

FLORENCE 12-14
NOVEMBER 2024



Molecules and planets in the outer Galaxy
Florence 12th - 14th November 2024

Molecular abundances of star-forming regions in the outer Galaxy and their relation with the Galactocentric distance

Diego Gigli (UniFi / INAF)

Francesco Fontani and Laura Colzi



INAF
ISTITUTO NAZIONALE
DI ASTROFISICA



UNIVERSITÀ
DEGLI STUDI
FIRENZE

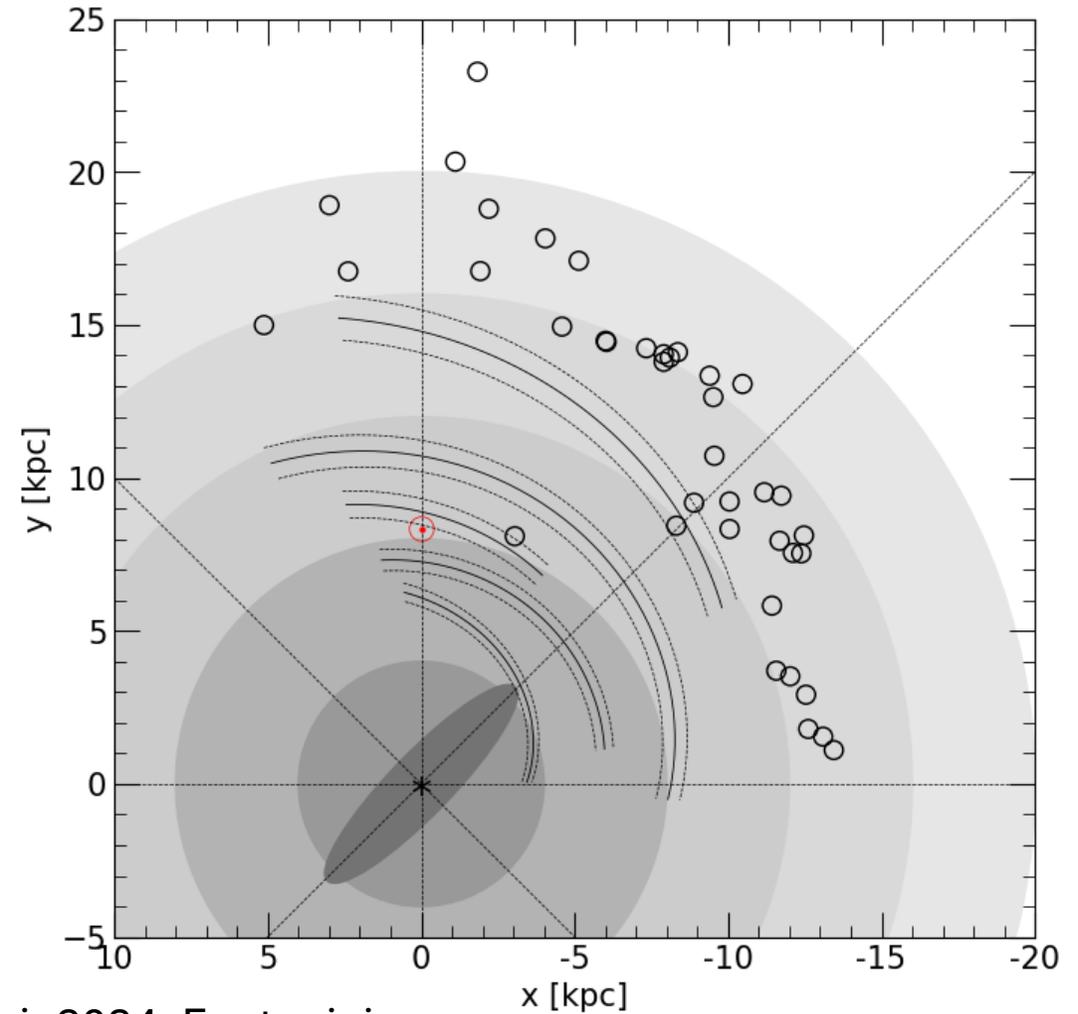
The CHEMOUT project

Observed sample

- 35 star-forming regions in different areas of the outer Galaxy: $9 \leq R_{GC} \leq 24$ kpc

Observation set-up

- IRAM-30m telescope: 2- and 3-mm spectral bands
- NIKA2 bolometer: 1.3- and 2-mm continuum maps



Fontani+2022a; Fontani+2022b; Colzi+2023; Fontani+2024; Fontani+in prep.

Analysis summary

- 34 molecular species were detected, but we focused on $c\text{-C}_3\text{H}_2$, HCN, HCO, HCO^+ , H^{13}CO^+ , SO (+ CH_3OH and H_2CO from Fontani+2022b)

Analysis summary

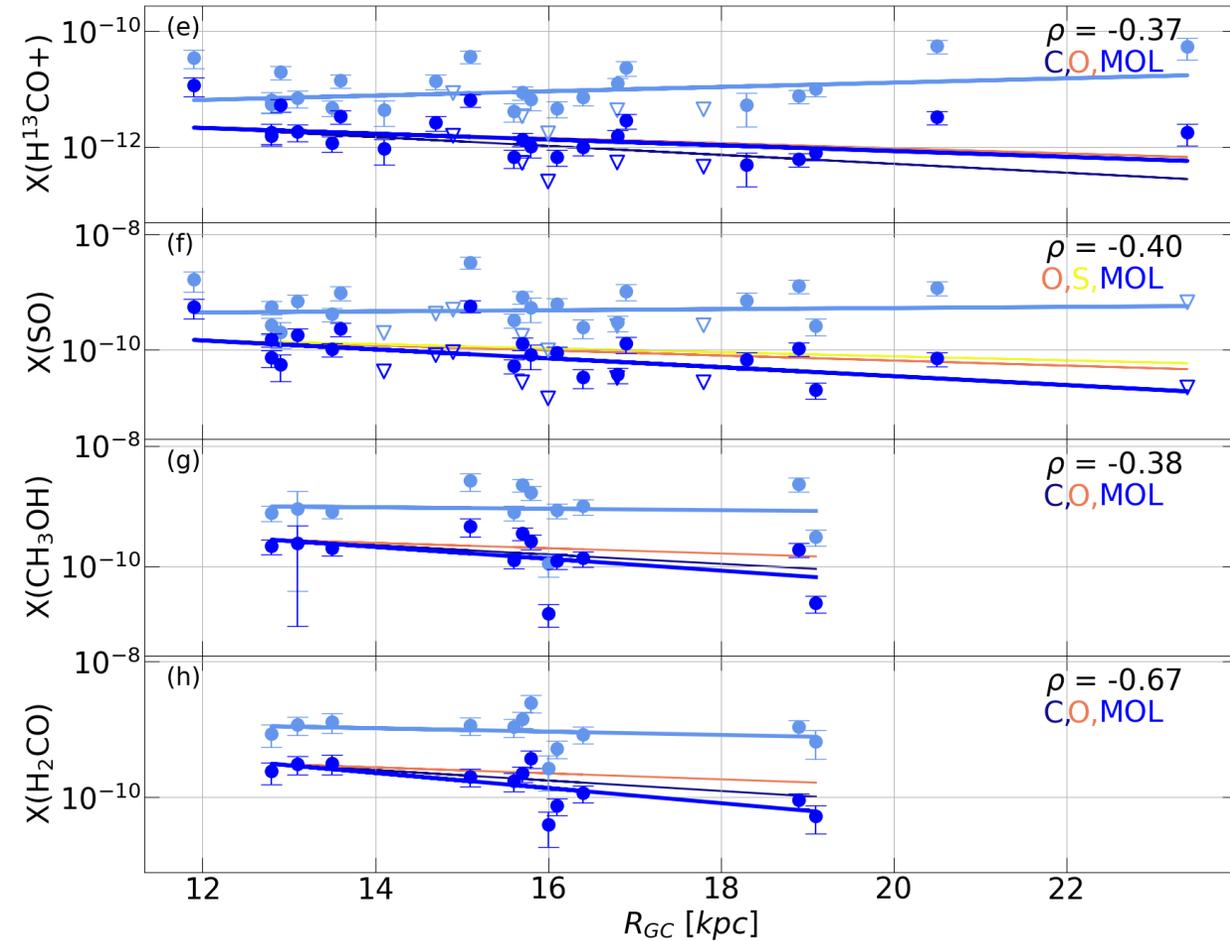
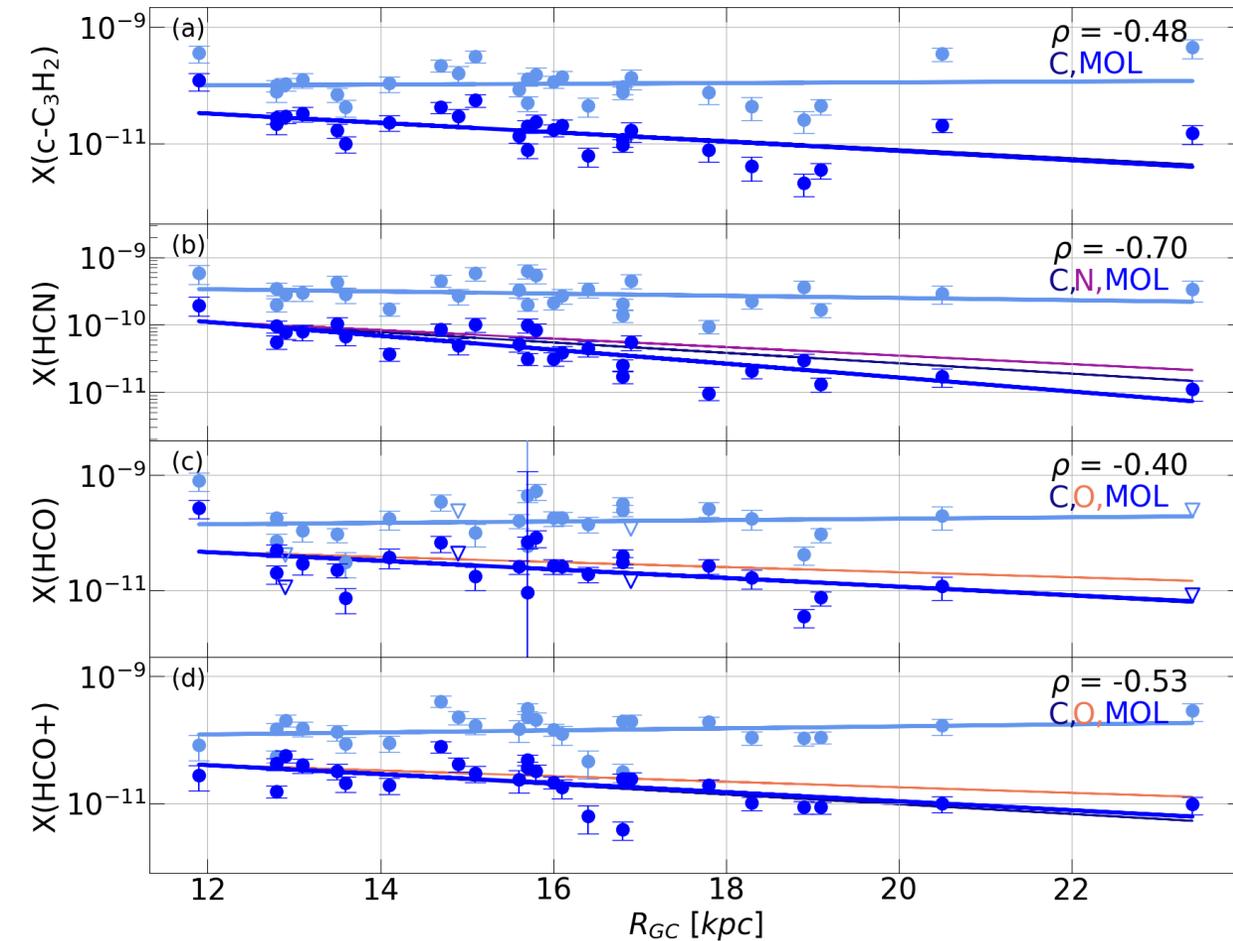
- 34 molecular species were detected, but we focused on $c\text{-C}_3\text{H}_2$, HCN, HCO, HCO^+ , H^{13}CO^+ , SO (+ CH_3OH and H_2CO from Fontani+2022b)
- We obtained **column densities** values of $\sim 10^{10} \div 10^{13} \text{ cm}^{-2}$, and these remain roughly **constant with R_{GC}** ($\rho \sim 0 \div 0.2$)

Analysis summary

- 34 molecular species were detected, but we focused on $c\text{-C}_3\text{H}_2$, HCN, HCO, HCO^+ , H^{13}CO^+ , SO (+ CH_3OH and H_2CO from Fontani+2022b)
- We obtained **column densities** values of $\sim 10^{10} \div 10^{13} \text{ cm}^{-2}$, and these remain roughly **constant with R_{GC}** ($\rho \sim 0 \div 0.2$)
- The molecular abundances of these species relative to H_2 were estimated, obtaining values of $\sim 10^{-13} \div 10^{-10}$

Molecular abundances vs R_{GC}

- Gas-to-dust ratio $\gamma = 100$
- Gas-to-dust ratio $\gamma = \gamma(R_{GC})$ (Giannetti+2017)



Gigli+in prep.

Conclusions

The trends found for molecular abundances, which scale at most like the parent element (i.e. carbon), indicate that the ***efficiency in the formation of the studied molecules in the outer Galaxy is at least as high as that observed in the local Galaxy.***

These results set the stage for a future discussion on the Galactic habitable zone.



Molecules and planets in the outer Galaxy
Florence 12th - 14th November 2024

Thank you for your attention

Molecular abundances of star-forming regions in the outer Galaxy and their relation with the Galactocentric distance

Diego Gigli (diego.gigli1@edu.unifi.it)



INAF
ISTITUTO NAZIONALE
DI ASTROFISICA



UNIVERSITÀ
DEGLI STUDI
FIRENZE