A Principle Component Analysis of the HI Mass Fraction of Galaxies in the MaNGA Survey

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Abstract:

Neutral Hydrogen (HI) is one of the main fuels for star formation in galaxies. By studying its quantities in a population galaxies, we are able to learn more about how galaxies are formed, and form stars. Using data from the MaNGA survey and Green Bank Radio Telescope, we observe correlations between the ratio of HI gas to stellar mass and other galactic properties, such as dust content, star formation rates, and stellar population age. We then construct a Principle Component Analysis (PCA) in order to determine which correlations are the most significant in determining HI mass fraction. We find that the strongest correlations are with stellar mass, g-r color, NUV-r color, Mg2, and HδA

Goals:

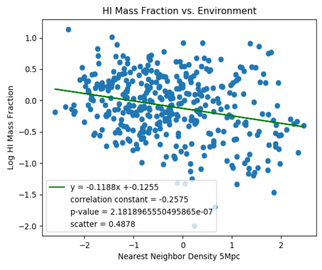
- Plot correlations between HI Mass Fraction and other galactic properties using data from MaNGA
- Determine which galactic properties could affect our HI Mass Fraction the most

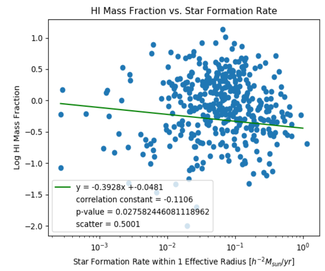
MaNGA:

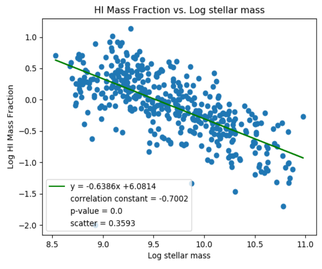
- Mapping Nearby Galaxies at Apache Point Observatory
- Part of Sloan Digital Sky Survey (SDSS)
- set of 2-dimensional optical spectral maps from which we can derive stellar velocity, stellar age, metallicity, star formation rate, and dust
- Further data were obtained as part of the HI-MaNGA survey at the Green Bank Telescope (GBT) in West Virginia.

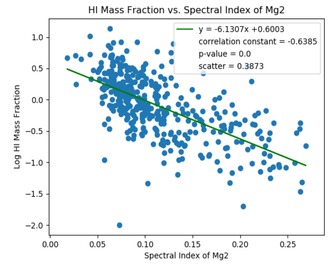
Correlations:

These scatterplots show the correlations between the HI Mass Fraction and various other galactic properties. Clockwise from top left, we have **(1)** the density of nearby galaxies within 5 Mpc to determine correlation with galactic environment, **(2)** the Star Formation Rate within 1 effective radius to determine correlation with star formation, **(3)** the spectral index of Magnesium to determine metallicity and **(4)** stellar mass.







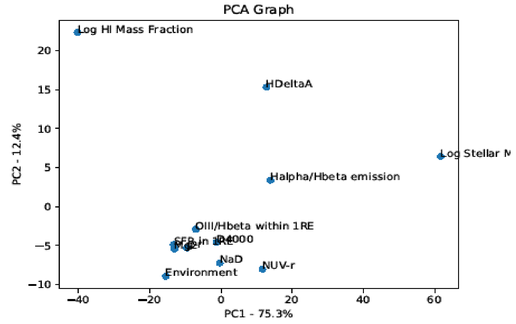


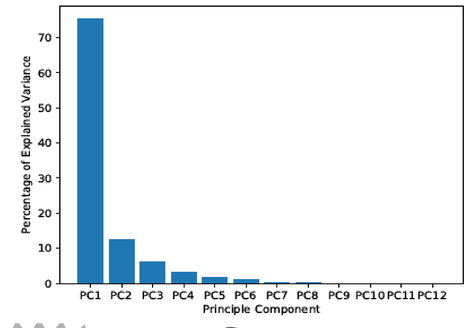
Principle Component Analysis:

- Takes scatterplot
- Normalizes it around the origin
- Determines dimensions around the origin
- Sorts by how much each variable affects each other
- Groups them into scatterplot

Results:

The plots below show the results of our PCA. On the upper plot, the PCA graph states that the spread of our data, when compressed and normalized into 2 dimensions, is effected the most lengthwise by the HI Mass Fraction and the Stellar Mass, and widthwise by the HI Mass Fraction and the Environment. This also shows that HDeltaA also significantly contributes to the width of the data. The lower plot is a scree plot showing how much each dimension effects the overall PCA. We were able to conclude that a 2-D scatterplot could best represent the data.





Conclusion:

•HI in galaxies was determined by PCA to be correlated with metallicity, stellar mass, NUV-r color, and g-r color.

Paper

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