High time resolution radio astronomy with low frequency interferometric arrays

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Abstract

Short-duration astrophysical phenomena such as pulsars make powerful probes for uncovering new physics. Recent discoveries of extragalactic fast radio bursts exemplify untapped potential for new science in this area and further reinforce the need for continued exploration of uncharted parts of the parameter space. While large single-dish type instruments have so far dominated such high time resolution science applications in radio astronomy, the future clearly lies in the efficient use of large-element, distributed arrays. Such interferometric array instruments offer unique advantages, such as higher resilience to radio frequency interference and superior localization capabilities, but they also come with significant challenges in terms of associated digital processing requirements, and the need to devise optimal observing strategies and processing techniques. I will give an overview of the ongoing efforts in developing related capabilities for the Murchison Widefield Array – the low-frequency pre-cursor to the Square Kilometer Array, and the Giant Metrewave Radio Telescope, now equipped with a versatile software backend. I will highlight some important lessons learnt, as well as the scientific accomplishments from some early science projects currently underway. I will also briefly describe the ongoing efforts to develop a transient detection capability for the Ooty Radio Telescope, where the new instrumentation under development will enable a large field of view – the Ooty Wide Field Array. Fast radio transients also pose major challenges in terms of conducting prompt follow-ups, for which multi-telescope approaches may prove to very effective, and I will highlight some prospects in this direction.

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