

## LAADS, a new code to study small perturbations in astrophysical discs

Galaxies, accretion discs and protoplanetary discs all exhibit complex structures caused by waves and instabilities. Those can be studied using numerical non-linear simulations, but these are costly and hard to interpret. Fortunately, if the amplitude of a perturbation is small, we can use a mathematical tool called linear analysis to predict its evolution.

Linear analysis is often seen as an analytical tool, but this is reductive. Indeed, analytical tools are limited to simple settings where the equations can be solved manually, whereas linear analysis is a powerful tool applicable to complex problems. Indeed, it removes the non-linear simulations' need for time-stepping, thereby allowing us to reduce the computational cost, increase the resolution, and add more physics into the model.

Our team is developing a Python software to automate linear analysis in astrophysical discs. We have already developed the core of the code (interface, solver, visualisation), as well as the first few modules (hydrodynamics, self-gravity, central object). We are now extending those modules from 2D to 3D and developing new modules for dust and MHD. Once this is done, we will make our code public.

It will have many applications: it could help estimate the resolution needed in simulations, it could help explore the interactions between waves and disc substructures, it could be connected to disc long-term-evolution models to determine when and where instabilities activate without relying on any prescription, *etc.*

The goal of our talk is two-fold. Firstly, we want to advertise our code to the French astronomy community. The “Journées de la SF2A” are ideal for this because we will be able to interact with people interested in all types of astrophysical discs. Secondly, we want to argue that ‘tailored’ codes like ours should play a larger role in the French “high performance computing” effort. Indeed, they are less versatile than traditional simulations, but to perform the one task they are designed for, they take half a second of CPU time instead of several thousand hours.