Constraints on dark matter annihilation from radio halos in galaxy clusters

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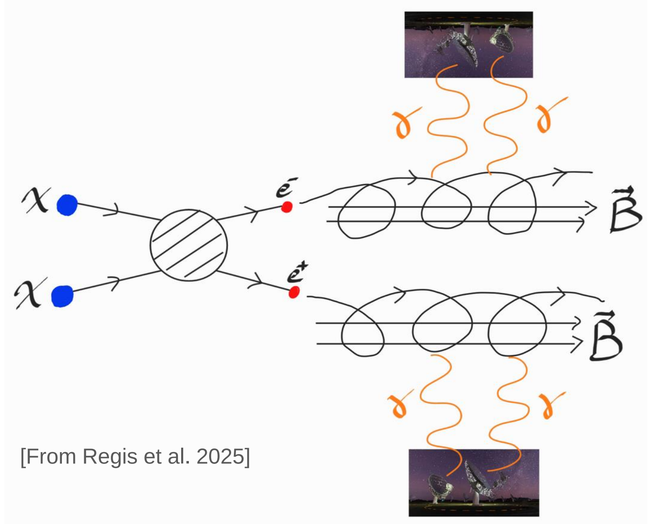
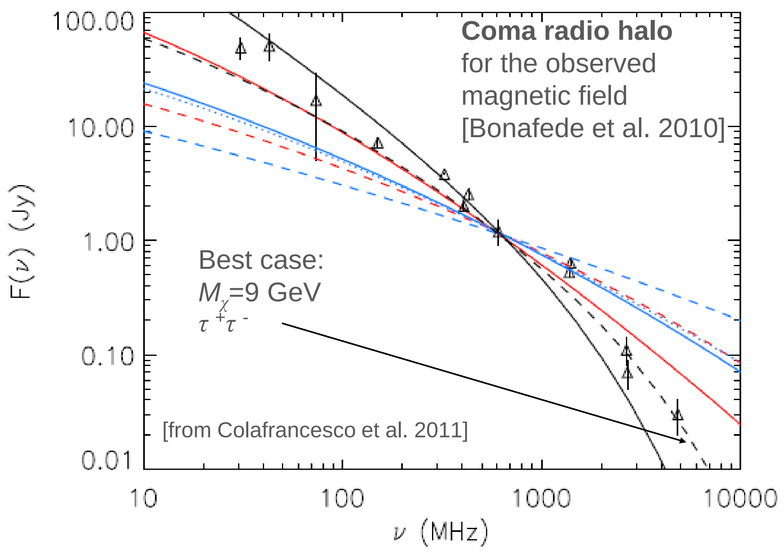
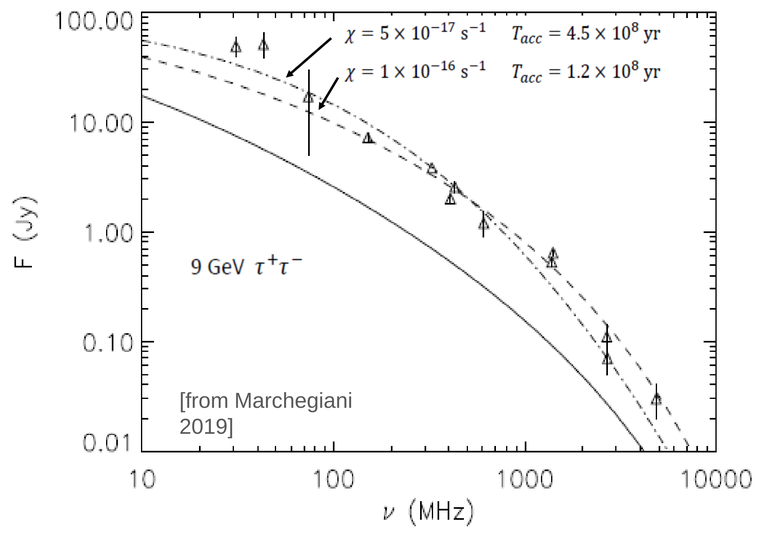


[From Regis et al. 2025]

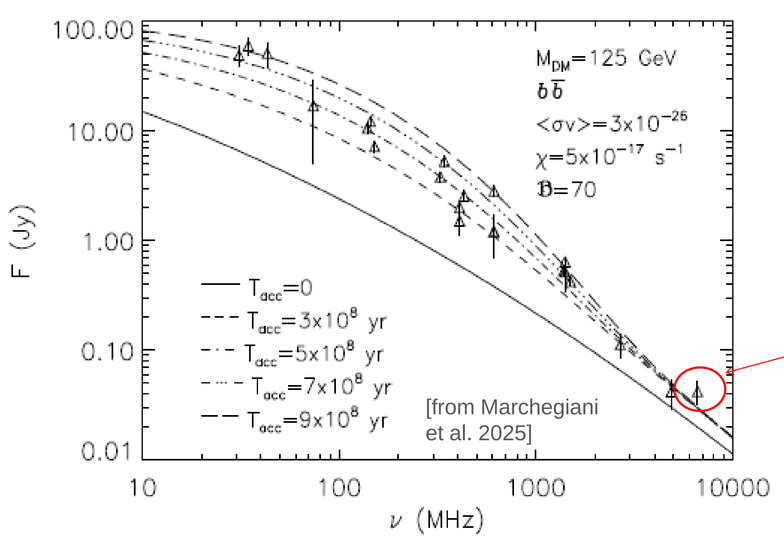
- WIMPs in galaxy clusters can self-annihilate in electrons/positrons pairs
- Interacting with magnetic field they can produce diffuse synchrotron emission
- Can DM-produced electrons have a role in producing radio halos?
- If yes, from the spectrum of radio halos it would possible to derive the properties of DM



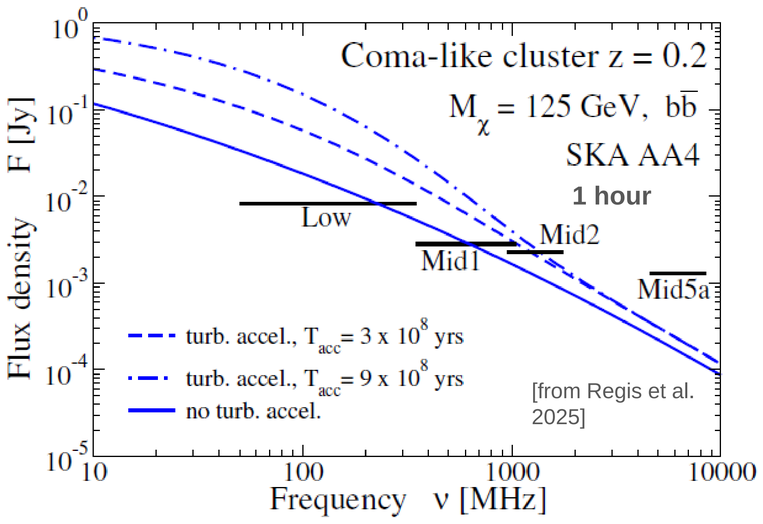
- Scenario without turbulent re-acceleration requires high values of annihilation cross section and substructures boosting factor
- It does not explain why radio halos are observed in disturbed clusters
- Alternative possibility: DM-produced electrons may be the seeds for turbulent re-acceleration [Marchegiani 2019]



- Turbulent re-acceleration can change the spectral shape depending on strength and duration
- Correspondence between DM properties and spectral shape is lost
- Possible solution: observing at high frequency



- At high frequency lifetime due to energy losses is smaller than re-acceleration characteristic time
- The spectral shape of the radio emission is due to electrons at equilibrium
- In principle, DM properties can be recovered
- Coma radio halo has been observed at 6.6 GHz [Murgia et al. 2024]
- Best DM mass range: 100 - 200 GeV [Marchegiani et al. 2025]
- Constraints also on strenght and duration of re-acceleration



- Observing radio halos at high frequencies is difficult
- For a Coma-like cluster at *z=0.2* SKA can detect the diffuse emission until Mid2 band, not Mid5
- Tapering or weighting to be sensitive to diffuse emission: beam 10-30 arcsec
- Noise is confusion dominated
- Possible solution: studying relaxed clusters

References:
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