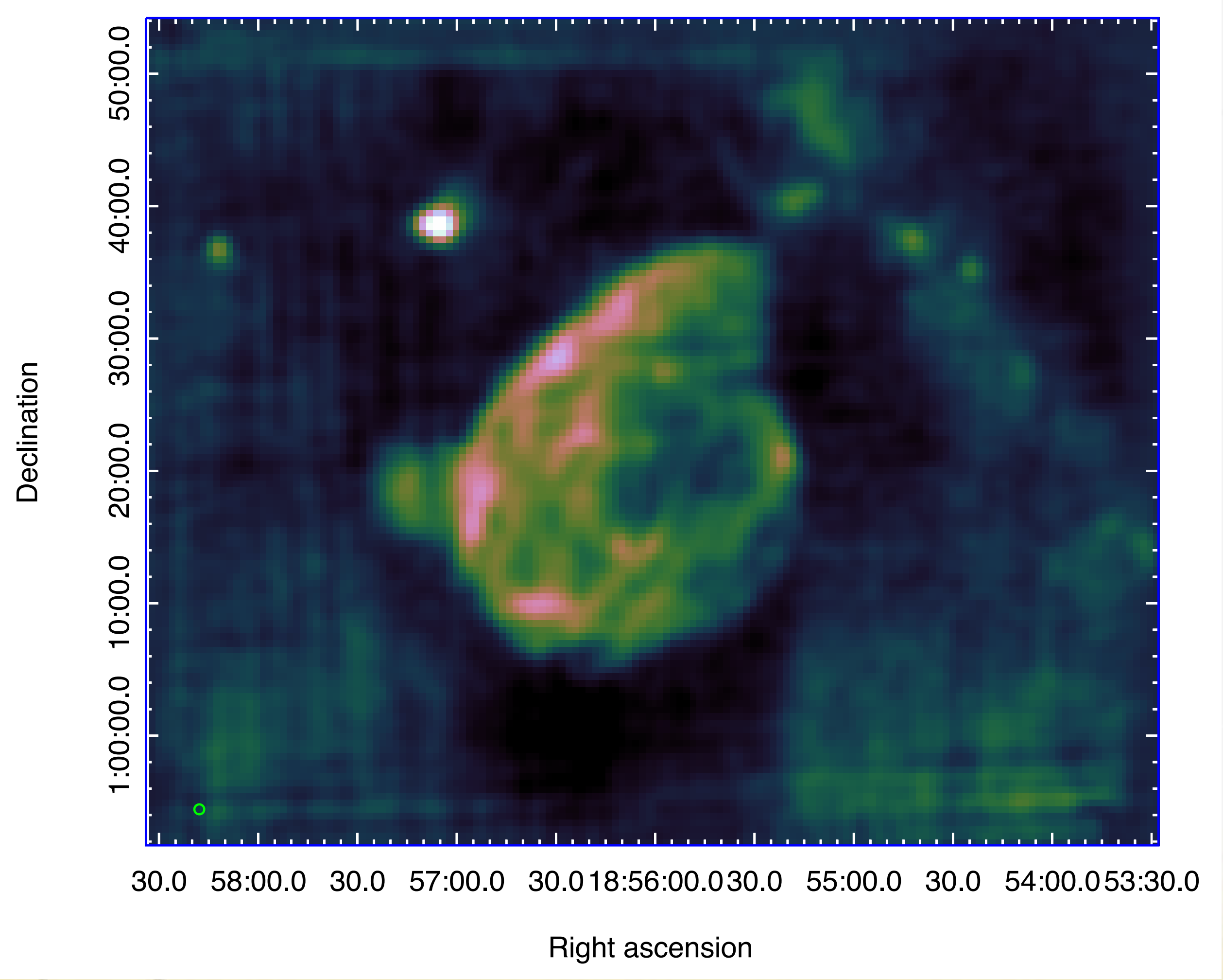




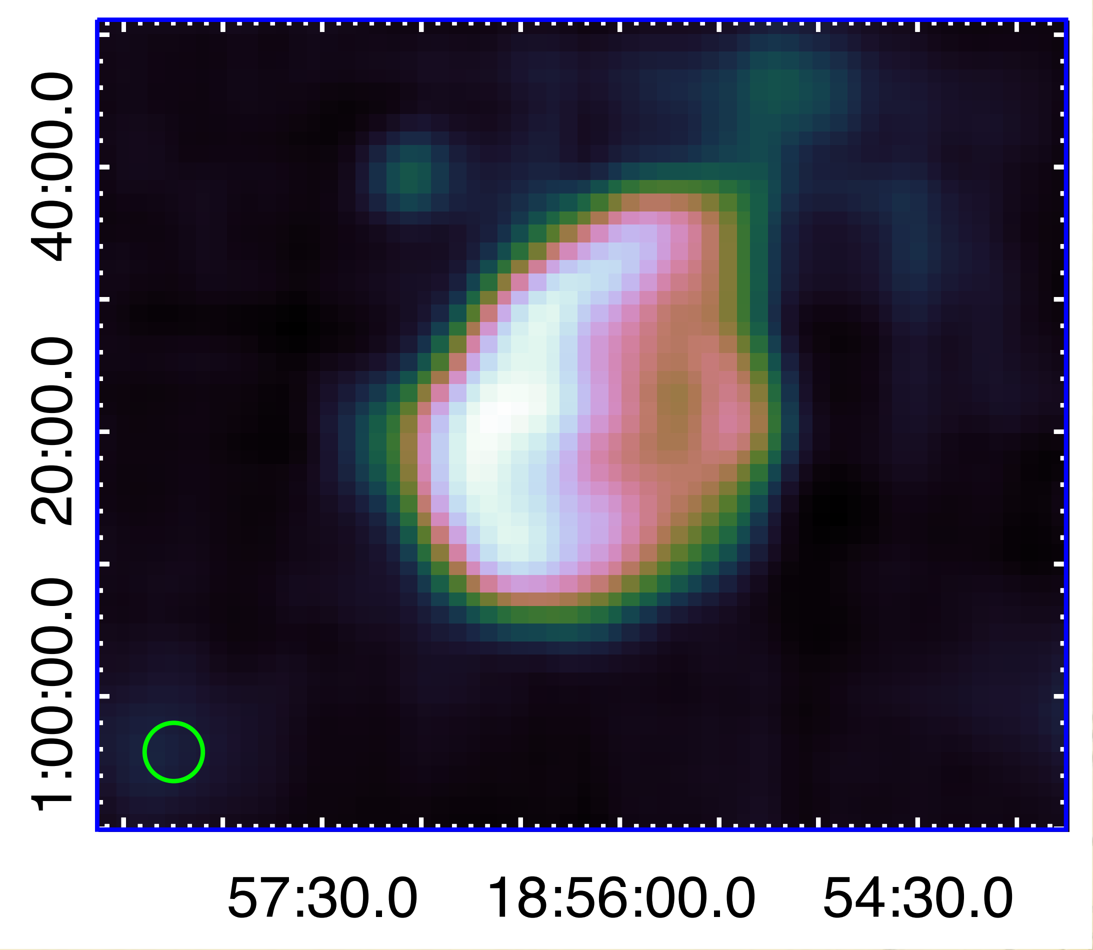
Work in progress...

* High-resolution maps with - K-band receiver (18-26 GHz)
  - S-band receiver (3-4.5 GHz; under construction)

* W44 at 21.4 GHz
(Loru et al. in prep)



* W44 at 4.4 GHz
(Iacolina et al. in prep)



Conclusions

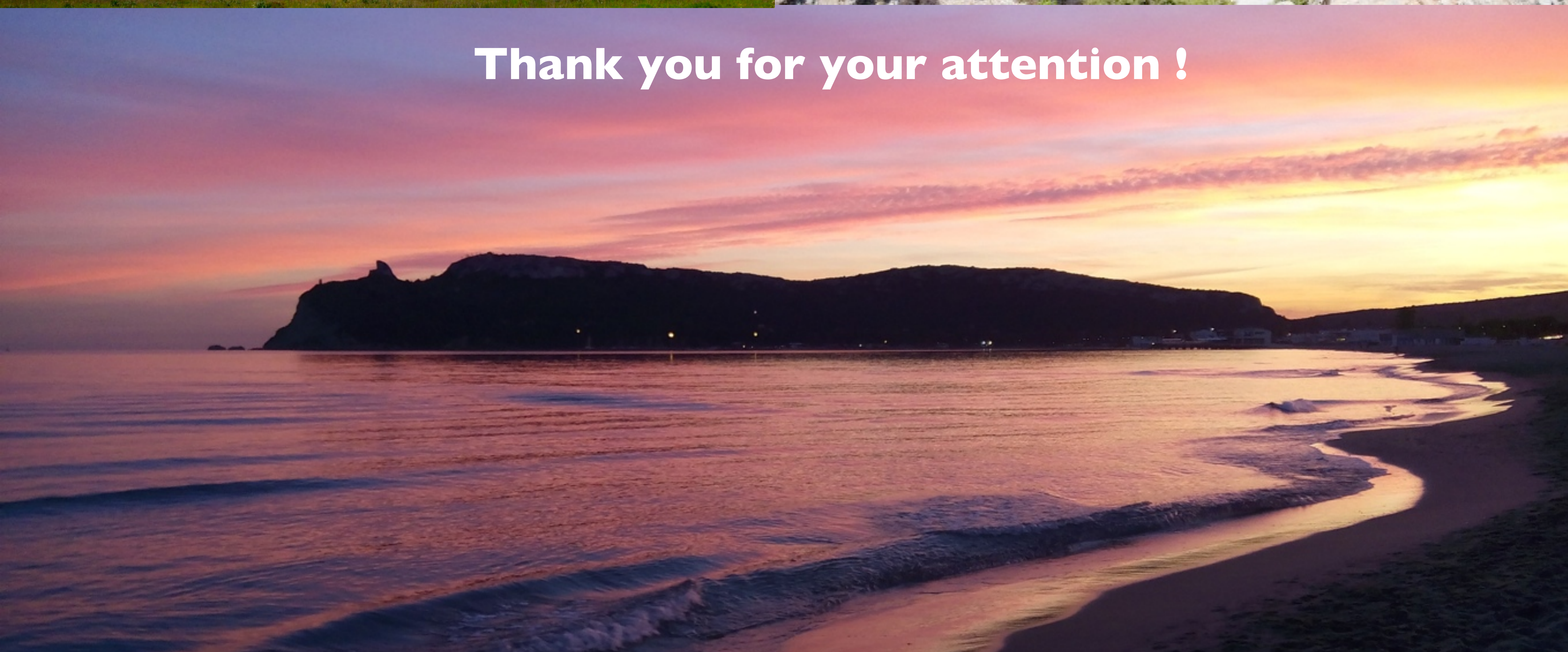
* High-quality maps => single-dish capabilities at 1.5, 4.4, 7, 21.4 GHz

* Flux measurements with precise error : 3% at 1.5 GHz, 5% at 7 GHz
  => integrated and local flux density

* Map of spectral index (talk A. Pellizzoni)

* Paper submitted to MNRAS (Egron et al.)

=> next steps : Analysis of spectral lines (Roach2 backend)
Polarization maps
Maps in Q-band (33 - 50 GHz)

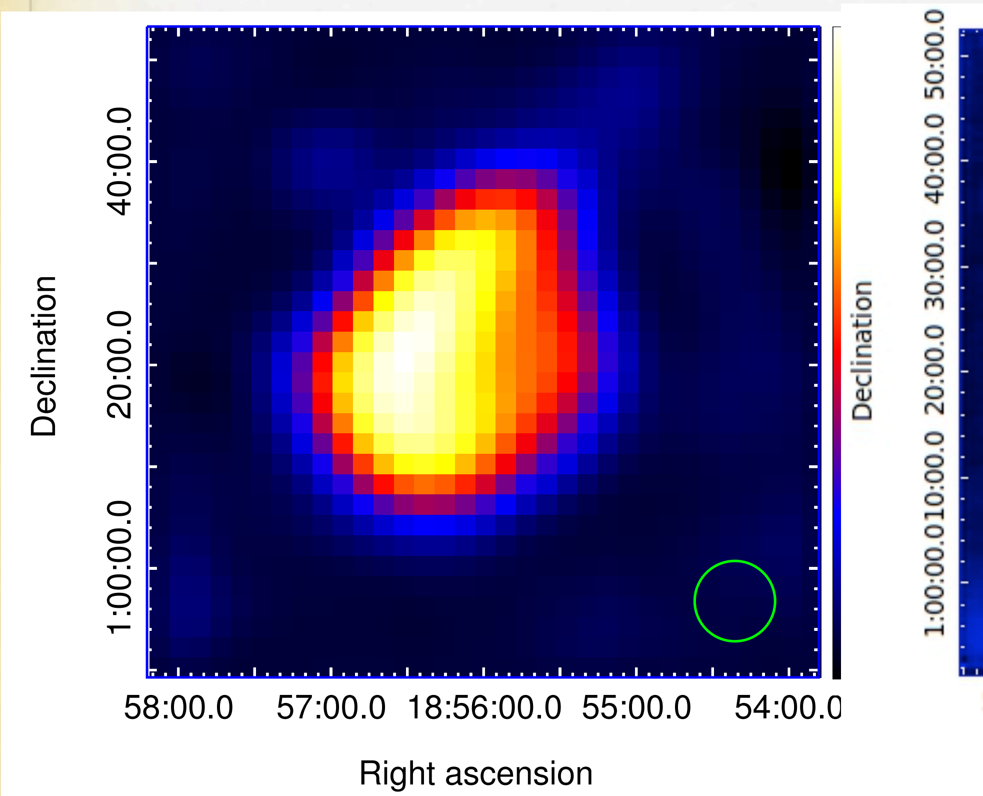

Thank you for your attention !

SNR W44

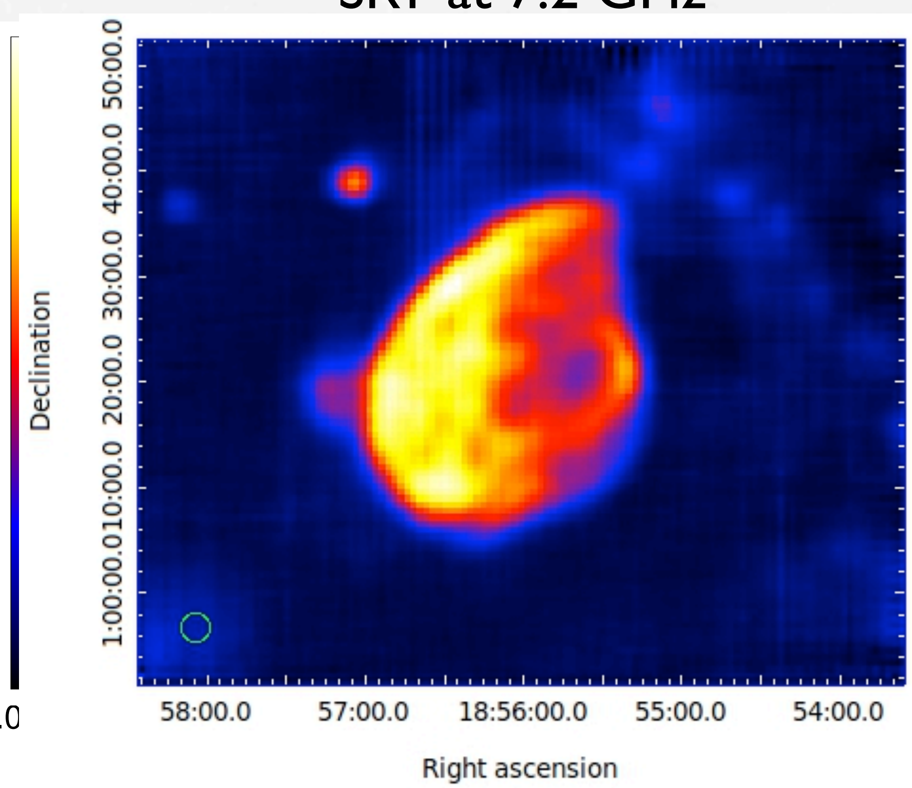
* Comparison between SRT (64m) and Medicina (32m)

beam size: 7.9’ 2.7’ 4.9’

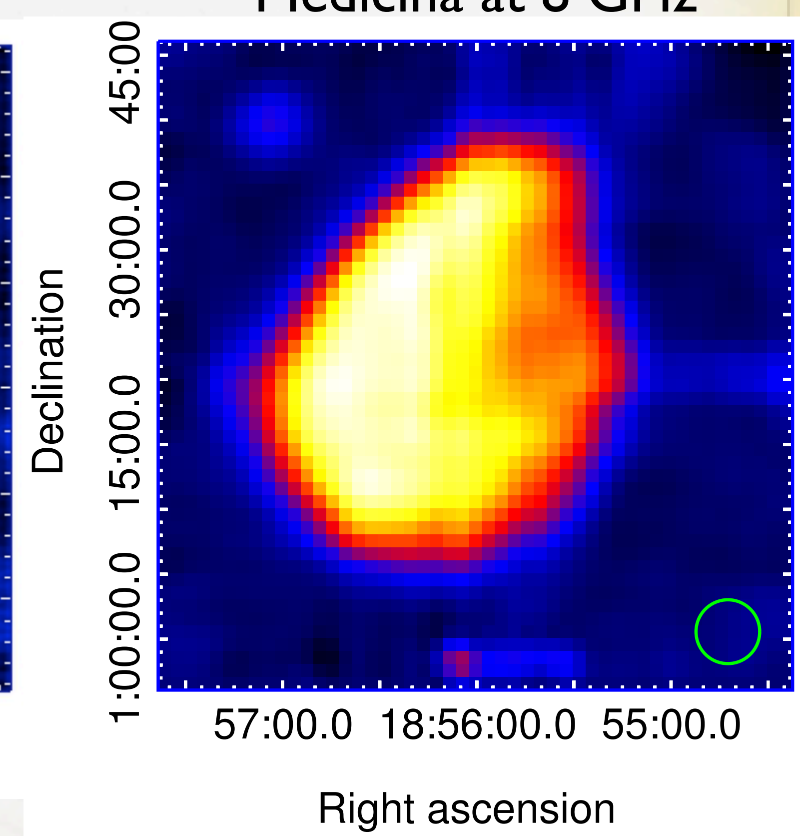
Medicina at 5 GHz



SRT at 7.2 GHz



Medicina at 8 GHz



Early Science Program

* First call for SRT proposals in Dec 2015

* Small number of large programs in shared-risk (15)

http://www.srt.inaf.it/astronomers/early-science-program-FEB-2016/

* A program dedicated to imaging of supernova remnants (110h)

* Observations: 01 February - 31 July 2016