# A Unified Binary Neutron Star Merger Magnetar Model for the Chandra X-Ray Transients CDF-S XT1 and XT2

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**Abstract**

Two bright X-ray transients were reported from the *Chandra* Deep Field South (CDF-S) archival data, namely CDF-S XT1 and XT2. Whereas the nature of the former is not identified, the latter was suggested as an excellent candidate for a rapidly spinning magnetar born from a binary neutron star (BNS) merger. Here we propose a unified model to interpret both transients within the framework of the BNS merger magnetar model. According to our picture, CDF-S XT2 is observed from the "free zone" where the magnetar spindown powered X-ray emission escapes freely, whereas CDF-S XT1 originates from the "trapped zone" where the X-ray emission is initially blocked by the dynamical ejecta and becomes transparent after the ejecta is pushed to a distance where Thomson optical depth drops below unity. We fit the magnetar model to the light curves of both transients and derived consistent parameters for the two events, with magnetic field, initial spin period, and X-ray emission efficiency being ($B_p = 10^{16}$ G, $P_i = 1.2$ ms, $\eta = 0.001$) and ($B_p = 10^{15.8}$ G, $P_i = 4.4$ ms, $\eta = 0.001$) for XT1 and XT2, respectively. The "isotropic equivalent" ejecta mass of XT1 is $M_{ej} \sim 10^{-3}\ M_\odot$, while it is not constrained for XT2. Our results suggest that more extreme magnetar parameters are required to have XT1 detected from the trapped zone. The model parameters for both events are generally consistent with those derived from short gamma-ray burst (SGRB) X-ray plateau observations. The host-galaxy properties of both transients are also consistent with those of SGRBs. The event rate densities of both XT1 and XT2 are consistent with that of BNS mergers.