URSI GASS 2020, Rome, Italy, 29 August - 5 September 2020

Spectral, Temporal, and Polarimetric Properties of ASKAP-localized Fast Radio Bursts

Cherie K. Day*[1,2], Adam T. Deller [1], Ryan M. Shannon[1], and Hao Qiu[2,3]
(1) Centre for Astrophysics and Supercomputing, Swinburne University of Technology, Hawthorn VIC 3122, Australia, *e-mail: cday@swin.edu.au; adeller@astro.swin.edu.au; rshannon@swin.edu.au
(2) CSIRO Astronomy and Space Science, PO Box 76, Epping, NSW 1710, Australia
(3) Sydney Institute for Astronomy, School of Physics, University of Sydney, NSW 2006, Australia, email: hqiu0129@uni.sydney.edu

Extended Abstract

One of the great mysteries of modern astronomy, Fast Radio Bursts (FRBs) are on order millisecond bursts of radio emission that remain detectable across cosmological distances, implying a hitherto unknown, incredibly energetic emission mechanism. Recent (sub-)arcsecond localizations (e.g., by the Australian Square Kilometer Array Pathfinder (ASKAP) [1]) have enabled their association with host galaxies, transforming the landscape of the field. Since FRB signals encode information about their emission mechanism and the ionized plasma encountered along their propagation paths, their high time resolution and full polarization dynamic spectra are a rich resource for investigating both the intrinsic properties of the bursts and, via the propagation effects experienced by these bursts, their local and host galaxy environments and the large-scale structure in the Universe.

The high time resolution polarimetric data for the sample of ASKAP-localized FRBs is providing new insights into the spectro-temporal-polarimetric properties of the FRB population. The full polarization dynamic spectra for FRB 190611 (Figure 1) illustrate the complex spectral and temporal morphology of the burst structure. As was the case for FRB 181112 [2], the subpulses within the FRB 190611 burst envelope exhibit both a differential dispersion measure (DM; the integrated electron column density along the line of sight) and a changing circular polarization fraction. In both FRBs, the higher DM and circular polarization fraction were found in the later subpulses. As with the downward drifting frequency structure that appears to be associated with repeating FRBs [3], this phenomenology might be connected to an (as yet unidentified) underlying property of the FRB source or emission mechanism. The sample presented here will be collectively considered to form a picture of FRB properties and how they correlate with their local and host environments.

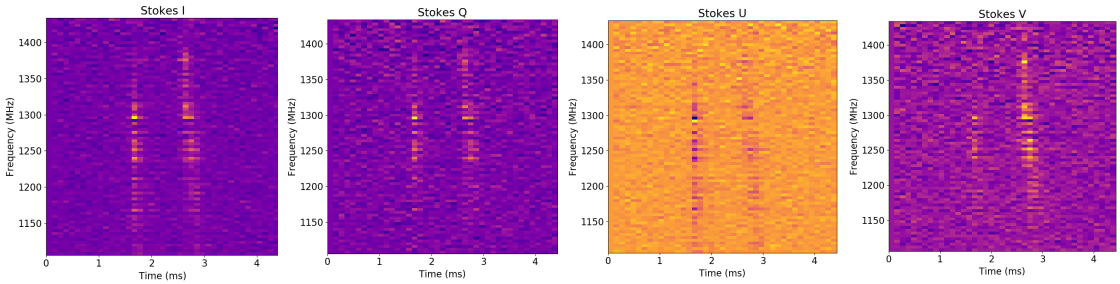

Figure 1. From left to right, the FRB 190611 Stokes I, Q, U, and V dynamic spectra (frequency vs. time), where color represents the flux density. The frequency dependent arrival time delay has been corrected with a DM of 332.60 pc cm^-3, where $\Delta t \propto DM\nu^{-2}$. It is evident that the dispersion measure and the fraction of circular polarization (Stokes V) change between the two pulses.

References

[1] K. W. Bannister *et al.*, "A single fast radio burst localized to a massive galaxy at cosmological distance," *Science*, **365**, 6453, August 2019, pp. 565-570, doi: 10.1126/science.aaw5903.

[2] Hyerin Cho *et al.*, "Spectropolarimetric analysis of FRB 181112 at microsecond resolution: Implications for Fast Radio Burst emission mechanism," *ApJ*, submitted

[3] J. W. T. Hessels *et al.*, "FRB 121102 Bursts Show Complex Time–Frequency Structure", *ApJ Letters*, **876**, 2, May 2019, pp. 23-36, doi: 10.3847/2041-8213/ab13ae