A Search for Pulsars and Transient Signals in M33 Using Arecibo

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1 Extended Abstract

We report on a search for radio pulsars and fast transients from neutron stars in the nearby spiral galaxy M33 using the Arecibo 305-m telescope. Millisecond-scale extragalactic transient radio signals have been detected from neutron stars in the Large Magellanic Cloud and from fast radio bursts (FRBs) at cosmological distances [1]. These would be the first such signals detected from pulsars in a spiral galaxy outside of the Milky Way. A number of radio searches of M33 have been previously conducted at several sky frequencies [2, 3, 4] but were unsuccessful. Our search uses the 327 MHz receiver and PUPPI backend which affords a much larger bandwidth (68.75 MHz) than what was previously available at Arecibo. We have conducted 14 separate tiled observations covering the optical disk of M33 (see Figure 1). Each observation totaled one hour of integration time. The narrow frequency channels (24 kHz) and small sampling time (82 μs) preserved sensitivity to both millisecond-scale single bursts and millisecond pulsars. Using the known characteristics of the Crab pulsar and the analysis done by [2] as a guide, we estimate that every Crab twin that is located in M33 and beaming toward us ought to emit giant radio pulses that are detectable with our system at the 7σ level every 1-4 min. These pulsars should therefore be easily detectable in one-hour integrations. However, a search of our data using both the PRESTO and SIGPROC toolkits revealed no periodic or transient signals of astrophysical origin. We are proposing additional Arecibo observations at both 327 MHz and 1.4 GHz that will target the nucleus of M33 (Figure 1). Higher frequency observations may be better for detecting FRB-type signals since no FRBs have yet been detected at low frequencies (< 800 MHz; see, e.g., [5]). These additional observations will improve our sensitivity limits to the level where pulsars in M33 with luminosities comparable to the most luminous known Galactic pulsars might be detectable as periodic sources.

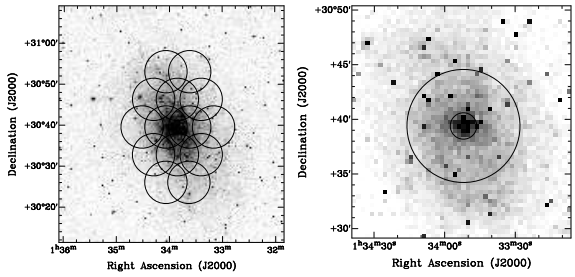

Figure 1. Left: The optical disk of M33 with the 14 Arecibo beam positions (at 327 MHz) overlaid as circles. Right: 327 MHz and 1.4 GHz Arecibo beams centered on the M33 nucleus.

References

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