Understanding emission line galaxies.

Dr. Violeta Gonzalez-Perez

Los estudiantes interesados pueden enviar su CV y carta de motivación a V. Gonzalez: violegp@gmail.com hasta el 1 de Mayo.

Abstract: In our best cosmological model, the Universe is dominated by the elusive dark energy from which little is known. In the next decade, satellites such as Euclid and ground-based surveys like DESI will try to understand the nature of dark energy using tracer galaxies, in particular emission line galaxies. The aim of this research proposal is to improve our understanding of emission line galaxies to enable billion Euros research projects like DESI and Euclid to achieve their goal of mapping the evolution of dark energy with time. As a first step towards achieving this target, we propose to study the evolution of the luminosity function, i.e. the number density per magnitude bin, of emission line galaxies modelled using different assumptions for their stellar populations, and to test the results against recent observations.

Background: In our most successful cosmological model, structure grows hierarchically and galaxies follow the gravitational potential wells originated by dark matter haloes. These only interact gravitationally with galaxies and their constituents (stars, gas and dust). The fate of galaxies is conditioned by the growth of dark matter structures which, in turn, is affected by the particular nature of the dark energy. However, gravity is not the only force shaping the formation and evolution of galaxies. Baryons are affected by a multitude of other processes, mostly related with the fate of gas. Computational modelling is the only way we can attempt to understand all the processes involved in the formation and evolution of galaxies.

Emission line galaxies is the generic name given to any galaxy presenting strong emission lines in their rest—frame optical spectra. The presence of these features allows for a robust determination of their redshift. For a detector sampling optical to near infrared wavelengths these galaxies can be detected up to z=2, when the Universe was about a quarter of its current age. The possibility of having galaxies at a wide range of cosmic epochs make them excellent candidates for constraining the nature of dark energy, as long as they can be detected in large enough numbers. Initial tests on small area surveys indicate that this might be the case[1].

Aim: We propose to use Galform[2], the semi-analytical model of galaxy formation and evolution developed in Durham, to study the evolution of the luminosity function of emission line galaxies and its dependency on the assumptions made about the stellar populations within them.

Investigation: We will render the model galaxies using snapshots output from simulations based on different stellar population assumptions[3]. The snapshots will be chosen to match those times at which observations were made. From these snapshot, luminosity functions will be calculated for the H_α, [OII] and [OIII] lines[4].

Student role: The student's tasks will include: i) writing software to read the simulation outputs, ii) adapting existing software to calculate luminosity functions, iii) devising a means to compare galaxy properties in different simulations with the observations, iv) interpreting the results. The student will be expected to follow the weekly timetable of our PhD students, attending seminars and talks to gain some background knowledge in the subject. In addition to attempting to complete the tasks outlined above, the primary objective is to give the student experience of what it is like to carry out research and to be a PhD student. This will be done through working on the project and also by interacting with the postgraduate students and finding out about their experience of studying for a PhD.

Duration: The student will be sponsored by the Royal Astronomical Society for 6 weeks (£200/week) to fulfil the goals of the proposed project, from the 3rd August to the 13th September (or other dates to be discussed). During the first 2 weeks the student will get the background for this project by reading peer reviewed papers on the subject and will get to know how to analysis the simulation outputs. The following 3 weeks will be devoted to the analysis and interpretation of the simulation outputs in comparison with recent observations. The last week will be devoted to wrap up the project by writing a paper draft.

Supervision: There will be two weekly meetings. Typically our PhD students have a weekly meeting, but in view of the short duration of this project, a higher meeting frequency seems appropriate to ensure progress. The student will be given a desk in one of our postgraduate offices to ensure that there is plenty of scope to ask for advice with scientific and technical problems.

Research Supervisor: Dr. Violeta Gonzalez-Perez is an ERC Postdoctoral Research Associate at the Institute of Computational Cosmology, Durham University, with previous experience supervising 2 graduated students during 6 and 7 week summer studentships, but also with ample undergraduated teaching experience.

References:

[1] Comparat et al. 2015, submitted to A&A. http://arxiv.org/abs/1408.1523
[2] Cole, S., et al. 2000, MNRAS, 319, 168. http://arxiv.org/abs/astro-ph/0007281
[3] Gonzalez-Perez, V., et al. 2014, MNRAS, 440, 920. http://arxiv.org/abs/1309.7057
[4] Orsi, A., et al. 2014, MNRAS, 443, 7990. http://arxiv.org/abs/1402.5145

Budgetary Breakdown:

No further funds are available to support the living expenses of the student. Full access will be given to desk space and the computing facilities, including time on our local supercomputer, needed to complete the project in the time available. Therefore, we ask for a budget of:

7 weeks * £200 = £1400