THE LONELIEST GALAXIES IN THE UNIVERSE: A STUDY ON THE MORPHOLOGY OF VOID GALAXIES

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Void Galaxy Background

Galaxies are organized into structures of filaments and tendrils, with most outliers being classified as void galaxies. The GAMA Large Scale Structure Catalogue (GLSSC) classifies void galaxies as a galaxy that is at minimum 4.56h^-1 Mpc from the nearest tendril galaxy (Alpaslan et al. 2014). Therefore, void galaxies exist in low-density regions designated as voids, and are truly isolated. True void galaxies will be some of the most isolated objects in the universe (Alpaslan et al. 2014)

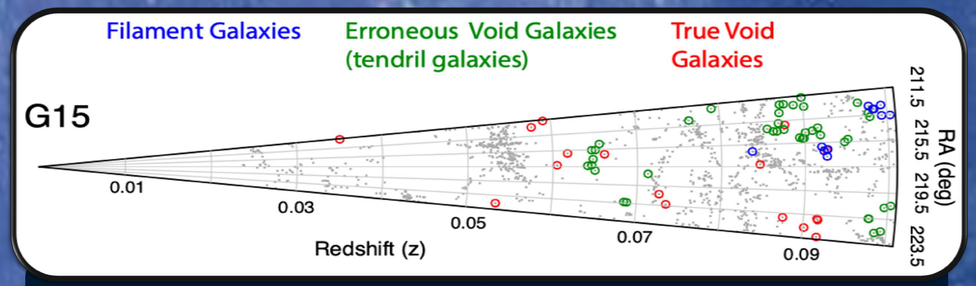

Figure 1 from Alpaslan et al. 2014: Each circled galaxy in this figure is a galaxy in the GLSSC that is located inside a void identified in SDSS-DR7 data.

SERSIC

The Sersic profile is a mathematical function that models the intensity of a galaxy *I* versus the distance *R* from the center. The Sersic index, *n*, represents the curvature of the profile. Therefore, the larger the value of *n*, the more centrally concentrated the galaxy is (Graham et al. 2005). Most elliptical galaxies will fall under a higher Sersic index, with spirals belonging lower on the scale. Plotting the Sersic index of void galaxies in the GAMA survey and comparing the results can give a mathematical representation of the morphology void galaxies tend to take on.

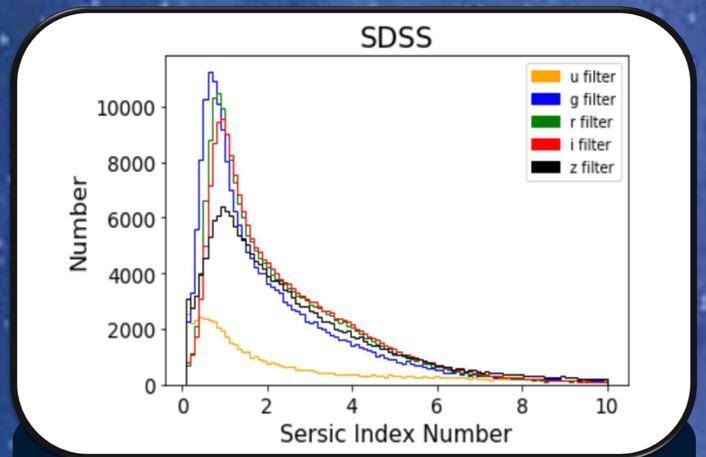

Figure 2: A current histogram using the GAMA SersicCatSDSS v09 data, specifically plotting the Sersic Index.

Galaxy Zoo

Galaxy Zoo is a collaboration of roughly 150 astronomers working to identify galaxies and classify them on their morphology. The Zoo works by presenting individuals with an image of a galaxy and prompting them to answer yes/no questions about the galaxy's visual characteristics. This data is collected and summarized to form a consensus on how the galaxy should be classified. In summary, Galaxy Zoo provides a visual summary for galaxy morphology in contrast to the mathematical data from Sersic.

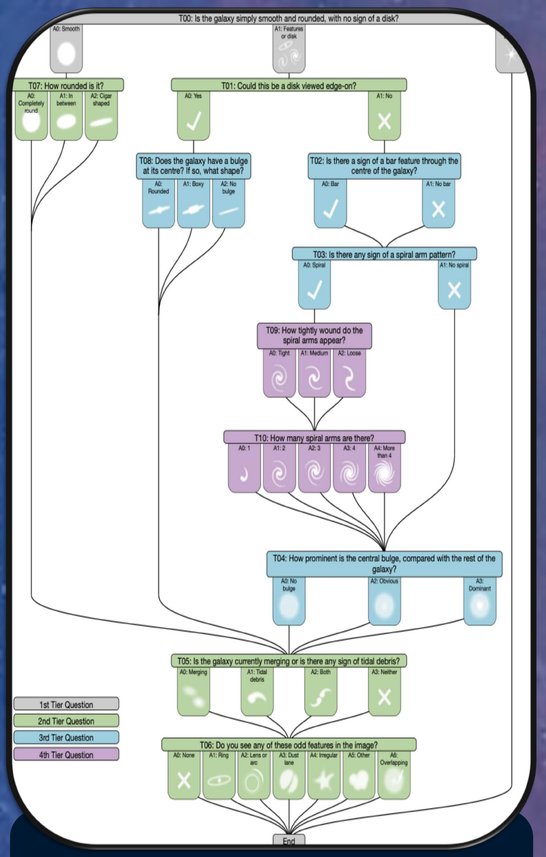

Figure 3: An insight from Galaxy Zoo into how the data is collected through a series of flow chart questions.

Figure 3: Void galaxy MCG+01-02-015 as shown by the Hubble Space Telescope in the Boötes void. According the ESA, void galaxies such as this can be examples of "pristine evolution" due to its isolation.

Hypotheses and Implications

Overall, the analysis of true void galaxies and their morphology is a relatively understudied field that this experiment hopes to rectify. Because of the nature of void galaxies and the tendency of their properties to follow specific patterns, we predict that the general morphology, based upon the Sersic model and Galaxy Zoo data, will be primarily elliptical galaxies. Their residence inside a void greatly reduces the opportunity for any external gravitational forces to affect their shape. Further study into the shape of void galaxies, and perhaps Green Valley void galaxies, can give insight into galactic evolution and how their inherent nature differs, if at all, from that of tendril or filament galaxies.

References: Alpaslan et al. 2014, Graham et al. 2005, ESA/Hubble & NASA, L. Ho et al., ESA/Hubble & NASA, Acknowledgement: Judy Schmidt, NASA, ESA and F. Bauer