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Physical Parameters of Type II Supernovae

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The understanding of core-collapse supernovae is crucial for learning more about the evolution of massive stars an their deaths. We extract physical parameters from CATS, C&T and other surveys' multicolor light curves (Galbany et al. 2015) and spectra (Gutiérrez et al, in prep.) of Type II supernovae using the global fitting technique of Pejcha & Prieto (2015a,b). We also obtain an indirect estimation of parameters like explosion energy and ejecta mass. We study the distribution of ^{56}Ni masses, ejecta masses, and explosion energies of a larger sample of well-observed Type II supernovae, including our sample.

Introduction

The necessity of a large sample of SNe to get statistical significance is crucial for our results. In this work we used Type II SNe from the different surveys. The code uses measurements from the light curve and velocities obtained from Doppler shift of the Fe II line at 5169 Å, to fit a model (Pejcha & Prieto 2015a,b).

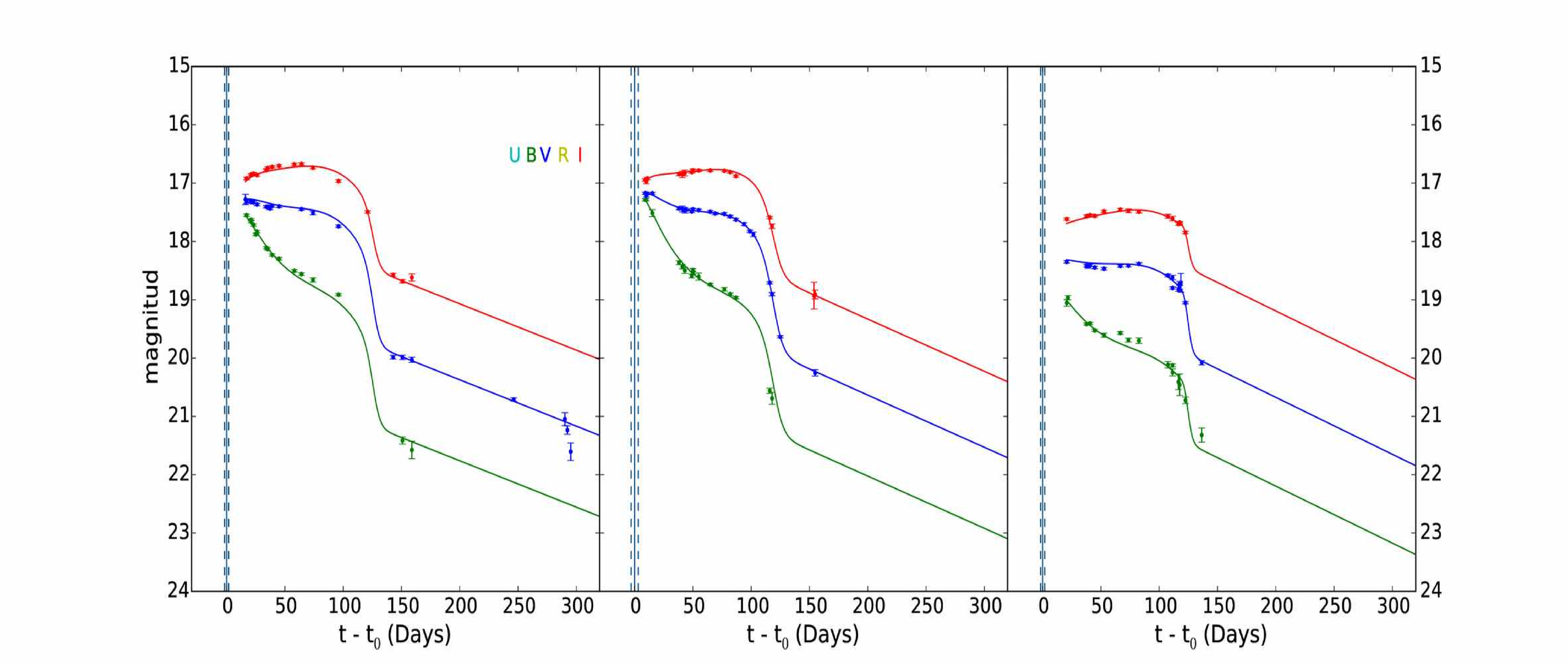


Fig.1: Light curves with fits for U, B, V, R and I bands of 3 SNe from our sample, from left to right:: SN2002gw, SN2003bn and SN2003E. The time scale starts from the explosion epoch, t_0, derived from the fit (vertical blue line with its uncertainties in dashed lines)

From our initial sample of 51 SNe, only 11 with enough measurements were kept and 5 others with public available data were added. A set of parameters was derived for this sample. The fits done for our set of SNe show good agreement with the measurements.

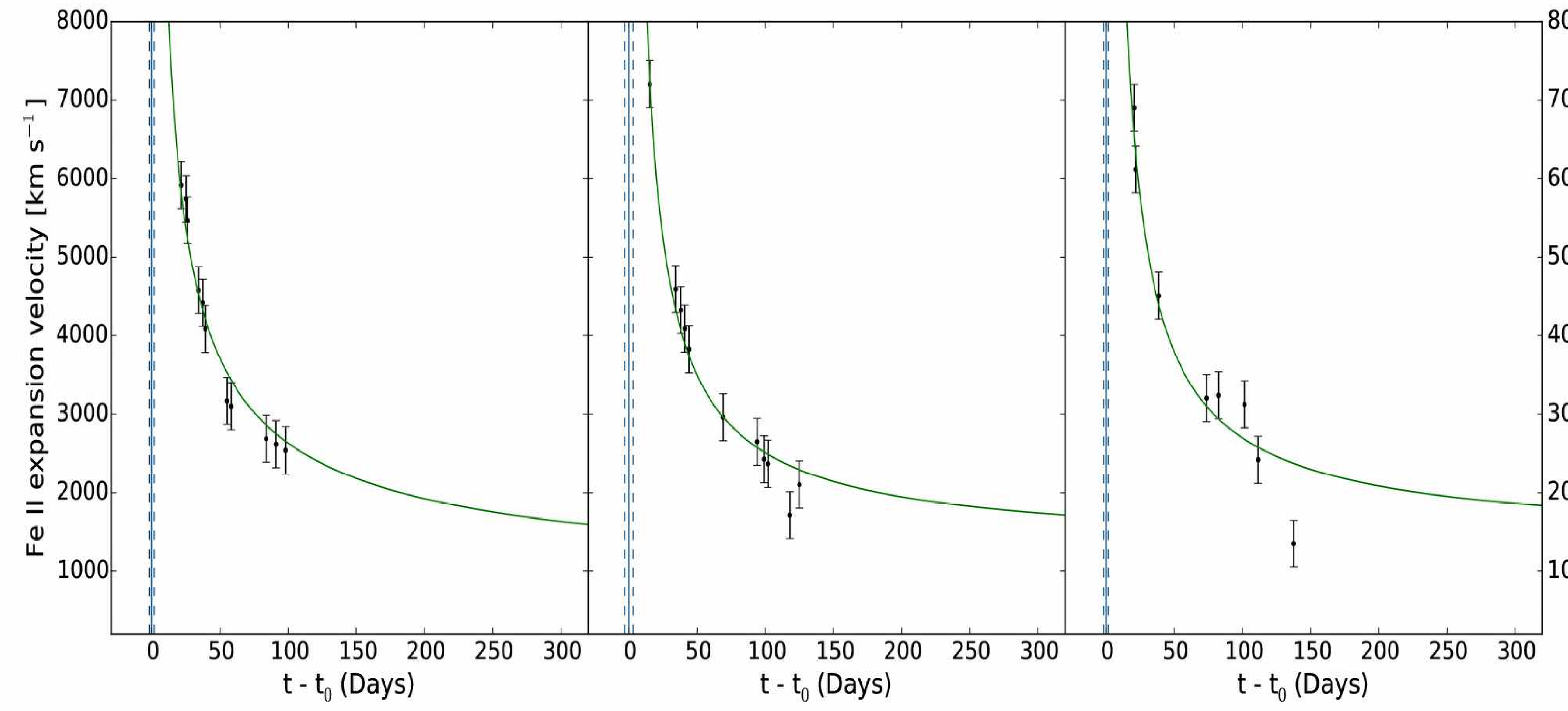
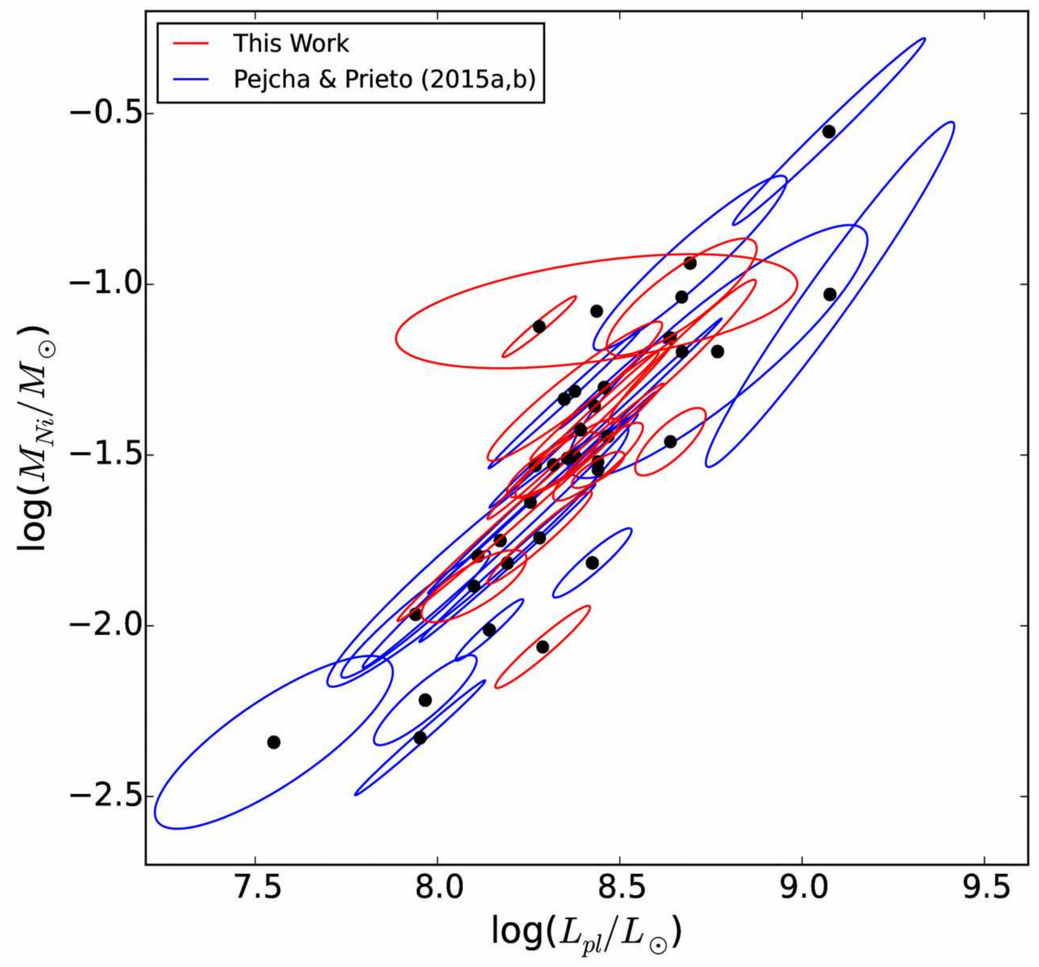


Fig.2: Evolution of the expansion velocity measured from the Fe II line at 5169 Å. We assigned an uncertainty of 300 km/s to every measurement. The rest of the description is the same as in Fig.1.

Results & Analysis

We have found that our results are consistent with previous ones, where we recover the correlation between plateau luminosity and nickel mass (Fig. 3) and between nickel mass and explosion energy (not shown). For this we used a joint sample between our sample and the one from Pejcha & Prieto (2015a,b).

Fig.3: Bolometric luminosity at 50 days after the explosion vs nickel mass ejected for our sample (red) and the sample from Pejcha & Prieto 2015a,b (blue) . The 1 sigma confidence ellipsoids are also shown.



We are interested in comparing the observed nickel mass distribution with theoretical models in order to understand the final stages of evolution of massive stars. We see that some models follow similar distributions than our sample, depending on the progenitor mass limit (see Fig.4 & Fig.5).

Smart 2015 proposes that the bulk of stars above M ≥ 18$M_\odot$ collapse to form black holes with no visible supernovae, hence, making some of the models less reliables.

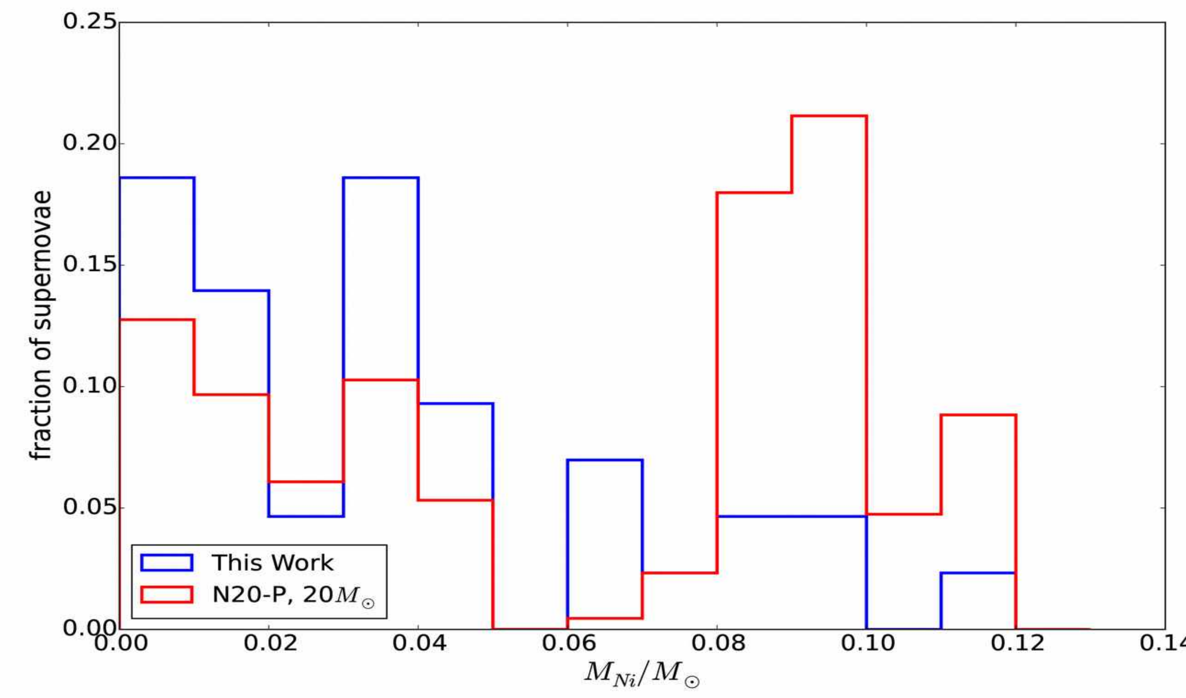
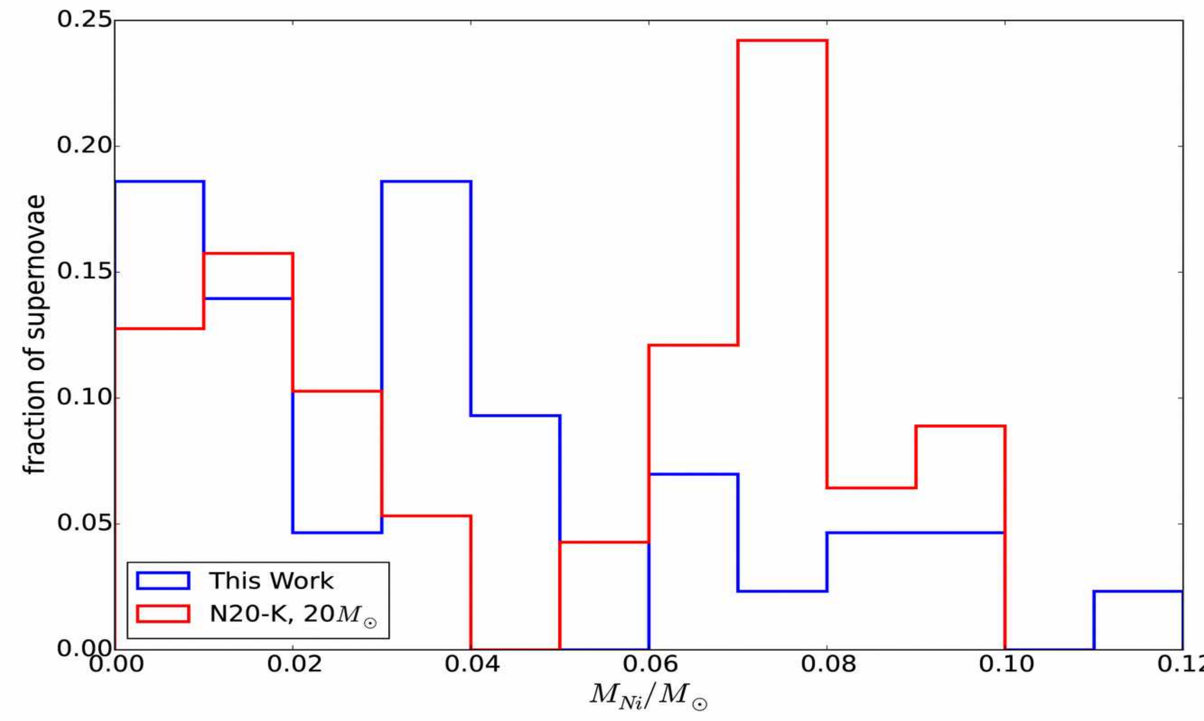


Fig.4: Comparison of nickel mass distribution between the joint sample and the model N20-P from Tuguldur Sukhbold et al. 2015, using a Salpeter IMF with a lower progenitor mass limit of 9$M_\odot$ and upper limit of 20$M_\odot$.

Fig.5: Same as in Fig.4 for the model N20-K from Tuguldur Sukhbold et al. 2015 with the same progenitor mass limits.



Even though we have comparable data, we still need to do some further analysis .

Goal

One of our main future goals is to get a better understanding of how the ejected nickel mass is related to the final stages of evolution of massive stars. In particular, we would like to shed more light into the conclusion by Pejcha & Thompson 2015 and Tuguldur Sukhbold et al. 2015 that there is no single mass below which all stars explode turning into a neutron star and above which black holes form, but rather there is a more complex behavior.

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