A relativistic type Ibc supernova without a detected Gamma-ray burst

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Long duration Gamma-ray bursts (GRBs) mark the explosive death of some massive stars and are a rare sub-class of type Ibc supernovae. They are distinguished by the production of an energetic and collimated relativistic outflow powered by a central engine (an accreting black hole or neutron star). Observationally, this outflow is manifested in the pulse of Gamma-rays and a long-lived radio afterglow. Until now, central-engine-driven supernovae have been discovered exclusively through their Gamma-ray emission, yet it is expected that a larger population goes undetected because of limited satellite sensitivity or beaming of the collimated emission away from our line of sight. In this framework, the recovery of undetected GRBs may be possible through radio searches for type Ibc supernovae with relativistic outflows. Here we report the discovery of luminous radio emission from the seemingly ordinary type Ibc SN 2009bb, which requires a substantial relativistic outflow powered by a central engine. A comparison with our radio survey of type Ibc supernovae reveals that the fraction harbouring central engines is low, about one per cent, measured independently from, but consistent with, the inferred rate of nearby GRBs. Independently, a second mildly relativistic supernova has been reported.

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