1 Questions - Theory

Gravitational microlensing is useful for detecting low mass planets that are on wide orbits. These far-out objects block such a small amount of the light from their host stars, meaning the transit method of detection is ineffective. For the same reason, the radial velocity method is also not ideal.The microlensing effect is almost independent of the mass of the planet. You do not get a weaker signal, just a shorter one. This means that you can achieve higher signal to noise ratios.
The value of alpha is always positive in our work. I have read about it being negative for negative shear rate (i.e. velocity increasing with increasing radius) but that is not the case in protoplanetary discs.
Not quite, dynamical friction refers to the loss of momentum of planetesimals due to interaction with the disc, causing them to migrate inwards. Pebble accretion is a process in which small (cm - m) pebbles are accreted by forming protoplanets as they settle into the mid-plane of the disc.

2 Questions - Code

Sink particles are used in SPH simulations to represent stars, blackholes, planets etc. They reduce the computational resources required for a simulation to run. They form when the density of gas reaches a certain critical value, ρ_{crit}. The reason we use them is because in high density regions, in order to follow each individual particle, we need a very small 'timestep'. The SPH **timestep** determines how often we 'look' at the disc in SPH simulations. It is computationally expensive to use very small timesteps and can cause the code to fail. To solve this, once a particle reaches the critical density ρ_{crit} it is replaced by a sink particle with a 'sink radius' (its accretion radius). Any particles that then move within the sink radius are removed from the simulation (accreted) and their mass is added to the mass of the sink. The snap.sinks['position'] array corresponds to the x, y and z position of the sink. You may find in your simulations that the code fails if the disc becomes unstable. This is because by default the code does not generate new sink particles during the course of the simulation and will instead try to use very small timesteps below the minimum timestep value.
At the moment, the transfer of angular momentum is only through viscosity. SPH simulations often use an 'artificial viscosity' to represent a physical viscosity in the code. You can read about it in quite a bit of detail in section 2.4 and 2.5 from Lodato, G., & Cossins, P. J. (2011). Smoothed Particle Hydrodynamics for astrophysical flows the dynamics of protostellar discs. European Physical Journal Plus, 126(4), 1–20.

3 Questions - Project

The goal of this project is to simulate locally isothermal discs in PHANTOM while varying the disc mass and temperature profile. We will talk about those parameters a little more in the meeting this afternoon. If you take a look at equation 13 in "construction protostellar discs for SPH simulations", you will be varying T0, T_∞ and q. Before varying those numbers though, you will benefit from reading a little more about the Toomre parameter which is the indicator of how unstable a disc is to fragmentation. You will see that it is dependant on sound speed (and therefore temperature). For the reason I mentioned in the question above about sink particles, you may find that a simulation of a more massive disc and cooler temperature will fail because the it my be unstable to fragmentation

and particle densities will become very high resulting in very small timesteps.
We are investigating how different temperature profiles and different disc masses effect the evolution of protoplanetary discs.