First Light And Reionisation Epoch Simulations (FLARES)

We propose a suite of simulations of galaxy formation at very high redshift ($z > 5$) with the aim of: making predictions for observations by JWST, Euclid, and other upcoming facilities; elucidating the contribution of the first galaxies to reionization. We will use resimulations of regions chosen at $z = 5$ to (i) obtain a large sample of massive, high-luminosity galaxies; (ii) explore a wide range of environments.

Stephen to provide some observational motivation.

(i) To obtain a large sample of high-redshift galaxies, we need to resimulate overdense regions in the early universe. We use as our background simulation the same 3.2 Gpc box previously used for the Bahamas (Bahe etal 2017) and C-EAGLE (Barnes etal 2017) projects. As demonstrated by Lovell etal (2018) and others, there is a large mismatch between overdensities at z=0 (as used by the above projects) and those at z=5; whereas at z=5 and above, the fluctuations are linear on the scales that we resimulate: for that reason, we resimulate spherical regions of high overdensity identified at that redshift.

Figure 1 shows the combined results of 5 test simulations (labelled G-EAGLE) that together comprise just five-eighths of the volume of one of our proposed resimulations, as compared to the number of galaxies in the EAGLE reference volume (Furlong etal 2015). This shows two things: firstly that resimulation technique is extremely efficient in probing the sites of galaxy formation at high redshift; and secondly that it probes the highest mass galaxies that are simply not present in smaller boxes which fail to sample the long-wavelength modes of the power spectrum.

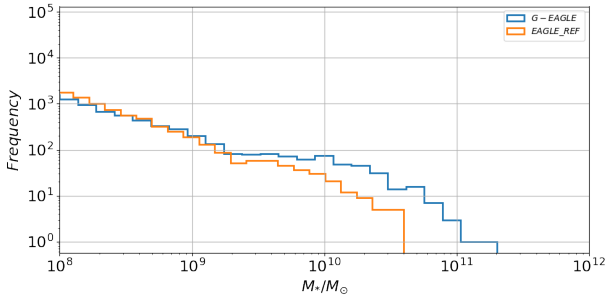

Figure 1: Number of galaxies in the EAGLE simulation (orange) and in test simulations (blue) at $z = 5$, as described in the text.

Plot and discussion about sampling of rare objects.

(ii) ***Discussion of cosmic variance.***

Technical details: This proposal will use the well-tested and highly successful galaxy simulation software suite used for the EAGLE simulation (Schaye etal 2015) and in cluster resimulations (Bahe etal 2017, Barnes etal 2017). We will use the P-Gadget3 EAGLE code with the AGNdT9 normalisation for AGN feedback. Outputs will be analysed using SUBFIND to identify halos, sub-halos and galaxies. Test runs have been performed on which the figures used above and in the technical case are based.

Summarise numbers that I gave to Adrian