A Study of Galactic Outflows in High Redshift Galaxies ($1 < z < 2$)

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Galactic Outflows/Winds

- Galactic winds occur when the combined kinetic energy and momentum of many supernovae explosions create a shell of very hot metal-enriched gas (~$10^7$ K)
- This “bubble” expands outwards at speeds of $\approx 10^3$ km/s and sweeps up ambient gas surrounding the galaxy center
- It is elongated along the axis perpendicular to the galaxy plane, where its pressure gradient is a maximum
Why do we care about galactic winds?

- Galactic winds have been proposed as the underlying mechanism for the following phenomena:
  - Mass-metallicity relation
  - Metal enrichment of IGM
  - Quenching of star formation in massive galaxies
  - Formation/Evolution of:
    - Dwarf galaxies
    - Massive elliptical galaxies
  - Formation of structure in the universe
Doppler shift: blueshifted absorption lines are evidence for an outflow
Ubiquitous in star-forming galaxies at $z \gtrsim 2$
By $z \approx 1$, only about 50% of similar galaxies show evidence of blue shifted absorption lines
My goal: Analyze $\approx 100$ galaxies between $1 < z < 2$ and understand the role that galaxy morphology plays in relation to galactic outflows
This research will enable:
  • More accurate cosmological simulations
  • A better understanding of how galaxy morphology impacts outflows
Determining Galaxy Morphology and Orientation

- Identify Structure
  - Oblate ellipsoid (disks)
  - Spheroidal ellipsoid
  - Prolate ellipsoid

- Orientation Correction
  - Edge-on
  - Face-on
Morphological Classification: Sérsic Index

• The Sérsic formula is used to approximate how the surface brightness of a galaxy varies with distance from its center

  \[ I(R) = I(0)e^{-\left(\frac{R}{R_0}\right)^n} \]

• Sérsic’s formula is:

• \( n = 4 \) is a good descriptor of a massive elliptical galaxy

• \( n = 1 \) describes spiral and dwarf elliptical galaxies.
Sersic Index and Visual Classification
Beyond Classification

• After identifying the appropriate morphology of each galaxy, we would like to investigate the following properties and their correlation to each galaxy’s morphology:
  • Evidence of an outflow
  • Solid angle of the outflow
  • Doppler shift and radial speed of the outflow
Conclusion

• This work will help create more accurate galactic models and cosmological simulation

• Through structural and spectroscopic analysis of approximately 100 unique galaxies with redshift $1 < z < 2$, we gain a better understanding of how galaxy morphology affects outflowing winds

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