SDSS-IV MaNGA: Spatial Evolution of Gas-phase Metallicity Changes Induced by Galaxy Interactions

H.-A. Pan et al. (2025), https://iopscience.iop.org/article/10.3847/1538-4357/adbbd2

Introduction

- The gas-phase metallicity of galaxies is strongly related to star formation, feedback mechanisms, and gas inflow and outflow.
- Galaxy mergers can cause gas inflow and metal redistribution.
- Previous studies have shown that interacting galaxies have a flatter radial metallicity gradient than isolated galaxies.
- However, observational evidence for stage-dependent spatial changes is still limited.

■ To investigate how gas-phase metallicity evolves spatially across different merger stages using MaNGA data.

Data and Analysis

- Sample:
  - **205** interacting galaxies and **1348** control galaxies from SDSS-IV MaNGA
- Merger stages are visually classified into 4 categories (S1–S4):
  - **S1**: Well-separated pairs that do not show any morphology distortion
  - **S2**: Close pairs showing strong signs of interaction, such as tails and bridges
  - **S3**: Well-separated pairs, but showing weak morphology distortion
  - **S4**: Merging or post-merger (1 or 2 nuclei)
- The gas-phase metallicity is determined using the O3N2 calibration.
- ΔO/H and Δlog(sSFR) are calculated by comparing with control galaxies matched in redshift, stellar mass, and radius.

Results and Discussion

- Galaxies in p/m generally have lower metallicity than isolated control galaxies (Fig3-a)

Metallicity gradient evolution

- Flattened metallicity gradients observed in S2 and S4 stages
- S3 shows a negative metallicity gradient similar to the initial gradient

Metallicity and sSFR

- There is an anticorrelation between ΔO/H and Δlog(sSFR): The higher the sSFR, the lower the central oxygen tends to be (Most pronounced in S2 and S4(1)) (Fig3-b, Fig4-b)
- It suggests a strong relation between the gas inflow triggering star formation and the subsequent metal enrichment

Metallicity and projected separation

- The closer galaxy proximities correlate with more significant changes in metallicity, particularly in central regions (Fig5)
- However, projected separation alone does not fully reflect merger stage

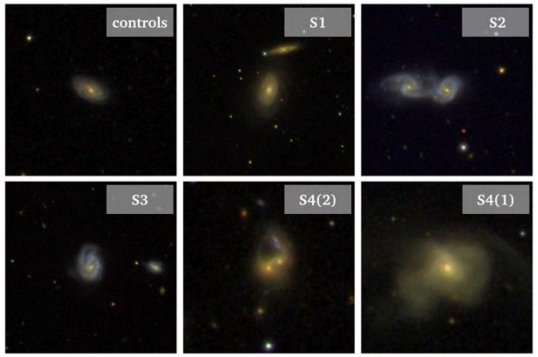

Figure 1

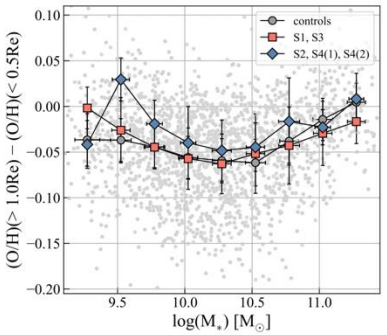

Figure 2

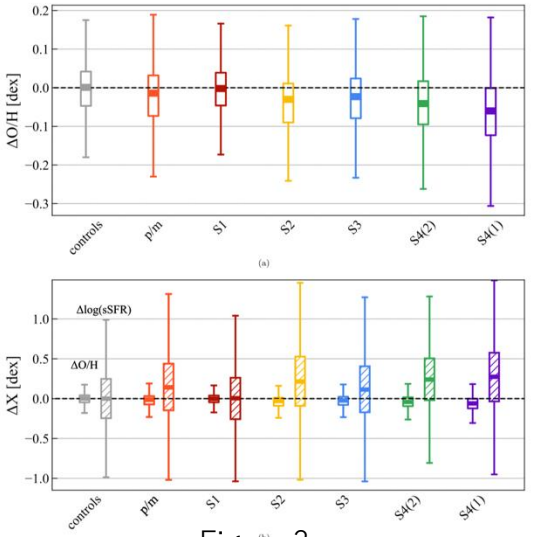

Figure 3

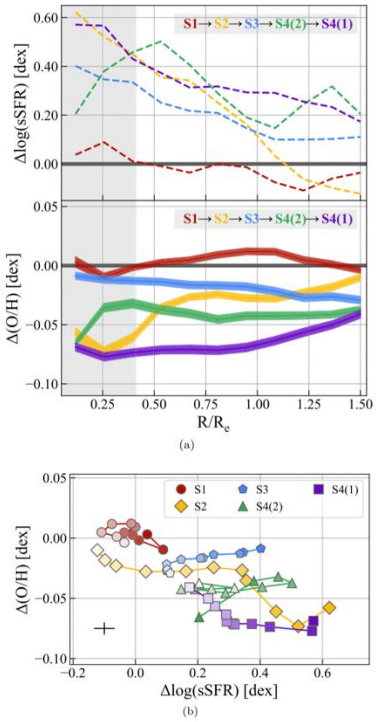

Figure 4

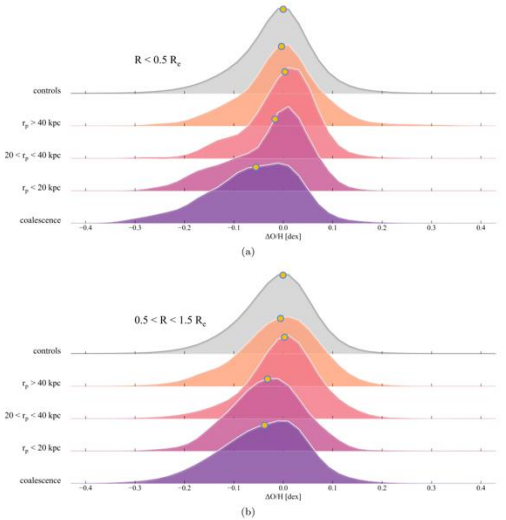

Figure 5