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What galaxy surveys really measure

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Galaxy redshift surveys measure the number of galaxies per solid angle as a function of redshift. This observation is then used to infer the underlying matter power spectrum and learn about structure formation and cosmological parameters. The link between observation and matter density is however not as simple as it is usually assumed. It is known since a long time that galaxy number density measurements are affected by redshift-space distortion. In this talk I will show that in addition to this well-known correction, various relativistic effects enter in the relation between the observed galaxy number density and the underlying physical quantities, i.e. density perturbation, peculiar velocity and gravitational potential. I will show how to express the observable in terms of gauge invariant variables and I will discuss the various corrections to the standard result. At small redshift, the dominant contribution comes from peculiar velocities of galaxies, whereas at large redshift magnification gives the largest contribution. These corrections are relevant at large scales and are large enough to be observed in future galaxy redshift surveys.

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