Cosmic Voids

Introduction

Cosmic voids constitute an important component of the large-scale universe and are integral part of the spatial organization of the Cosmic Web. The pristine low-density environment they provide is an ideal setting for studying galactic evolution and effects of the cosmological neighborhood on those galaxies.

Proposed research

There has been a dearth of a recent, more comprehensive review literature on the cosmic voids and this work aims to change that. The methods of observation and identification of voids will be discussed along with the galaxies that inhabit them. Milky Way itself is believed to be part of a void which might lead to biased inferences about the current theories of physical cosmology and that if the hypothesized dark energy is really required to explain the expansion of the universe.

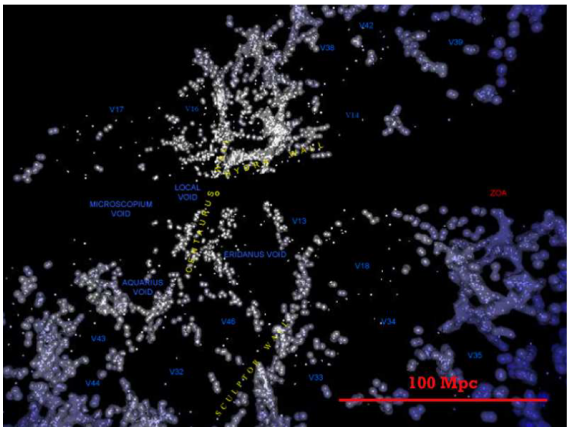

Figure 1: A region of the 6dF redshift survey marked by the presence of various major voids. The image concerns a 3D rendering of the galaxy distribution in a $1000\,\mathrm{km\,s^{-1}}$ thick slice along the supergalactic (SGX) direction, at $\mathrm{SGX} = -2500\,\mathrm{km\,s^{-1}}$. Image courtesy of A. Fairall.

Methods

I will start with the introduction to cosmological parameters that help in identifying the voids using existing work by Lindner et al. (1995), Thompson & Gregory (2011) and van de Weygaert & Platen (2011). The Sloan Digital Sky Survey (SDSS) has been the most expansive sky surveying project yet, and this work will extensively discuss several of its aspects, from the processes involved in collecting the data to the conclusions which can be drawn from it. Publicly available catalogs like Pan et al. (2012), Sutter et al. (2013) will be used to study the preliminary idea of void galaxy distribution, which will then be discussed extensively through a more recent work (Tavasoli, 2021). Lastly, the current theories of physical cosmology and how do voids might challenge them will also be addressed.

Research output

The work will be submitted to *Monthly Notices of the Royal Astronomical Society.*

Timeline

The work will require 10 weeks in total. I will spend the first week in learning the basics of distance measures in cosmology, followed by two weeks exploring the basics of void observation and identification techniques using the projects like SDSS. The next two weeks will be spent studying observational and theoretical results from the literature concerning the void galaxy properties and their distribution. The next two weeks will be devoted to review the consistency of theories of physical cosmology to that of observations and conclusion made from the study of cosmic voids. The final three weeks will be spent writing the report, while continuing to consult the literature.

Summary

I propose to review the current status of research on cosmic voids and void galaxies by compiling a fairly exhaustive study, including the most recent findings that can aid in furthering the interest in this field.

References

Lindner U., Einasto J., Einasto M., Freudling W., Fricke K., Tago E., 1995, The Structure of Supervoids – I: Void Hierarchy in the Northern Local Supervoid, doi:10.48550/arXiv.astro-ph/9503044, http://arxiv.org/abs/astro-ph/9503044

Pan D. C., Vogeley M. S., Hoyle F., Choi Y.-Y., Park C., 2012, Monthly Notices of the Royal Astronomical Society, 421, 926

Sutter P. M., Lavaux G., Wandelt B. D., Weinberg D. H., 2013, A response to arXiv:1310.2791: A self-consistent public catalogue of voids and superclusters in the SDSS Data Release 7 galaxy surveys, doi:10.48550/arXiv.1310.5067, http://arxiv.org/abs/1310.5067

Tavasoli S., 2021, The Astrophysical Journal Letters, 916, L24

Thompson L. A., Gregory S. A., 2011, An Historical View: The Discovery of Voids in the Galaxy Distribution, http://arxiv.org/abs/1109.1268

van de Weygaert R., Platen E., 2011, International Journal of Modern Physics: Conference Series, 01, 41