Hawking Fellowship: Pathways to Impact

1 Research Impacts

My research project is expected to have two major impacts in the scientific/research community. Firstly, using STEEL I intend to add constraints to long standing questions in galaxy formation such as:

- The connection between galaxy mergers, AGN, and, star formation in central galaxies.
- Constrain the contributions of effects such as ram pressure stripping, strangulation, and harassment on the quenching of satellite galaxies in the group/cluster environment.

Secondly, using STEEL as a tool alongside galaxy fitting routines I will add reliability and consistency to the outcomes of upcoming major surveys such as Euclid. The methods though which I will ensure the academic impact of this project are as follows:

- Use contacts within the Euclid collaboration to ensure STEEL is used as part of the mock catalogue creation and used within the data pipeline concerning fitting models.
- Organise a workshop to publicise the motivation behind the fellowship. Inviting key figures in the modelling community as well as key researchers from upcoming major surveys will ensure the project has support and visibility.
- The results of this fellowship will create numerous peer-reviewed manuscripts and presentations at conferences both nationally and internationally.

2 Outreach Impacts

The aims of outreach with STEEL will be twofold:

- Promote interest in galactic cosmology in the general public and what it can teach us about the universe we live in.
- Give A-Level students hands-on experience with empirical modelling and real galaxy data to make them enthusiastic about pursuing Physics at University and a career in research.

I have two planned public engagement projects for use with STEEL:

- Create an engaging demonstration by combing Astera, a cosmological galaxy visualisation code developed in the group at Southampton, with the outputs of STEEL. By use of careful prepossessing and accelerations of these codes it will be possible to make an ‘interactive’ Universe where it is possible to directly see the effects of changing cosmological parameters or assumptions.
- Create a empirical modelling workshop using a reduced data set and a simplified version of STEEL. The workshop will be aimed to engage the 16-18 age range, and show young students what actual research looks like.

3 Economic Impacts

The cost of any observational mission is huge. For example, Euclid has a budget of €500 million, and JWST is reported to cost of order $10 billion. The types of flaws in observational fitting found in my work substantially reduce the abilities of missions such as these to achieve their science goals of precision cosmology and limit our theoretical understanding of the universe. The work I will undertake during this fellowship will ensure these surveys are self consistent in observational fitting models and cosmological models. In addition to this STEEL will provide corrections to previous missions to unbias the data they provided allowing it to also be used for precision cosmology. Left unaddressed, the issues I present will reduce the impact of the UK's (and worldwide scientific community's) current scientific investment and could potentially lead to misplaced future investments.

We are entering the era of 'big data'. however without suitable analysis techniques we seriously risk not to take proper advantage of incoming massive data sets. STEEL is the ideal model to coexist with astronomical 'big data' and will ensure the value of the UK's investment in theoretical astronomy.