smaller than a hundredth of the RM_{src} value of FRB 121102 (Fig. 3), which is also about 500 times larger than those previously detected in fast radio bursts[27]. The five other known fast radio bursts with polarimetric measurements present a heterogeneous picture, with a range of polarization fractions and rotation measures[3]. As previously considered[28], the large Faraday rotation of FRB 121102 further suggests that fast radio bursts with no detectable linear polarization may actually have very large $|RM|$, higher than 10^4–10^5 rad m^{-2}, that was undetectable because of the limited frequency resolution (0.4-MHz channels at 1.4 GHz) of the observations.

Monitoring the rotation measure and polarization angle of FRB 121102 with time, along with searches for polarization and Faraday rotation from the persistent source, can help differentiate among competing models. FRB 121102 is unusual not only because of its large rotation measure but also because it is the only known repeating fast radio burst. This may indicate that FRB 121102 is a fundamentally different type of source compared to the rest of the fast radio burst population; future measurements may investigate a possible correlation between fast radio burst repetition and rotation measure. Perhaps the markedly higher activity level of FRB 121102 compared to other known fast radio bursts is predominantly a consequence of its environment; for example, because these magnetized structures can also boost the detectability of the bursts via plasma lensing[29].

Online Content Methods, along with any additional Extended Data display items and Source Data, are available in the online version of the paper; references unique to these sections appear only in the online paper.

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Author Contributions A.S. led the development of the Arecibo observing functionality used here and discovered the first bursts near 4.5 GHz. L.G.S. is Principal Investigator of the Arecibo monitoring campaign. D.M. discovered the rotation measure and analysed the burst properties in detail. K.G. searched all Arecibo datasets near 4.5 GHz for bursts. J.W.T.H. led the discussion on the interpretation of the results and writing of the manuscript. A.M.A. guided the development of the rotation measure fitting code. G.H.H. and C.S. performed the rotation measure synthesis and deconvolution analysis. G.C.B., S.C., J.M.C., V.G., V.M.K., C.J.L., M.A.M. and D.M. also contributed to the writing of the manuscript and analysis. V.G. observed, searched and detected bursts from the GBT at 6.5 GHz as a part of the BL monitoring campaign of known fast radio bursts. A.P.V.S. is the Principal Investigator of the BL project. C.B. helped with the polarization calibration of the test pulsar. G.H. wrote a code to splice raw voltages across computer nodes. All other co-authors contributed to the interpretation of the analysis results and to the final version of the manuscript.

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