First broad-band X-ray observations of a young extragalactic Supernova: Chandra and NuSTAR monitoring of SN2014C

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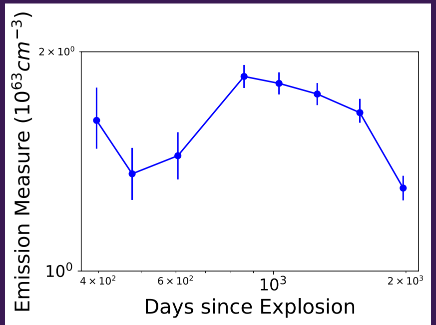
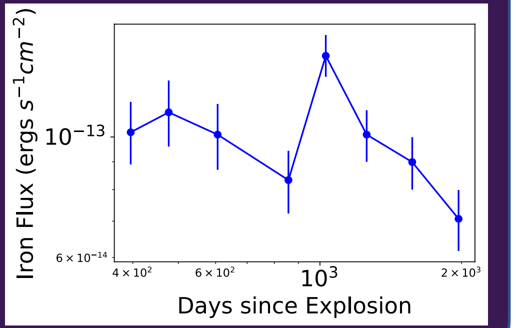
Introduction

Undergoing a remarkable metamorphosis that has rarely been observed, SN2014C transitioned from initially being a Type Ib to Type IIn supernova. This likely indicates that when the progenitor star exploded, its immediate surroundings were mostly clear of debris. However, as time progressed the ejecta expanded and slammed into a hydrogen rich circum-stellar medium (CSM) surrounding the progenitor and thus slowing down. Utilizing coordinated observations of the Chandra X-Ray Observatory and NuSTAR, we observed SN2014C between 0.5 and 79 keV to track the temporal evolution of explosion parameters in the first ~2000 days after explosion. We find that the broad-band X-ray emission is well modeled by a thermal bremsstrahlung spectrum with time evolving temperature and absorption, which will allow us to constrain the turbulent mass-loss history of the stellar progenitor of SN2014C before exploding.

Spectral Features

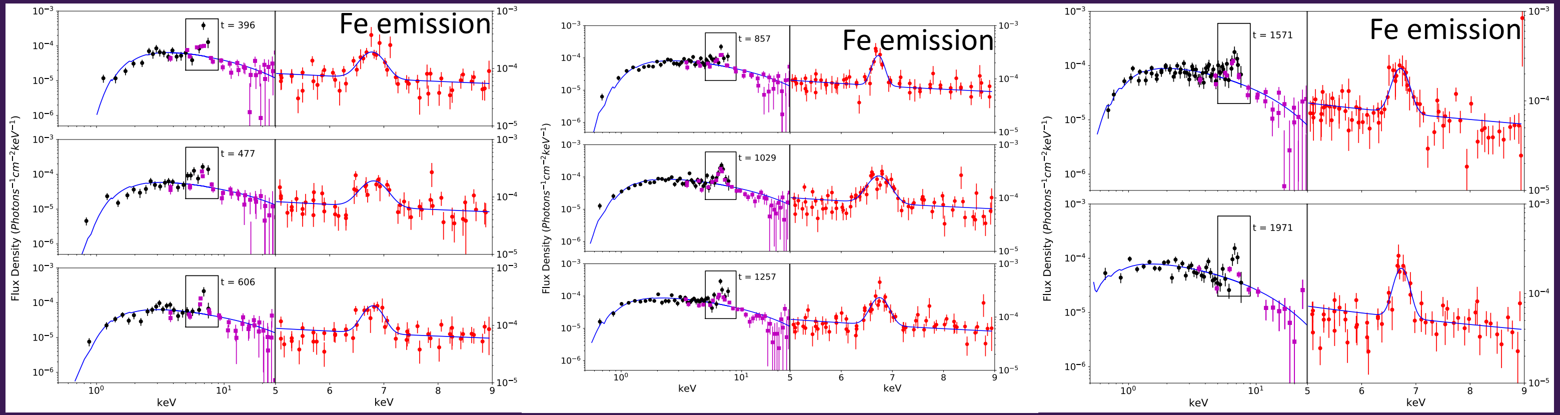


Emission measure as determined by joint modeling of CXO+NuSTAR data over time



Flux generated from H-like and He-like Fe line emission over time

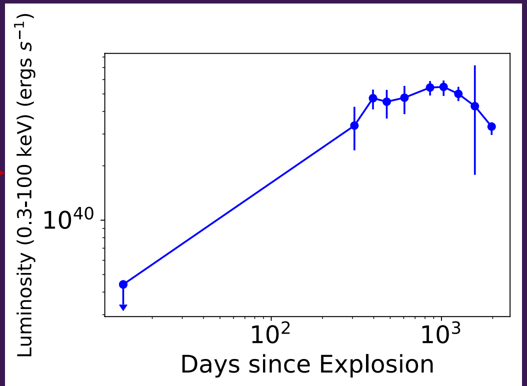
Bremsstrahlung and ionized Fe line emission: Temporal Evolution of the spectrum



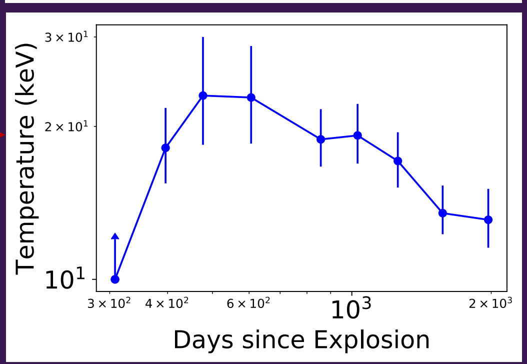
Bremsstrahlung radiation spectra on the left with insets of the Fe line emission on the right. Time flows downward and to the right in units of days.

X-ray Emission Properties

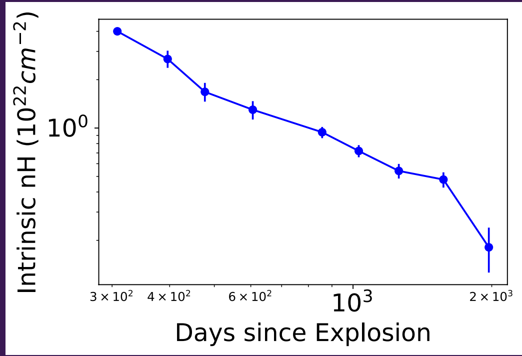
The mostly constant then downturn in x-ray luminosity likely represents the time the shockwave was within then began to break free of the CSM



Forward shock temperature evolution with time, which implies shock velocities between ~3.3-4.4 x 10^3 km/s (Chevalier 1996)



The decreasing linear nature of the intrinsic nH on a logarithmic plot suggests a wind-like density of material around the progenitor, indicating the CSM likely originated as a mass-loss event prior to stellar death (Chugai and Chevalier 2006)



Note: d = 14.7 Mpc

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References: Chevalier 1996, Chugai and Chevalier 2006, Margutti et al. 2017

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