Contribution ID: **209** Type: **Talk**

Short gamma-ray bursts from binary neutron star mergers: the time-reversal scenario

Sunday 6 December 2015 14:00 (21 minutes)

Leading models relate short gamma-ray bursts (SGRBs) to a relativistic jet launched by the black hole (BH)-accretion torus system that can be formed in a binary neutron star (BNS) or a NS-BH binary merger. However, recent observations by Swift have revealed a large fraction of SGRB events accompanied by X-ray afterglows with durations $\sim 10^2 - 10^5$ s, suggesting continuous energy injection from a long-lived central engine that is incompatible with the short (< 1 s) accretion timescale of a BH-torus system. The formation of a supramassive NS (SMNS), resisting the collapse on much longer spin-down timescales, can explain these X-ray afterglows as powered by the magnetic spin-down of the star, but leaves serious doubts on whether a relativistic jet can be launched at merger. Here we present a novel "time-reversal" scenario that can solve this dichotomy. In this scenario, the SGRB is produced *after* the eventual collapse of the SMNS to a BH, but observed *before* part of the long-lasting X-ray signal powered by magnetic spin-down.

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Session Classification: 13 - Gamma-ray bursts