W14a Nonthermal afterglow of GW170817: a more natural electron energy distribution leads to a new solution with radio flux in the low frequency synchrotron tail

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Background A long lasting nonthermal afterglow has been observed to follow the binary neutron star merger event GW170817. The observed properties of the spectrum are consistent with synchrotron radiation from a population of shock-accelerated electrons, and is commonly explained in the context of either an off-axis structured jet, or a stratified, quasi-spherical "cocoon" produced by the jet. Independent of these scenarios, the previous modelings frequently assumed that the entire fraction f of electrons in the shock are accelerated into a nonthermal population (i.e. $f = 1$). This is clearly an oversimplification, and in reality, it is conceivable that a substantial fraction of electrons remains thermal, as normally observed in supernova remnants. With this assumption, the minimum electron Lorentz factor γ_m is related to the total electron energy in the shock, but γ_m should be independently determined by the degree of equipartition between protons and electrons.

Methods & Results We propose a more natural model of electron energy distribution in the sense that both γ_m and f are allowed to vary freely. In the context of stratified, quasi-spherical ejecta model, we find a new solution to the nonthermal afterglow of GW170817 with early radio flux in the regime of low frequency synchrotron tail ($\nu < \nu_m$, where ν_m is the synchrotron frequency corresponding to γ_m), in contrast to previous fits that found the entire spectrum above ν_m. We present a Markov-Chain Monte-Carlo analysis to discuss the change of best-fit parameters of GW170817 and implications for the outflow from binary neutron star mergers.