**Hunting for weirdos: a search for rare populations in**

**multi-wavelength galaxy surveys using machine learning**

**Supervision team:** Prof Stephen Serjeant

**External supervisor**: N/A

**Lead contact**: Prof. Stephen Serjeant

**Project description:**

We made a breakthrough a few years ago in finding rare strong gravitational lensing systems by using the Herschel Space Observatory. These systems turned out to be unusually bright rare objects at submm-wavelengths, making them easy to pick out for Herschel, and have led to many insights into the physical processes underpinning star formation at its peak epoch of activity.

Our wide-area Herschel surveys have turned out to be peppered with many other types of rare object, such as ultra-high-redshift galaxies (redshifts z>5) with very red submm colours (see e.g. our paper on a lensed z=6 galaxy submitted to Nature Astronomy at <https://arxiv.org/abs/1707.09022>). Such objects have been a challenge to accommodate in many semi-analytic models of galaxy evolution.

Meanwhile, we have pioneered other ways of finding rare strong lensing systems at other wavelengths, such as with the forthcoming Euclid space telescope and the Square Kilometre Array.

The aim of this project is to use machine learning (initially starting with Gaussian mixture models, and moving to other techniques) to identify rare populations such as ultra-high-redshift galaxies and strong gravitational lenses. The project will be using imaging data from our multi-wavelength follow-ups to Herschel surveys, which we will then compare to galaxy evolution and lensing model predictions, and simulated data sets for Euclid and other facilities.

**Qualifications required**: First class honours in a first degree or a Merit at MSc preferred, or 2:1 combined with relevant skills sets