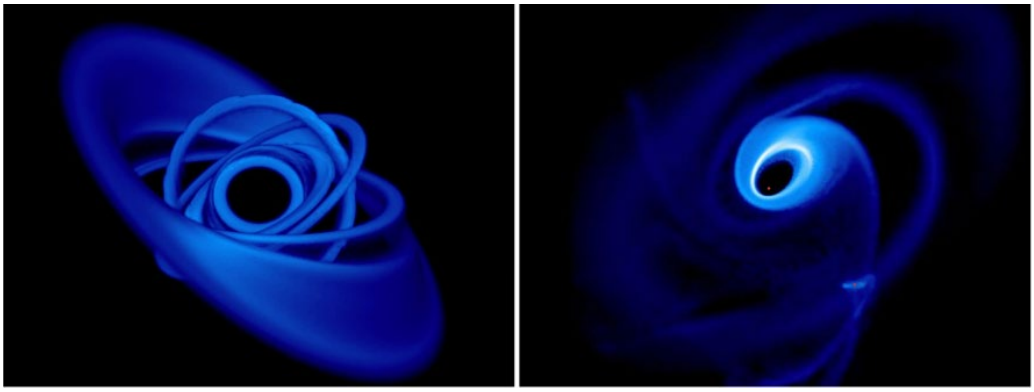
Astrophysical accretion: theory and computation

- **Accretion discs are central to much of modern astronomy and this project will advance our understanding of these systems.**
- **Detailed theoretical models of accretion discs can be used to explain the recent observations of complex structures in planet forming discs**
- **Accretion on to black holes is always highly variable and numerical models that can explain this will show us what is going on in these systems**

Level	PhD
First Supervisor	Chris Nixon
Second Supervisor	Richard Alexander
Application Closing Date	19 January 2022
PhD Start date:	26 September 2022

Project Details:

Accretion discs are central to much of astronomy: they are the birth sites of stars and planets, and they surround supermassive black holes in active galaxies and quasars. These discs form when gas moves on orbits around a star or black hole, balancing the central gravitational pull with the centrifugal effect of rotation. Angular momentum is transported outwards by a viscosity, allowing most of the gas to spiral inwards. This process turns gravitational potential energy into light, and is the most efficient way of extracting energy from ordinary matter. In some systems this can be observed across much of the entire visible Universe. Accretion on to supermassive black holes can outshine galaxies and significantly affect the hole's surroundings through energy and momentum feedback. When we observe these systems they always show complex time variability, and our theoretical models are now starting to produce plausible mechanisms to explain these phenomena. Observations of accretion discs in stellar and planetary systems are now revealing complex structures that require detailed analytic and numerical models to be fully understood.



Simulations of dynamic discs

During this project you will develop our understanding of these systems through analytical and numerical models of the accretion process. You will have access to the high-performance computing (HPC) facilities hosted at Leicester, and this project is supported by a computing time allocation on the national HPC facility DiRAC. Additional funding for the research on this project is currently available through an EU Marie-Curie RISE grant which supports the international Dustbusters collaborative network (https://dustbusters.fisica.unimi.it).

As a member of the Dustbusters network, you will have the opportunity to visit and work with leading researchers from around the world. Through this research project you will gain or enhance valuable skills in computing and mathematical and data analysis, and employ these to answer important questions in astrophysics.

References:

1 Accretion discs with non-zero central torque; Nixon & Pringle 2021; https://arxiv.org/abs/2008.07565

2 Disk Tearing: Numerical Investigation of Warped Disk Instability; Raj, Nixon & Dogan 2021; https://arxiv.org/abs/2101.05824

3 On the orbital evolution of binaries with circumbinary discs; Heath & Nixon 2020; https://arxiv.org/abs/2007.11592

4 What is wrong with steady accretion discs?; Nixon & Pringle 2019; https://arxiv.org/abs/1907.08206

5 The Maximum Mass Solar Nebula and the early formation of planets; Nixon, King & Pringle 2018; https://arxiv.org/abs/1803.04417