Radio afterglow from fast radio bursts

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Binary neutron star (BNS) mergers are one of the proposed origins for both repeating and non-repeating fast radio bursts (FRBs), which associates FRBs with gravitational waves and short gamma-ray bursts (GRBs). In this study, we explore detectability of radio counterparts to an FRB by calculating the radio afterglow flux, in the scenario that FRBs are produced by BNS mergers.

We considered the two components of outflow: a relativistic jet and a mildly relativistic and isotropic ejecta. Detection probabilities were calculated as a function of sensitivity, source redshift and an observation time, assuming random viewing angles from the jet axis (i.e. assuming that FRBs are not strongly beamed) and adopting the model parameter distributions inferred from short GRB observations.

As a result, we found that the detection probability from FRBs at $z < 1$ is between 1–10% for the typical sensitivity ($10-100\ \mu$Jy) of current radio telescope, which enhances to $>$10% if a 1μJy sensitivity can be achieved by future facilities (e.g. SKA). The expected flux peaks typically at $\sim$10 days for a jet afterglow and $\sim$1 year for an isotropic afterglow. We also found a tendency of later peak time towards closer source and higher sensitivity, which can be attributed to the contribution from low luminosity events whose afterglows peak at a later time (Fig.1).

In particular for the repeating FRB 180916.J0158+65, we found a 60% chance of detection for the isotropic component whose flux peaks at about 10 years after the merger and remains detectable for a few decades, as a natural consequence of its close distance ($z = 0.03$). The time scale of 10 yrs is also comparable to the lifetime of repeating FRBs formed by a BNS merger. Though the detection probability is not close to 100% because of the distribution of model parameters, a long-term radio monitoring of this object is thus interesting.

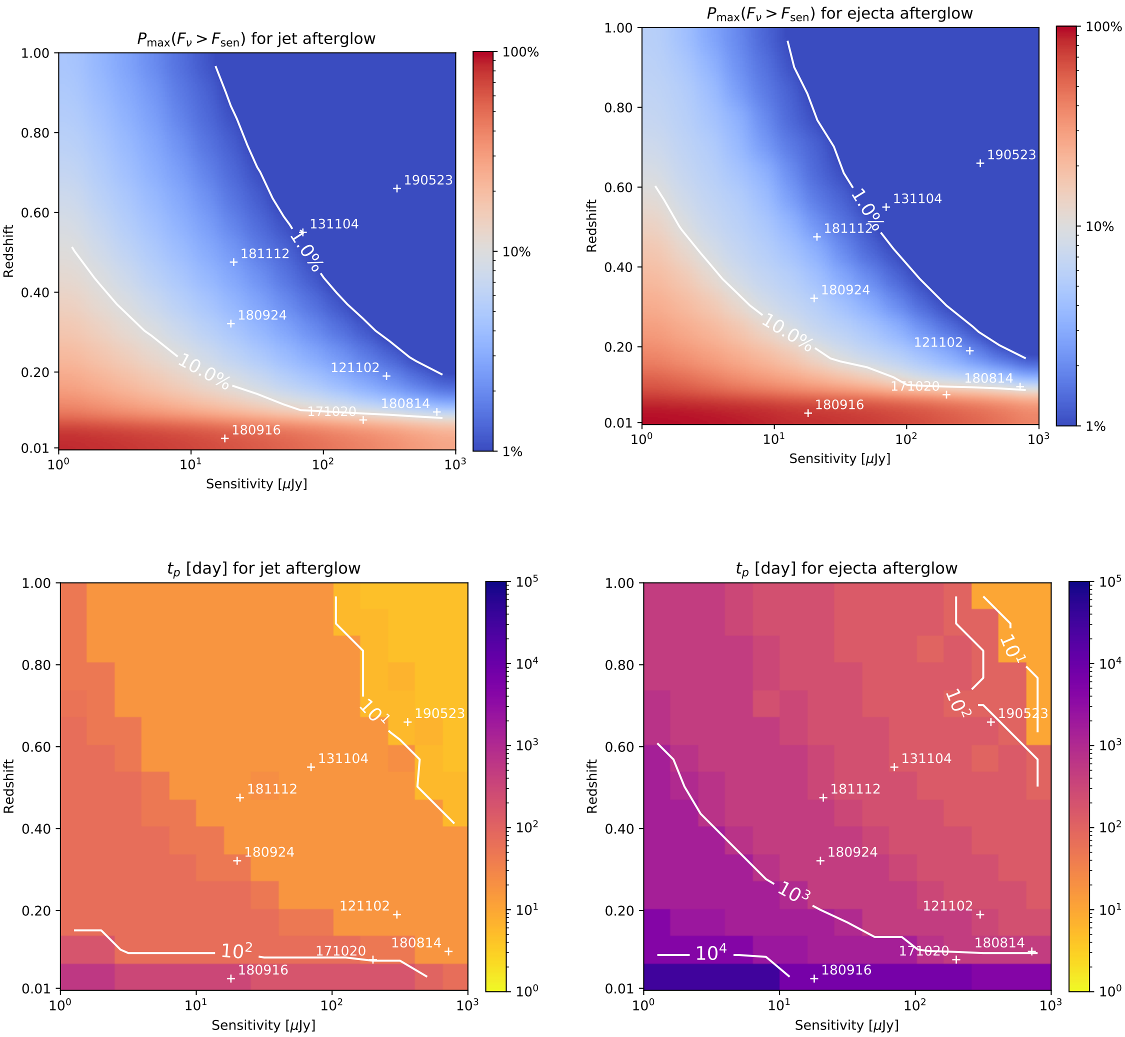

図 1: The maximum detection probability (upper) and the corresponding best observation time (lower) as a function of redshift and detector sensitivity. FRBs with reported upper limits on a persistent radio emission are shown by plus marks.