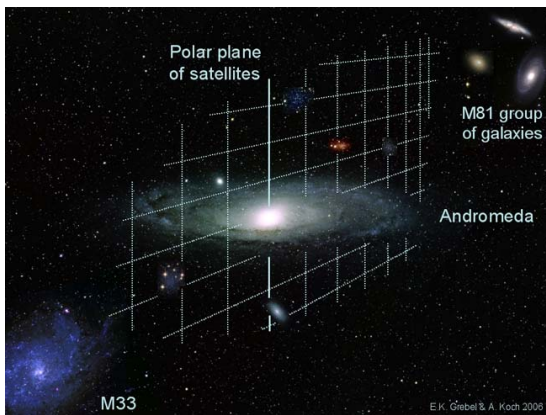




# A search for faint satellites around isolated galaxies



## SUMMARY.

An isolated galaxy is a galaxy that does not have any nearby massive and luminous neighbors. However, they may be accompanied by small satellite galaxies. A satellite galaxy is a smaller companion that travels on bound orbits within the gravitational potential of their host galaxy, in the same way that planets within the Solar System are gravitationally bound to the Sun. Our galaxy, the Milky Way (MW), has several satellite galaxies, being the more massive the Large and Small Magellanic Clouds (LMC and SMC). However the MW is not an isolated galaxy, it belongs to the Local Group with the Andromeda (M31) galaxy, which also has a system of satellites, and the Triangulum (M33) galaxy. Are satellite galaxies only related to group galaxies or there is a population of satellites around isolated galaxies?

## — OBJECTIVES —

- **Knowledge:** Students will gain knowledge on the topic of extragalactic astrophysics, in particular on how the environment affects galaxy formation and evolution.
- **Skills:** Students will learn to manage large databases and to use SDSS and DESI data.

## — INSTITUTE —

The project will be developed in the Galactic Astrophysics Group of the Department of Theoretical Physics and Cosmology at the Faculty of Sciences of the University of Granada (UGR), Spain.

- University of Granada
- Galactic Astrophysics Group
- Edificio Mecenas, Campus Universitario de Fuentenueva, Universidad de Granada, 18071-Granada, Spain.

## — THEORY —

by M. ARGUDO-FERNÁNDEZ

Detecting satellite galaxies is a difficult task, since they are small and faint, and therefore their detection is mostly limited to very nearby galaxies, as M31. The Dark Energy Spectroscopic Instrument (DESI) Bright Galaxy Survey (BGS) is producing the most detailed map of the nearby Universe, providing optical spectra for millions of

galaxies brighter than 19.5–20.2  $r$ -band magnitude.

The objective of this project is to look for faint satellites around a sample of isolated galaxies, with the aim of identifying satellites similar to the LMC and the SMC.

If such population exists, their distribution carries important information for the underlying cosmology, dark matter properties and galaxy formation processes. In this sense, studying the faint small-scale structure of isolated galaxies therefore provides a valuable test for  $\Lambda$ CDM.

## — APPLICATIONS —

by M. ARGUDO-FERNÁNDEZ

To carry out this project, we will use the Sloan Digital Sky Survey (SDSS) catalogue of isolated galaxies (SIG). The galaxies in the SIG are brighter than 15.7  $r$ -band magnitude and are isolated, with no physically bound neighbours brighter than 17.7  $r$ -band magnitude.

If we confirm that, on the other hand, this population of faint satellites is simply a line-of-sight coincidence, these results would confirm the SIG as the sample of the most extremely isolated galaxies in the local Universe. Such a sample would be the most ideal laboratory to test models of galaxy formation and evolution. Besides, the SIG would offer the opportunity to start statistically significant studies of galaxy properties and interpret them in light of their relations with their local and large-scale environments.

## — MAIN PROGRESSION STEPS —

- Tier 1: Python course completion and review of relevant references.
- Tier 2: Sample selection, data analysis, interpretation of the results.
- Tier 3: Preparation of written project and presentation.

## — EVALUATION —

- Theory grade [30%]  
Comprehension of theoretical background as part of the written report.
- Practice grade [30%]  
[20%]: Project development, progress, analysis, and conclusions, as detailed in the report.  
[10%]: Initiative, pro-activity, teamwork.
- Defense grade [40%]  
– Oral and slides quality  
– Context  
– Project / Personal work  
– Answers to questions

## — BIBLIOGRAPHY & RESOURCES —

- Argudo-Fernández et al. 2015
- Hahn et al. 2023
- SDSS webpage
- DESI webpage

## — CONTACT —

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