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Observing repeating radio blasts from cosmological sources with the Northern Cross telescope

Fast radio bursts (FRBs) are powerful ms blasts of celestial origin detected only at radio frequencies. Since their discovery in 2007, about 800 FRB have been found.FRBs come from cosmological distances (within redshift $z \sim 1$) and present kJy flux densities. Due to these properties and brightness temperatures $T_{\rm B} > 10^{36}$ K, most FRB progenitor models invoke coherent emission mechanisms in strongly magnetised neutron stars (magnetars). The vast majority of FRBs are one-off events, but a fraction ($\sim 8.5\%$) are observed to repeat, excluding catastrophic events as their origin. Repeating FRBs are of particular interest, since they can be monitored over time and localised with precision. Long-term monitorings of repeating FRBs are key also to shed light on their activity patterns, the spectral and polarimetric properties of the bursts, and energetic distribution. We are studying a sample of repeating FRBs, including the newly discovered and very active FRB\,20240114A located at redshift z ~ 0.42, using the high-sensitivity Northern Cross transit telescope and the 32-m parabolic dish in Medicina, near Bologna, and the 32-m dish in Noto, Sicily. Given the large data sets, the thousands of FRB candidate signals, and the presence of strong radio frequency interferences (RFIs), we implemented for each antenna a new pipeline based on RFI mitigation tools, a transient detection algorithm, and a machine learning classification of the bursts with 11 neural network models. Furthermore, we are carrying through a monitoring of a number of Galactic magnetars to search for possible FRB-like events, which would confirm their link with FRBs.

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