

Martin Rey



Title

From quenched to gas-rich to star-forming: the diversity of faint dwarf galaxies

Abstract

I present results from high-resolution, "genetically modified", cosmological simulations quantifying the diversity in the structural properties of faint dwarf galaxies.

Ultra-faint dwarf galaxies are the least luminous objects in the Universe. Their shallow potential well makes them highly sensitive to the interaction between dynamical mass growth and internal, feedback processes. This sensitivity provides an ideal laboratory for testing galaxy formation models, while also generating significant scatter in their stellar and gaseous properties. Quantifying the expected scatter will be essential to interpret findings in the next generation of deep, wide sky, surveys (e.g. LSST).

To begin this quantification, I present a suite of simulated low-mass, field dwarf galaxies, evolved with cosmological zoom simulations capable of resolving the explosions of individual supernovae (Rey et al. 2019, 2020). These high-resolution simulations are complemented with the "genetic modification" approach, allowing us to resimulate chosen galaxies making targeted changes to their cosmological mass growth history. This unique combination of abilities provides a complete overview of the interaction between feedback and assembly in these systems.

I will show how this interplay regulates the ability of the lowest-mass galaxies to accrete fresh gas at late times, leading to diverse cold gas content at similar stellar masses. I will further show how this accretion can allow dwarfs to re-ignite and sustain continuous, low levels of star formation until today, highly reminiscent of observed star-forming low-mass dwarfs (e.g. Leo T, Leo P).

Dr. Martin P. Rey

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Research Interests • Formation and evolution of galaxies in our Universe
• Dynamics and statistics of cosmological structure formation
• Dwarf galaxies and low-surface brightness systems

Employment **Postdoctoral research fellow**, 2019 - Present
Lund University, Sweden

Education **Ph.D in Astrophysics**, 2016 - 2019
University College London, UK
Supervisors: Andrew Pontzen, Amélie Saintonge
Examiners: George Efstathiou, Richard Ellis

MSc in Aerospace engineering, 2012-2014; 2015 - 2016
ISAE Supaéro, France

MSc in Physics with Distinction, 2014 - 2015
Imperial College London, UK

Publications **Selected works**, see [exhaustive list](#) for more information

- **Rey**, Pontzen, Agertz, Orkney, Read et al., 2020, MNRAS, 497, 1508
EDGE: From quiescent to gas-rich to star-forming dwarf galaxies
- **Rey**, Pontzen, Agertz, Orkney, Read et al., 2019, ApJL, 488, L3
EDGE: The origin of scatter in ultra faint dwarf stellar masses and surface brightness
- **Rey**, Pontzen, Saintonge, 2019, MNRAS, 485, 190
Sensitivity of dark matter haloes to their accretion histories
- **Rey** and Pontzen, 2018, MNRAS, 474, 45
Quadratic genetic modifications: a streamlined route to cosmological simulations with controlled merger history

Bibliometry: 7 refereed publications (4 as first author);
3 further submitted; 88 citations; h-index of 6, g-index of 9.
[Source NASA ADS](#), ORCID: 0000-0002-1515-995X, 17th December 2020

Summary of Talks **1 invited seminar**, 11 contributed talks (4 conference talks, 6 group seminars, 2 further scheduled), 3 contributed posters, 1 general public lecture
see [exhaustive list](#) for more information.

Grants and Awards	<p>Computing time, ~ 74M CPUh PI: How do Milky Way galaxies grow their stellar halos, 0.85M, 2020 – Co-I: the Milky Way Galaxy at Unprecedented Resolution, 60M, 2020 – Co-I: Engineering Dwarfs at Galaxy formation’s Edge, 12.5M, 2018 – 2020</p> <p>Travel awards, ~ \$3500 IAU, CASPEN and Royal Astronomical Society Travel Funds</p>				
Supervision and Teaching	<p>Supervision Tamina Lund: Awarded bachelor thesis with first-class honours, 2020, secured a Master at LTU University Elise Darragh-Ford: Undergraduate project, 2018, secured a Ph.D position at KIPAC Stanford University</p> <p>Teaching since 2016 Lecturer for Topics in Theoretical Astrophysics Graduate Course Teaching Assistant for Stellar Structure and Evolution, Java, Git programming Mathematical Methods for Physics, Astrophysics and Quantum Physics</p> <p>Peer-mentoring for incoming fellow PhD students, 2017 - 2019 for foreign students arriving in France, 2012 - 2016</p> <p>Student project manager of a scientific satellite mission, 2012 - 2016 Leading a 50-student team to design a spacecraft, launched in 2019</p>				
Media and Outreach	<p>Press coverage “How dwarf galaxies form their stars”, featured in ScienceNews and F&F</p> <p>Public events Public lecture to ~ 250 persons, Billom, France, 2018 Radio interview, Clermont-Ferrand, France, 2018 Astronomy summer schools for over 300 children and teenagers, 2017-2020 KLB Building Opening Day, 2018 Your Universe Festival, 2017</p>				
Skills	<p>Computing: expert in Python, C++ — fluent in Java, L^AT_EX, git, Bash — user of Fortran, Mathematica, Matlab, Maple, OpenMP, MPI</p> <p>Cosmological simulations pipeline: main developer of GENETIC — public contributor to RAMSES, PYNBODY, TANGOS</p> <p>Languages: French (native), English (fluent), Spanish (basic)</p>				
Professional Activities	<p>Reviewer for MNRAS SOC, Compact Objects for All 2020</p>				
References	<table> <tr> <td>Prof. Andrew Pontzen University College London</td> <td>Dr. Oscar Agertz Lund University</td> </tr> <tr> <td>Prof. Amélie Saintonge University College London</td> <td>Dr. Jonathan Pritchard Imperial College London</td> </tr> </table>	Prof. Andrew Pontzen University College London	Dr. Oscar Agertz Lund University	Prof. Amélie Saintonge University College London	Dr. Jonathan Pritchard Imperial College London
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