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3D magnetised jet break-out from neutron-star binary merger ejecta: afterglow emission from the jet and the ejecta

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We perform three-dimensional (3D) general-relativistic magnetohydrodynamic simulations to model the jet break-out from the ejecta expected to be produced in a binary neutron-star merger. The structure of the relativistic outflow from the 3D simulation confirms our previous results from 2D simulations, namely, that a relativistic magnetized outflow breaking out from the merger ejecta exhibits a hollow core of $\theta_{core} \approx 4^\circ$, an opening angle of $\theta_{jet} > 10^\circ$, and is accompanied by a wind of ejected matter that will contribute to the kilonova emission. We also compute the non-thermal afterglow emission of the relativistic outflow and fit it to the panchromatic afterglow from GRB170817A, together with the superluminal motion reported from VLBI observations. In this way, we deduce an observer angle of $\theta_{obs} = 35.7^{\circ}{}^{+1.8}_{-2.2}$. We further compute the afterglow emission from the ejected matter and constrain the parameter space for a scenario in which the matter responsible for the thermal kilonova emission will also lead to a non-thermal emission yet to be observed.

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