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There and back again: Recovering autospectra information from crosscorrelation measurements

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Intensity mapping experiments will soon have surveyed large swathes of the sky, providing information about the underlying matter distribution of our early Universe. The resulting maps can be used to recover statistical information, such as the power spectrum, about the measured spectral lines (for example, H i, [C ii], and [O iii]). However precise power spectrum measurements, such as the 21 cm autocorrelation, continue to be challenged by the presence of bright foregrounds and non-trivial systematics. By cross-correlating different data sets, it may be possible to mitigate the effects of both foreground uncertainty and uncorrelated instrumental systematics. Beyond their own merit, cross-correlations could also be used to recover autocorrelation information, and such a technique has been proposed in the literature for recovering the 21 cm power spectrum. Generalizing this result, I will present a statistical framework for combining multiple cross-correlation signals in order to infer information about the corresponding autocorrelations. I do this first within the least squares estimator framework, and show how one can derive the previously proposed technique, along with several alternative estimators. I also investigate the posterior distribution of recovered autocorrelation and associated model parameters. I will show that, for certain noise regimes and cosmological signal modelling assumptions, this procedure is effective at recovering autospectra from a set of cross-correlations. Finally, I will showcase this new framework in the context of several near-future line intensity mapping experiments.

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