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HI Asymmetries and deficiencies in ALFALFA

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Galaxies exhibit a wide variety of observable properties. The environment in which a galaxy resides is known to significantly impact its characteristics. A galaxy's cold gas component (usually a disk for late-type systems) is particularly sensitive to environmental conditions. Neutral atomic hydrogen (HI) as we know it, makes up the large majority of a galaxy's gas content.

Galaxies are often observed to be HI-deficient if they are located in dense environments such as galaxy clusters, or towards the centres of groups. There are several processes that can lead to HI-deficiency in a galaxy, each of which affects the asymmetry of the galaxy's spatially integrated (i.e., global) HI profile. Some of these processes include tidal interactions, galaxy mergers, interactions with satellite galaxies, flyby interactions as well as ram-pressure stripping.

Therefore, by studying the properties of asymmetric HI galaxy spectra, we learn more about the important environmental processes that influence the ways galaxies evolve with time.
HI is particularly well-suited as a tracer of environmental processes given that a galaxy's HI disk is typically >2 times more extended than its stellar disk, and is therefore less gravitationally bound.

In this work, we aim to use HI line data from the Arecibo Legacy Fast Alfa (ALFALFA) survey to study the prevalence of HI spectral asymmetries in the context of galaxy environment.
From the full ALFALFA sample, we define 2 samples so as to quantify environment.
We define as merger candidates those galaxies that have a neighbouring galaxy within 25 kpc spatially and 750 km/s spectrally. A sample of well-isolated galaxies is also procured. A galaxy is said to be isolated if it has no neighboring galaxies within 750 kpc spatially and 7500 km/s spectrally. The goal is to quantify the asymmetries in these two galaxy samples in order to generate quantifiable evidence of the environment-induced effects. From our results, we find that on average, the merger sample does show enhanced asymmetries compared to the isolated sample. This tells us that the HI gas of galaxies in denser environments (merger sample) is interacting with other galaxies in the environment and thus perturbing the distribution of gas within the galaxy. This results in a disturbed HI profile morphology or rather in simple terms, an asymmetric HI profile. This thus alludes to the idea that environment is indeed one of the drivers of asymmetries observed in the HI profiles of galaxies.

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