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Spectral signatures of super-luminous supernovae powered by magnetars and black holes

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Wide-field optical surveys have discovered a population of super-luminous supernova explosions in the past several years, including some where it is difficult to explain the light curve shape using energy deposition from radioactive decay. Many of these events can be explained by a model in which a rapidly rotating magnetar forms in the explosion and deposits its spindown energy into the supernova ejecta. I will show that the injected energy could also be provided by fallback accretion of material which remains bound to the proto-neutron star. At late times, the central engine in these models should shine through the supernova ejecta, significantly affecting the observed properties. I will discuss calculations of the ejecta opacity as a function of waveband and time for the magnetar model, and the resulting predictions for multi-wavelength observations of super-luminous supernovae.

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