New high-frequency radio observations of Cygnus Loop SNR

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SRT
Sardinia Radio Telescope

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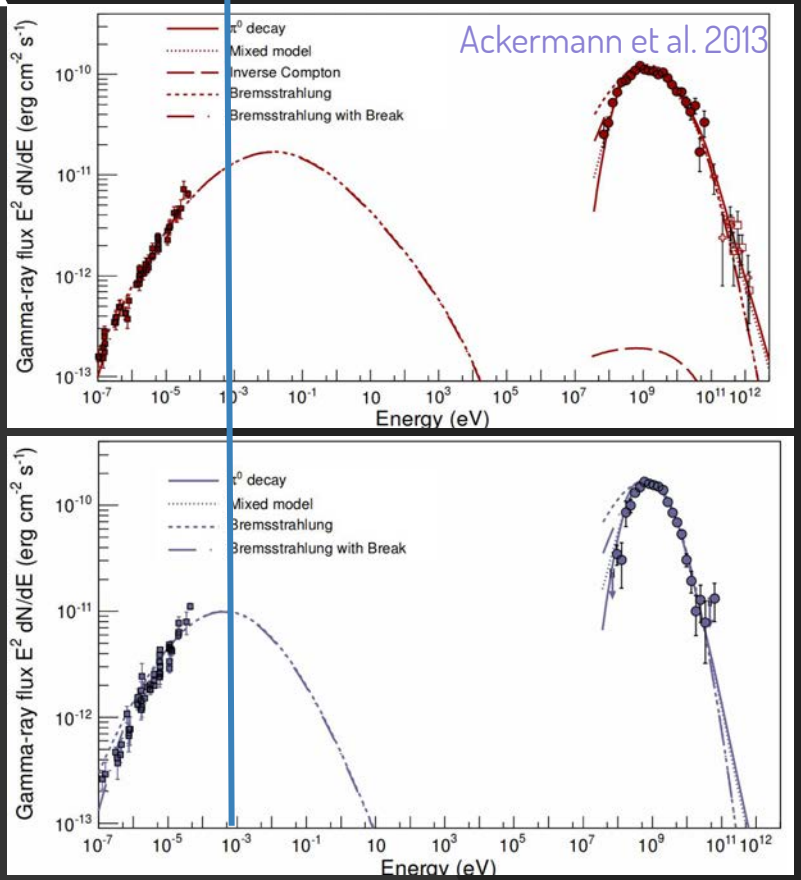
Summary

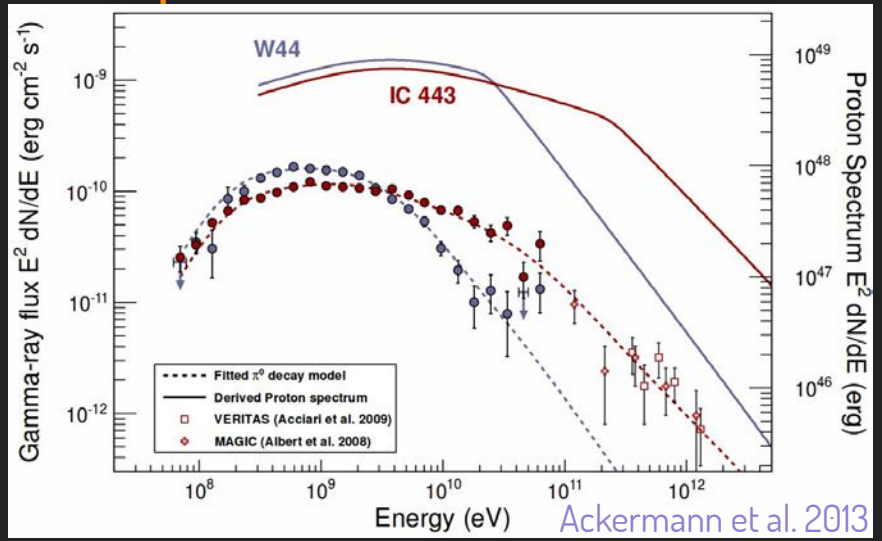
- The radio spectra of SNRs
  - Single-dish observations up to high-frequencies
    - Characterization of the Cygnus Loop radio spectrum
      - Conclusion and work in progress

~20 GHz



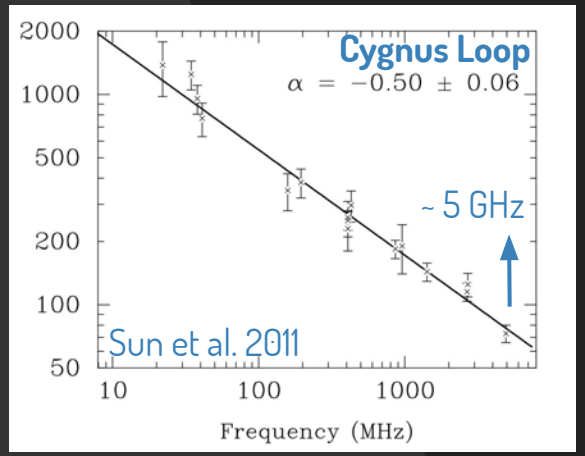
$S=\nu^{-\alpha}$

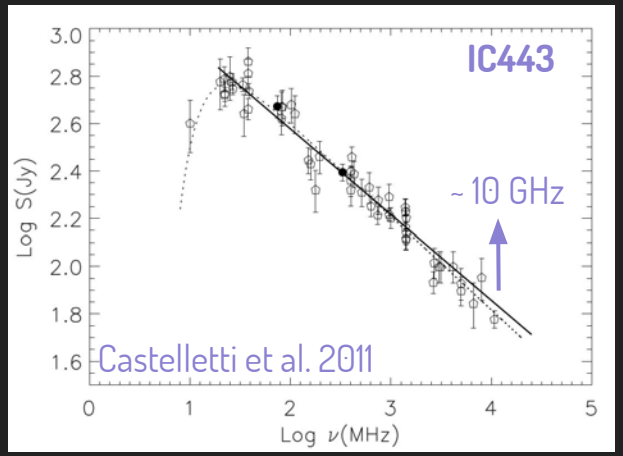
A spectral index steepening is expected in evolved SNRs

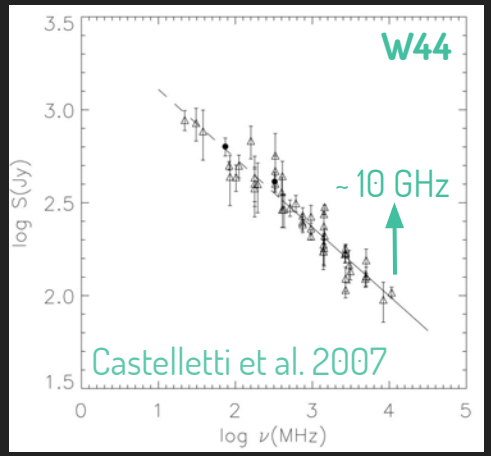


A possible spectral radio steepening allow us to assess the high energy tail of the electron distribution

Investigating SNR spectral features





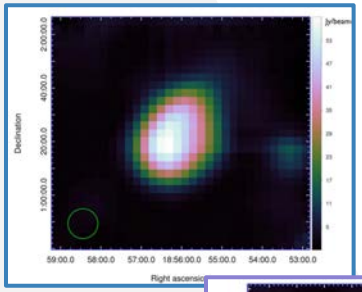


Sensitive high-resolution images of SNRs above ~10 GHz are lacking and are not easily achievable

SNRs observations with the Italian Radio Telescopes

Only single-dish telescopes can perform sensitive radio continuum observations of large sources at high frequencies

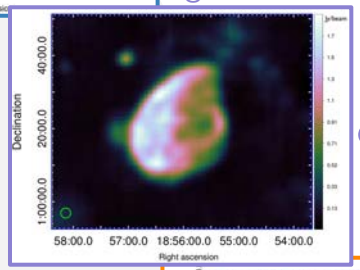
Integrated spectrum of W44



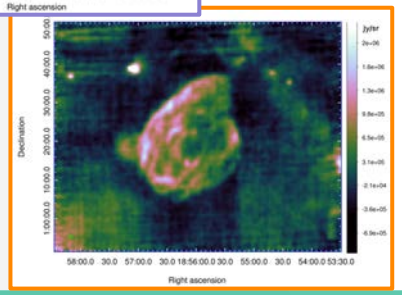
See Pellizzoni's poster S4.11

- 1.5 GHz

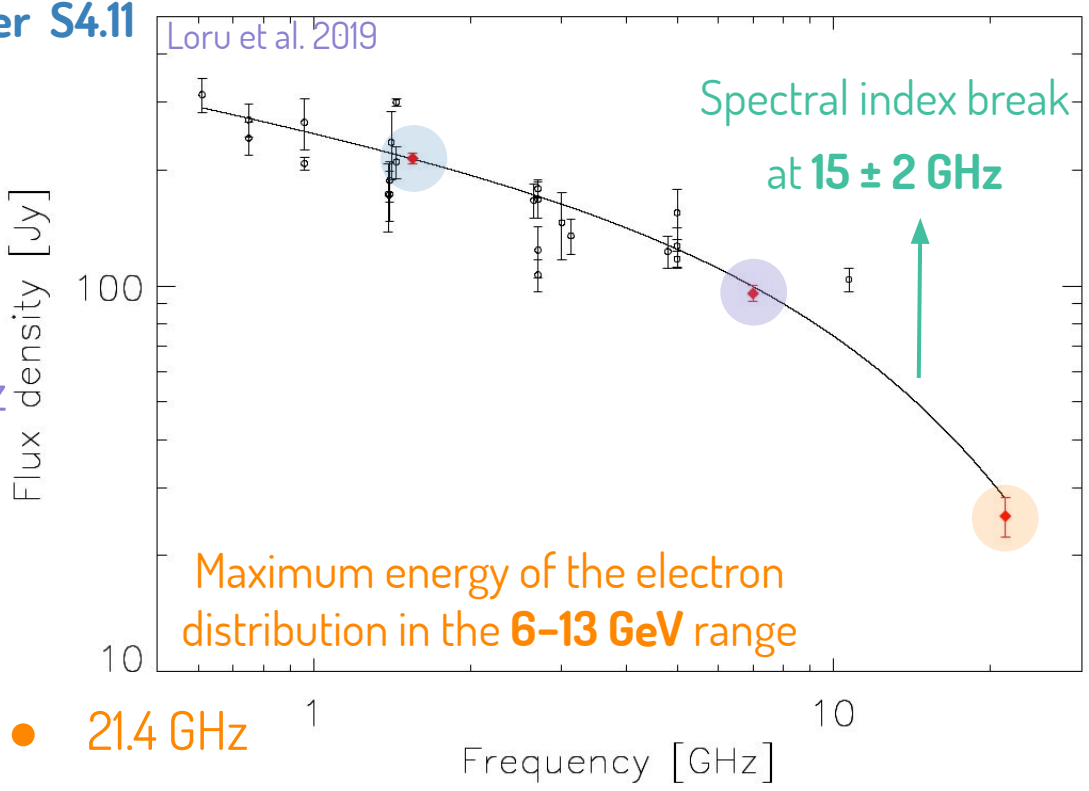
Egron et al. 2017



- 7.0 GHz

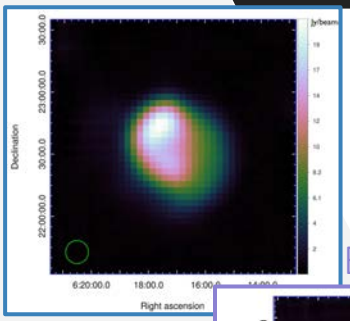


- 21.4 GHz



SRT early science project S0009

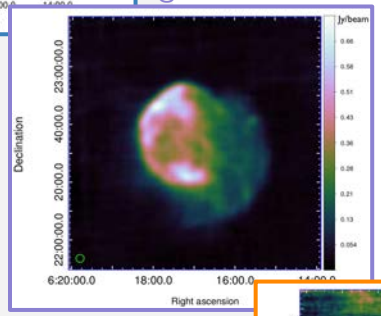
Integrated spectrum of IC443



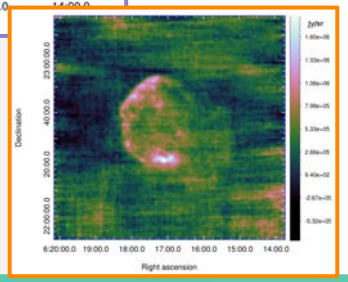
See Pellizzoni's poster S4.11

- 1.5 GHz

Egron et al. 2017



- 7.0 GHz



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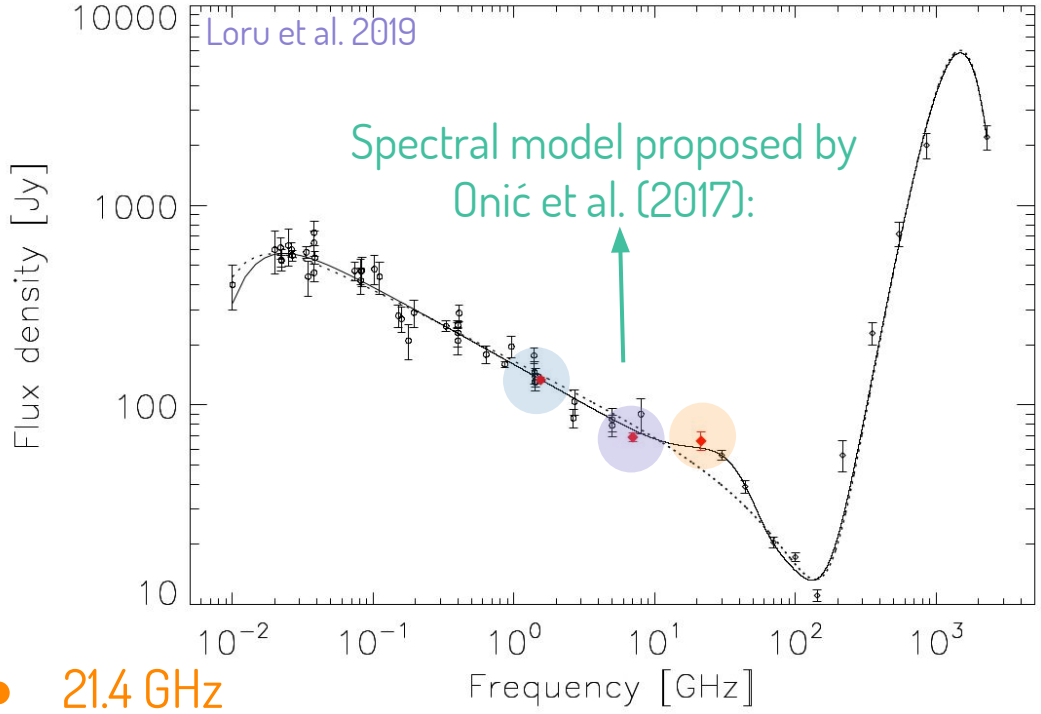
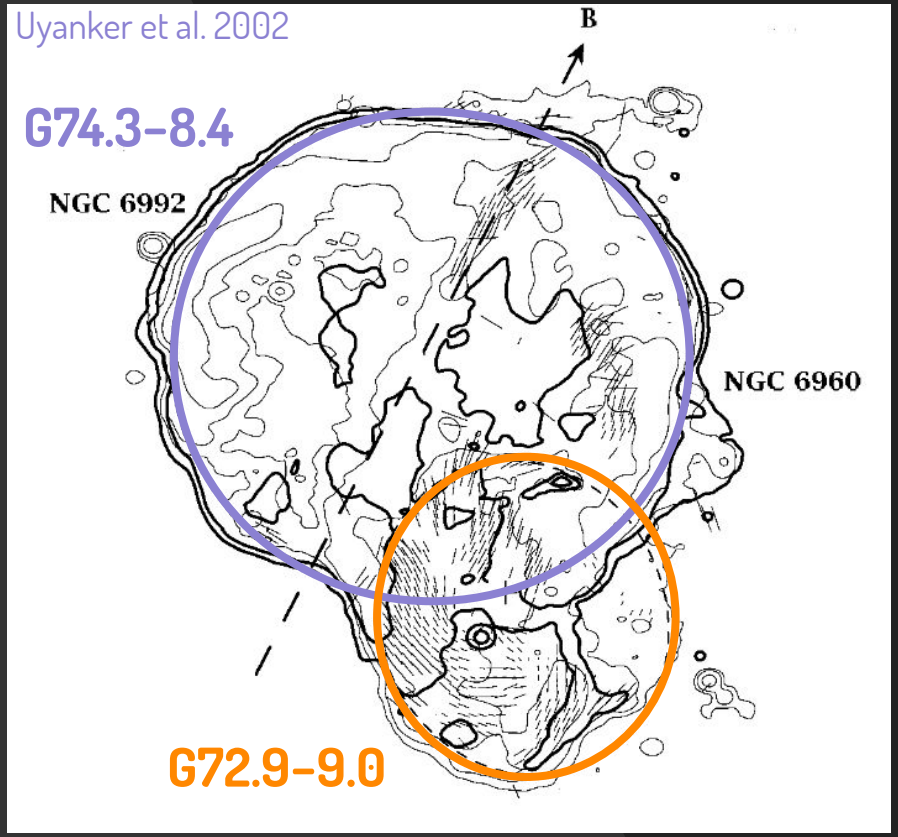


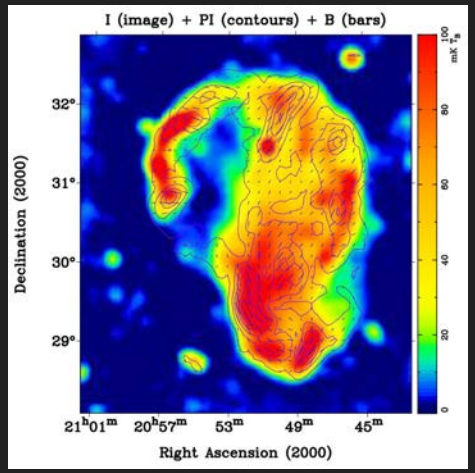
SRT early science project S0009

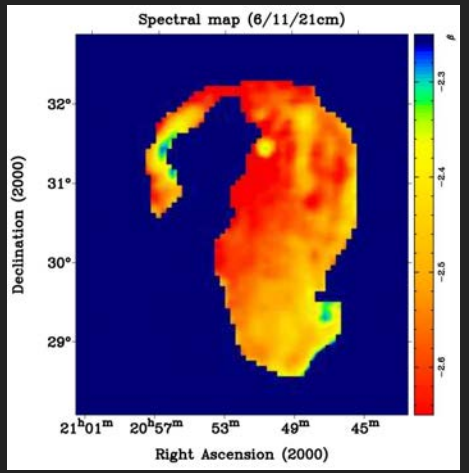
Cygnus Loop SNR

Uyanker et al. 2002



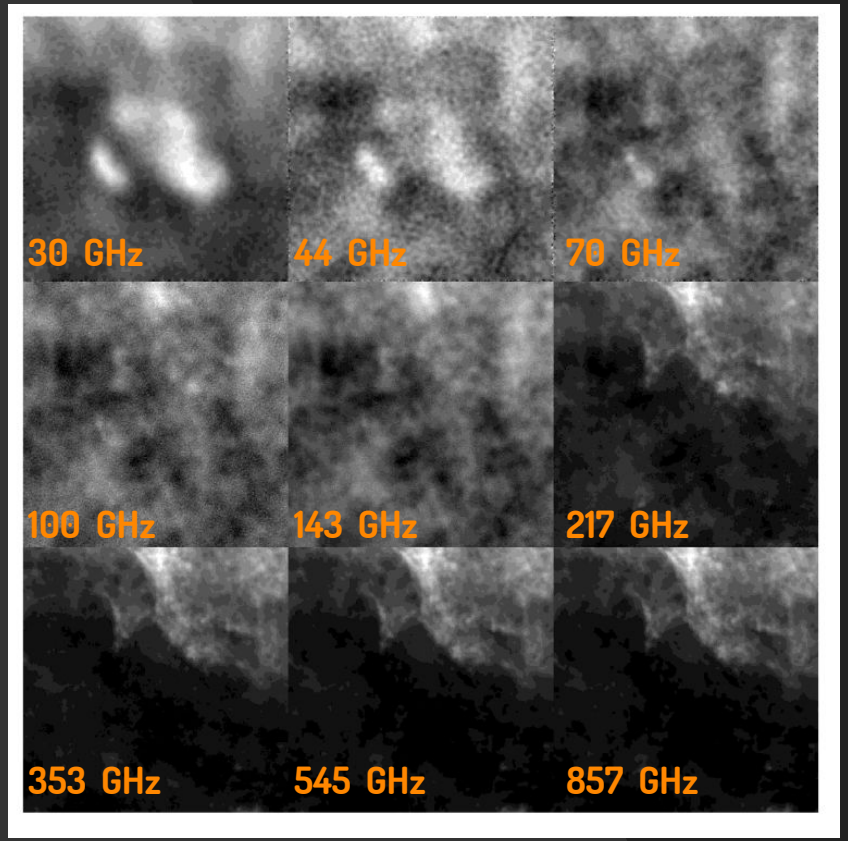
Han et al. 2013



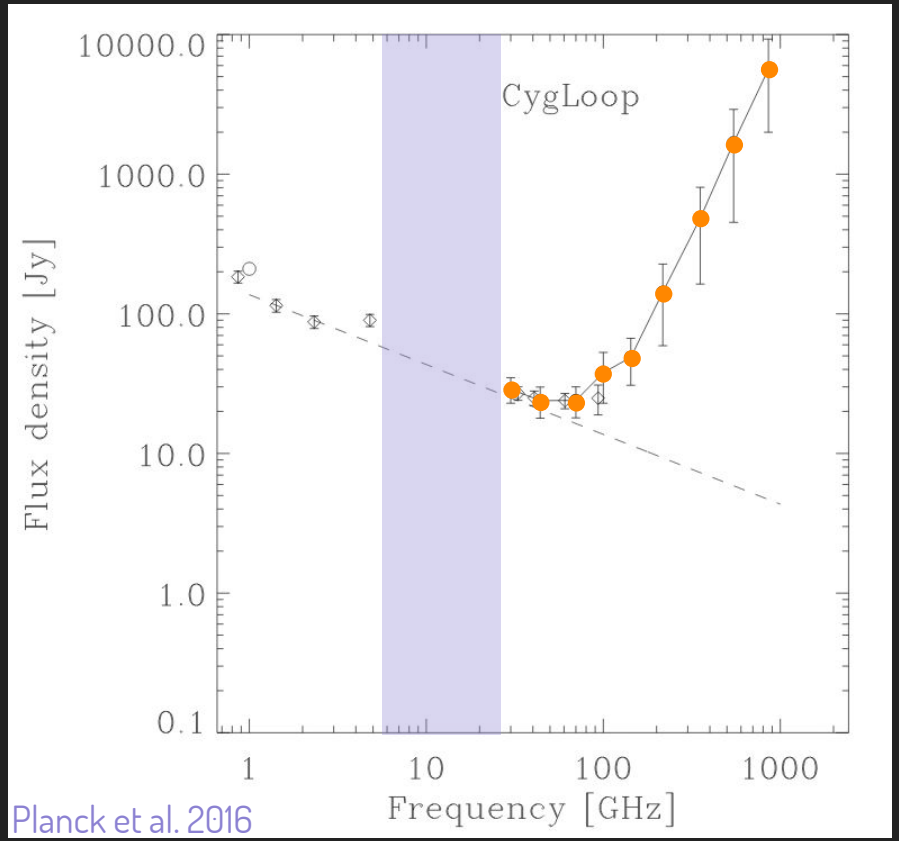


- The two shells show different polarization properties
- Variations of the spectral index from the outer shock fronts and the central faint regions

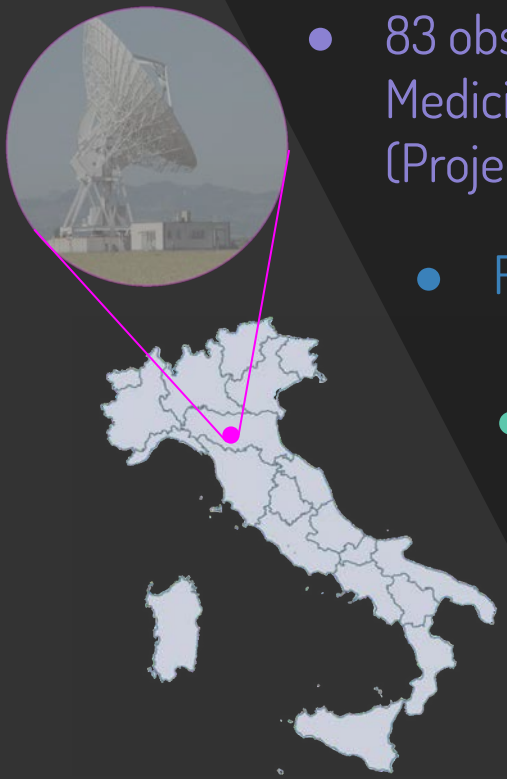
Cygnus Loop SNR



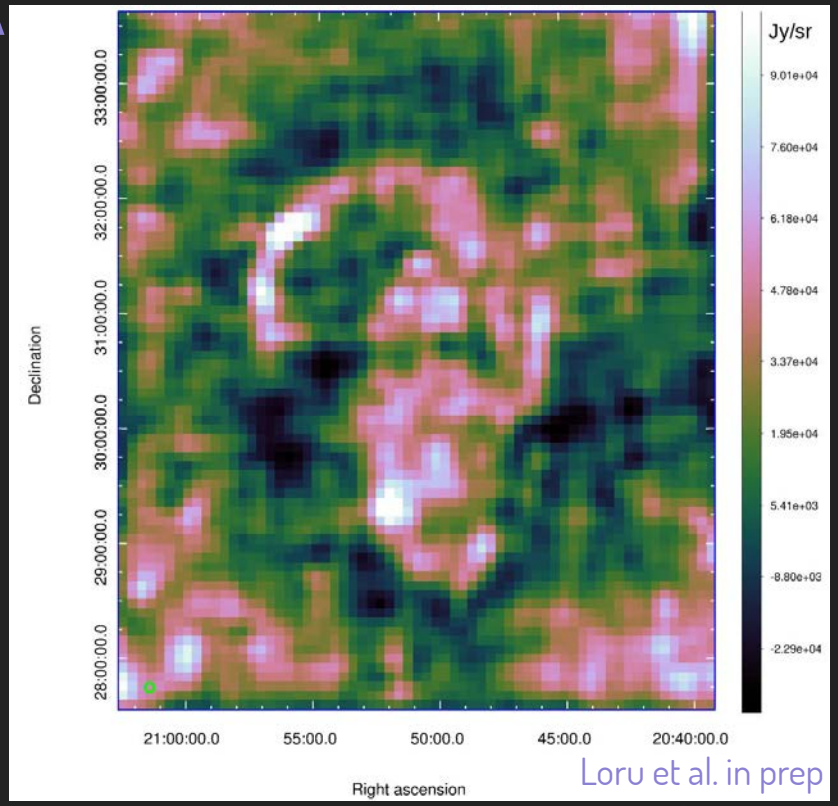
Unexplored frequency range



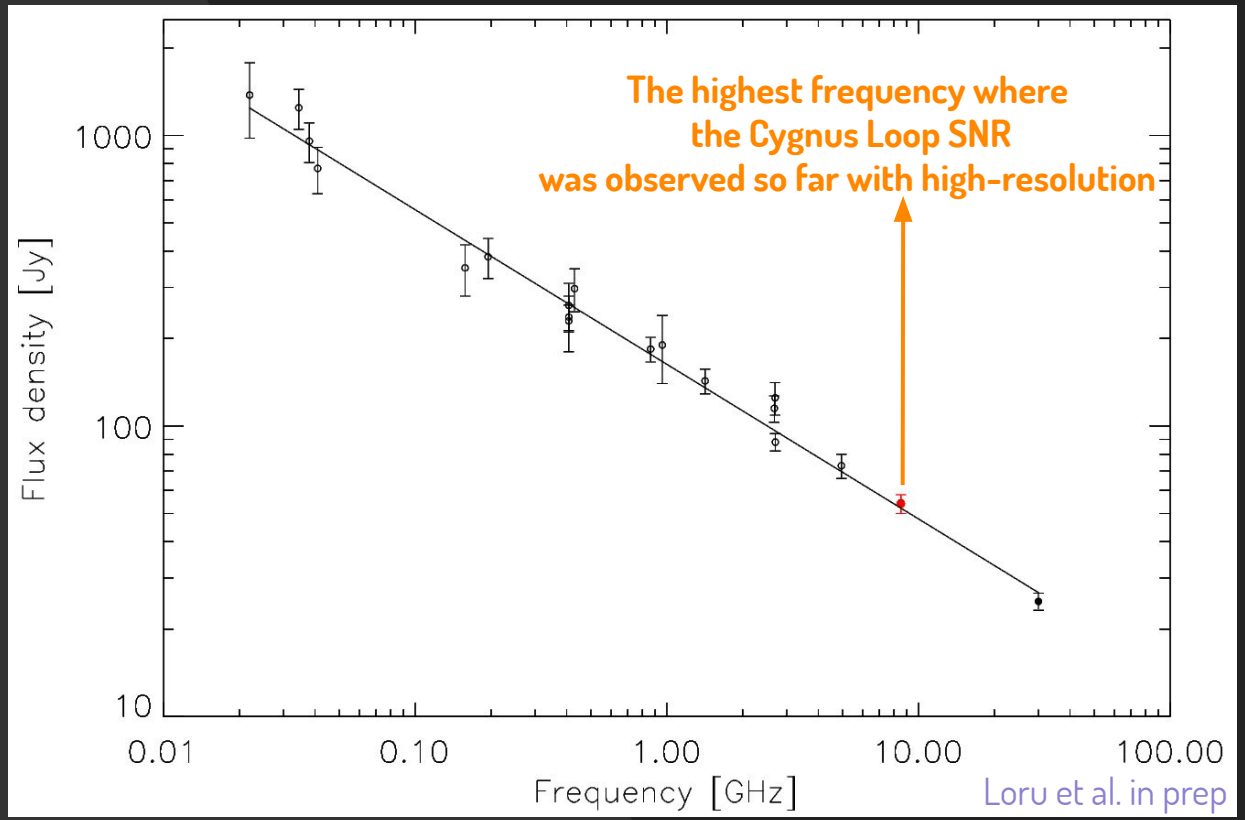
Cygnus Loop SNR at 8.5 GHz



- 83 observing hours with the Medicina Radio Telescope (Project 14-17)
  - Resolution: 2.5'
  - Flux density: 54 ± 4 Jy



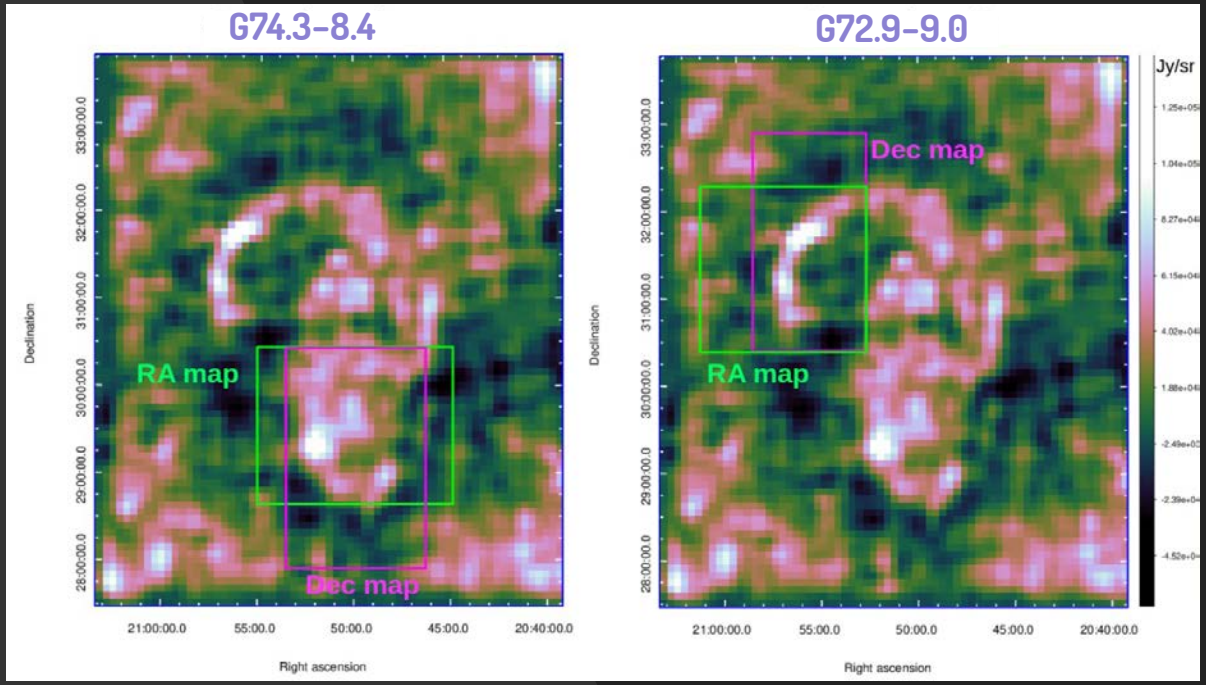
Integrated spectrum of Cygnus Loop



Spectral index=0.53 ± 0.01

Our measurement rules out any spectral steepening up to high radio frequencies

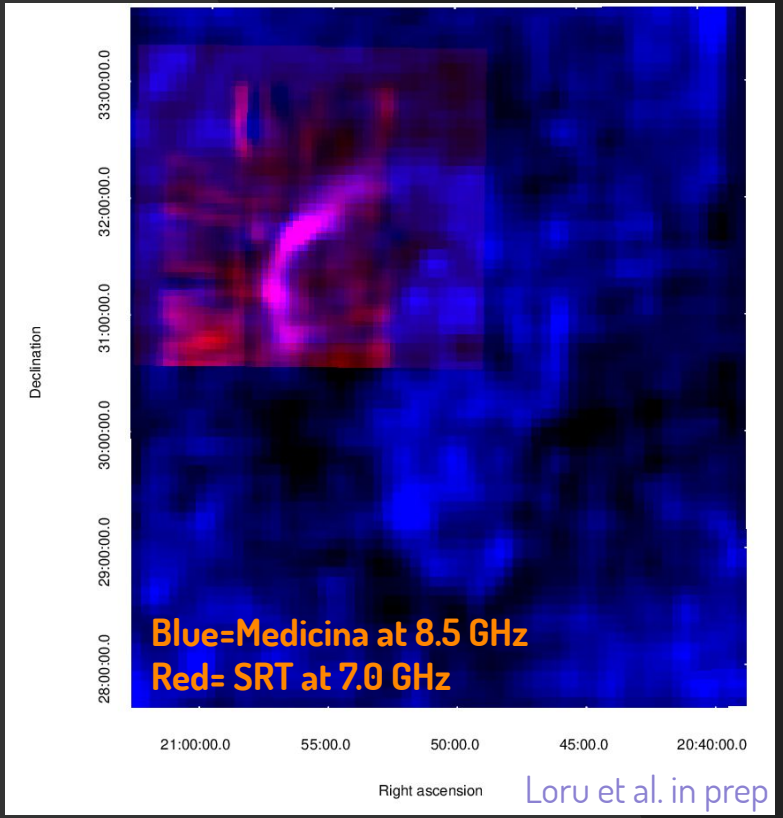
Cygnus Loop with the Sardinia Radio Telescope



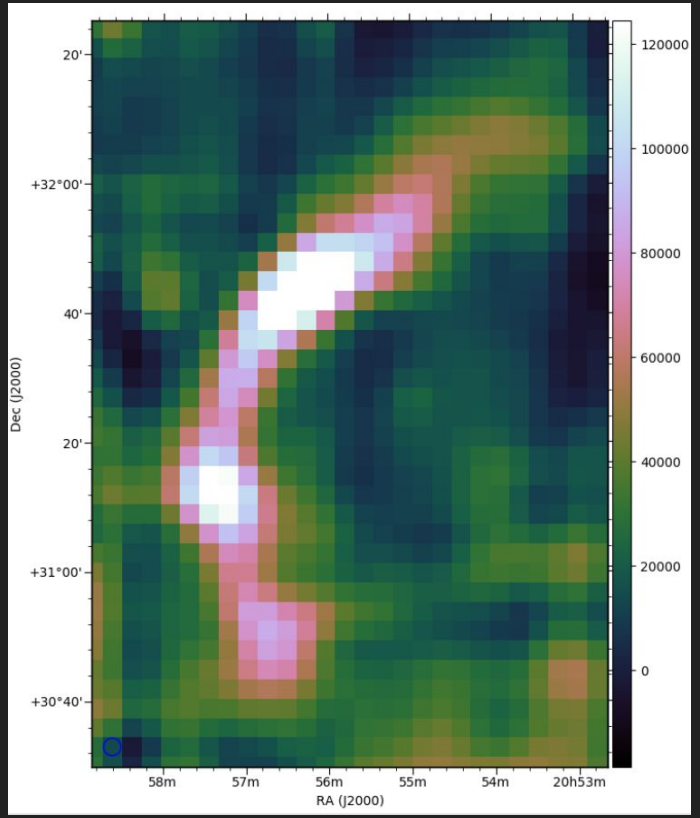
Our goal:
Perform high-frequency and polarimetric investigations of the north and south shells

- Observations between **2018 December** and **2019 May** (Project 22-18)
- Frequencies:
  7.0 GHz (C-band)
  20 GHz (K-band)

North-bright filament of Cygnus Loop at 7.0 GHz



Loru et al. in prep

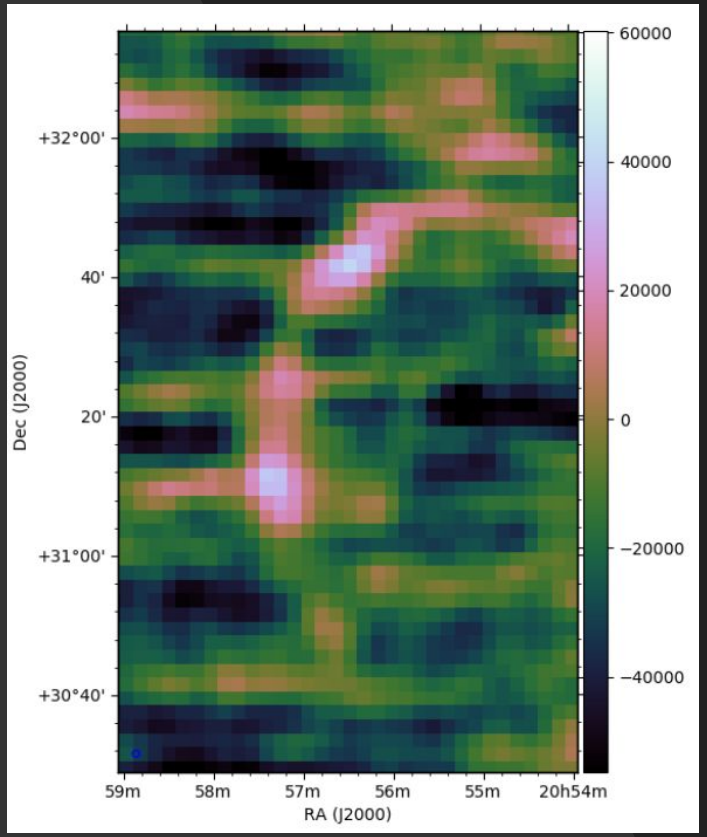


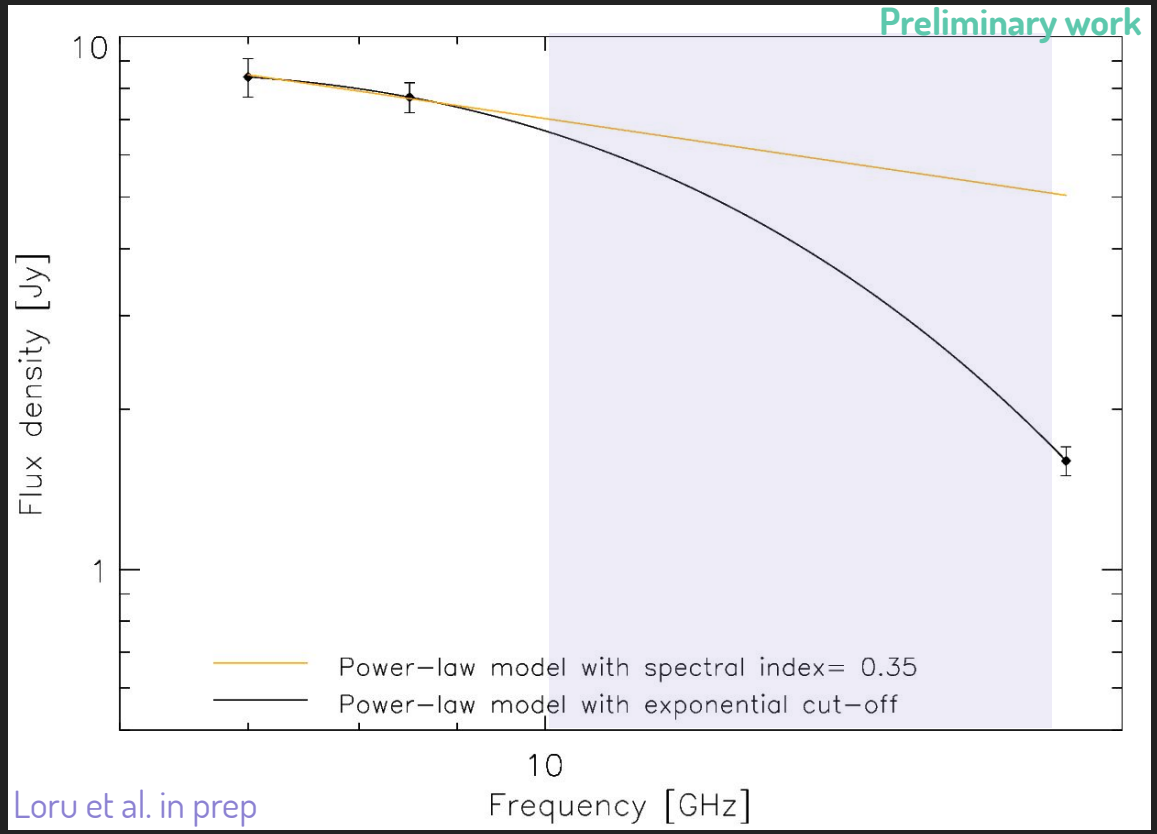
Flux density:

- 8.4 ± 0.7 Jy at 7.0 GHz
- 7.7 ± 0.5 Jy at 8.5 GHz

Preliminary work

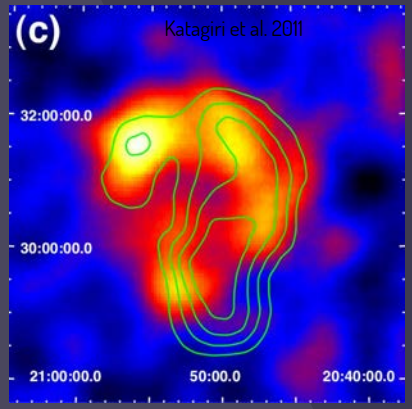
North-bright filament of Cygnus Loop at 20 GHz





North-bright filament of Cygnus Loop at 18.7 GHz

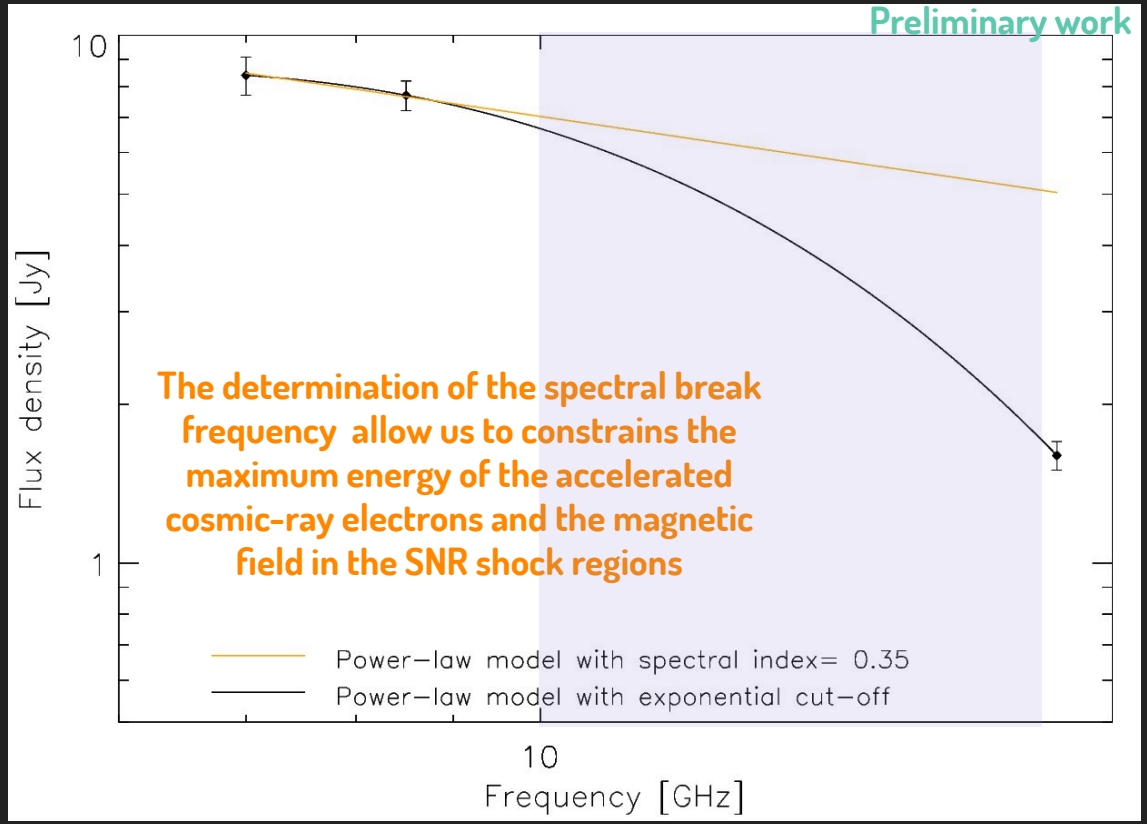
Gamma-ray studies



Spectral break in the cosmic-ray energy spectrum: **1-10 GeV**

→ Implying a synchrotron spectral break at: **0.3-28 GHz**

Preliminary work

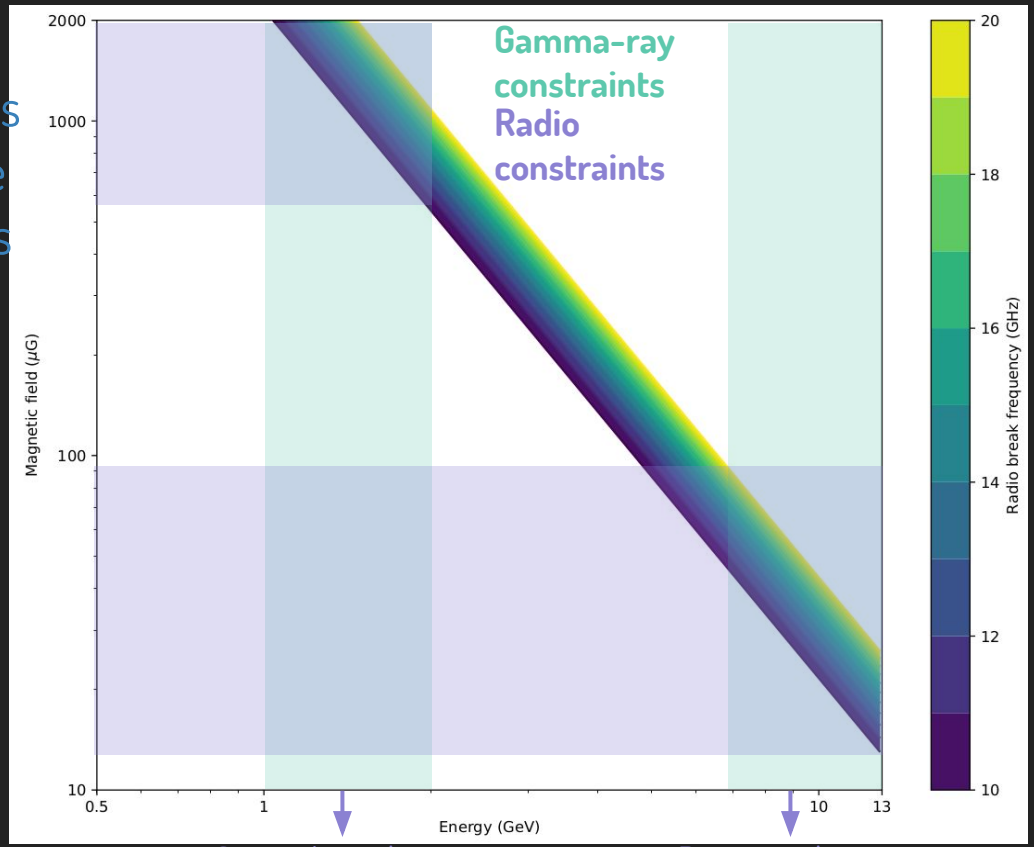


The determination of the spectral break frequency allow us to constrains the maximum energy of the accelerated cosmic-ray electrons and the magnetic field in the SNR shock regions

Conclusions and future work

$$E_{CRs} = 14.7\left(\frac{\nu_{GHz}}{B_{\mu G}}\right)^{\frac{1}{2}} GeV$$ (Reynolds 2008)

- The high-frequency radio observations of evolved SNRs allow us to assess the **maximum energy** of accelerated CRs and **magnetic field strength** in the evolved SNRs



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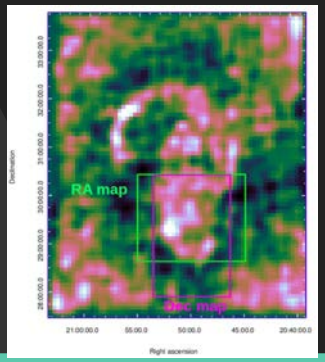
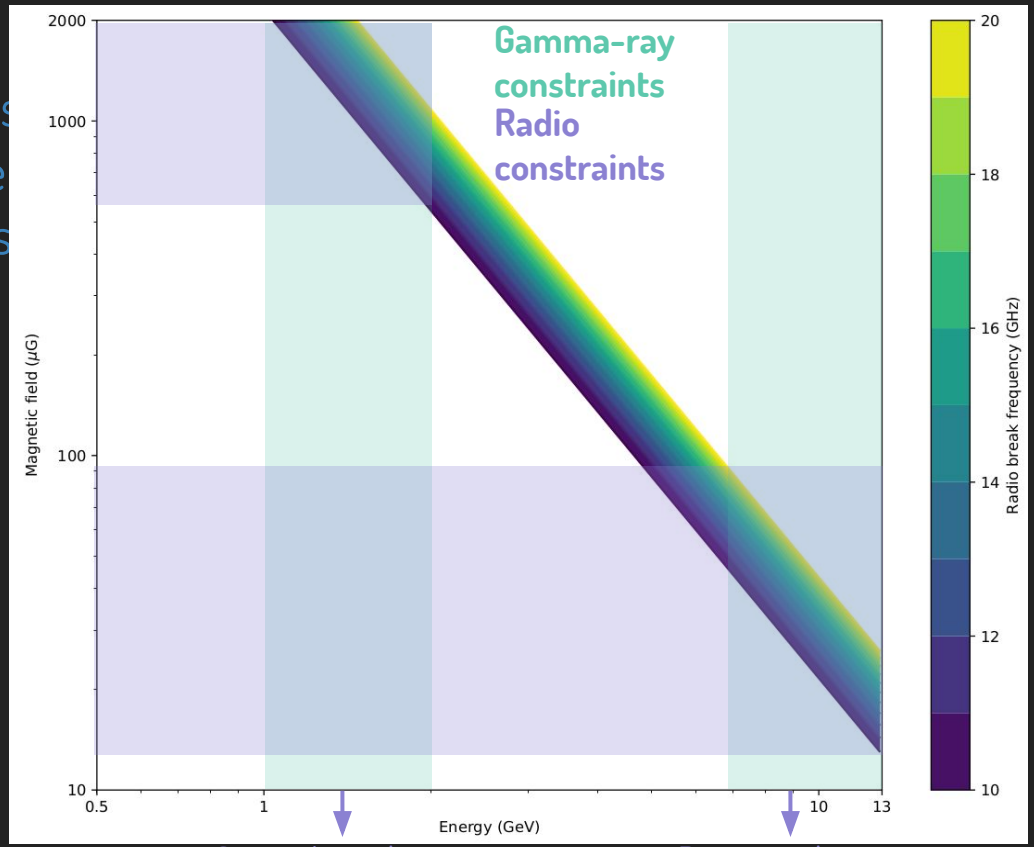
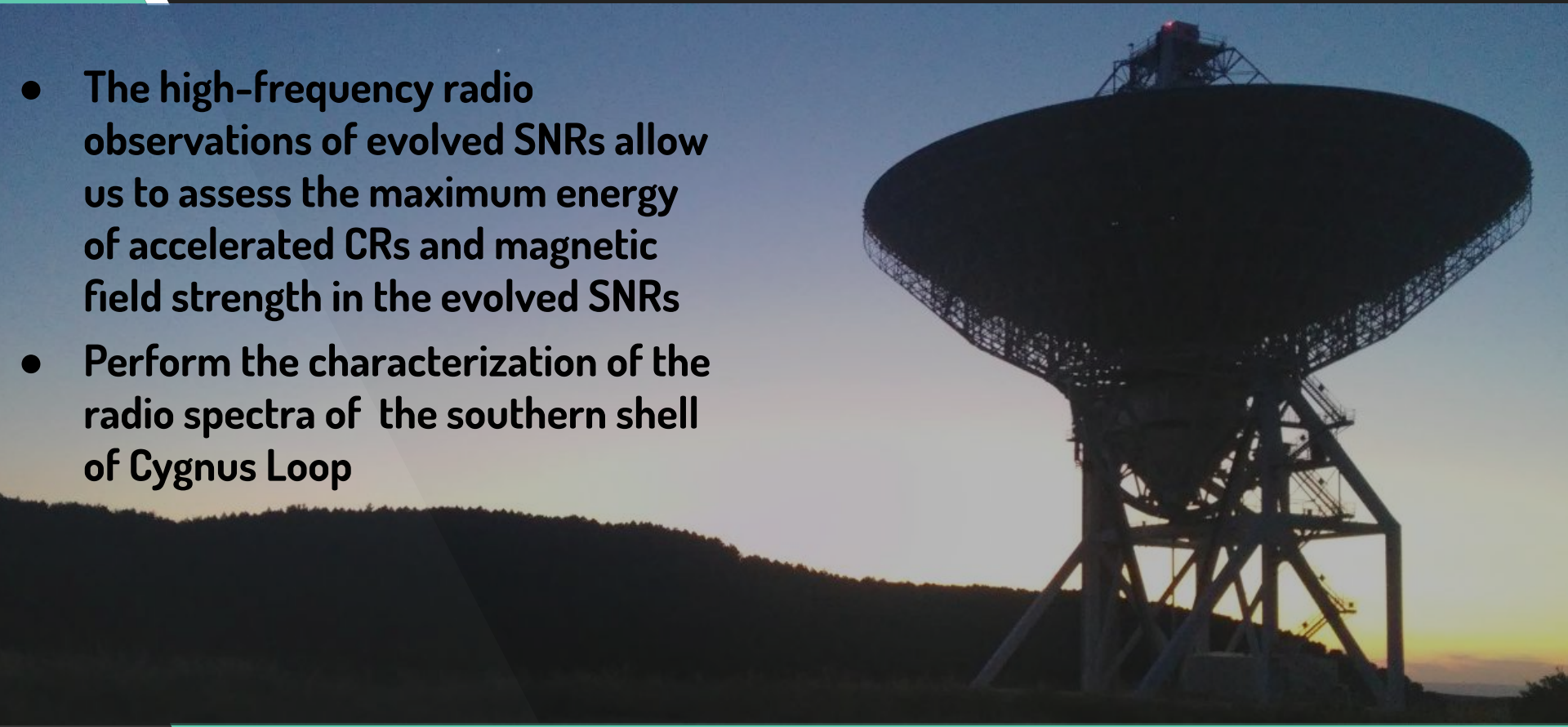
- The high-frequency radio observations of evolved SNRs allow us to assess the **maximum energy** of accelerated CRs and **magnetic field strength** in the evolved SNRs
- Perform the characterization of the radio spectra of the southern shell of Cygnus Loop





Thank you for your attention !



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