Our understanding of cosmology and the major constituents of the Universe has improved greatly over the last three decades, but it is far from complete. We still know very little about the two most significant constituents of the Universe, dark matter and dark energy. Computer simulation and modelling play an essential role in translating the predictions of our cosmological model into observable quantities and in analysing complex data sets to extract the relevant information. This project will involve several branches of research in numerical simulation and modelling of gravitational lenses.

One of the most productive and promising ways of studying dark matter and dark energy is through gravitational lensing - the bending of light by matter. Lensing causes distortions in the images of galaxies and causes us to see multiple images of single galaxies and quasars. By measuring these distortions, the magnification of quasar images, time delays between quasar images and other observables, we can learn about the distribution of mass in the Universe and measure the rate at which the Universe has expanded in the past.

This work will be attached to several ongoing projects in the simulation and modelling of strong gravitational lenses. One branch is the development of realistic simulations of gravitational lenses for the EUCLID mission and other purposes. These simulations are essential for developing lens finding algorithms and for making predictions that will connect the observations to our theories of dark matter, galaxy formation and cosmology. The simulations will include galaxy scale and galaxy cluster scale gravitational lenses as well as microlensing and weak lensing. Using software developed within the group, we will investigate how baryonic structure formation and the properties of dark matter affect the number and properties of strong lenses. There is also an opportunity to apply and develop methods for modelling lenses from high quality data to, for example, constrain the level of self interaction between dark matter particles. There is also an opportunity to develop machine learning techniques to making mock galaxy images and to extracting information from data.

The researcher should have a strong background in computer programming and cosmology. There will be some freedom to pursue the projects within this area that are of most interest to the researcher. The fellowship will be extendable up to three years.