

Life of radio galaxies in cluster environment

Giulia Lusetti

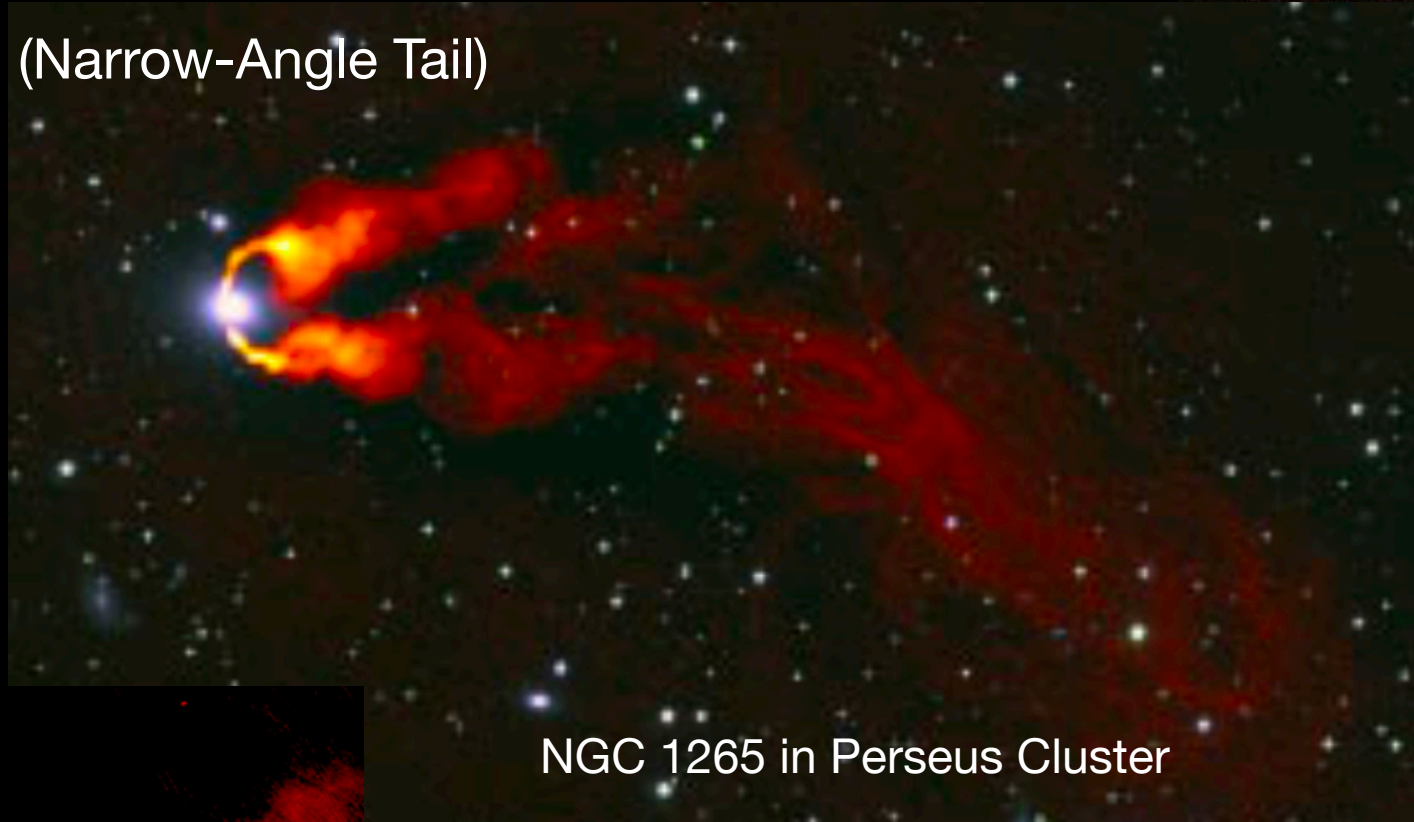
Phd student @ Hamburg University

Collaborators

F. De Gasperin, V. Cuciti, M. Brueggen et al.

NAT

(Narrow-Angle Tail)

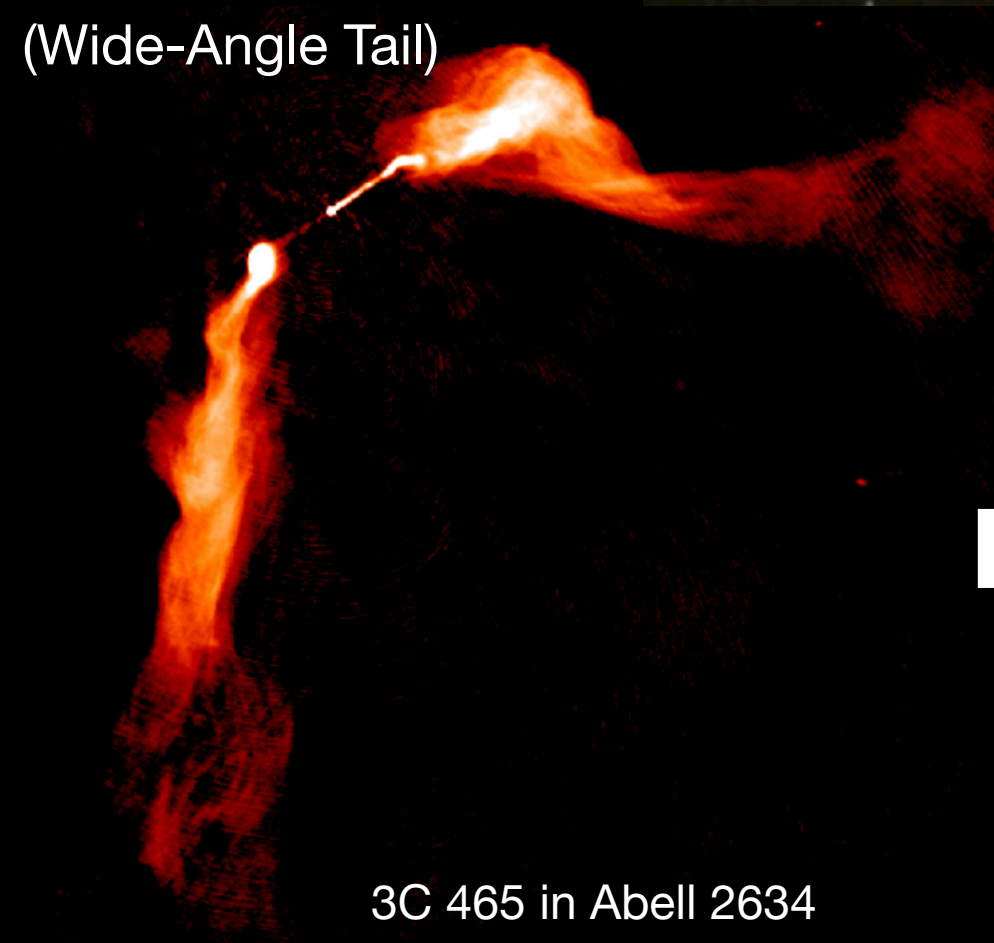


NGC 1265 in Perseus Cluster

Image credit: Gendron-Marsolais et al.
NRAO / AUI / NSF / Sloan Digital Sky Survey

WAT

(Wide-Angle Tail)



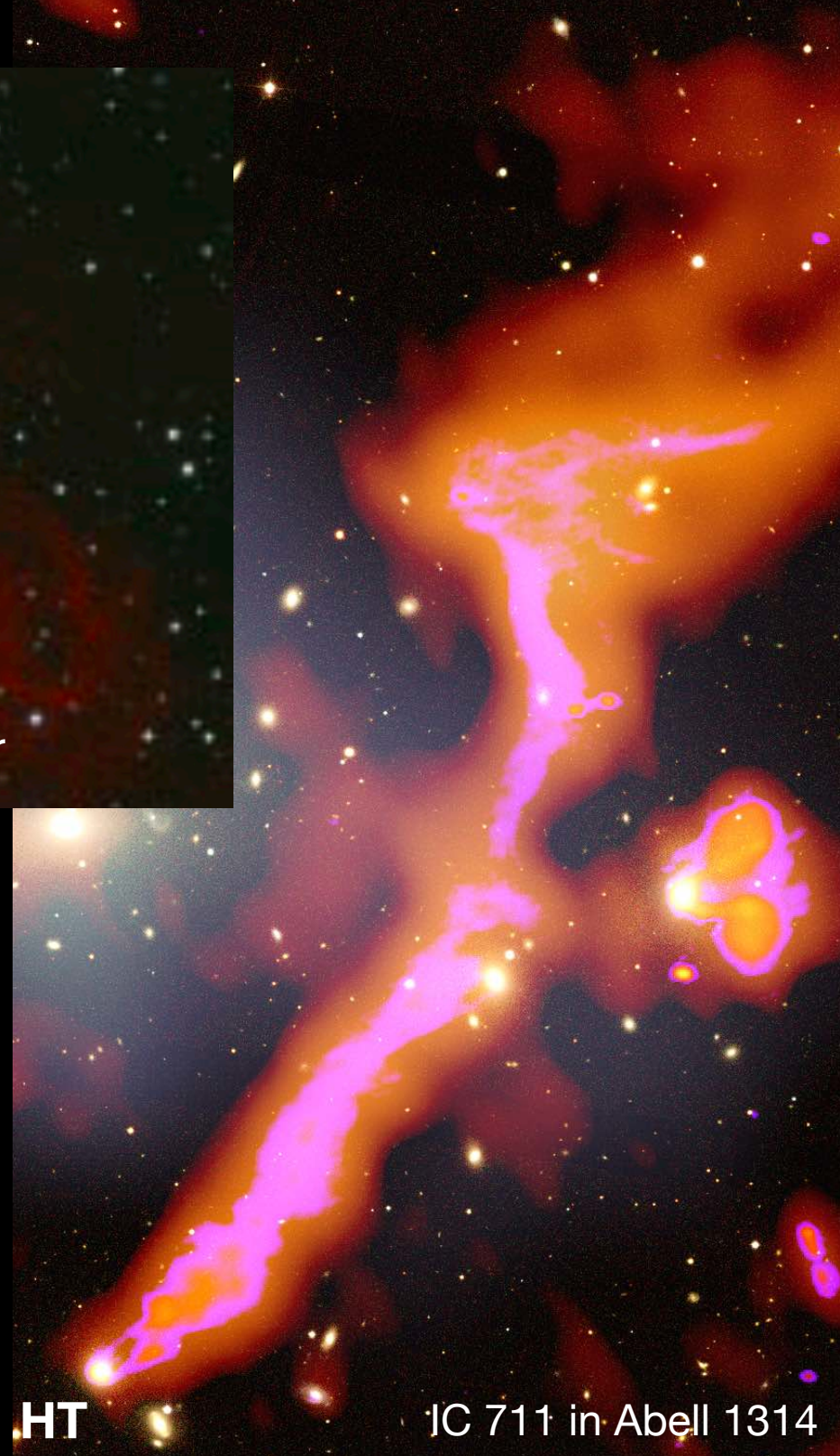
3C 465 in Abell 2634

Image credit: Gendron-Marsolais et al.
NRAO / AUI / NSF / Sloan Digital Sky Survey

Radio Galaxies in Clusters

HT

(Head-Tail)



IC 711 in Abell 1314

Image credit: Amanda Wilber
LOFAR Surveys Team/NASA/CXC

> Tails properties

- Jets bent in the same direction forming a **single tail**
- **Surface brightness** *decreases* along the tail
- **Size of hundreds of kpc**
- **Spectral index** becomes *steeper* from the core
- **Fraction of polarization** *increases* along the jets

> Tails properties

- Jets bent in the same direction forming a **single tail**

- **Surface brightness** *decreases* along the tail

Low surface-brightness

- **Size of hundreds of kpc**

- **Spectral index** becomes *steeper* from the core

Steep-spectrum emission

- **Fraction of polarization** *increases* along the jets

> LOFAR capabilities in tails detection

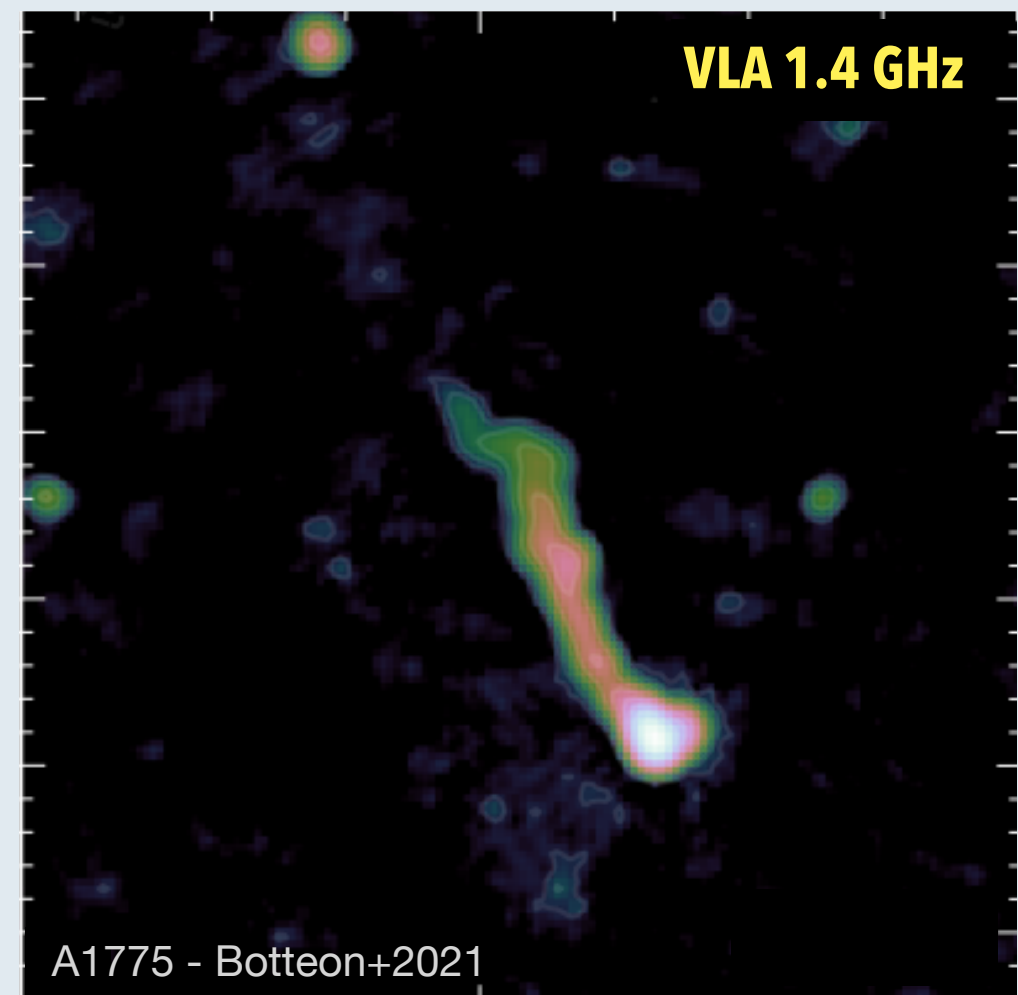
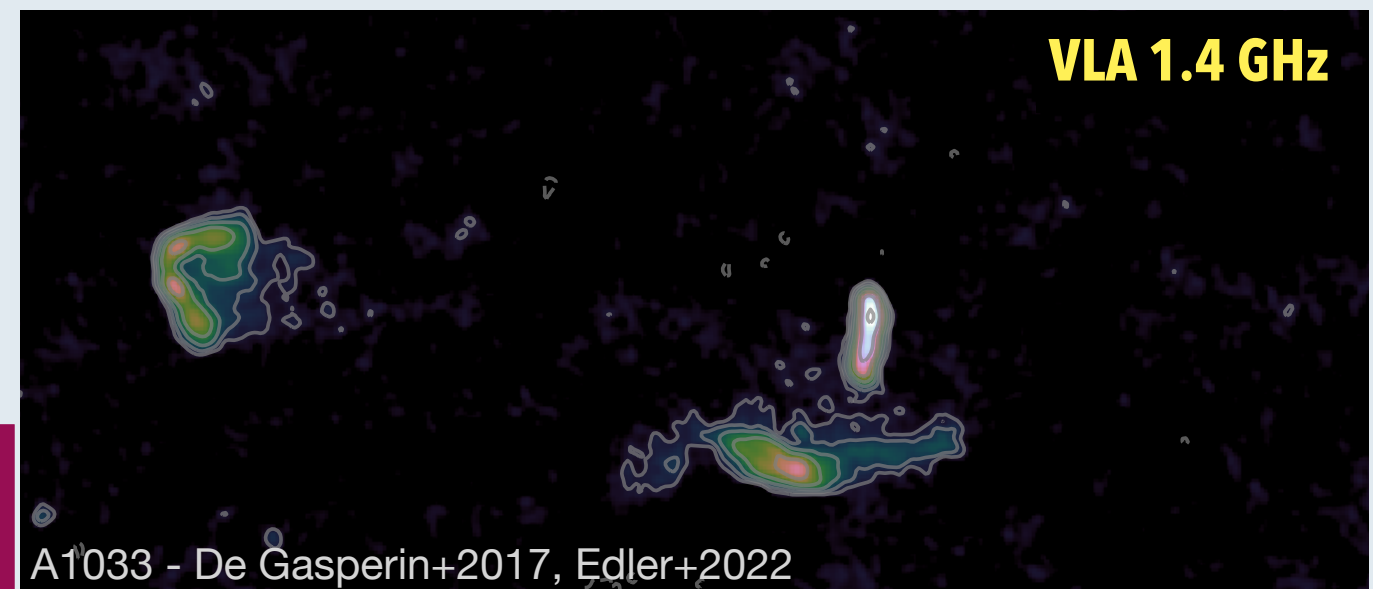
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LOFAR capabilities in tails detection

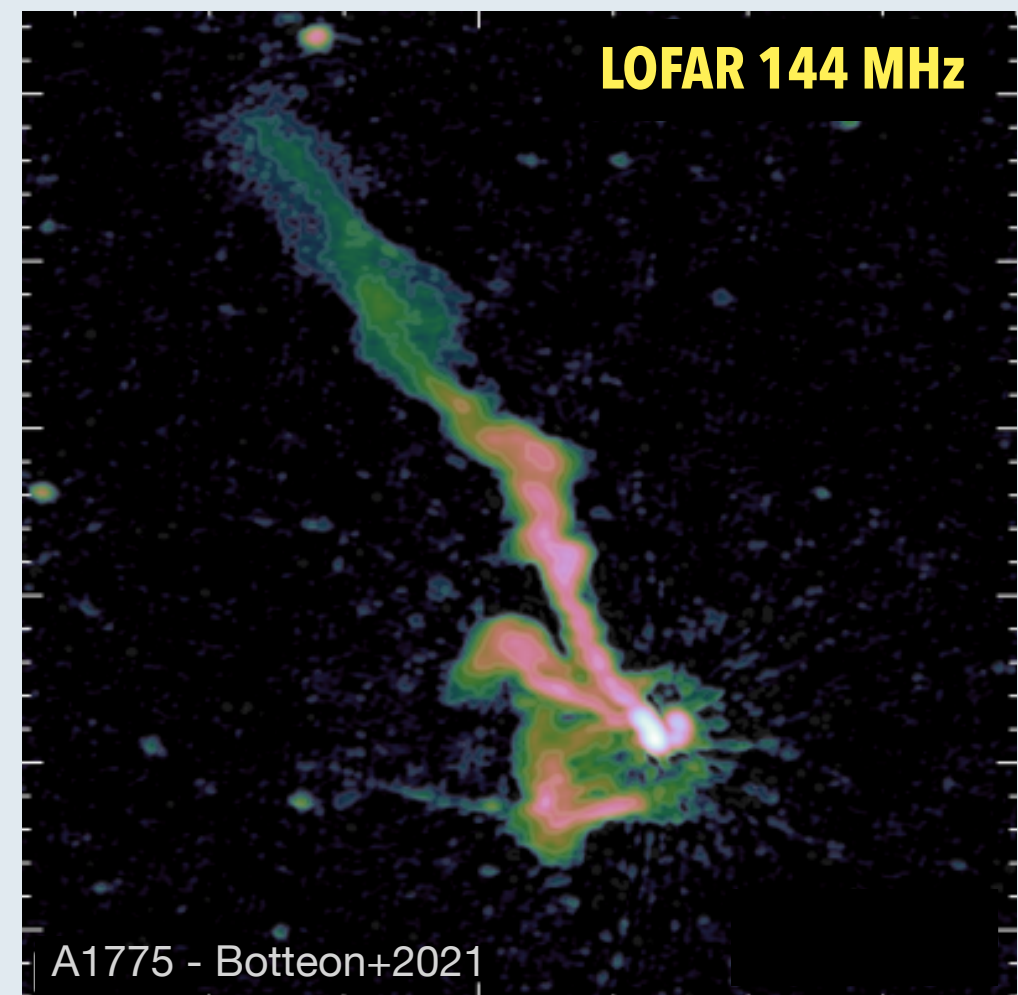
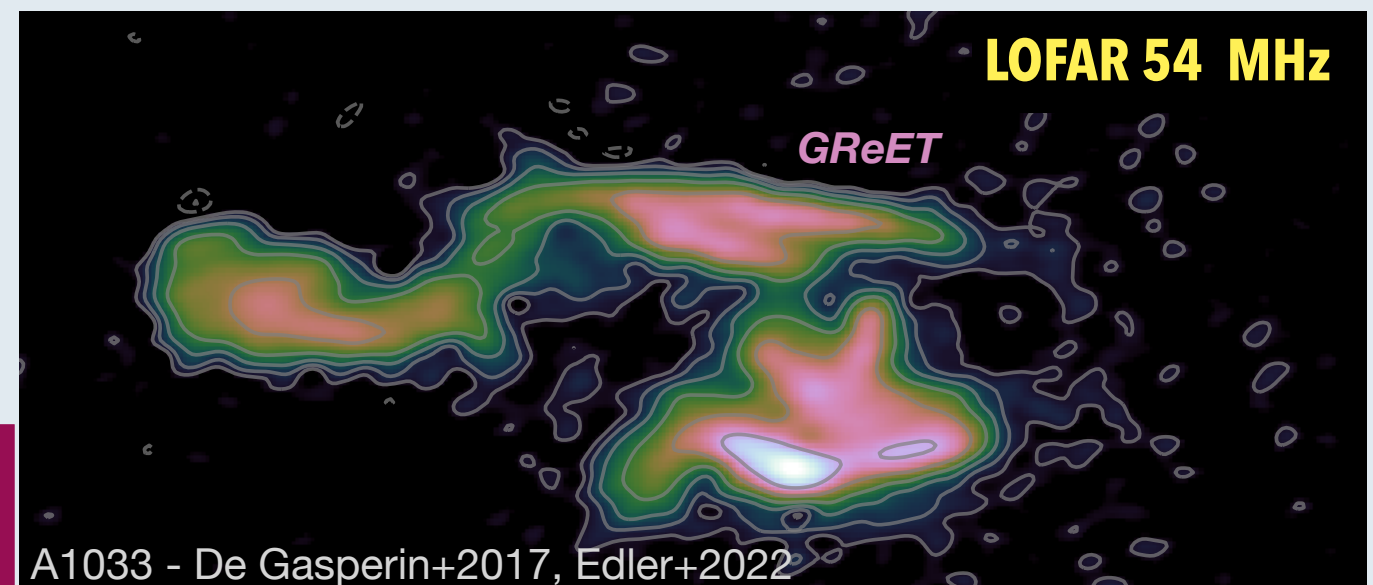
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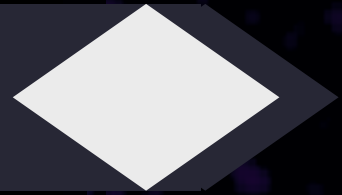
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The galaxy cluster ZwCl 0634.1+4747

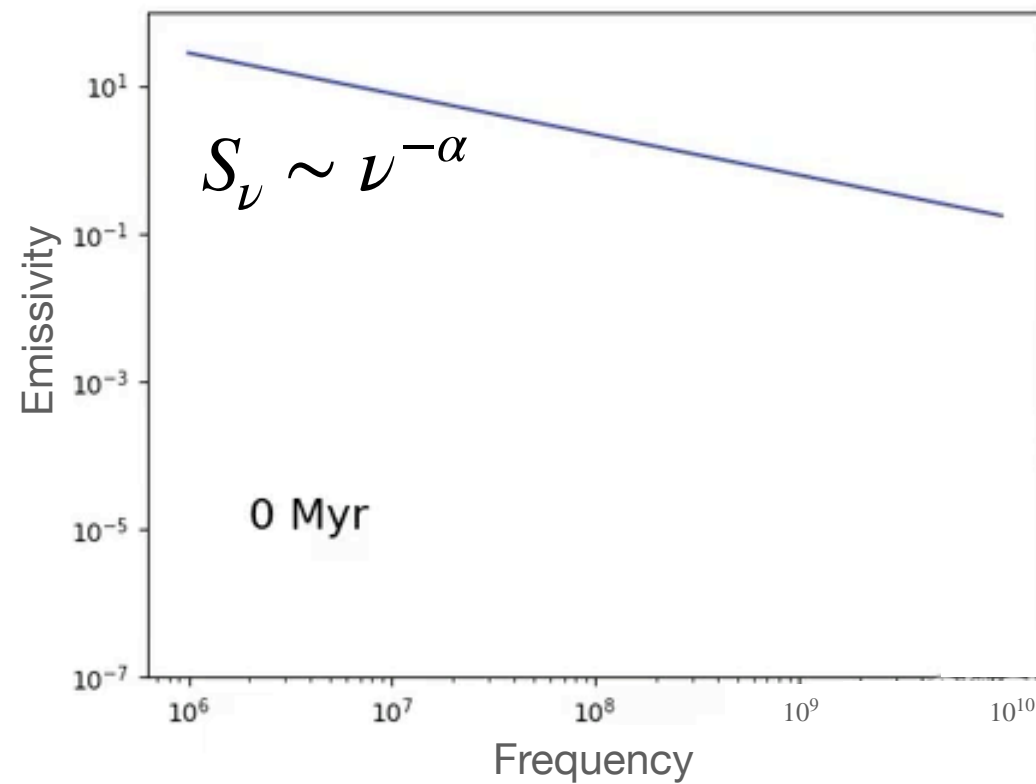
Multi-frequency radio study:

LOFAR LBA (53MHz), **HBA**(145MHz), **GMRT**(323MHz), **VLA**(1518MHz)

pc

1518 MHz

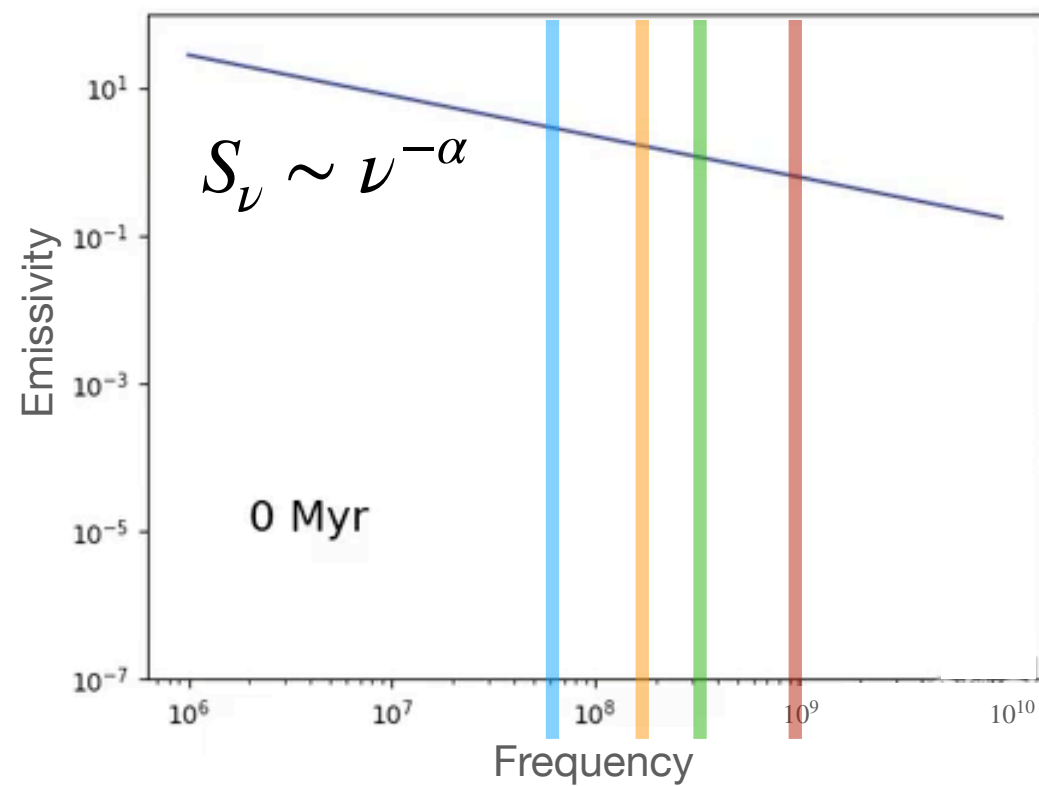
> Ageing of tails



Pure ageing scenario
simply including
Sync and IC losses

Jaffe-Perola model (JP, JaffePerola, 1973)

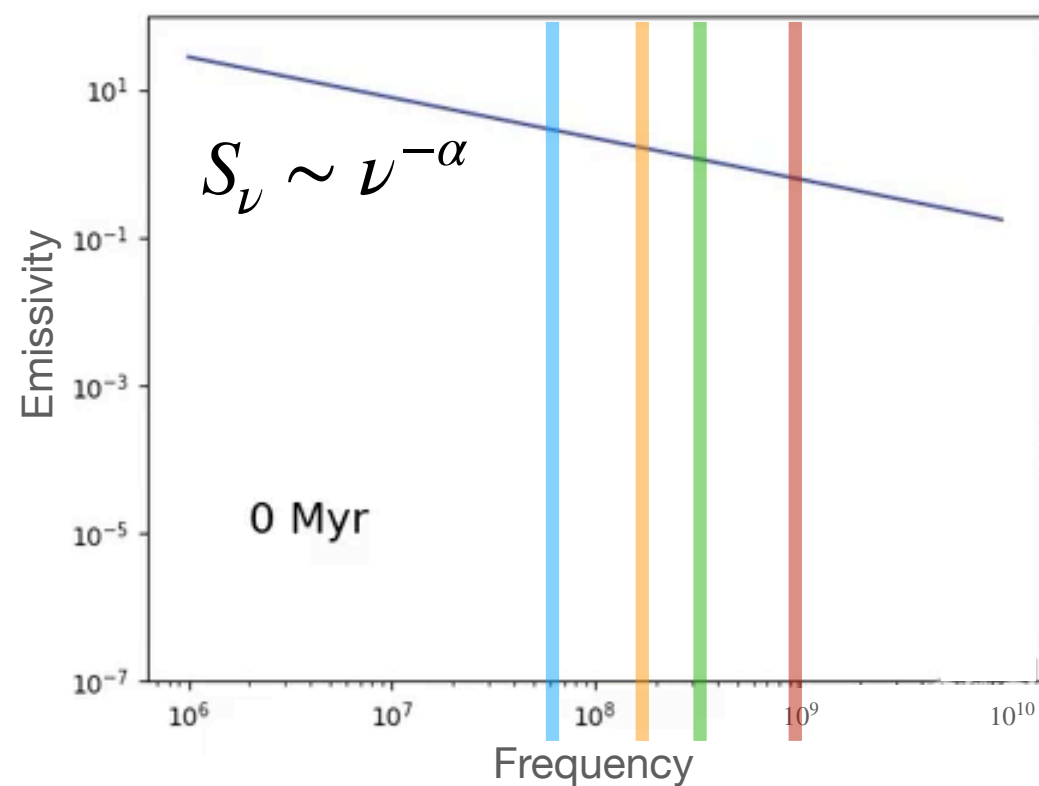
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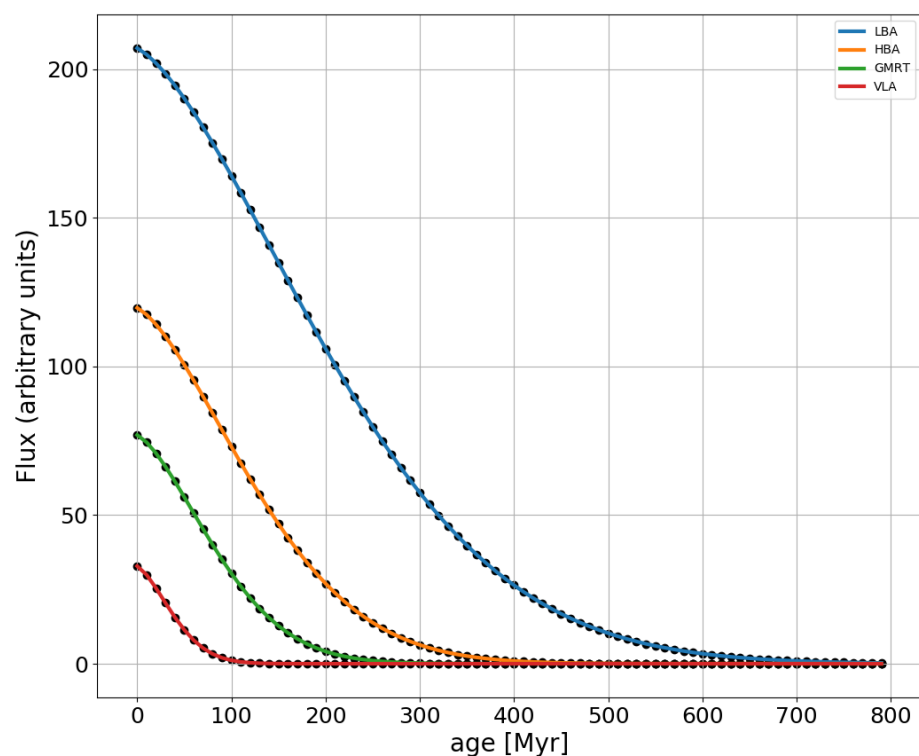
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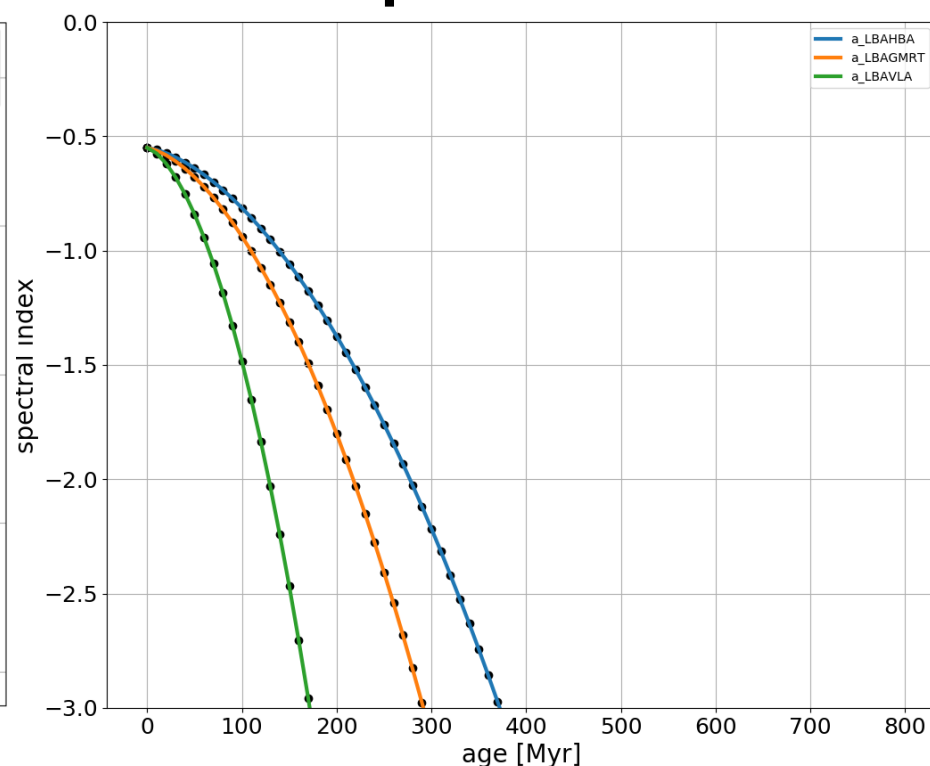
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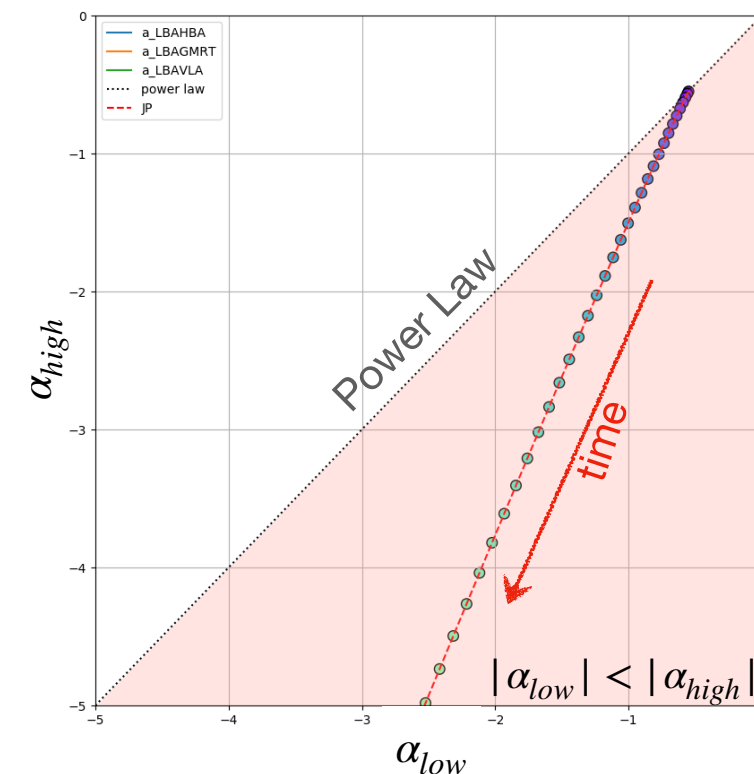
Flux



Spectral index

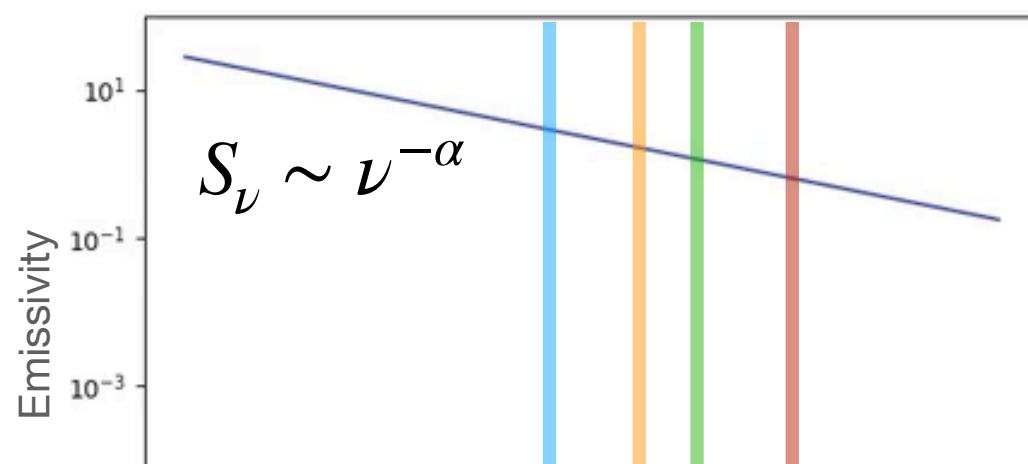


Color-color





Ageing of tails



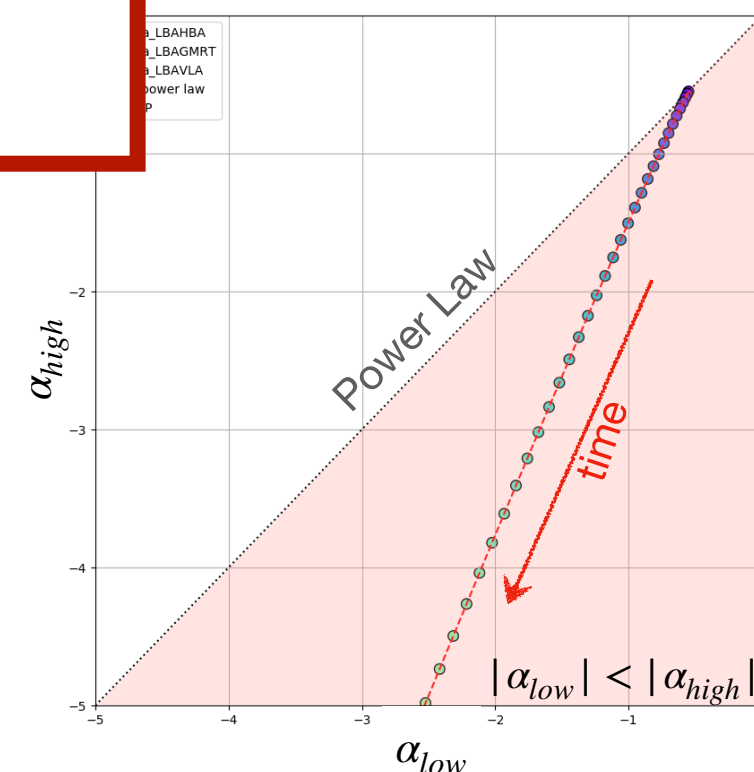
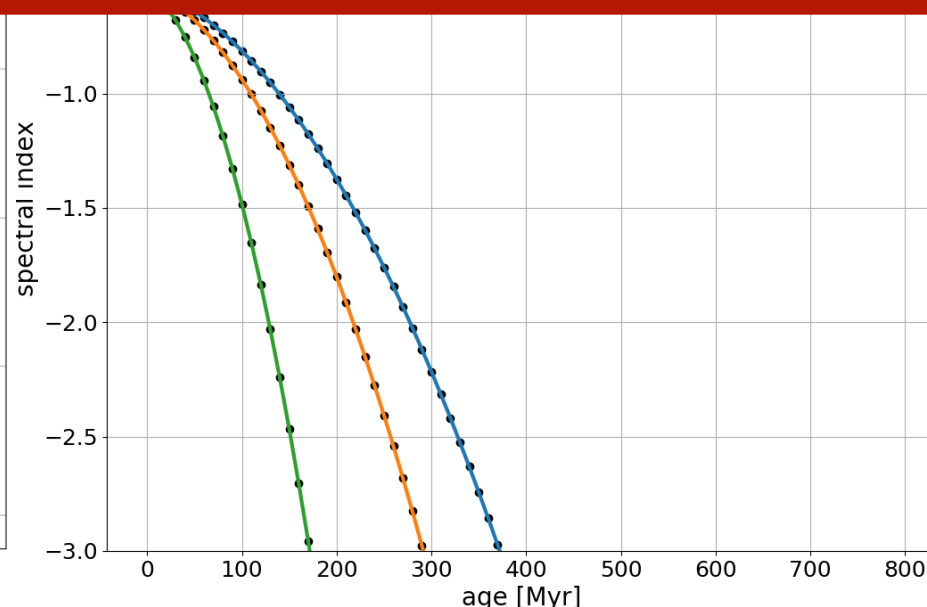
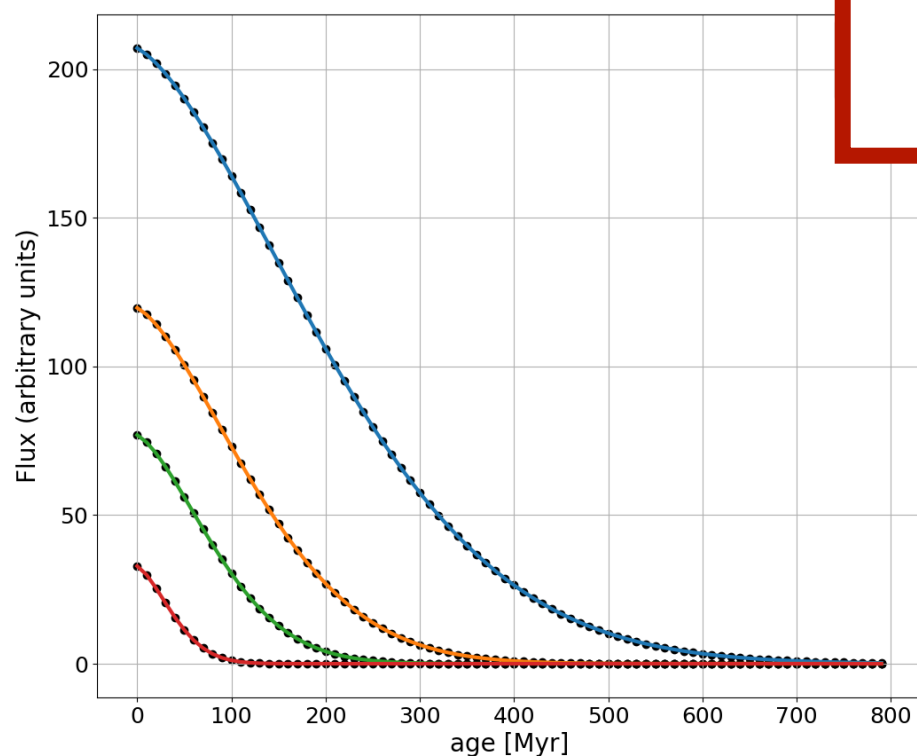
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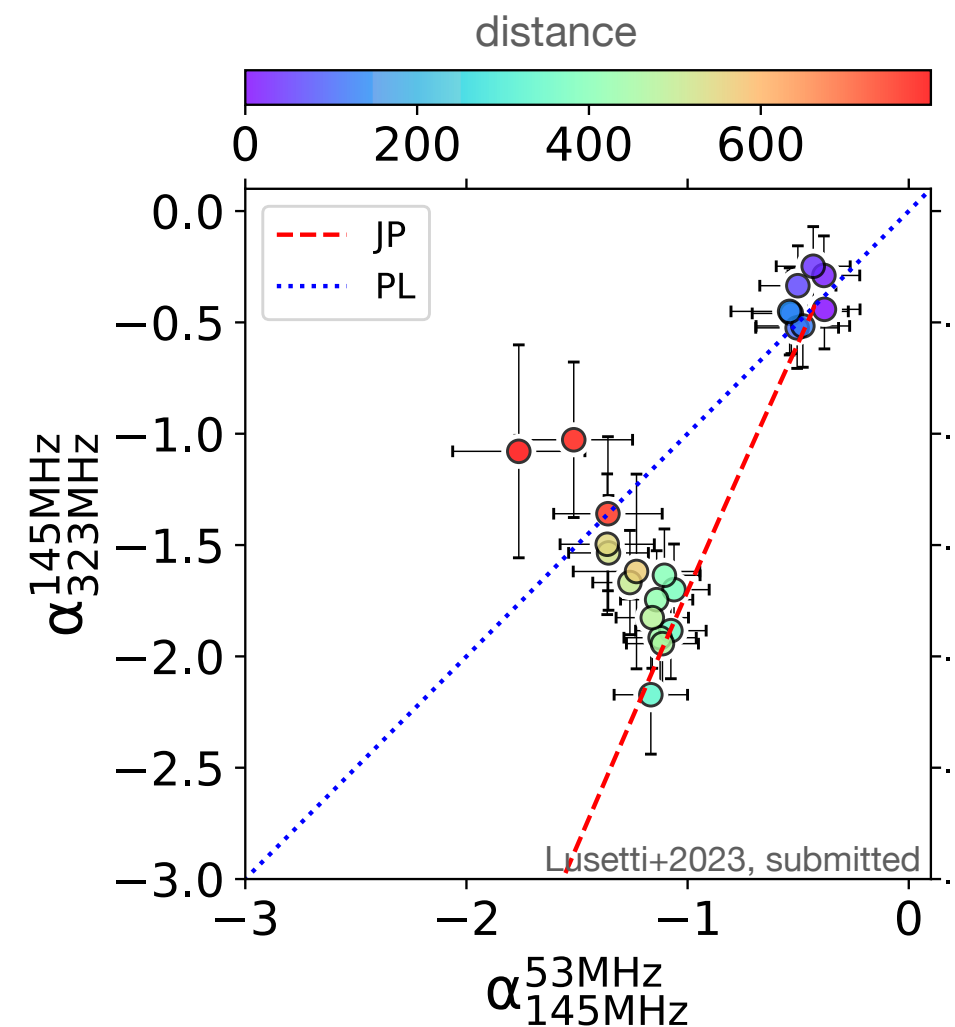
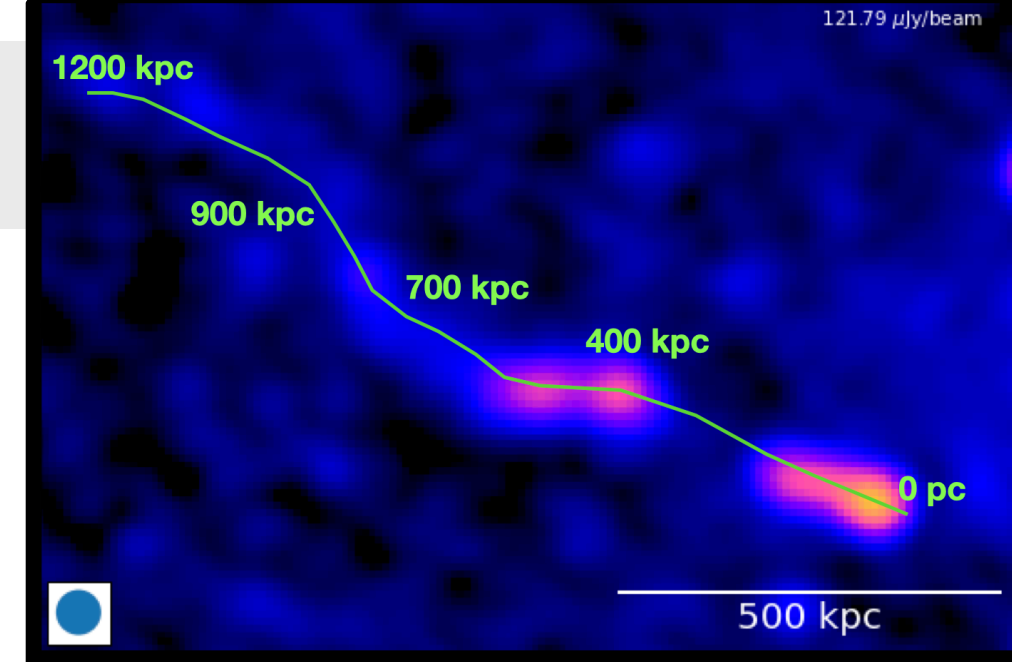
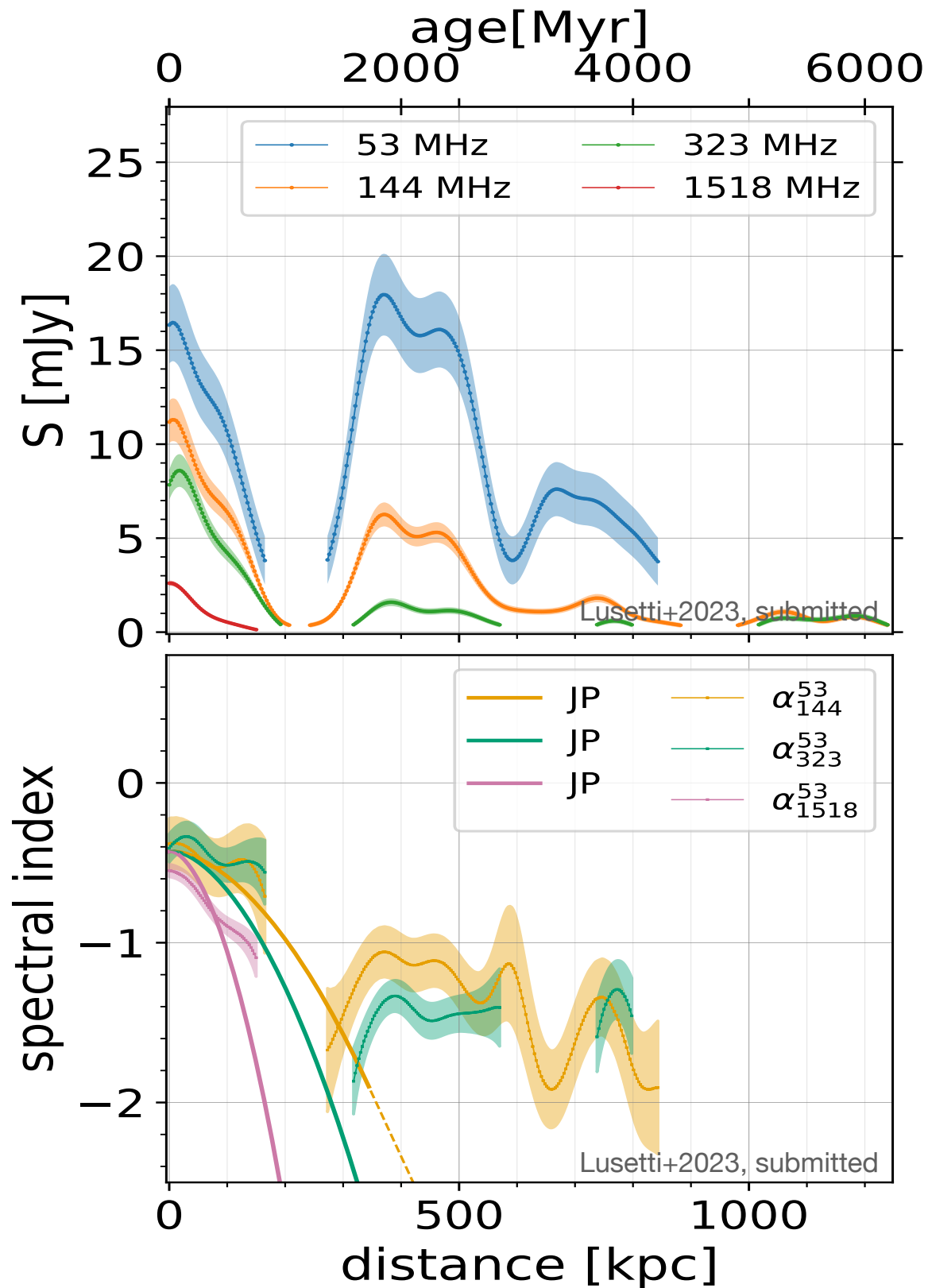
Can our observed profiles
be explained by a
pure-ageing scenario?

Flux

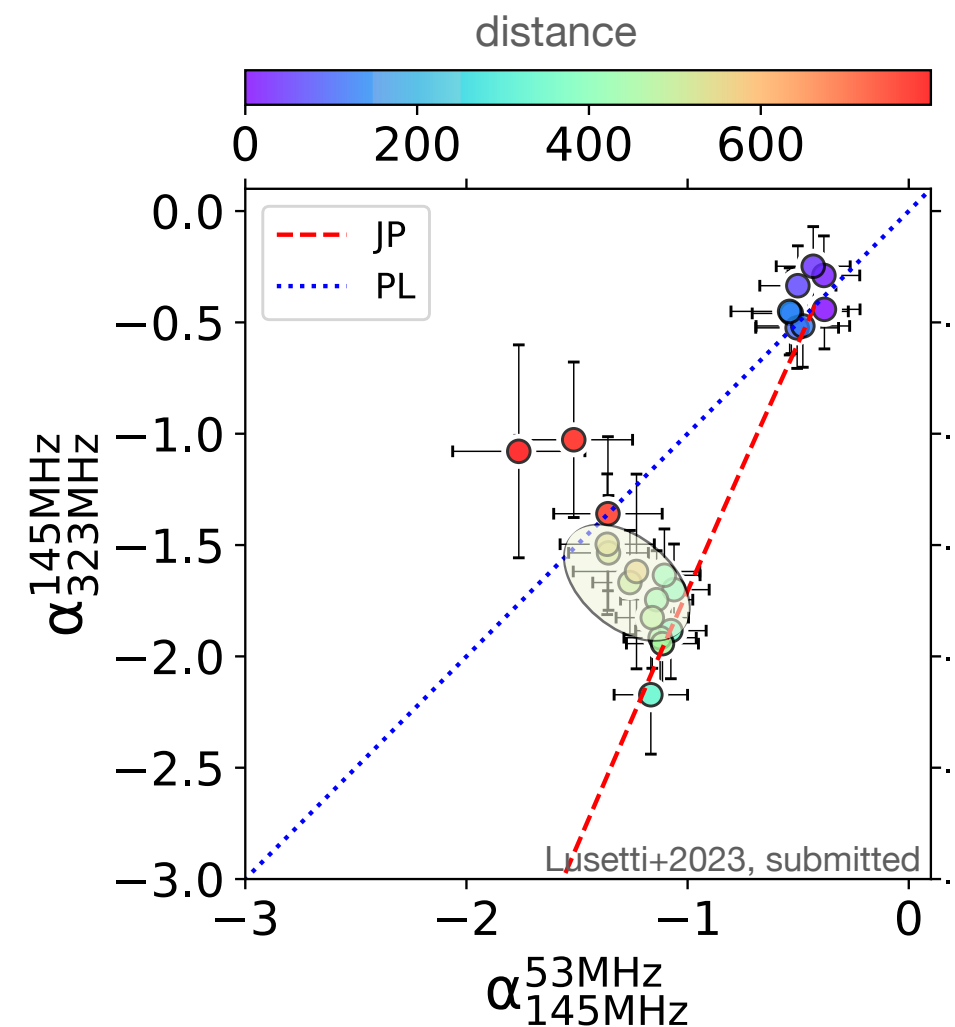
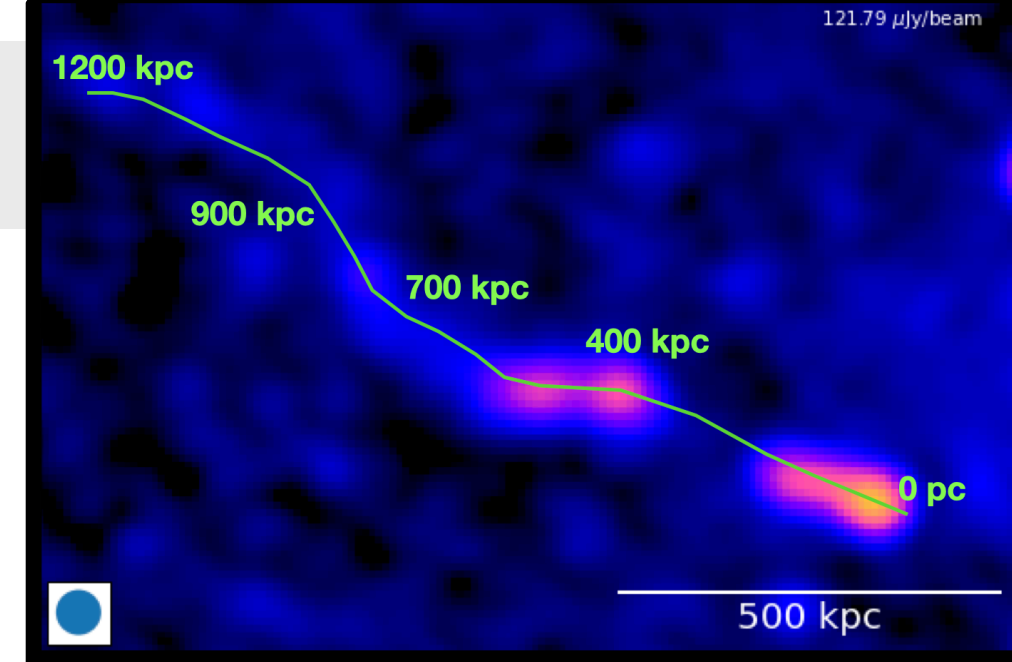
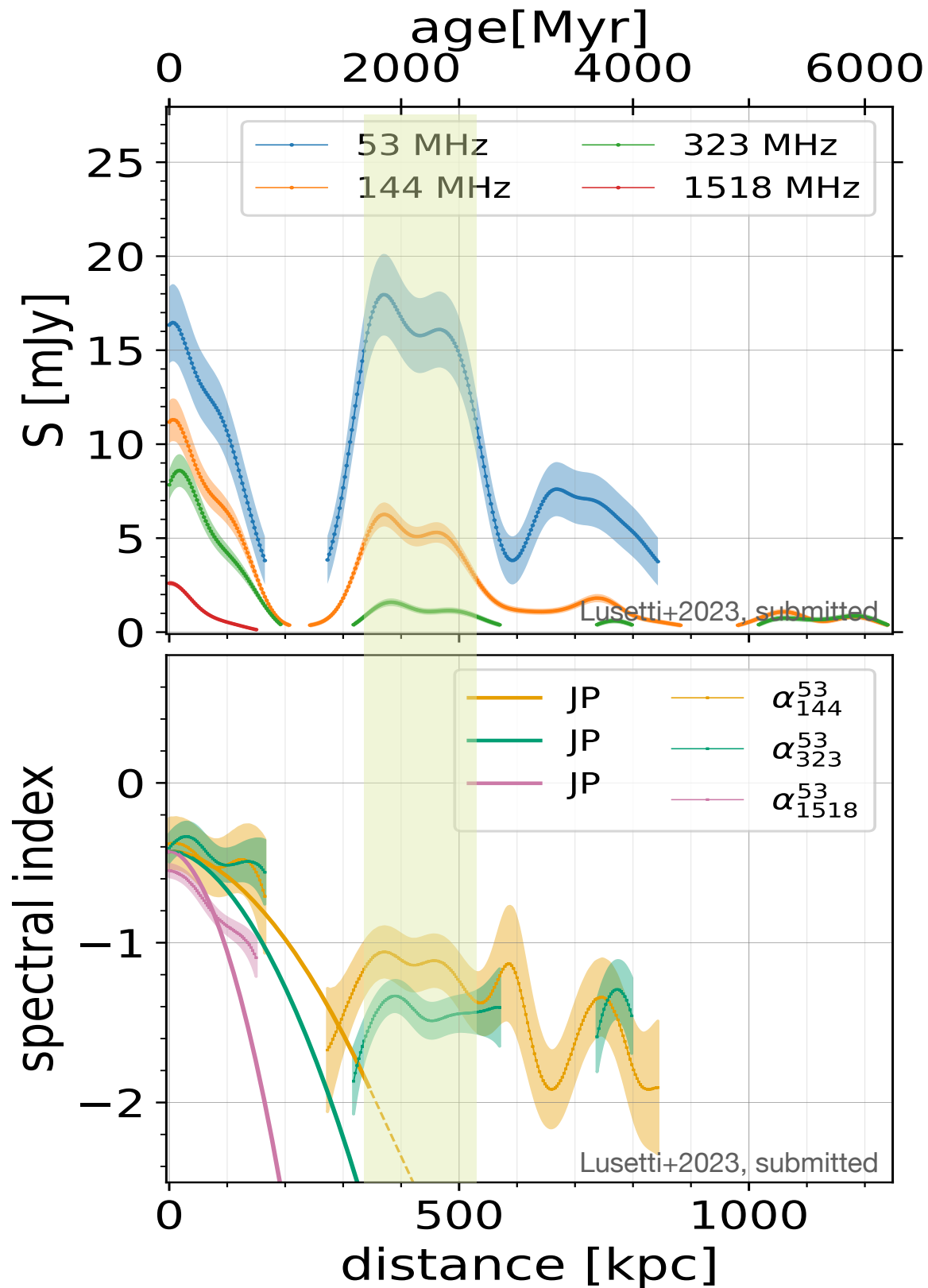
Color-color



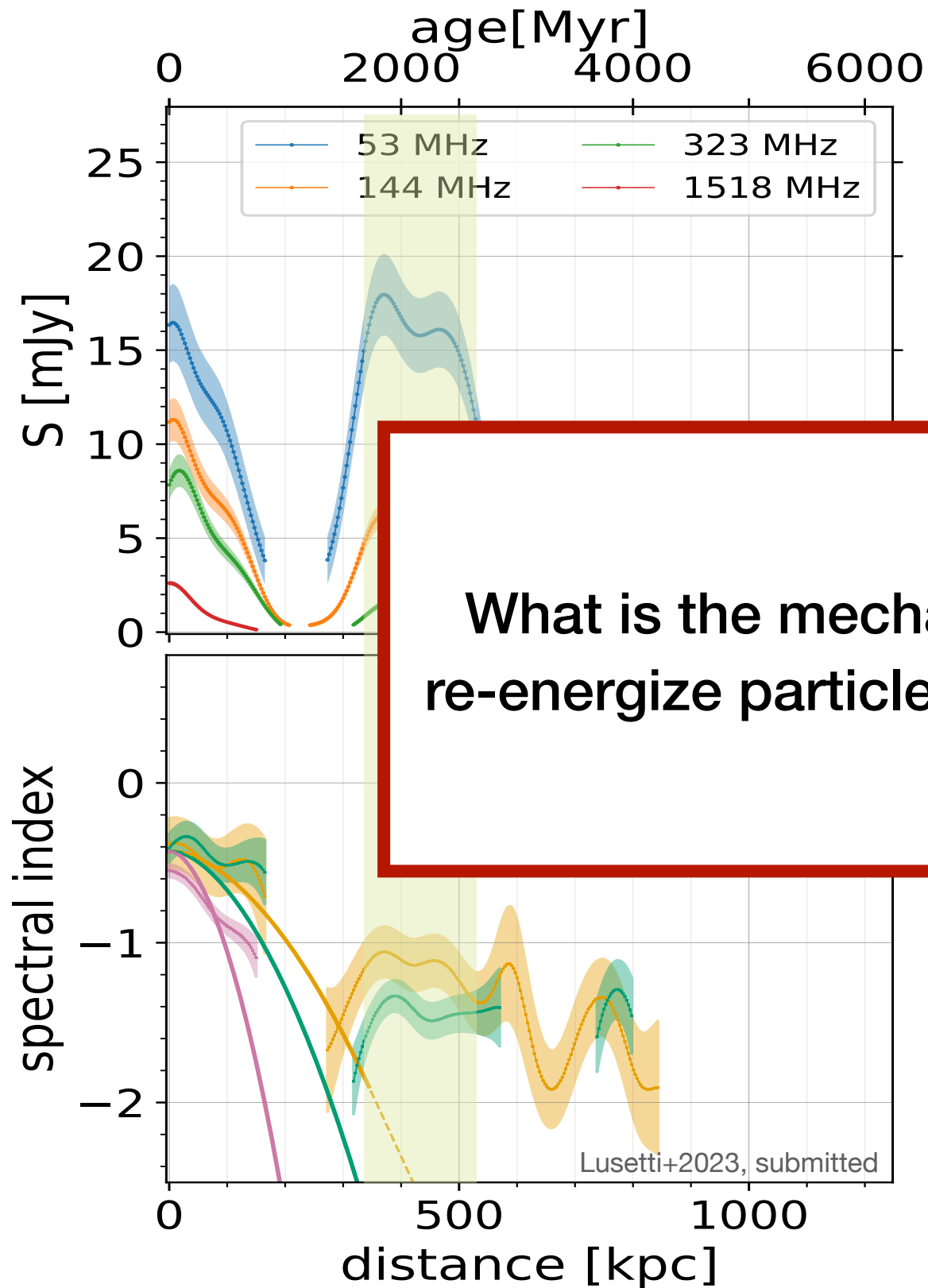
Tails profiles - HT A



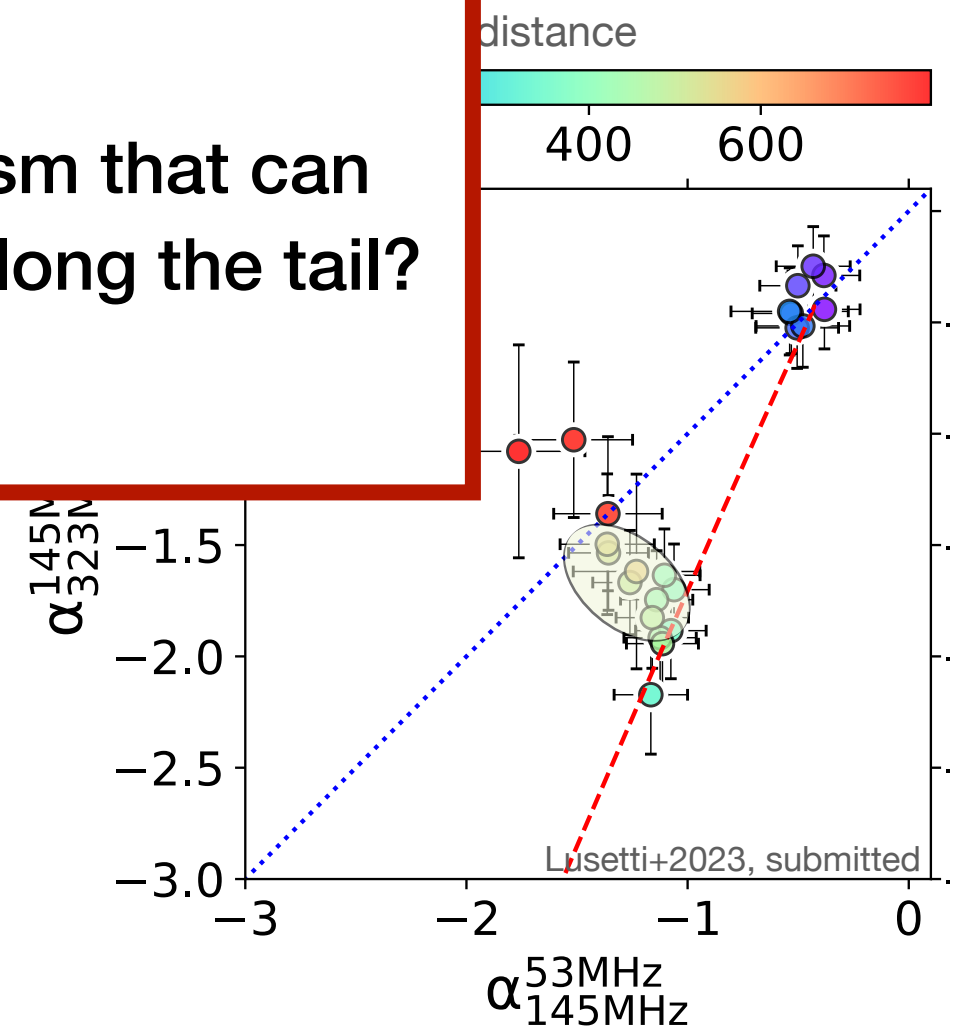
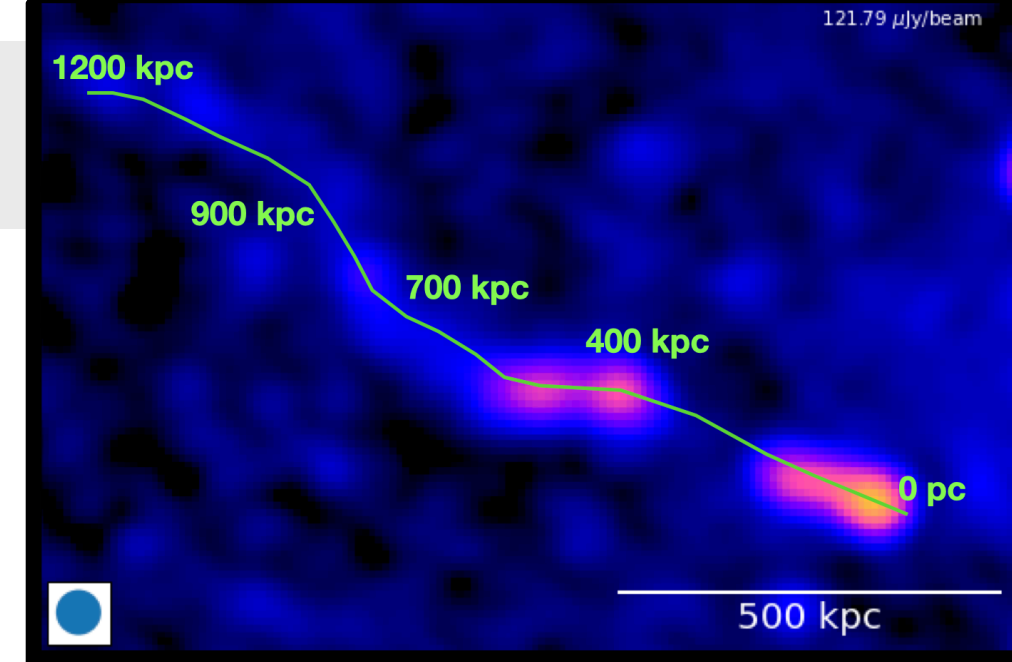
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Tails profiles - HT A

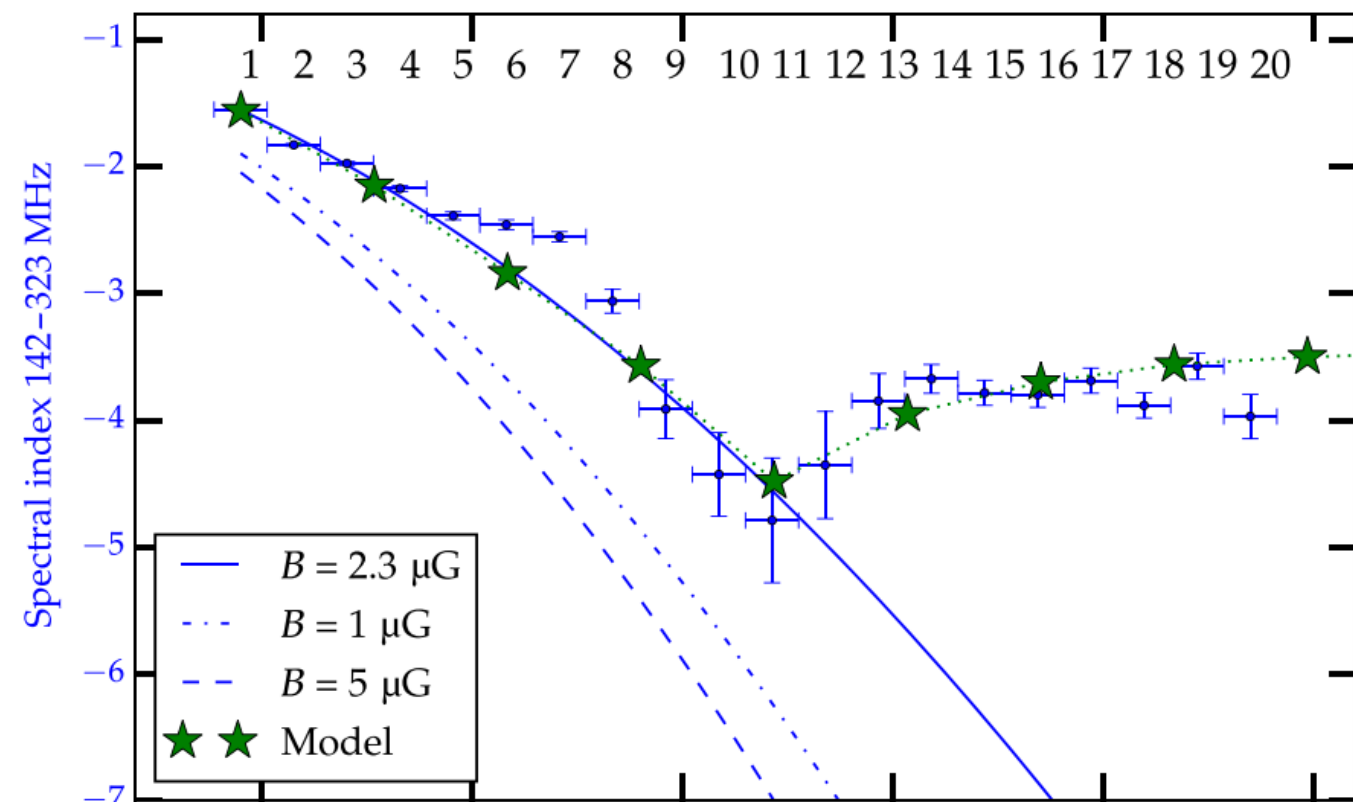
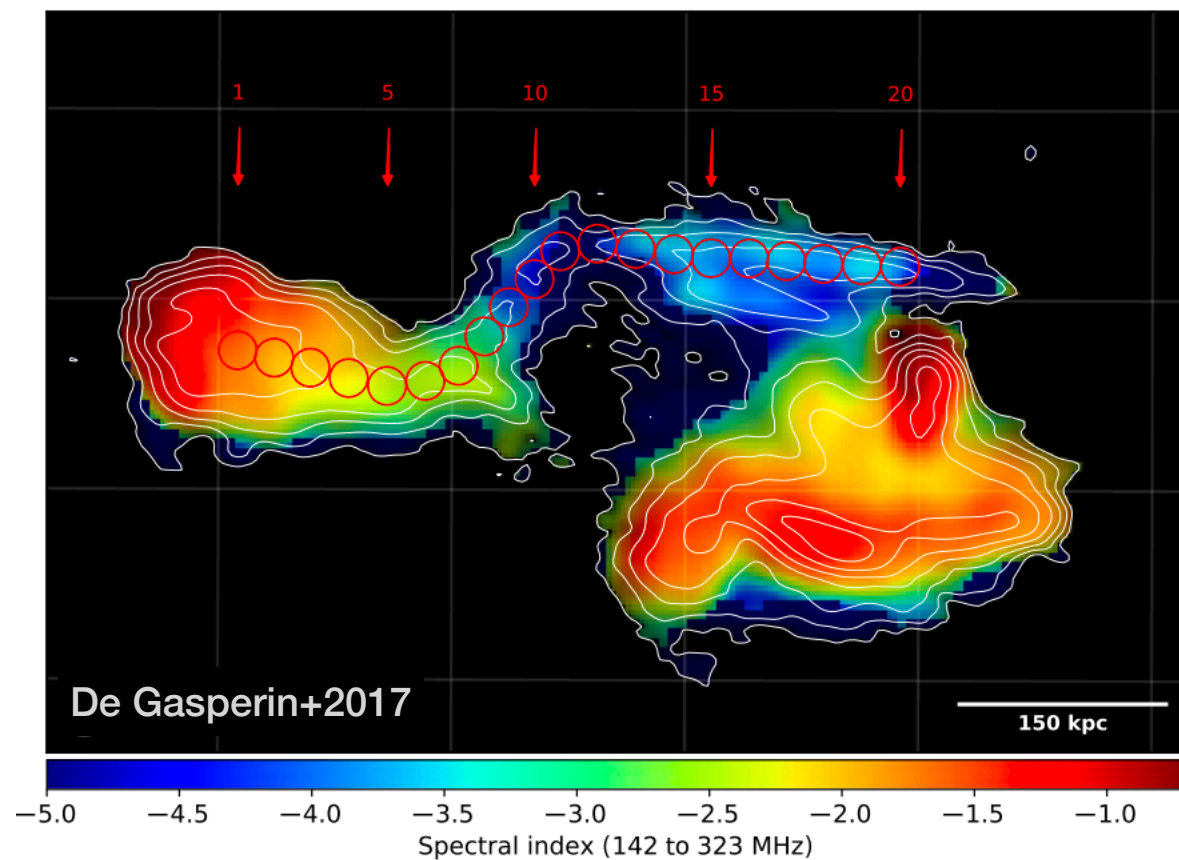


What is the mechanism that can re-energize particles along the tail?



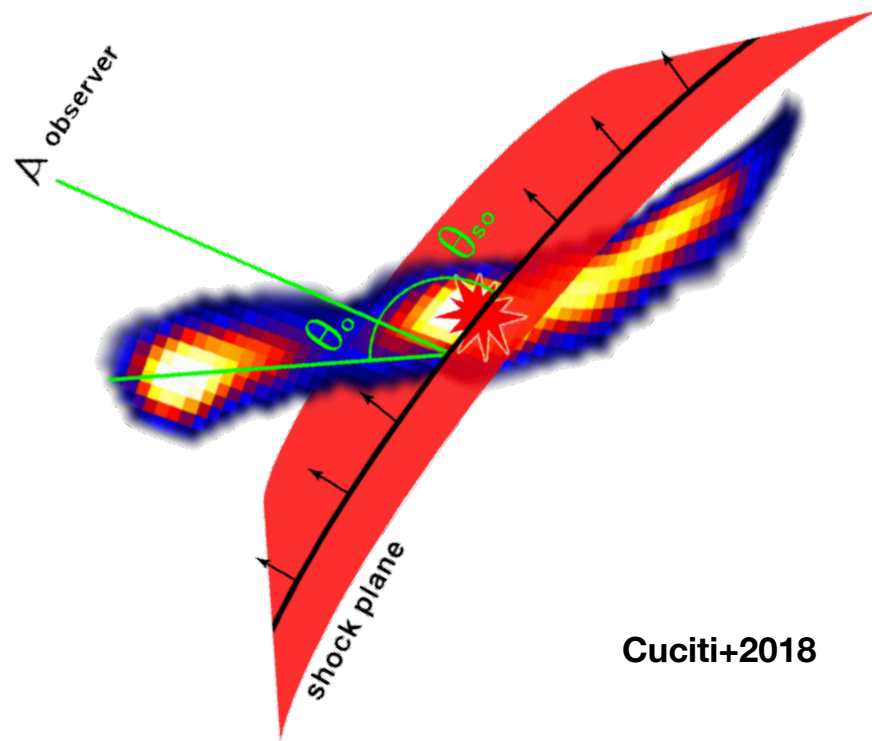
HT-ICM interaction

GReET - gently reenergized tail



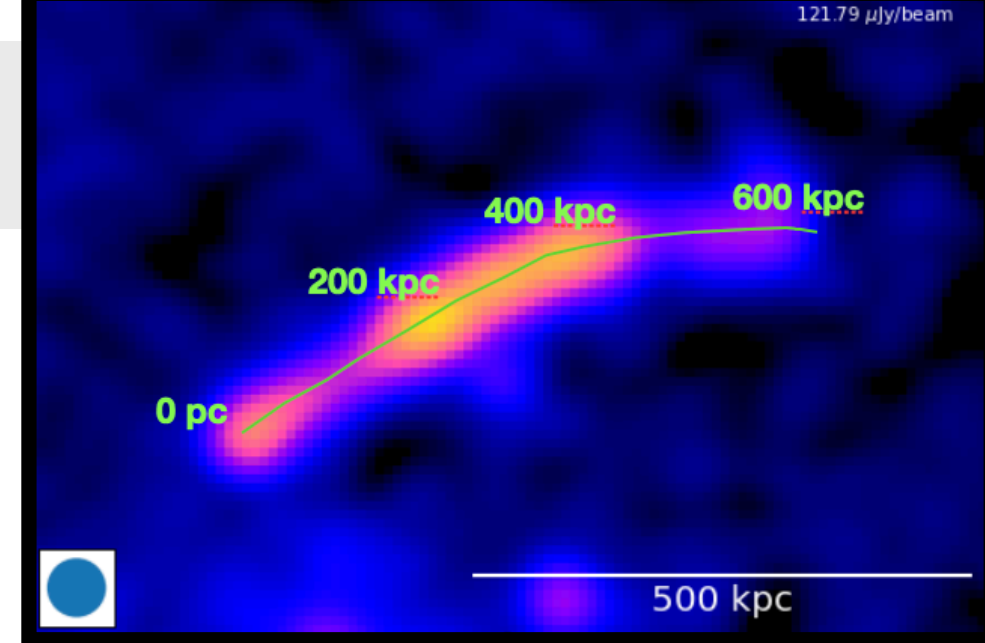
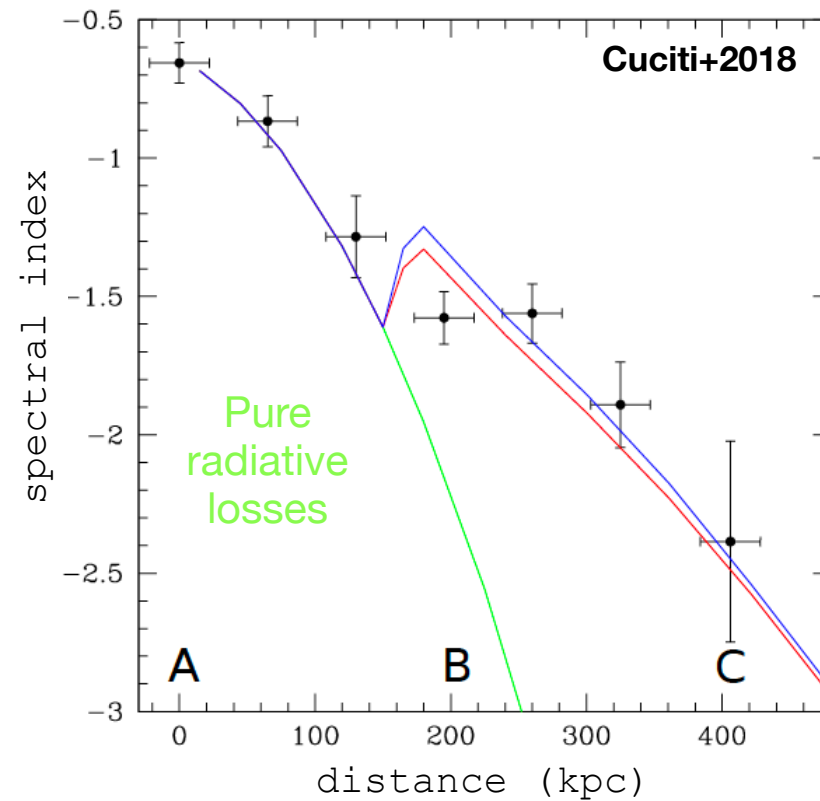
Tails profiles - HT B

High frequency
323 MHz
1.5 GHz



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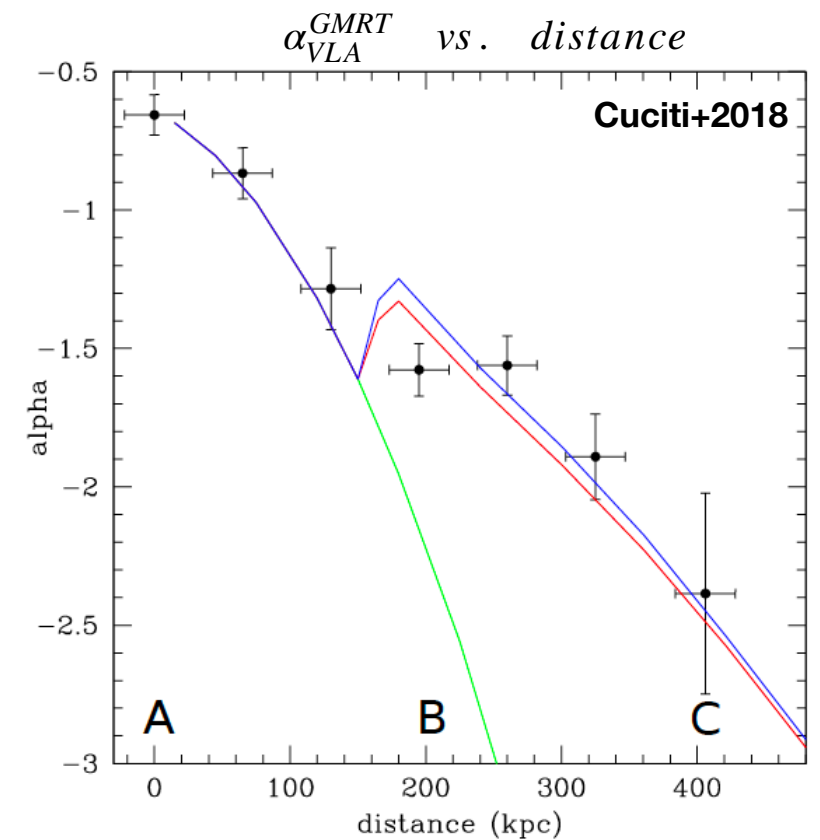
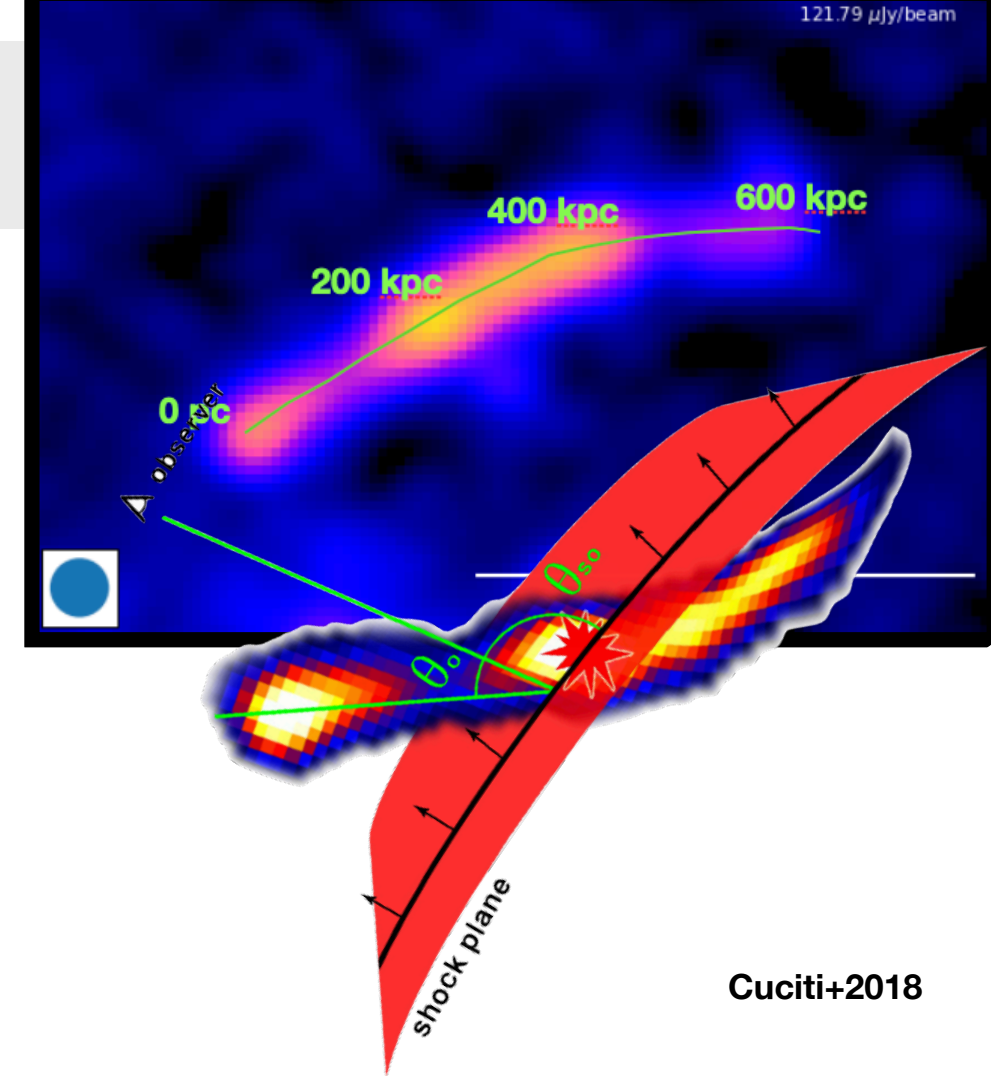
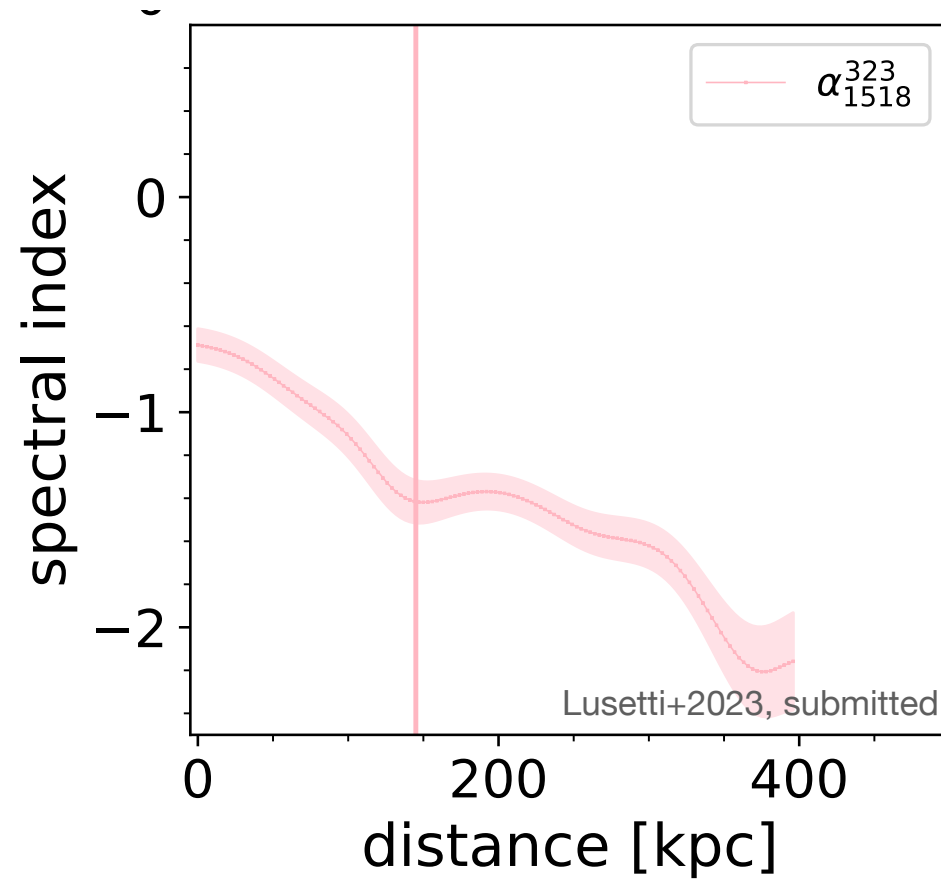
α_{VLA}^{GMRT} vs. distance



Shock - radio tail
interaction

Tails profiles - HT B

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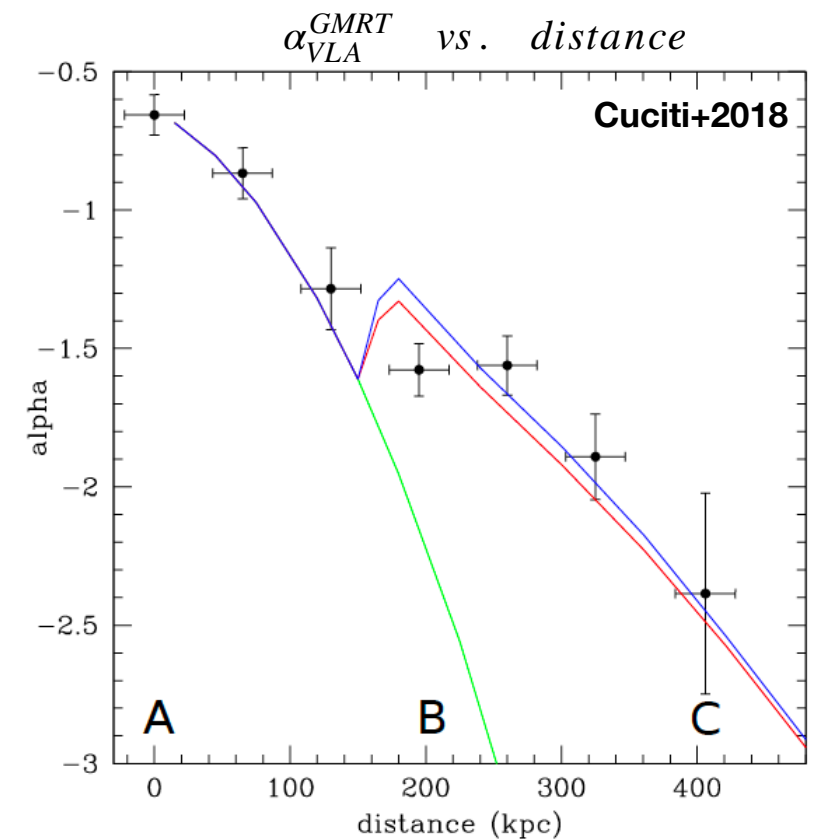
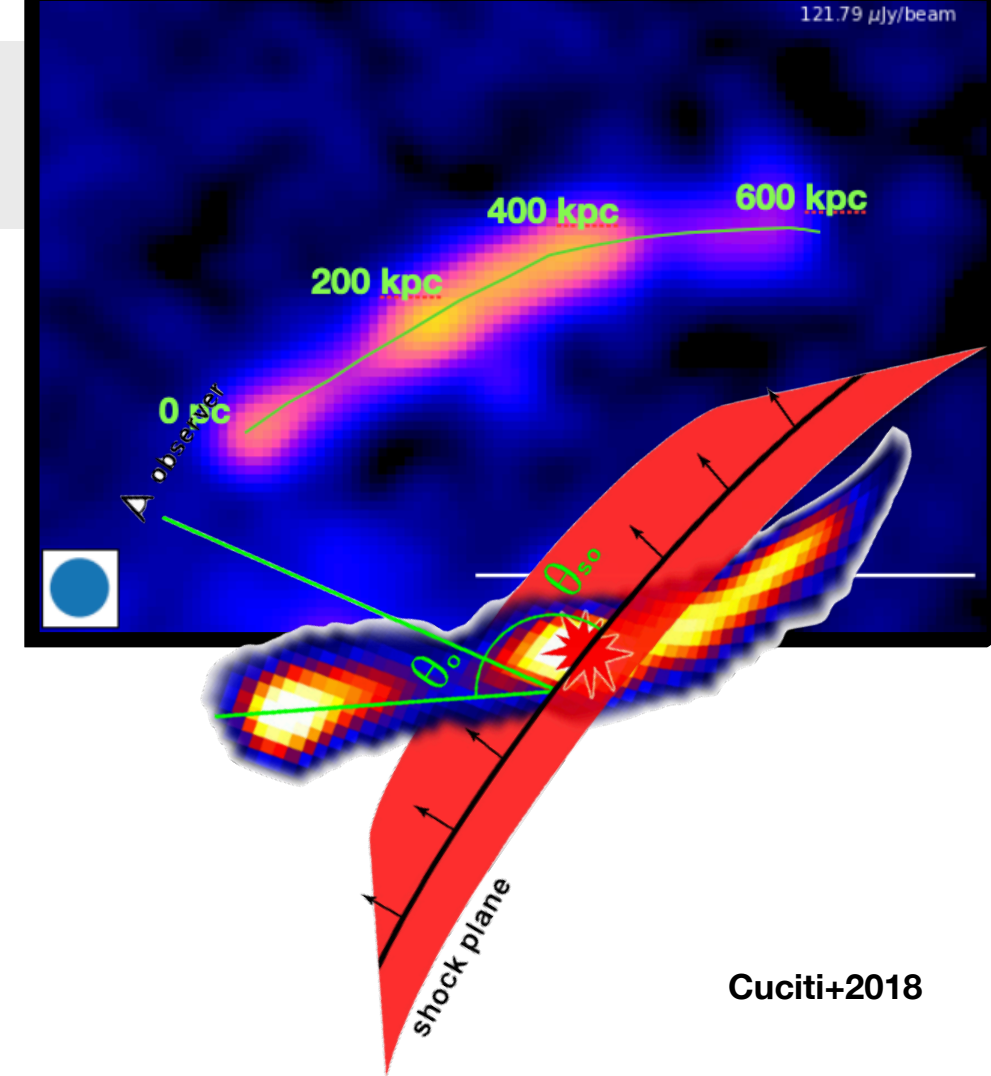
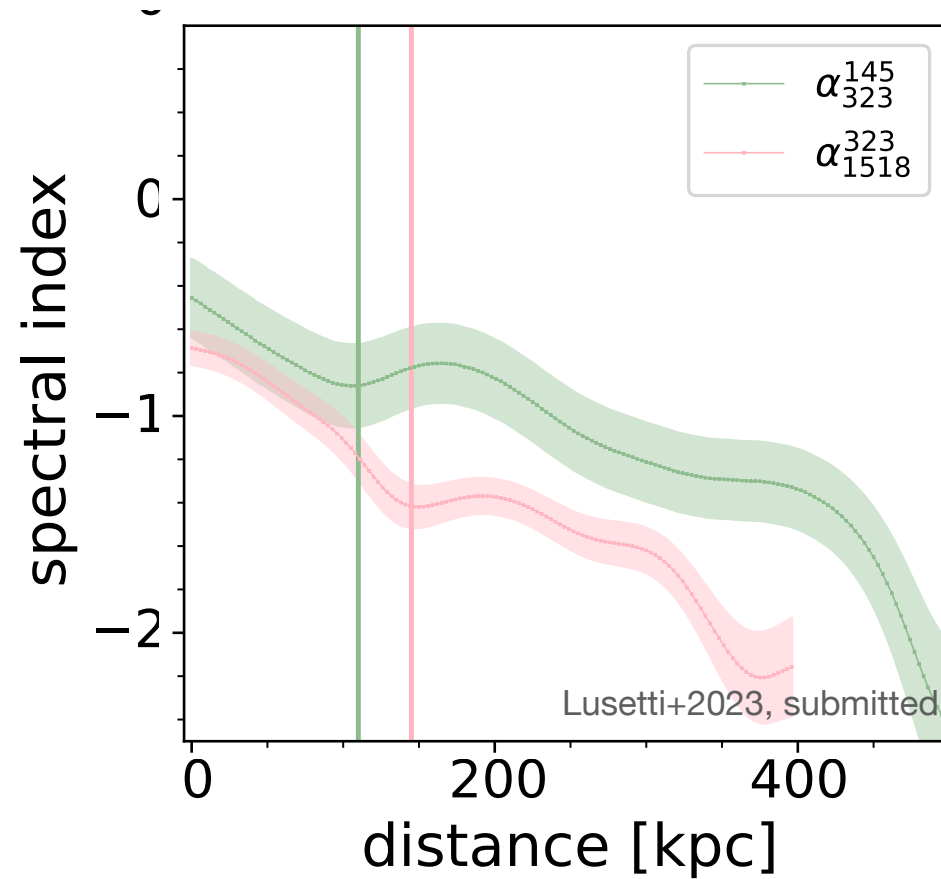


Tails profiles - HT B

High frequency
323 MHz
1.5 GHz

+

Low frequency:
53 MHz
144 MHz

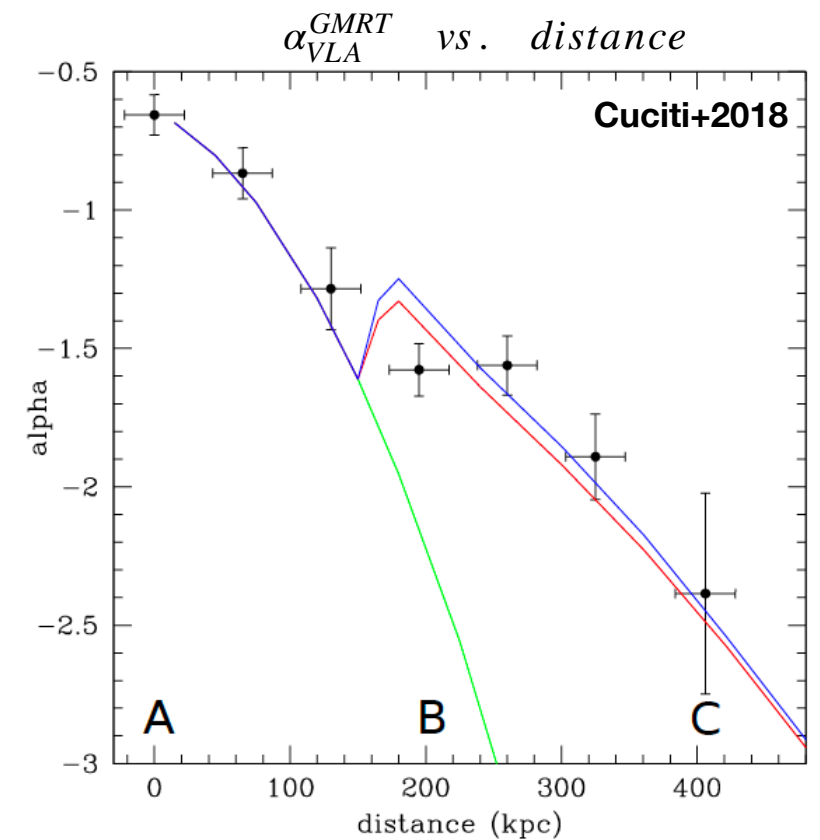
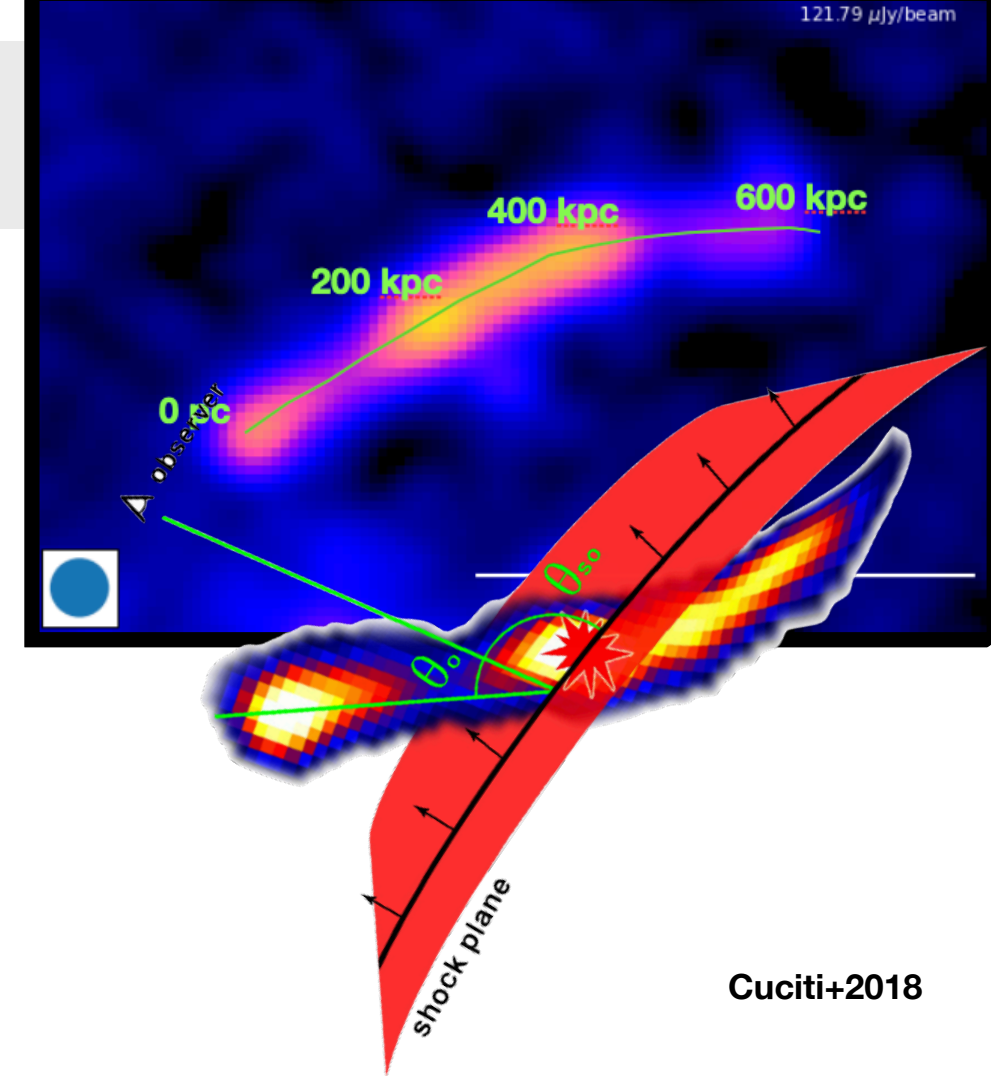
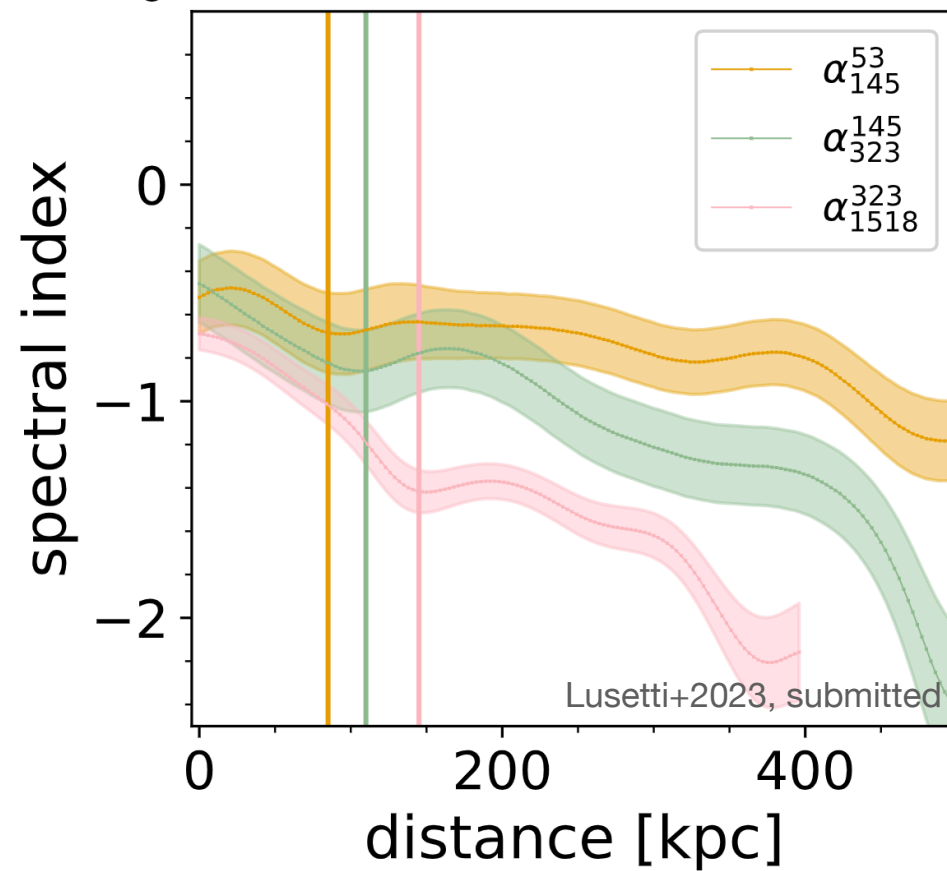


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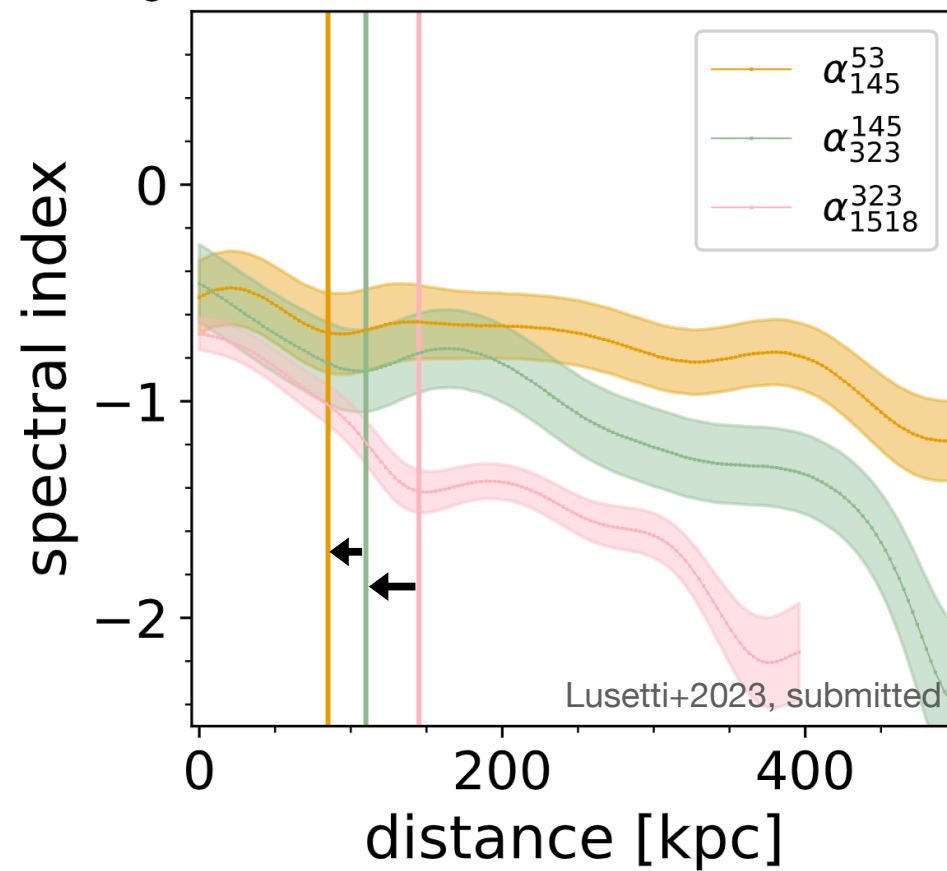


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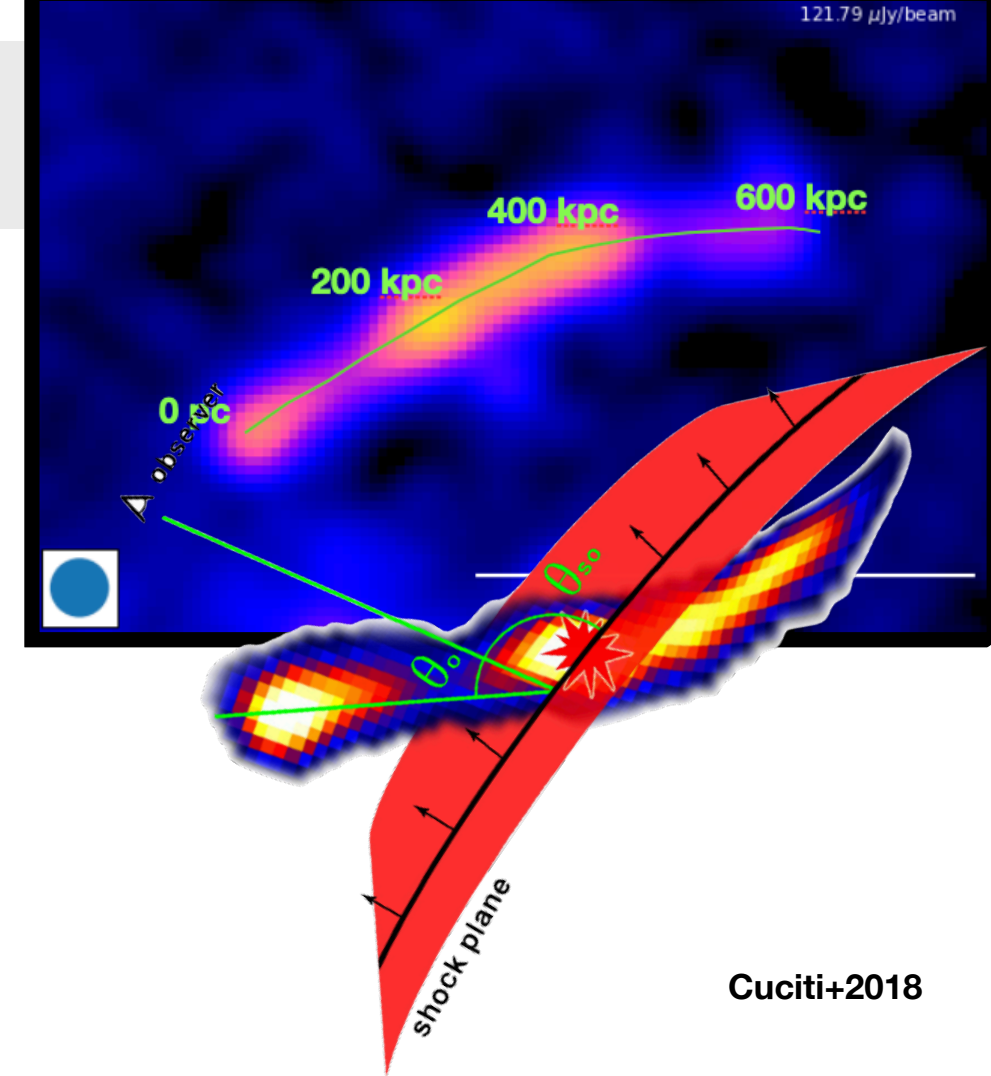
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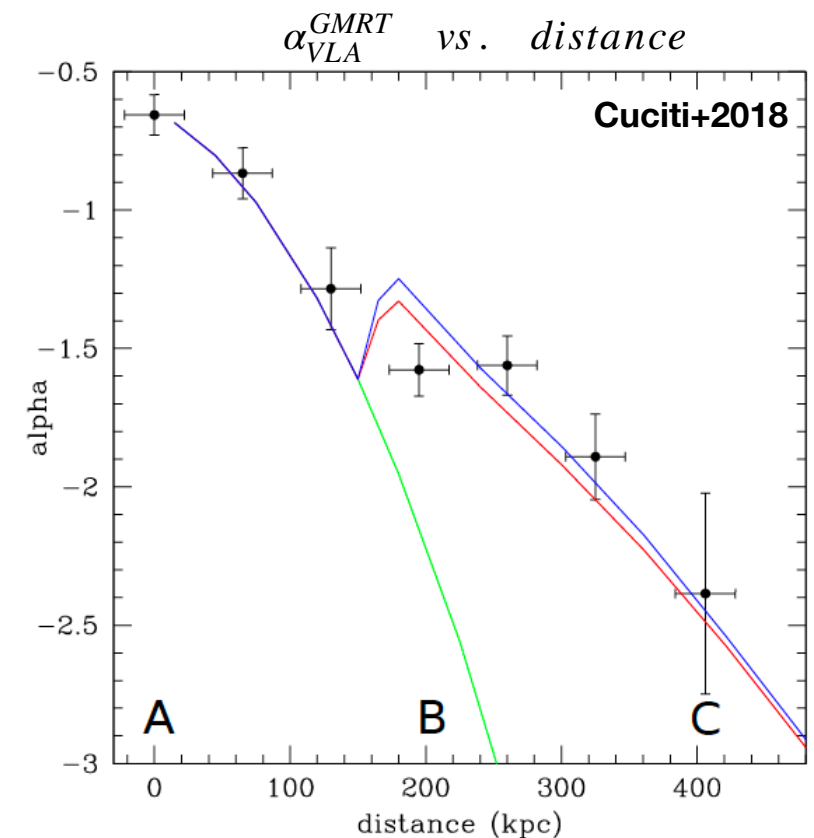
Low frequency:
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Long flattening of the spectral index
+
frequency-dependent feature

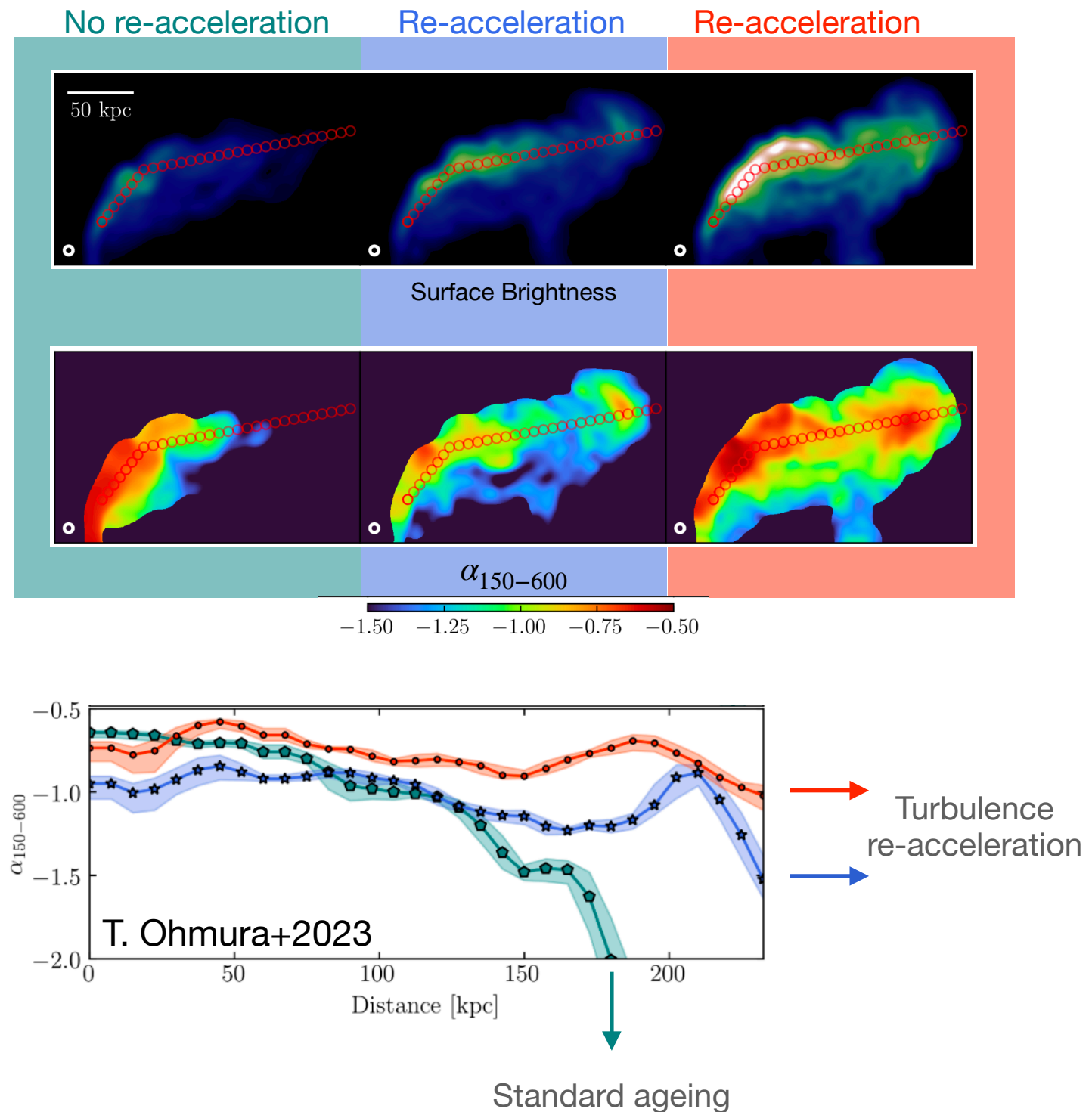
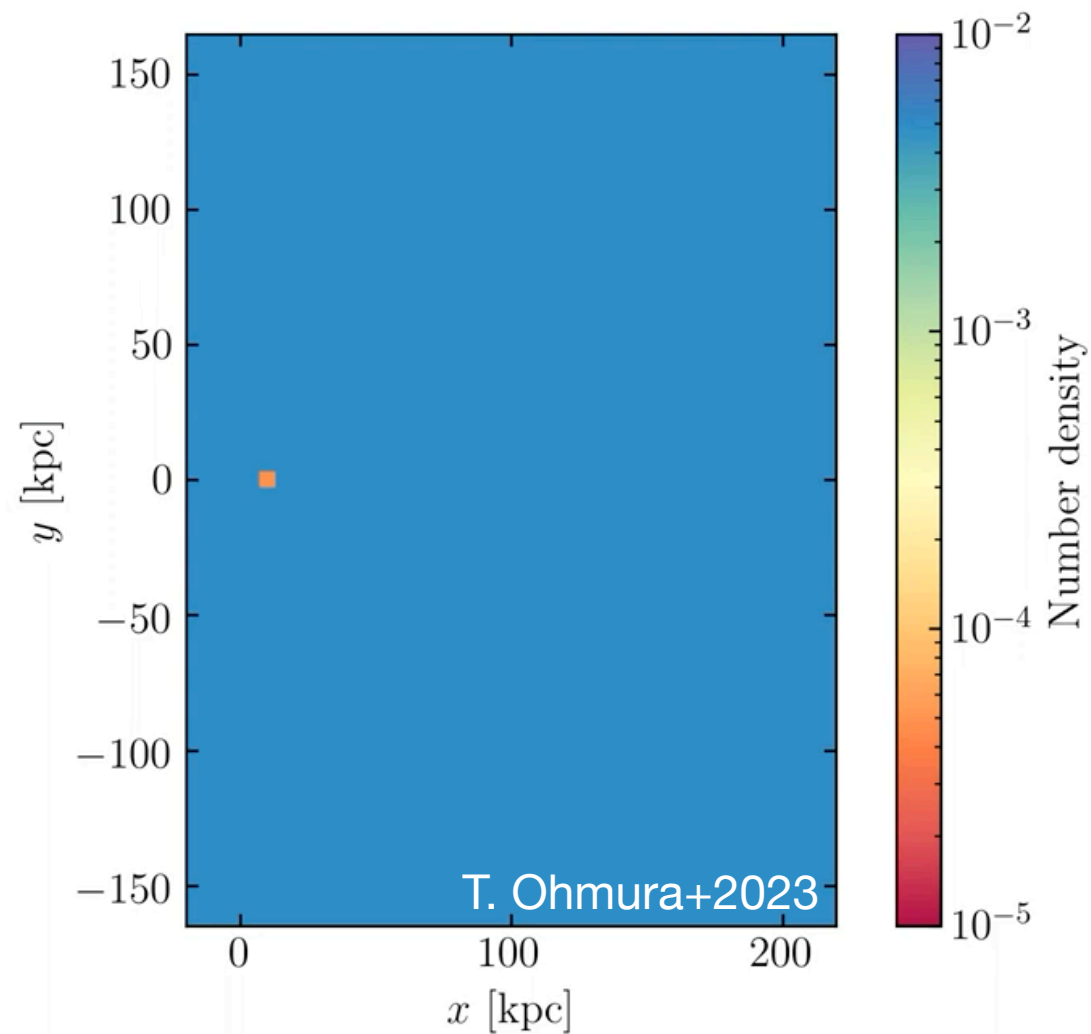


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Simulations: stochastic turbulence acceleration

MHD jet-wind interaction & evolution of CRe particle spectra: energy losses + stochastic turbulence acceleration



> Conclusions

- LOFAR LBA and HBA are able to detect long tails left behind as the host galaxy moves through the ICM
- The HT radio galaxies in ZwCl 0634 exhibit
 - ripples in the surface brightness profiles
 - spectral index flattening along the tail
- Standard ageing scenario cannot reproduce the spectral profiles
 - ➡ Re-energization of the tails
- Turbulence re-acceleration mechanisms produced within the tail enrich the ICM with a seed population of mildly relativistic particles

Thanks