On the lifetime of the remnant of GW170817, through the properties of the ejected mass

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The main hard pulse of prompt gamma-ray emission in GRB 170817A had a duration of $\sim 0.5\,$s and its onset was delayed with respect to the gravitational-wave chirp signal by $t_{\rm del} \approx 1.74\,$s. Detailed follow-up of the subsequent broadband kilonova emission revealed a two-component ejecta – a lanthanide-poor ejecta with mass $M_{\rm ej,blue} \approx 0.025\,M_\odot$ that powered the early but rapidly fading blue emission and a lanthanide-rich ejecta with mass $M_{\rm ej,red} \approx 0.04\,M_\odot$ that powered the longer lasting redder emission. Both the prompt gamma-ray onset delay and the existence of the blue ejecta with modest electron fraction, $0.2 \lesssim Y_e \lesssim 0.3$, can be explained if the collapse to a black hole was delayed by the formation of a hypermassive neutron star (HMNS). Here, we determine the survival time of the merger remnant by combining two different constraints, namely, the time needed to produce the requisite blue-ejecta mass and that necessary for the relativistic jet to bore its way out of the expanding ejecta. In this way, we determine that the remnant of GW170817 must have collapsed to a black hole after $t_{\rm coll} = 0.98^{+0.31}_{-0.26}\,$s. We also discuss how future detections and the delays between the gravitational and electromagnetic emissions can be used to constrain the properties of the merged object.