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

The nonthermal afterglow of the binary neutron star merger GW170817 has been modeled by synchrotron radiation of nonthermal electrons accelerated in the shock generated by ejecta or outflow from the merger. The previous afterglow modelings assumed that all the electrons in the shock are accelerated as a nonthermal population, and the minimum electron Lorentz factor gamma_m is the only parameter to control the total energy given to nonthermal electrons. However, in reality only a small fraction would be accelerated and the majority of electrons should remain as a thermal population, as normally observed in supernova remnant. Here we report the afterglow modeling with one more degree of freedom, i.e., the fraction of accelerated electrons, while gamma_m is another parameter corresponding to the degree of proton-electron equipartition. In the framework of stratified, quasi-spherical ejecta model, we performed a Markov-Chain Monte-Carlo analysis to find the best-fit parameters and allowed regions for the data of GW170817. We find a new solution in which the radio flux in the early phase is in the regime of low frequency synchrotron tail (nu < nu_m), in contrast to previous fits that found the entire spectrum above nu_m. Implications of this new result for physics of the outflow and ambient medium are discussed.

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