Constraining the spiral features with 2D interstellar medium distributions

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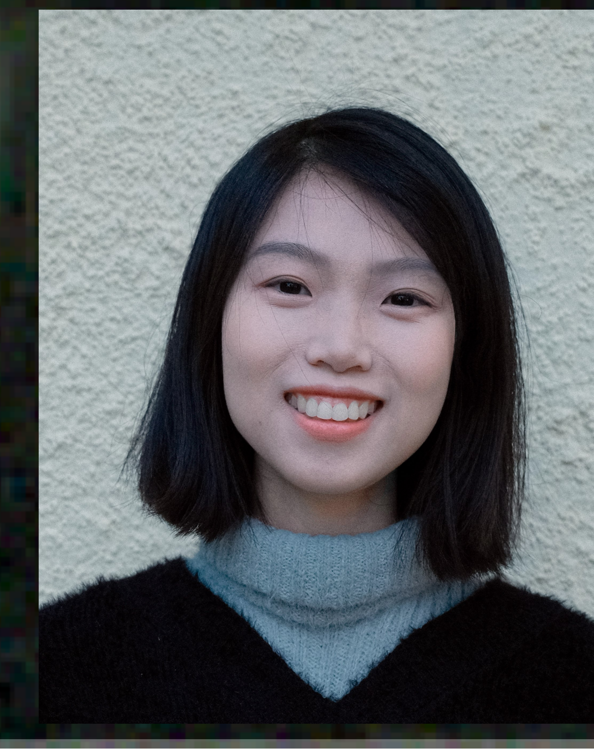
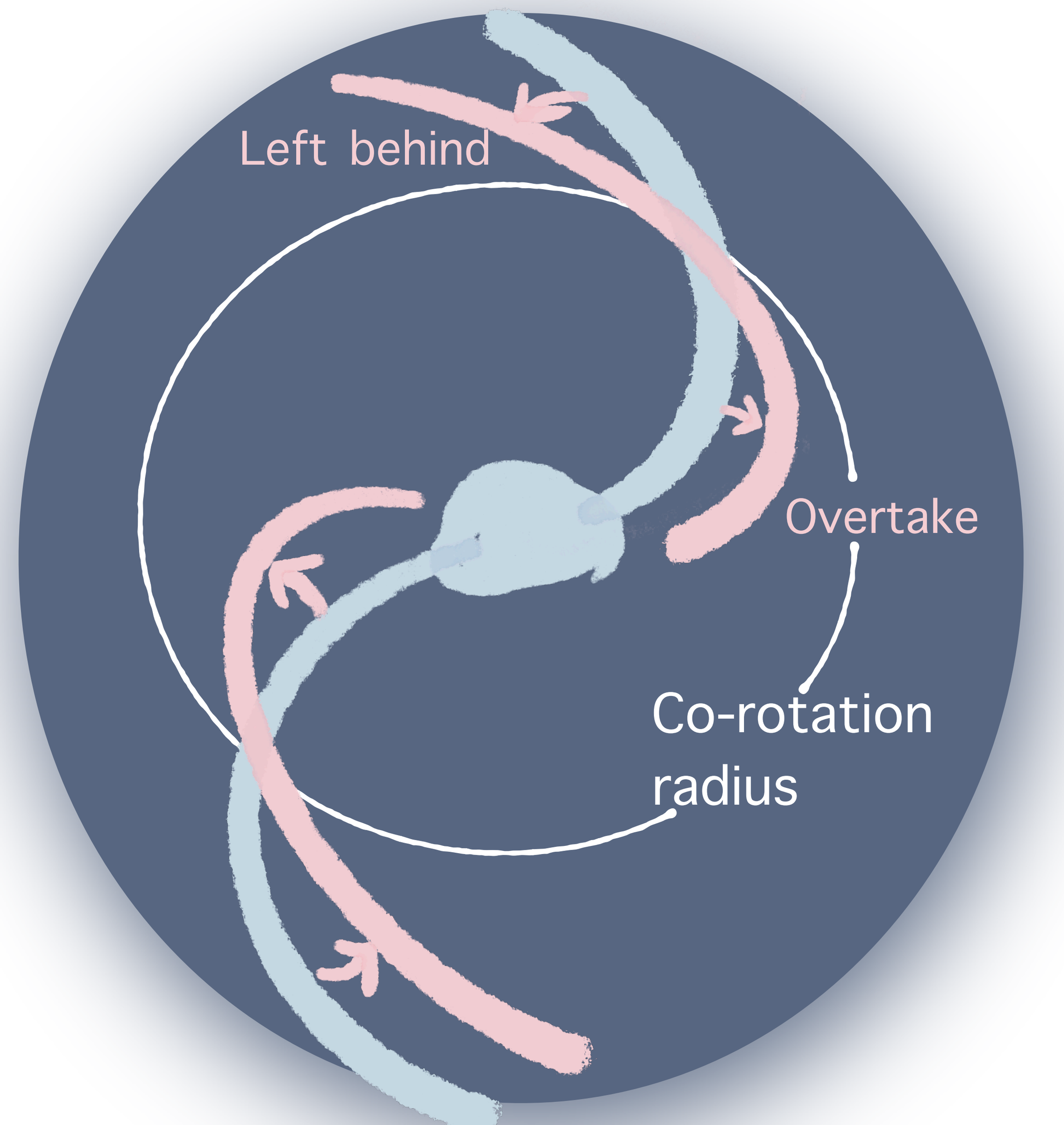


Introduction

Spiral galaxies host the majority of star formation and take up two thirds of massive galaxies locally.

Understanding the formation and evolution of spiral features is essential in our understanding of galaxy evolution.

Our knowledge of spiral galaxies remains limited due to the complexity of spiral features. We use **observational data at different redshift to investigate the long-term effects of spiral arms.**



Density wave theory

The spiral pattern rotates at a fixed angular velocity across the disc.

Inside(outside) the corotation radius, the material overtakes (lags behind) the spiral pattern.

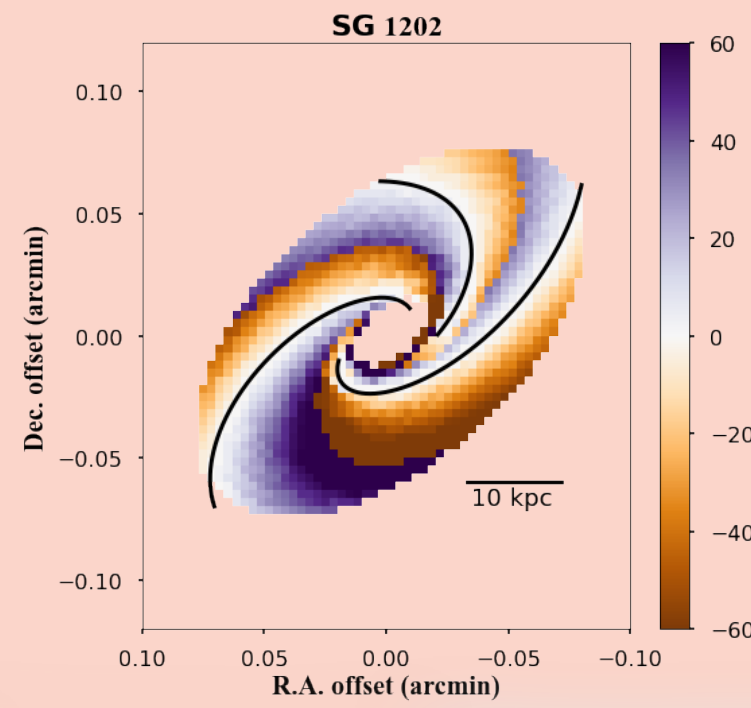
We expect difference in the gaseous and stellar properties between the leading and trailing edge of the spiral arms.

The 2D gaseous and stellar medium hints the effects of spiral arms on the galaxy evolution as well as the origin of the spiral features.

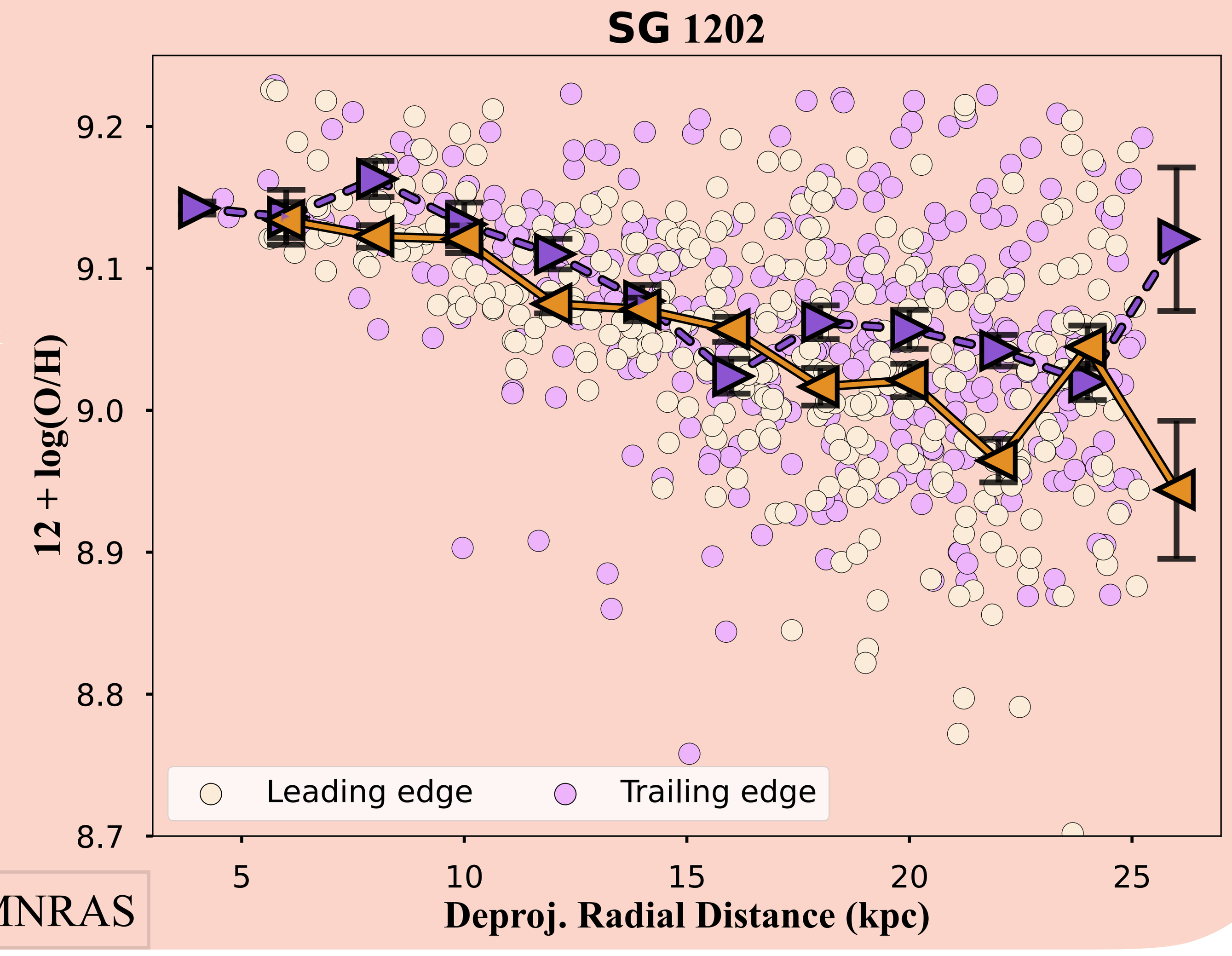
Galaxies at z ~ 0.3

We use the Middle Age Galaxy Properties with IFU (MAGPI) survey on ESO VLT using MUSE.

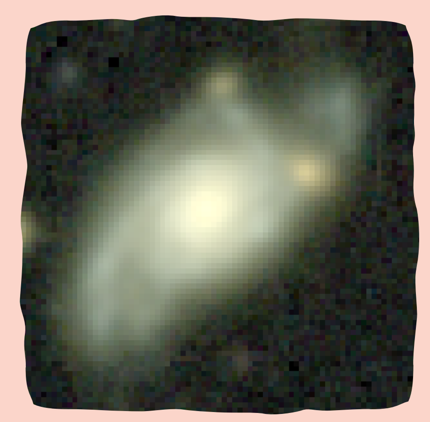
We classify the disk region into the leading edge ($\Delta\Phi < 0$) and the trailing edge ($\Delta\Phi > 0$).

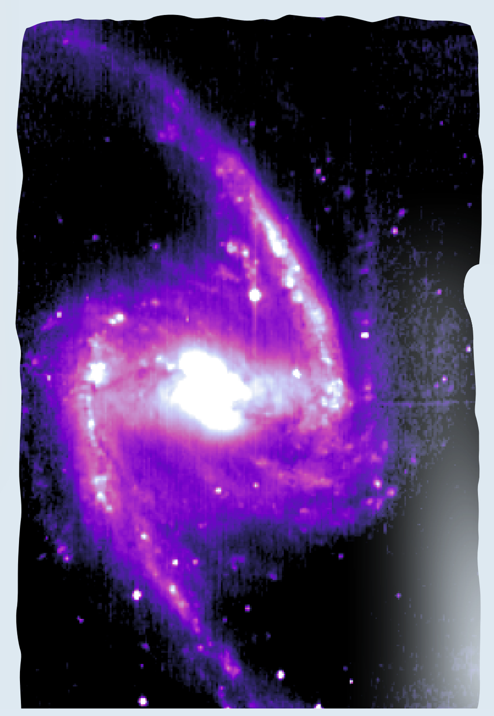


We find no significant variance in the gas-phase metallicity between the leading and trailing edge of the spiral arms.



Chen et al., 2024, MNRAS





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More Results

- ✔ More spiral galaxies
- ✔ SFR & stellar ages
- ✔ Analysis on simulations

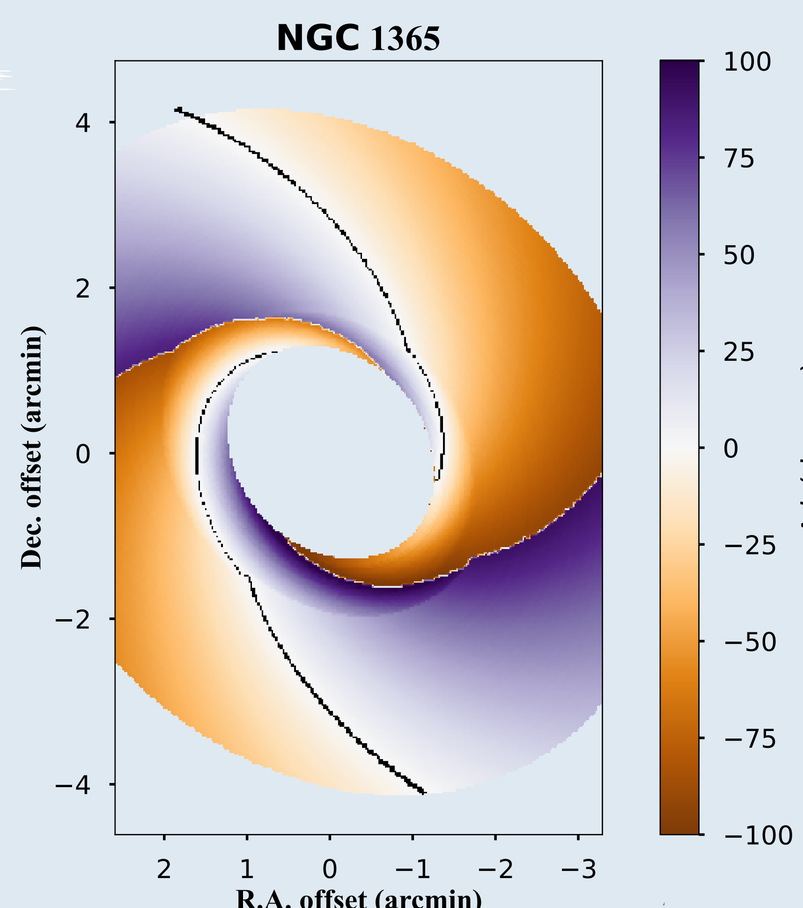
Conclusion

Distinct gas-phase behaviours indicate:

a) diverse spiral theories at play.
b) a change in environmental impacts at varying redshifts.
c) different evolutionary stages of spiral galaxies.

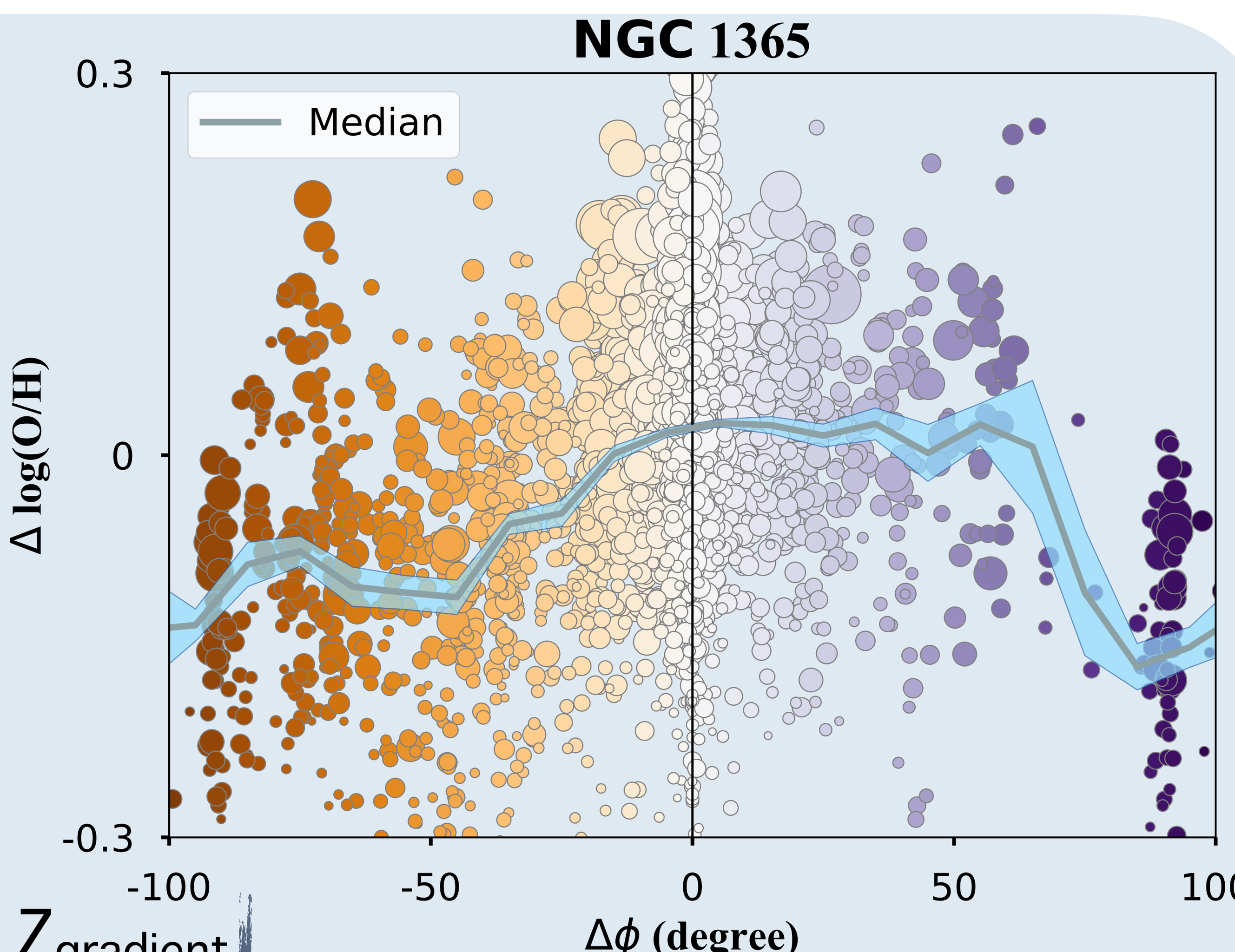
Galaxies at z ~ 0

We continue our study with TYPHOON survey, based on the 2.5m du Pont telescope. It is a psudo-IFU survey using step-and-stare method. We define $\Delta\Phi$ as the azimuthal distance to the defined spiral arms, shown as below.



Submitted to MNRAS

We find an increase in gas-phase metallicity (~0.15 dex) when crossing from the leading to the trailing edge.



$$\Delta \log(O/H) = Z_{gas} - Z_{gradient}$$

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Reference: [1] Peterken T. G., Merrifield M. R., Aragón-Salamanca A., Drory N., Krawczyk C. M., Masters K. L., Weijmans A.-M., Westfall K. B., 2019, Nature Astronomy, 3, 178. [2] Sellwood J. A., Masters K. L., 2022, ARA&A, 60. [3] Foster C., et al., 2021, Publ. Astron. Soc. Australia, 38, e031.