**MSE Synergies with the SKA for Galaxy Formation and Cosmology**
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The SKA will be a transformational telescope with the capability of detecting Milky Way-type galaxies via synchrotron radiation into the epoch of reionization, AGN of all types and luminosity, in addition to tracing the neutral hydrogen content of galaxies to z~2. However, optical spectroscopy of such galaxies will still be crucial to maximise the scientific output of the SKA, and to gain the biggest leap in our understanding of galaxy formation and cosmology.

**MSE and SKA: Tracing the evolution of galaxies**

The extreme sensitivity of the SKA means that it will be able to detect star-forming galaxies in radio continuum emission to the highest redshifts. However, the lack of spectral features in the radio continuum means that additional wavelength observations are required to obtain redshift information, along with obtaining important physical characteristics of the stellar populations via measurement of ages and metallicity etc., or for the presence of AGN activity via emission line diagnostics. Therefore, MSE could play a critical role in providing key information for understanding the evolution of AGN and star-forming galaxies detected with the SKA.

On the HI side, even the SKA will not be sensitive enough to directly detect HI in all but the gas rich galaxies out to z~2. Therefore, much effort is currently being focussed on methods for stacking based on galaxies with known redshifts. The precision required for the redshifts is such that spectroscopic data is far more valuable than the more abundant imaging data from which photometric redshifts can be derived. Thus, MSE could provide the ideal spectroscopic sample to carry out HI stacking analyses of galaxies based on galaxy properties such as age, morphology, redshift etc.

**MSE and SKA: Cosmology**

One of the most straightforward and obvious experiments to carry out with MSE and SKA is to perform a redshift survey of all continuum radio sources over a large volume. Such a survey would allow the low-redshift radio sources to be separated out from those faint, and predominantly high-redshifts sources, where obtaining a spectroscopic redshift is all but impossible. This information can then be used to measure the galaxy power spectra in tomographic shell, thus providing novel measurements of the large-sale power on super horizon distances at high redshift (see e.g. Camera et al. 2012).
It is now becoming apparent that cosmology is becoming systematics limited rather than statistics limited. Thus, optimal methods of combining data from experiments with different systematic uncertainties can lead to fully cancelling such issues. One particular area of synergy between MSE and SKA will be the construction of galaxy redshifts catalogues based on different tracers of the underlying density distribution, e.g. precise redshifts for luminous red galaxies from MSE and precise redshifts for lower mass, gas-rich galaxies detected in HI with the SKA. These galaxies trace the underlying dark-matter distribution with

vastly different bias, thus allowing the so-called “multi-tracer” technique (Seljak 2009) to be used in order to overcome cosmic variance effects (see e.g. Ferramacho et al. 2014).