BACKGROUND:

(Correlating dark matter haloes with large-scale structure of the cosmic web, how it points towards the hierarchical structure formation)

(STRUCTURE FORMATION THEORY?)

The standard theory for the origin of angular momentum in the large-scale structure of the universe is the framework of hierarchical structure formation, which occurs due to the assumption of gravitational instability drawing structures together. That is, that most angular momentum is gained gradually by protohaloes in the linear regime of the growth of density fluctuations (presumed to be the beginnings of the universe) that occur due to tidal torques from neighbouring fluctuations. This angular momentum growth continues until the protohalo reaches its maximum extent, after which only smaller angular momentum exchanges occur.

(WHY STUDY IT?)

The push towards investigating the process by which angular momentum is formed is the ‘spin crisis’ seen in simulations today, where luminous galaxies are observed to be significantly smaller and with much less angular momentum than observed in disc galaxies. There is also motivation coming from the need to understand angular momentum build up processes in order to develop semi-analytic models capable of galaxy formation. Finally, in a more observational sense, there is a need to understand these processes in order to work around them when doing weak gravitational lensing studies.

AIM:

(CORRELATION WITH COSMIC WEB)

A number of previous studies have found that dark matter haloes (within which baryonic galaxies form) have structural properties that correlate with their local environment, that is, the part of the cosmic web that they reside in. This local environment can be thought of as different densities, or more specifically, as voids, walls and filaments along which haloes can be aligned or misaligned. The fact that these halo properties correlate with the local environment suggests that the baryonic galaxies that form within will likely do so as well, albeit to a lesser degree. In particular, the stellar halos of these galaxies could possibly show a correlation to local environment.

(AIM)

In this project, we wish to measure the properties of stellar haloes in the Horizon-AGN hydrodynamical simulation, as well as information about the cosmic web in which they reside (their local environment). These structural properties – orientation, mass and angular momentum profiles – will then be measured against the orientation and properties of the cosmic web to see if a correlation exists.

METHOD:

(I.e. computing the inertia and shear tensor, using linear tidal torque theory to relate this to the angular momentum, using the inertia tensor to get the shape)