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Microsecond-duration bursts of FRB 20121102A

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Fast radio bursts (FRBs) are bright transient flashes of radio waves originating from extragalactic distances with an unknown origin. The FRBs observed to date typically last for order milliseconds. Bursts from FRB 20200120E, however, can be as short as 50 microseconds, and some of these bursts show sub-structure down to 60 nanoseconds. Probing FRB emission timescales constrains emission models. Motivated by the microsecond structure seen from some FRBs, we re-searched archival Green Bank Telescope data that targeted FRB 20121102A, the first-known repeater, at 4-8 GHz. Temporal broadening due to scattering is expected to be negligible at these high observing frequencies. Previous analyses of these data (see, e.g., Gajjar et al. 2018) detected close to one hundred bursts, with typical durations of 700 microseconds. We used the voltage data available through the Breakthrough Listen project to coherently dedisperse and search these data at 2 microsecond time resolution. We also employed a systematic subband search across the 4.5 GHz of available bandwidth. These searches have led to the discovery of multiple new bursts, some of which are extremely short in duration, with their entire burst envelope lasting only 5 microseconds. I will present an analysis of these bursts at 341 nanosecond time resolution, including an investigation of dispersion measure variations. This work demonstrates that there is a population of ultra-fast radio bursts that are undetectable by standard searches, and motivates us to further explore the transient phase space at microsecond time resolution.

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