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Understanding various optical transient phenomena with the magentar engine model

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A rapidly rotating and highly magnetized neutron star (i.e., magnetar) may be formed in extreme stellar explosions or binary compact star mergers. In observation, the implement of various high-cadence transient surveys has discovered a considerable number of unusual optical transients in the past decades, which are generally analogy to ordinary supernovae but usually distinct in their luminosity or variability timescales. Two representative phenomena are superluminous supernovae (SLSNe) and fast blue optical transients (FBOTs), which could provide a realistic path for studying the magnetar-driven explosions and the corresponding radiation processes. Specifically, the existence of the mangetar engine can lead to the enhancement of the thermal radiation of the supernova ejecta, the shock breakout driven by the magnetar wind, and the leakage of non-thermal radiation from the magnetar wind nebula. Furthermore, the statistical properties of SLSNe and FBOTs and as well as the gamma-ray burst phenomena even indicate a possible united origin for them, which are very likely to be related to a stellar explosion occurring in an interacting close binary system.

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