W14a Luminosity functions of repeating and non-repeating fast radio bursts

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Fast radio bursts (FRBs) are mysterious radio bursts with a time-scale of approximately milliseconds. Two populations of FRB, namely repeating and non-repeating FRBs, are observationally identified. However, the differences between these two and their origins are still cloaked in mystery. Here we show the time-integrated luminosity-duration (L_ν-$w_{\rm int,rest}$) relations and luminosity functions (LFs) of repeating and non-repeating FRBs in the FRB Catalogue project. These two populations are obviously separated in the L_ν-$w_{\rm int,rest}$ plane with distinct LFs, i.e. repeating FRBs have relatively fainter L_ν and longer $w_{\rm int,rest}$ with a much lower LF. This result suggests essentially different physical origins of the two. The faint ends of the LFs of repeating and non-repeating FRBs are higher than volumetric occurrence rates of neutron star (NS) mergers and accretion-induced collapse (AIC) of white dwarfs (WDs), and are consistent with those of soft gamma-ray repeaters (SGRs), Type Ia supernovae (SNe Ia), magnetars, and WD mergers. This indicates two possibilities: either (i) faint non-repeating FRBs originate in NS mergers or AIC and are actually repeating during the lifetime of the progenitor, or (ii) faint non-repeating FRBs originate in any of SGRs, SNe Ia, magnetars, and WD mergers. The bright ends of LFs of repeating and non-repeating FRBs are lower than any candidates of progenitors, suggesting that bright FRBs are produced from a very small fraction of the progenitors regardless of the repetition. Otherwise, they might originate in unknown progenitors.