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Einstein Probe Discovery of a New Type X-ray Transient and its Mysterious Link to Supernovae

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Massive stars end their lives as core-collapse supernovae, among which some extremes are broad-lined type Ic supernovae from Wolf–Rayet stars associated with long-duration gamma-ray bursts (LGRBs) with powerful relativistic jets. Their less-extreme brethren make unsuccessful jets that are choked inside the stars, appearing as X-ray flashes or low-luminosity GRBs. However, there exists a population of extragalactic fast X-ray transients with timescales ranging from seconds to thousands of seconds, whose origins remain obscure. Here we report the discovery of the bright X-ray transient EP240414a detected by the Einstein Probe, which is associated with the type Ic supernova SN 2024gsa at a redshift of 0.401. The X-ray emission evolution is characterized by a very soft energy spectrum peaking at <1.3 keV, which makes it different from known LGRBs, X-ray flashes or low-luminosity GRBs. Follow-up observations at optical and radio bands revealed the existence of a weak relativistic jet that interacts with an extended shell surrounding the progenitor star. Located on the outskirts of a massive galaxy, this event reveals a population of explosions of Wolf–Rayet stars characterized by a less powerful engine that drives a successful but weak jet, possibly owing to a progenitor star with a smaller core angular momentum than in traditional LGRB progenitors.

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