Synchrotron Emission from the Halo of the Sgr B Molecular Cloud

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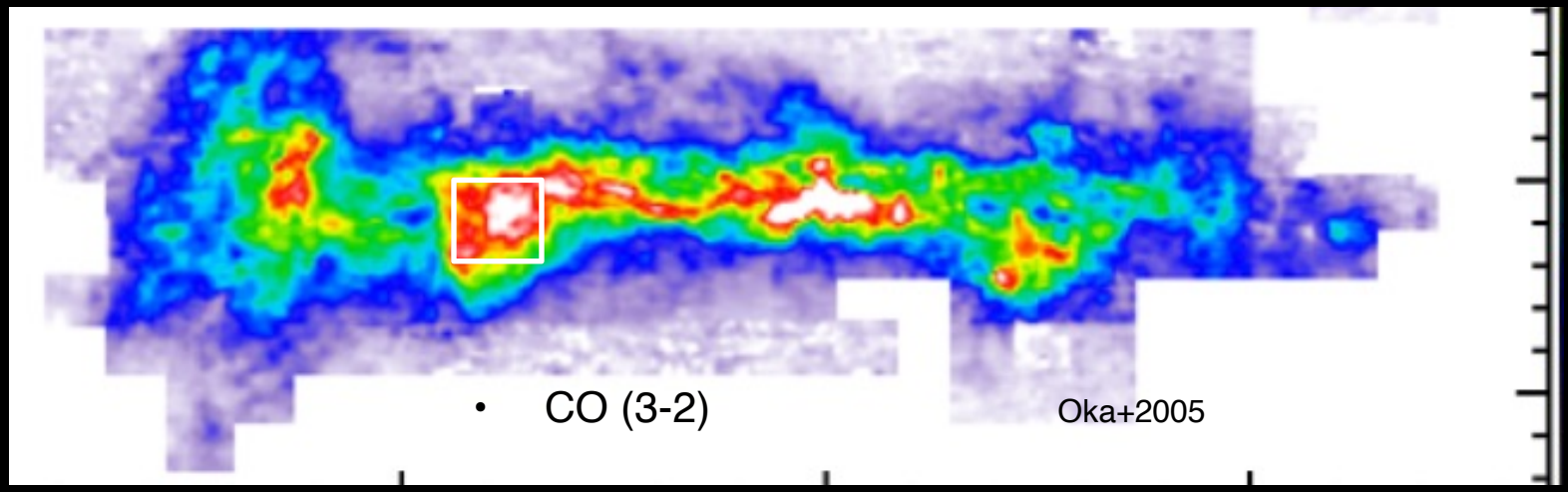
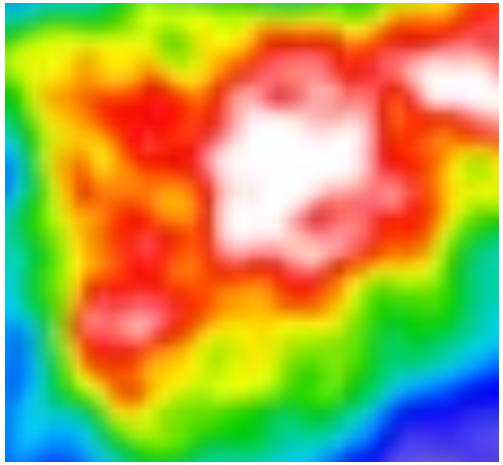
- The Sgr B cloud
- The origin of high ionization rate



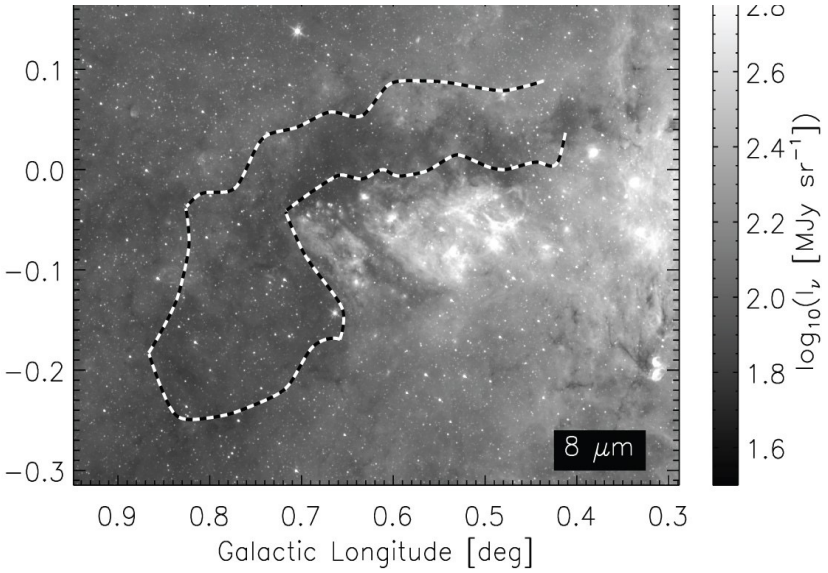
2 Degrees (~300 pc)

Collaborators: R. Arendt, M. Wardle, I. Heywood, N. Kassim, J. Hewitt

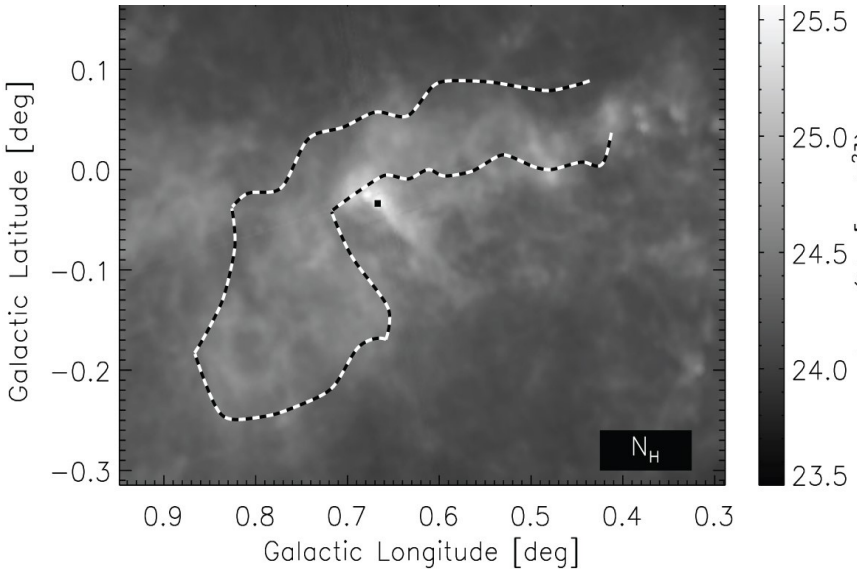
The Sgr B Halo Molecular Cloud



- CO (3-2)

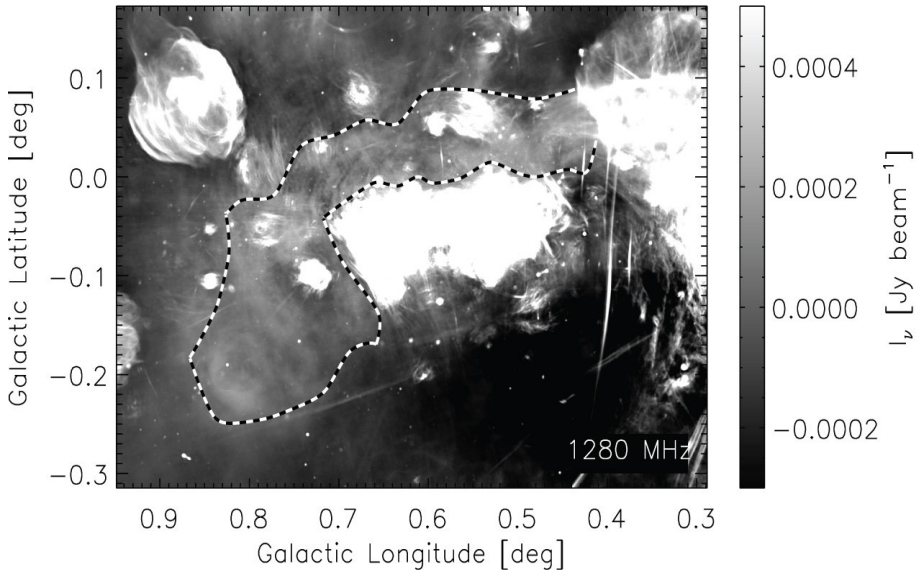


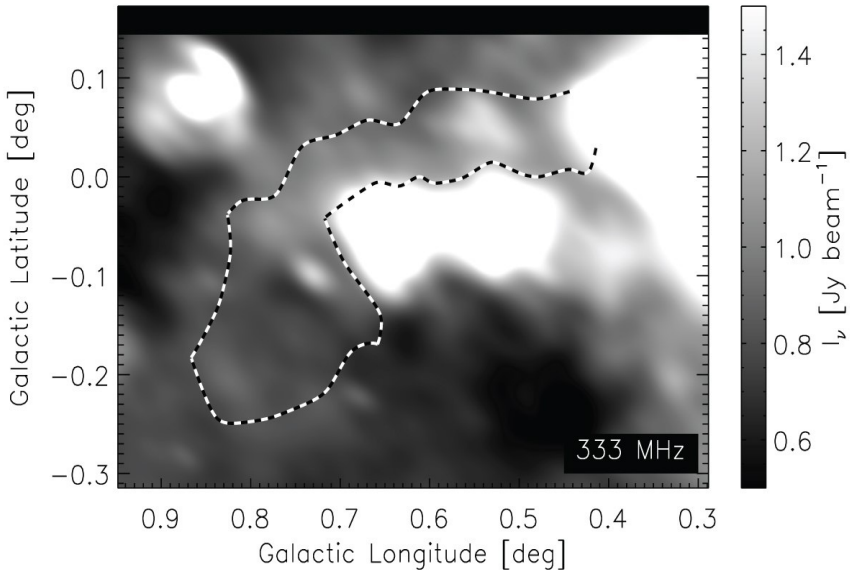
IRDC

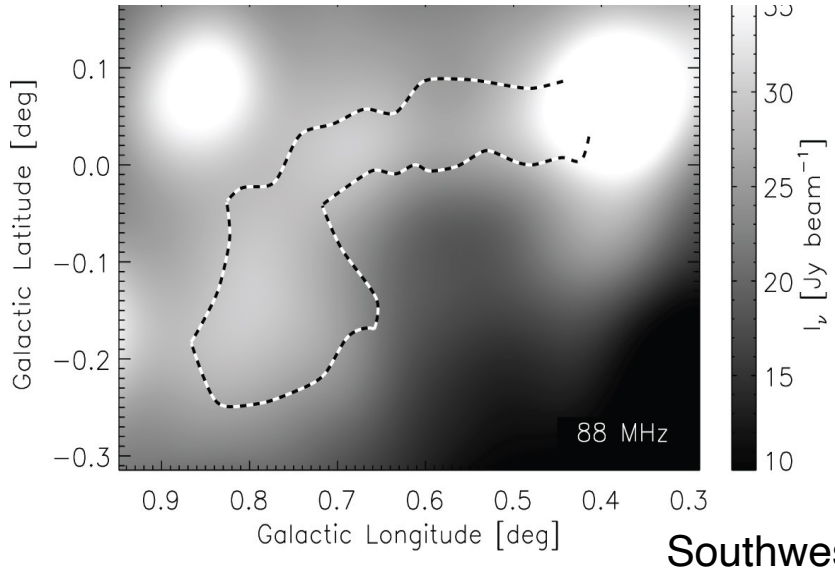


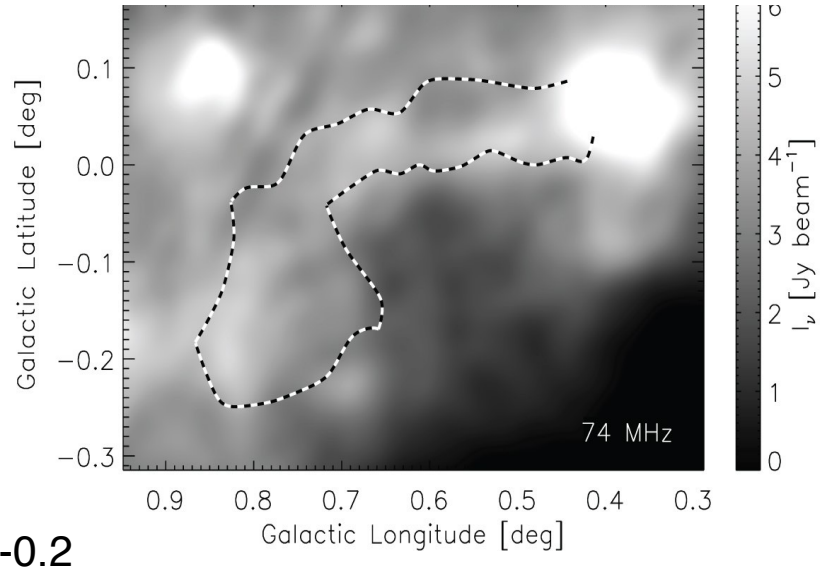
H_2 Column density

Correlation of IRDC and Radio Continuum







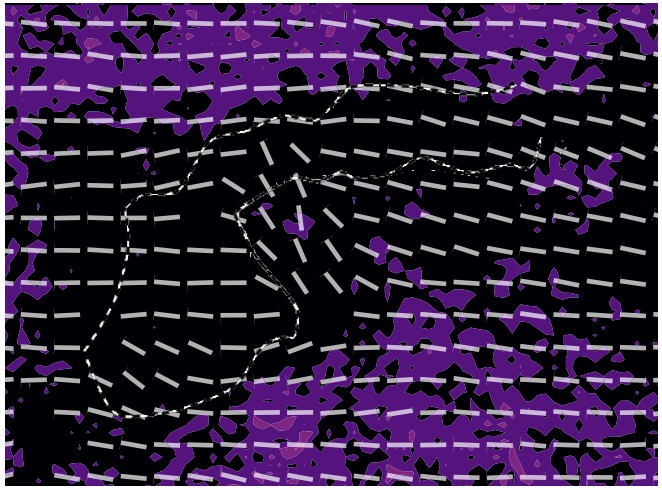


Southwest α ~-0.9+/-0.2

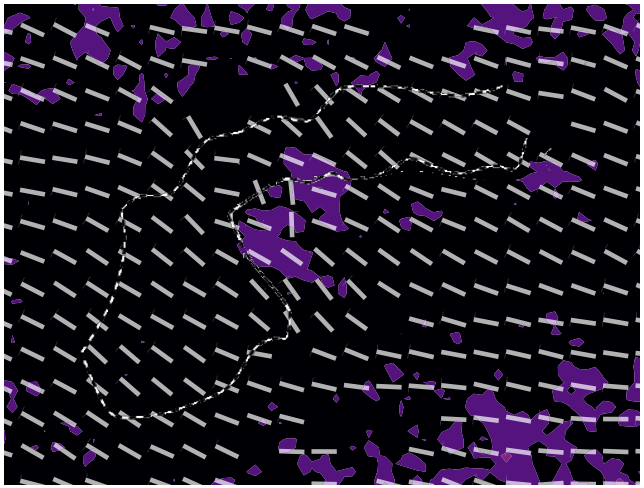
Northwest $\alpha^{333/74\ \mathrm{MHz}}$ ~ -0.6+/-0.2

mean $\alpha \sim -1+/-1$

Sgr B Millimeter Polarization



- 90 GHz

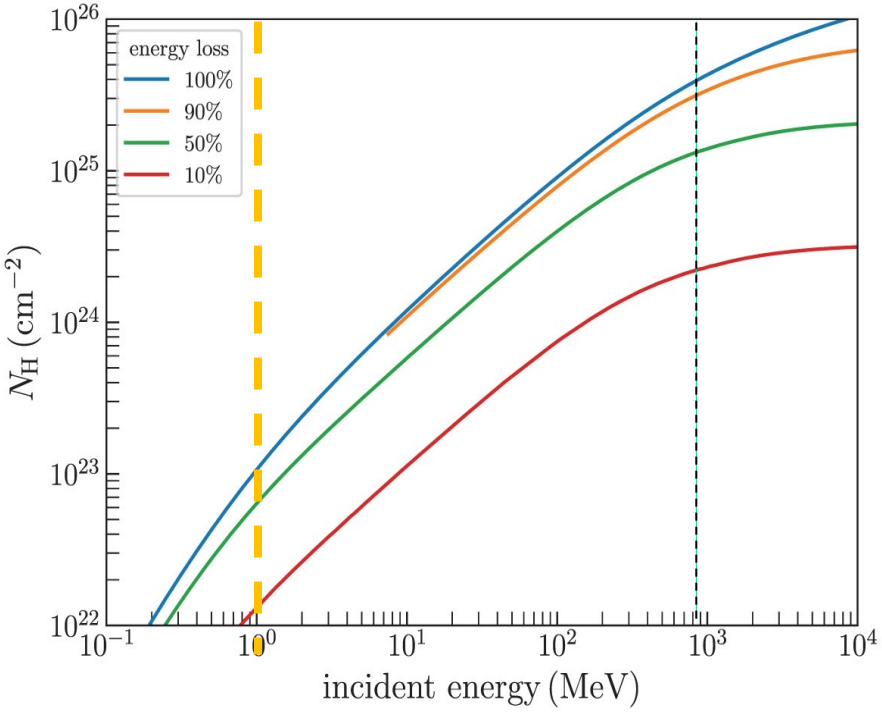


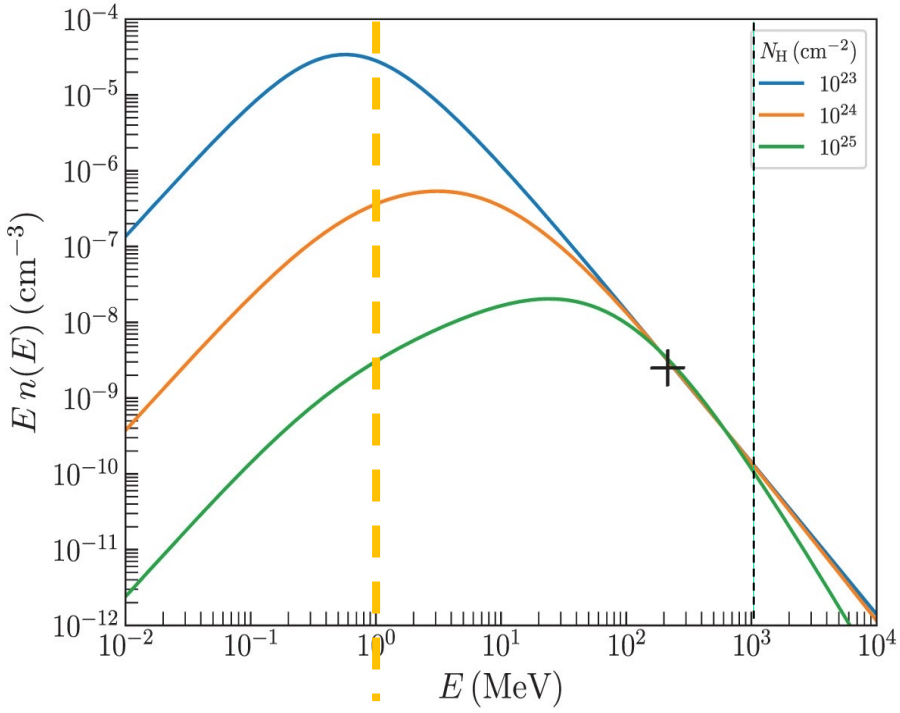
- 220 GHz

Guan+ 2021

Mixture of dust and Synchrotron polarization?
Future radio continuum polarization map needed

Stopping power and spectral modification of incident CR electrons

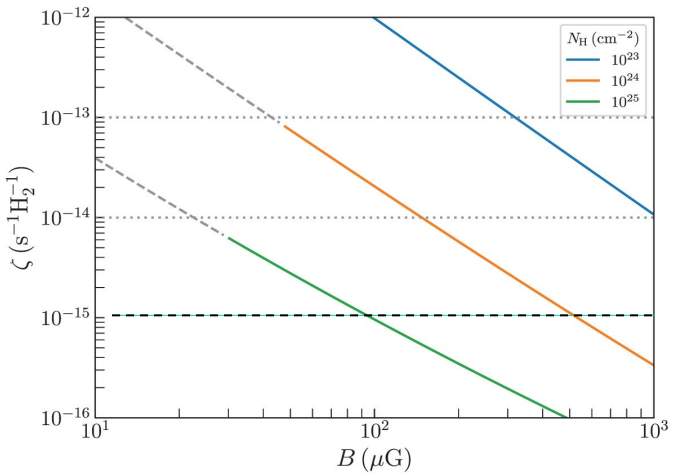


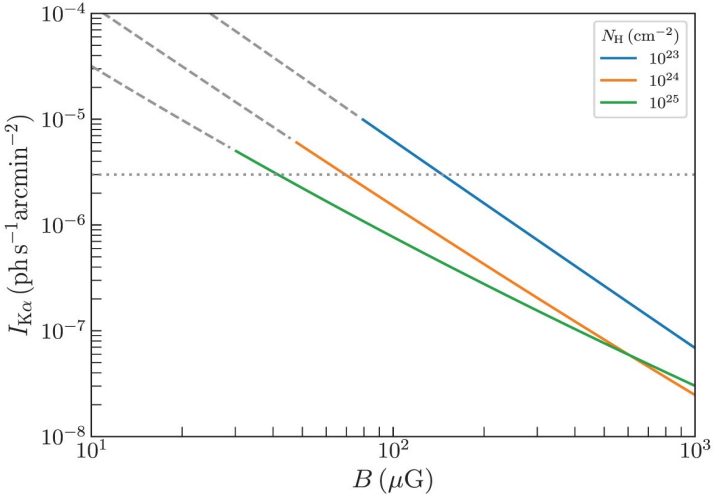


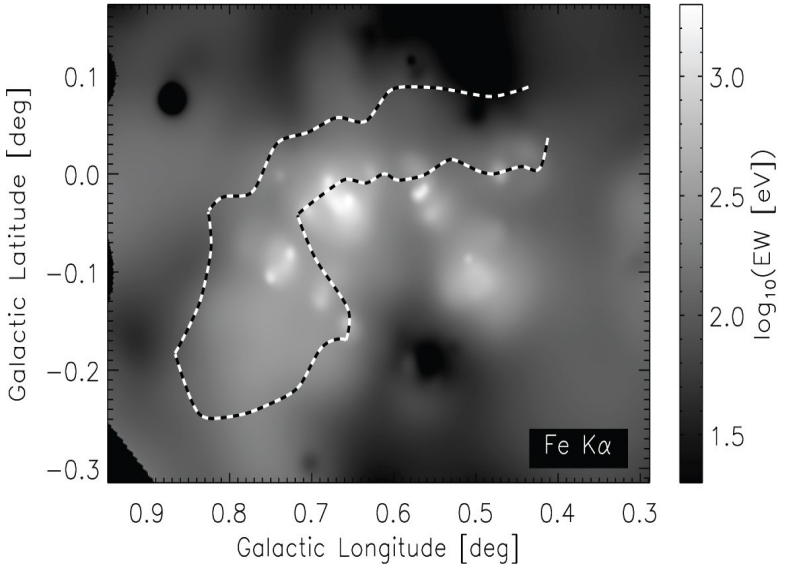
- Loss of <1MeV electrons vs GeV electrons
- Traverse a column ~10^{23} vs ~4×10^{25} cm^{-2}
- Bulk of heating is done in the MeV range

Attenuation of power-law spectrum

Ionization losses and Kα line emission



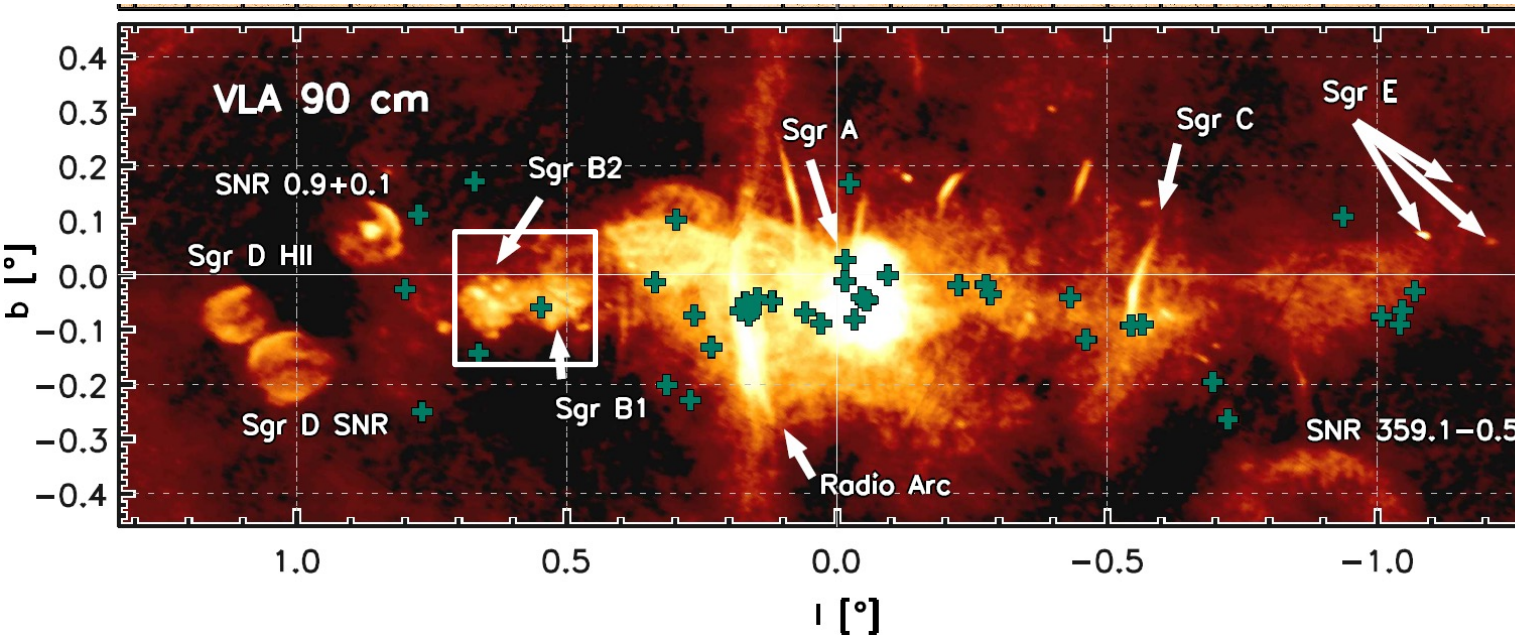




The energy loss rate due to collisional losses Steep decline with increasing magnetic field

Conversion of ionization losses to $I_{6.4\ keV\ line}$

Central Molecular Zone: Warm gas and high ζ (s^{-1})

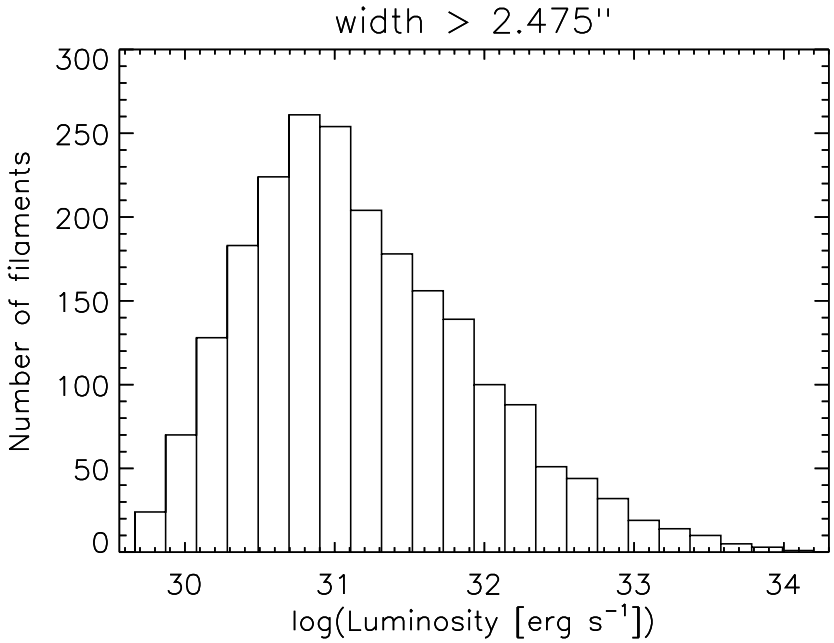


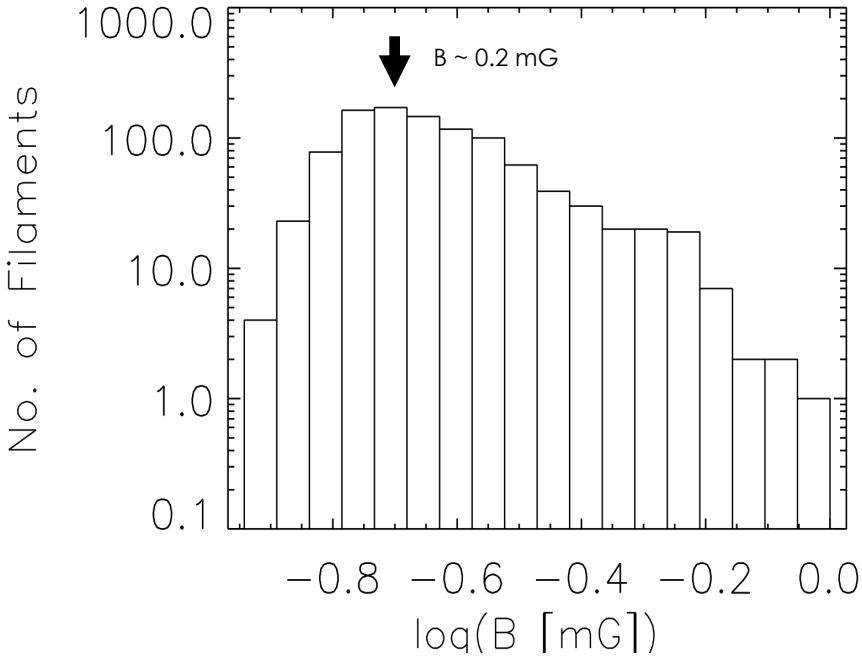
- Ubiquity of high ionization rate 10^{-13} to 10^{-15} s^{-1}

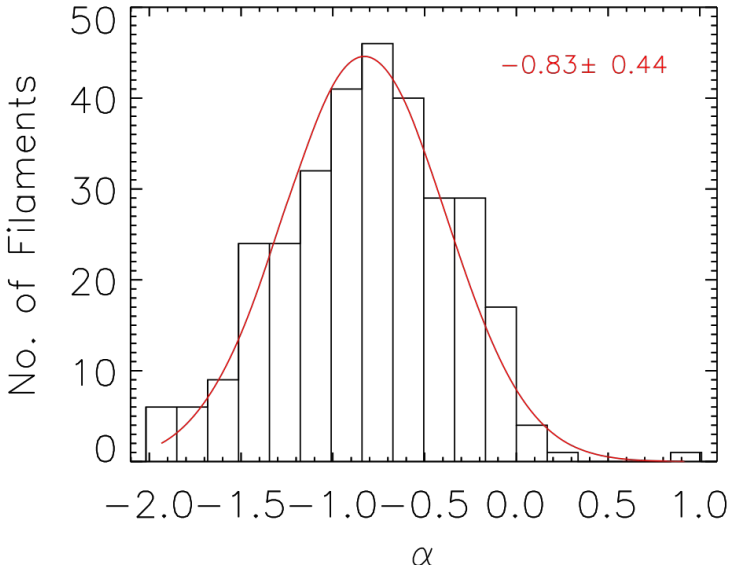
Abundance of nonthermal radio filaments

fyz, Arendt, Wardle, Heywood, Cotton and Camilo (2022)

Radio luminosity, the magnetic field and the spectral index







Summary

The Sgr B IRDC as a synchrotron source due to the interaction of magnetic field and ambient CRs.

A probe of the magnetic field inside the cloud

- The cause of high ionization rate?

Future:

Radio polarization of the Sgr B halo

Total energy of individual filaments with varying magnetic field and spectral index