No bursts detected from FRB121102 in two 5-hour observing campaigns with the Robert C. Byrd Green Bank Telescope

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INTRODUCTION

More than 10 years after the discovery of Fast Radio Bursts (FRBs; see Lorimer et al. 2007), an understanding of their origins remains elusive. Of the 29 reported FRBs[1], only one of these, FRB 121102, has been shown to repeat (Spitler et al. 2016). This has allowed numerous follow-up campaigns, resulting in an unambiguous localization to its host galaxy (Chatterjee et al. 2017; Marcote et al. 2017). Multi-wavelength campaigns to characterize and monitor its spectral index, burst rate, polarization, and spectro-temporal variations (e.g. Scholz et al. 2016; Gajjar et al. 2017; Michilli et al. 2018) are ongoing.

Here, we report non-detection of radio bursts from FRB 121102 during two 5-hour observation sessions on the Robert C. Byrd 100-m Green Bank Telescope in West Virginia, US (GBT) on December 11, 2017, and January 12, 2018. In addition, we report non-detection during an abutting 10-hour observation with the Kunming 40-m telescope in China (KM40), which commenced UTC 10:00 January 12, 2018. These are among the longest published contiguous observations of FRB 121102, and support the notion that FRB 121102 bursts are episodic.

These observations were part of a simultaneous optical and radio monitoring campaign with the the Caltech HIgh-speed Multi-color CamERA (CHIMERA, Harding et al. 2016) instrument on the Hale 5.1-m telescope. The data analysis of CHIMERA data is ongoing and will be published elsewhere.

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OBSERVATIONS

We observed FRB 121102 for two 5-hour sessions with the GBT, commencing UTC 2017-12-11T03:00 and 2018-01-12T02:30 using the Breakthrough Listen digital backend (MacMahon et al. 2017) to record baseband data across the nominal bands of the receivers. On 11th December, 2017, we observed using the 4.0–8.0 GHz receiver (SEFD[2] ∼10 Jy); at the start of observations we ran the GBT autopeak focus routine to calibrate the active surface. On 12th January, 2018, we observed using the 1.6–2.6 GHz receiver (SEFD ∼10 Jy); no autopeak calibration is required at these frequencies. During both sessions, we observed 3C161 and PSR B0525+21 for flux and polarization calibration. Observations of FRB 121102 were conducted in 30-minute segments (Table 1).

From UTC 2018-01-12T10:00 onwards, the source became visible to the KM40 telescope, using which a 10-hour observation was carried out with the newly-installed 4.7–5.2 GHz receiver (SEFD ∼256 Jy).

RESULTS AND DISCUSSION

At the GBT, baseband data were reduced to form high time resolution (300 μs) Stokes-I dynamic spectra (183 kHz frequency resolution) using the Breakthrough Listen GPU-accelerated spectroscopy suite. The reduced products were searched for dispersed pulses consistent with the known 557 pc cm^{-3} dispersion measure of FRB 121102, using the Heimdall software package (Barsdell et al. 2012). At the KM40, Stokes-I dynamic spectra (64 μs, 1 MHz) were recorded and searched in real-time using the Bear software package (details forthcoming).

No bursts were detected during either session. In contrast, 15 bursts were detected within 30 minutes in previous GBT observations over 4.0–8.0 GHz using the same procedure (Gajjar et al. 2017, Gajjar et. al., in prep). Taken together, these observations support models that predict episodic emission (Scholz et al. 2016). We have published these non-detections here foremostly so that a better statistical model can be formed by combination with burst statistics from other observing campaigns.

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[2] SEFD: System Equivalent Flux Density

Table 1. Details of FRB 121102 observing sessions on GBT and KM40. No radio bursts were detected during these periods.

Telescope	Scan ID	Frequency band (GHz)	Flux limit† (mJy)	Observation start date (UTC)	Observation start date (MJD)	Duration (min)
GBT	20171211-1	4.0–8.0	24.8	2017-12-11T03:46:40.000	58098.1574074074	30
GBT	20171211-2	4.0–8.0	24.8	2017-12-11T03:47:50.000	58098.1582175925	30
GBT	20171211-3	4.0–8.0	24.8	2017-12-11T04:18:12.000	58098.1793055555	30
GBT	20171211-4	4.0–8.0	24.8	2017-12-11T04:48:22.000	58098.2002546296	30
GBT	20171211-5	4.0–8.0	24.8	2017-12-11T05:44:14.000	58098.2390509259	30
GBT	20171211-6	4.0–8.0	24.8	2017-12-11T06:14:50.000	58098.2603009259	30
GBT	20171211-7	4.0–8.0	24.8	2017-12-11T06:45:01.000	58098.2812615740	30
GBT	20171211-8	4.0–8.0	24.8	2017-12-11T07:15:12.000	58098.3022222222	30
GBT	20171211-9	4.0–8.0	24.8	2017-12-11T07:45:22.000	58098.3231712962	14
GBT	20180112-1	1.6–2.6	55.6	2018-01-12T02:44:37.000	58130.1143171296	30
GBT	20180112-2	1.6–2.6	55.6	2018-01-12T03:14:46.000	58130.1352546296	30
GBT	20180112-3	1.6–2.6	55.6	2018-01-12T03:44:55.000	58130.1561921296	30
GBT	20180112-4	1.6–2.6	55.6	2018-01-12T04:15:04.000	58130.1771296296	30
GBT	20180112-5	1.6–2.6	55.6	2018-01-12T04:45:13.000	58130.1980671296	30
GBT	20180112-6	1.6–2.6	55.6	2018-01-12T05:15:22.000	58130.2190046296	30
GBT	20180112-7	1.6–2.6	55.6	2018-01-12T05:45:31.000	58130.2399421296	30
GBT	20180112-8	1.6–2.6	55.6	2018-01-12T06:15:40.000	58130.2608796296	30
GBT	20180112-9	1.6–2.6	55.6	2018-01-12T07:03:04.000	58130.2937962962	28
KM40	20180112-10	4.7–5.2	2536.6	2018-01-12T09:59:53.862	58130.4165956206	600

† assuming pulse width of 1 ms, detection SNR threshold of 7σ