
Dwarf galaxies of the Local Group as cosmological probes

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Thanks to large surveys mapping the halo of the Milky Way and the Andromeda galaxy, numerous dwarf galaxies resolved in stars have been discovered over the last 15 years, changing our views of how faint a dwarf galaxy can be. Nevertheless, dwarf galaxies remain far less numerous than the predicted dark matter sub-halos that should be orbiting within the Local Group. Coined the "missing satellite problem," this discrepancy has numerous solutions (supernova feedback in small dark matter sub-halos push out their gas, reionization prevents the formation of stars in sub-halos,...), which we can only hope to constrain via direct comparisons with the number, the luminosity, the radial distribution, and the global properties of observed dwarf galaxies.

A key ingredient of this comparison that has been little investigated over the last decade is the detection limits of dwarf galaxy searches. If we aim to compare simulations and observations, we need to know which dwarf galaxies we can hope to find or not in a given survey. This project aims to do so in a systematic manner, using all photometric survey data available around the Milky Way and the nearby Andromeda galaxy. Thanks to these surveys efficient algorithms that uses all available information (location of stars and their color information in the survey), we have found more than a dozen new dwarf galaxies.

During this PhD, the student will combine the exquisite Gaia data set with deep panoptic surveys (Pan-STARRS1, DES, PAndAS) of the Local Group to perform the most up-to-date search for Local Group dwarf galaxies and determine accurate detection limits for dwarf galaxy searches. These will in turn be used for a direct comparison of detailed cosmological simulations with observations in order to both put limits on compatible cosmological models and predict future constraints enabled by the next generation of surveys (Euclid, LSST).

References:

- The PAndAS survey - McConnachie et al. (2018);
<https://ui.adsabs.harvard.edu/abs/2018ApJ...868...55M/abstract>
- The dwarf-galaxy search algorithm - Martin et al. (2013)
<https://ui.adsabs.harvard.edu/abs/2013ApJ...776...80M/abstract>
- A similar, early study conducted on the Milky Way dwarf galaxies - Koposov et al. (2008)
<https://ui.adsabs.harvard.edu/abs/2008ApJ...686..279K/abstract>
- Dwarf galaxy searches in the Pan-STARRS1 survey - Laevens et al. (2015)
<https://ui.adsabs.harvard.edu/abs/2015ApJ...813...44L/abstract>