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Studying high redshift galaxies is essential to have a complete picture of the formation and evolution of galaxies. The detection of high redshift galaxies is however a challenging process due to the low brightness of these objects, and hence the shape of the luminosity function at high redshift is poorly constrained. The Brightest of Reionizing Galaxies (BoRG; Trenti et al. 2011) is a HST/WFC3 parallel survey aiming to find bright ($M_{AB} \sim -21$) galaxies at $z \sim 8$. The first release of the data covers ~ 120 $arcmin^2$ of the sky.

With the help of simulations and modelling, it will be possible to predict how many bright galaxies are more likely to be found in the survey area. For this purpose we use the Millennium simulation (MS; Springel et al. 2005) dataset to predict the number density of galaxies brighter than the Milky Way (MW), i.e. $M_{AB} < -20.5$, in the redshift range $[8, 10]$.

The first step is to construct a pencil beam between redshifts 8 and 10 with dimensions similar to the survey, $\sim 10 \times 12$ $arcmin^2$, assuming a WMAP-1 cosmology (Spergel et al. 2003) adopted by the MS. Since the angular diameter distance changes by a small amount between redshift 8 and 10 ($\sim 1Mpc$ for $10arcmin$), we assume a cuboid shape for the pencil beam. We note that the MS is a box with periodic boundary conditions. Thus where the pencil beam reaches sides of the box, it will reappear from the other side. Special care needs to be taken if the pencil beam is larger than the size of the box to avoid overlapping the pencil beam with itself while wrapping it around the box. In our case, however, dimensions of the pencil beam are smaller than the size of the box. We, therefore, construct the pencil beam parallel to the sides of the simulation box for simplicity.

The simulation catalogues have been recorded in discrete redshifts. Around our desired range of redshift, the MS have three outputs at redshifts 7.88 , 8.55, and 9.27 . While selecting halos along the pencil beam we change the catalogue at the average redshift between two consecutive outputs. Since we are interested in the number counts of galaxies brighter than the MW and the MS is a pure N-body simulation, we need to adopt a model to map between halo mass and galaxy luminosity. We use the halo mass-luminosity relation derived from the model of Trenti et al. (2013) at redshift 9. Even though the model uses the Planck cosmology (Planck Collaboration et al. 2013) parameters rather than WMAP-1, we suspect the difference is negligible in our work.

As the last step, we construct 100000 different pencil beams starting from 100000 random points in the MS box and record number of galaxies brighter than MW along the pencil beam. The result is shown in Figure 1 where the blue histogram corresponds to the normalized distribution of the number counts of galaxies. The average number of galaxies brighter than MW expected to exist in the survey area between redshift 8 and 10 is 243 . The width of the distribution is rather large with rms around the mean of ~ 50. The red curve is the Poisson distribution with the same mean as the number counts of galaxies. One can note that the distribution of galaxies is wider than the Poisson distribution, which reflects the fact that the galaxies are not randomly distributed in the

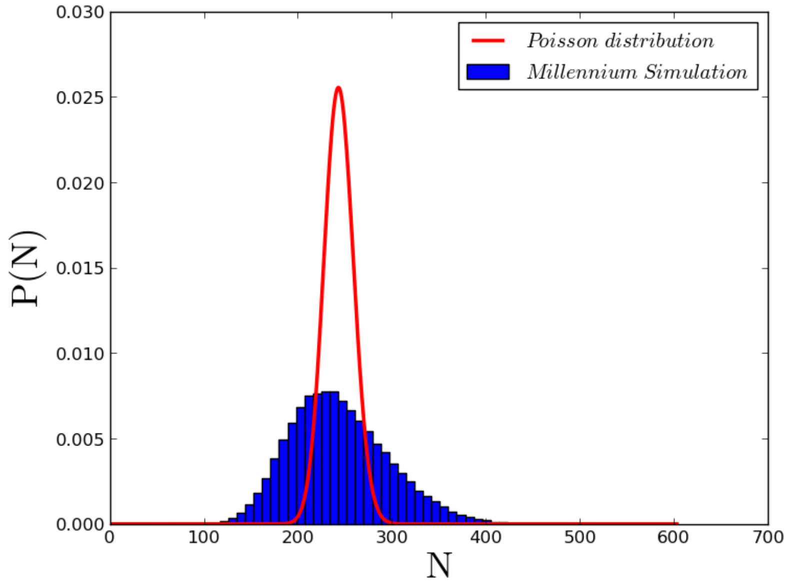

Figure 1: Blue: The distribution of the number counts of galaxies brighter than MW in pencil beams with dimension 10×12 $arcmin^2$ in redshift range $[8, 10]$ in the Millennium Simulation. Red: Poisson distribution with a mean the same as the previous distribution.

universe and are clustered in the over dense regions.

The code we used in this work is public and available. [1]

References

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[1] https://github.com/jngaravitoc/CosmicVariance