**Timing and Transients**

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The time domain is currently seen as a potentially rich discovery space for astronomy, across the entire range of the electromagnetic (and potentially gravitational wave) spectrum. In radio astronomy, time domain and transient studies include well-known phenomena such as pulsars, newly discovered phenomena such as fast radio bursts, and expected but still unrealized goals including gravitational wave event counterparts. All of these require specialized and demanding instrumentation that pushes the boundaries of currently used technology. Here I will review the state of the art in time domain radio astronomy. This will include a highlights of the work presented in the "Timing and Transients" special session, as well as more detailed description of current and future directions in pulsar astronomy and fast radio burst searches:

It has long been recognized that high-precision timing of millisecond pulsars has potential to provide a means of directly detecting gravitational waves (GW). In this case, GW are emitted not from the neutron stars themselves but from supermassive black hole binaries throughout the universe; the expected signals have periods of $\sim$1–10 years, or nanohertz frequency. This effort has expanded rapidly over the past five years, and is now consuming a significant fraction of current telescope time as well as driving the design of future instruments such as the SKA. Here I will summarize the latest results from the NANOGrav project, which is currently monitoring $\sim$50 pulsars using the Green Bank and Arecibo telescopes. In particular I will discuss recent and near-future progress in instrumentation, including plans to design ultra-wideband receiver systems for these telescopes. I will also discuss how our evolving knowledge of the effect of the interstellar medium on pulse propagation may shape plans for future high-precision timing projects.

The recent disocvery of a population of of fast radio bursts (FRBs) – millisecond-duration dispersed pulses of apparently extragalactic origin – has given increased motivation for the construction of time domain capabilities in radio instrumentation. These events were first detected in large-area pulsar surveys done by the Parkes telescope. To date all such detections ($\sim$10 total) have been made by large single dishes devoting hundreds of telescope hours per burst found. There is still no definitive explanation for the origin of these pulses, and it is clear that for progress to be made there must be improvement in both the localization of the events on the sky (to identify hosts) and the rate of discovery. Both of these criteria point to interferometric rather than single-dish instruments. A number of such projects are ongoing, and I will present highlights from two ongoing efforts: a project to enable FRB detection and localization with the VLA; and add FRB detection capability to the planned high survey speed instrument CHIME.