Nickel Mass Distribution of normal Type II Supernovae

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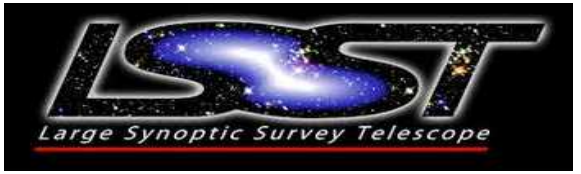
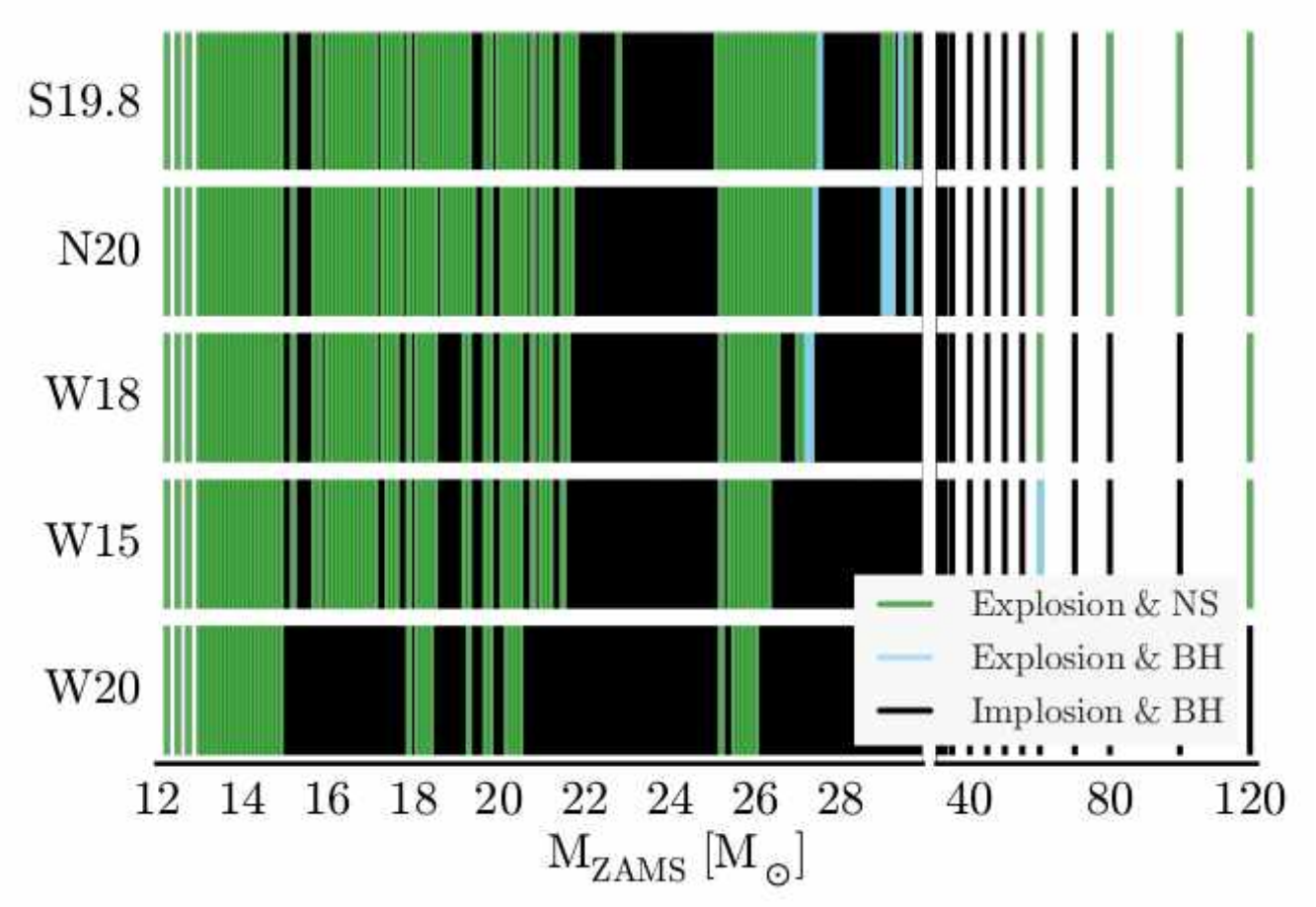


Alejandro Clocchiatti
PUC

Ondrej Pejcha
Princeton University

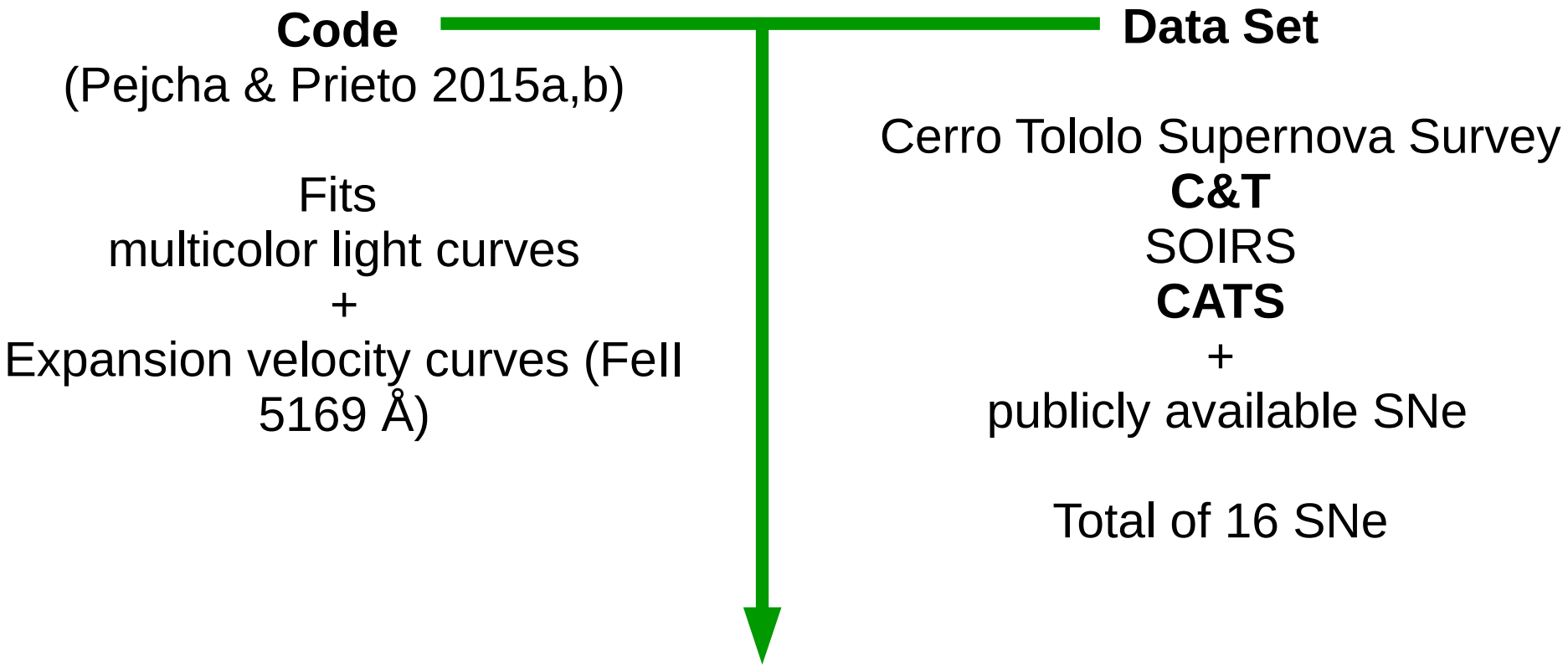
José Luis Prieto
UDP

Motivation



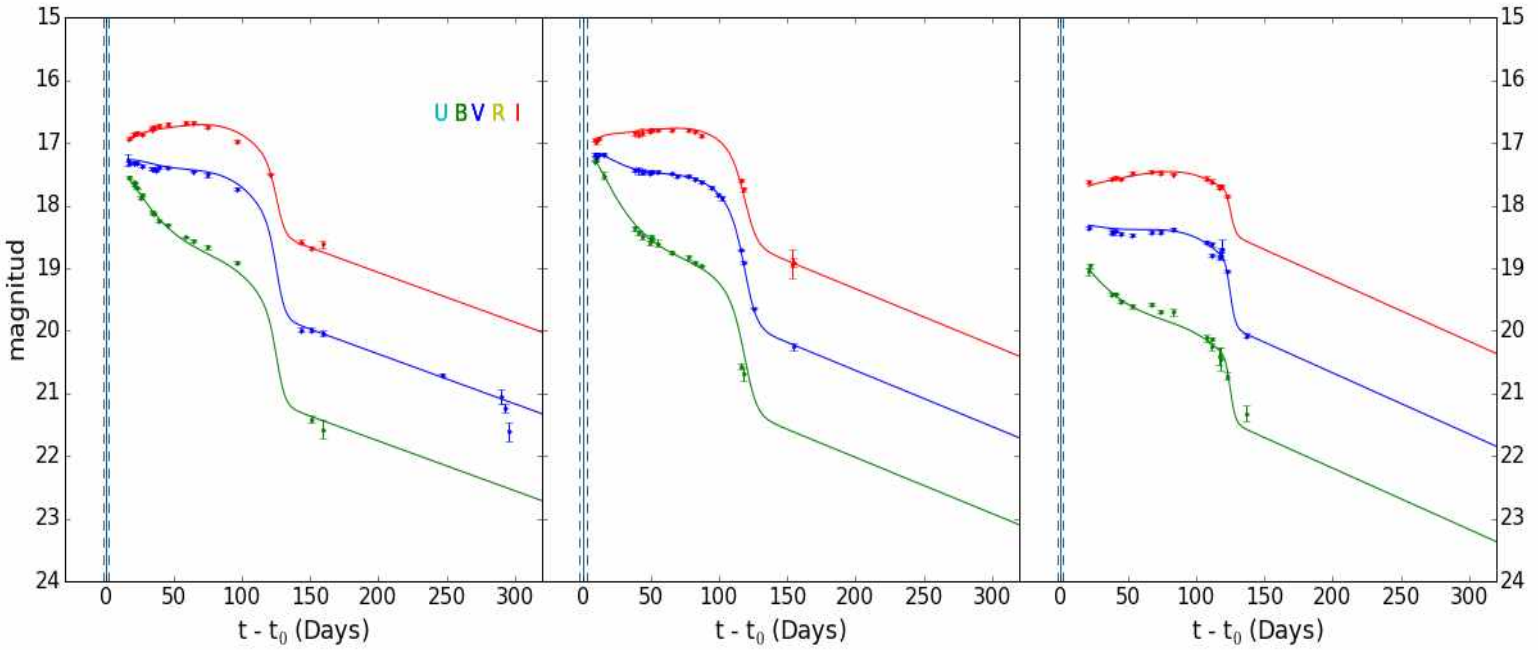
Sukhbold et al. 2016

SN Model + Data



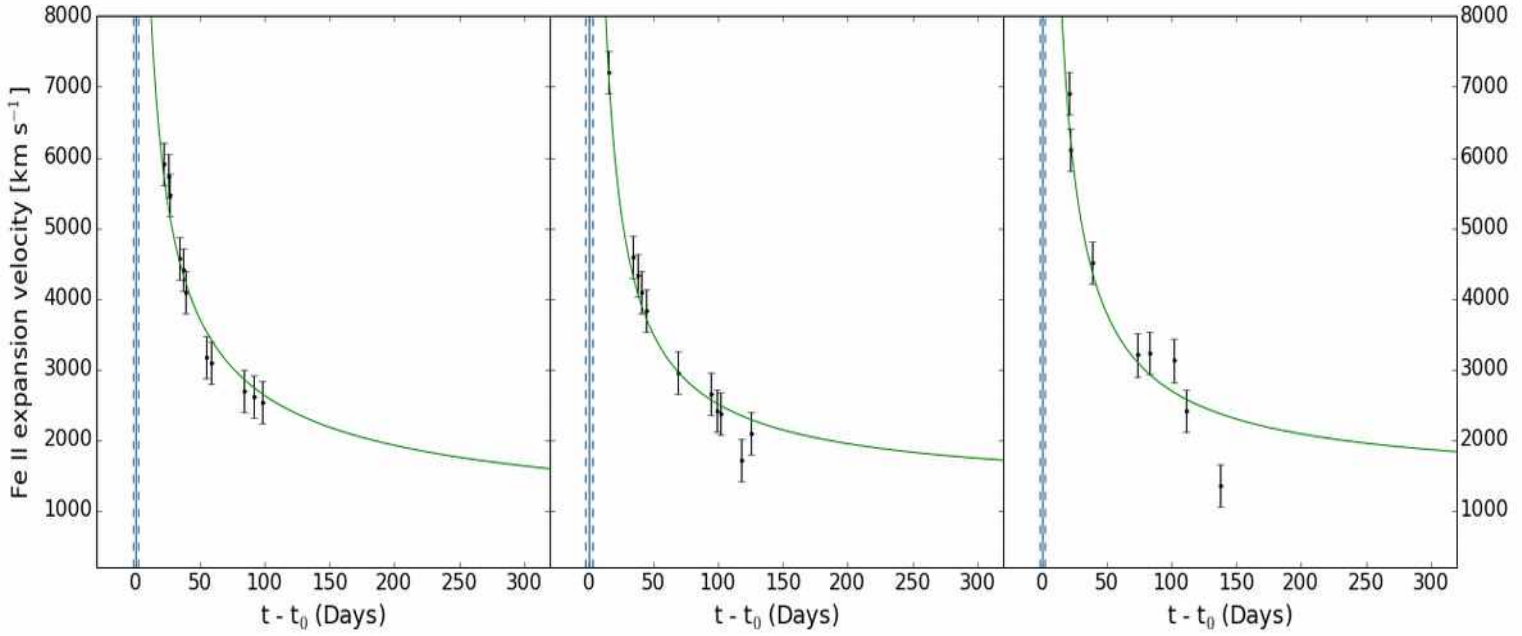
Results

SN2002gw SN2003bn SN2003hl

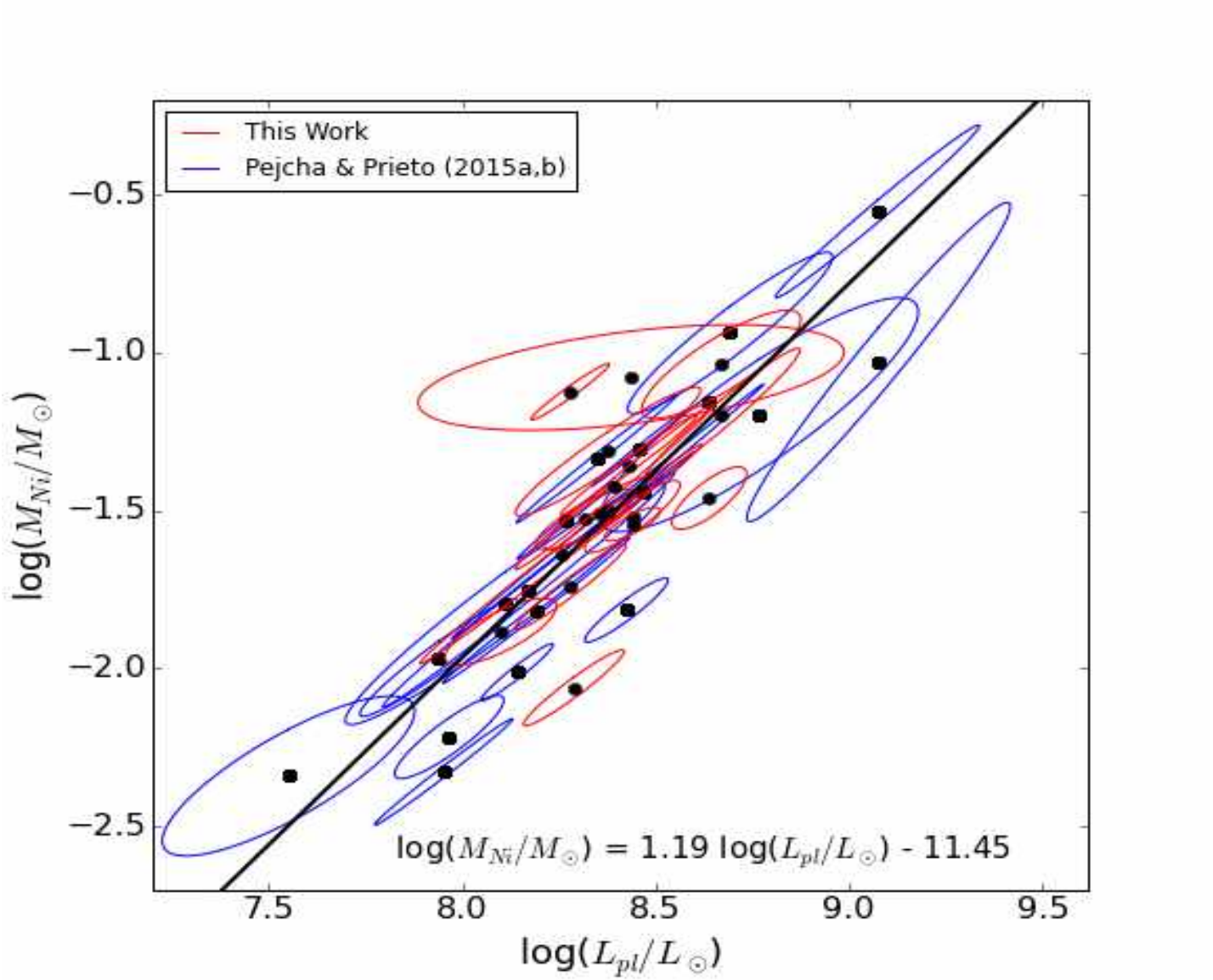


Results

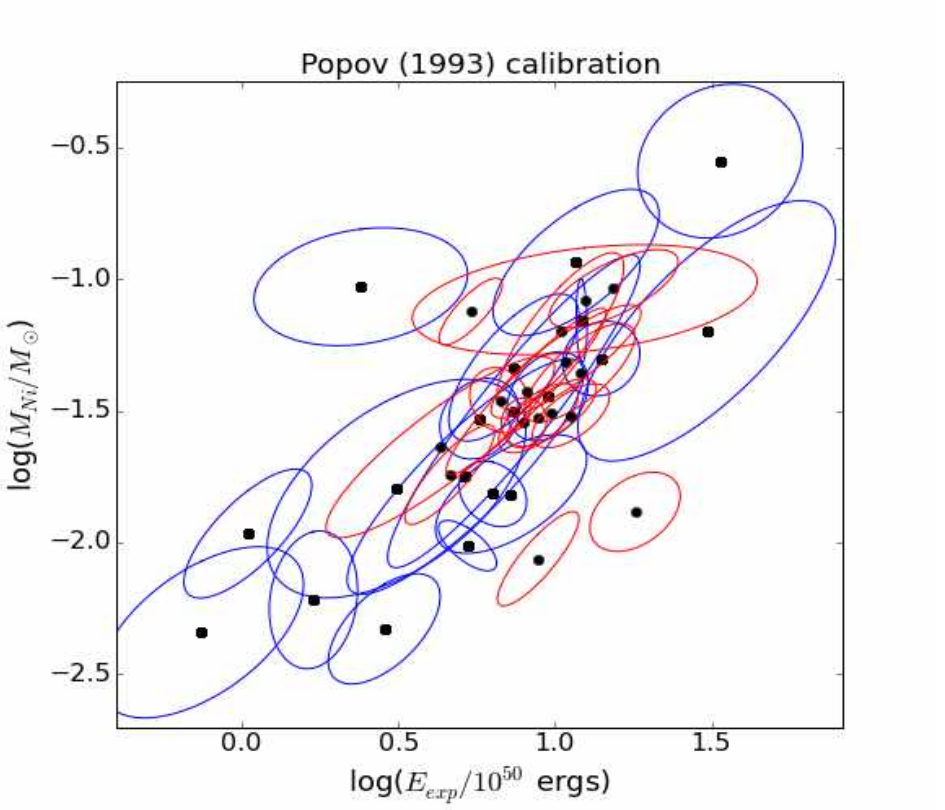
SN2002gw SN2003bn SN2003hl

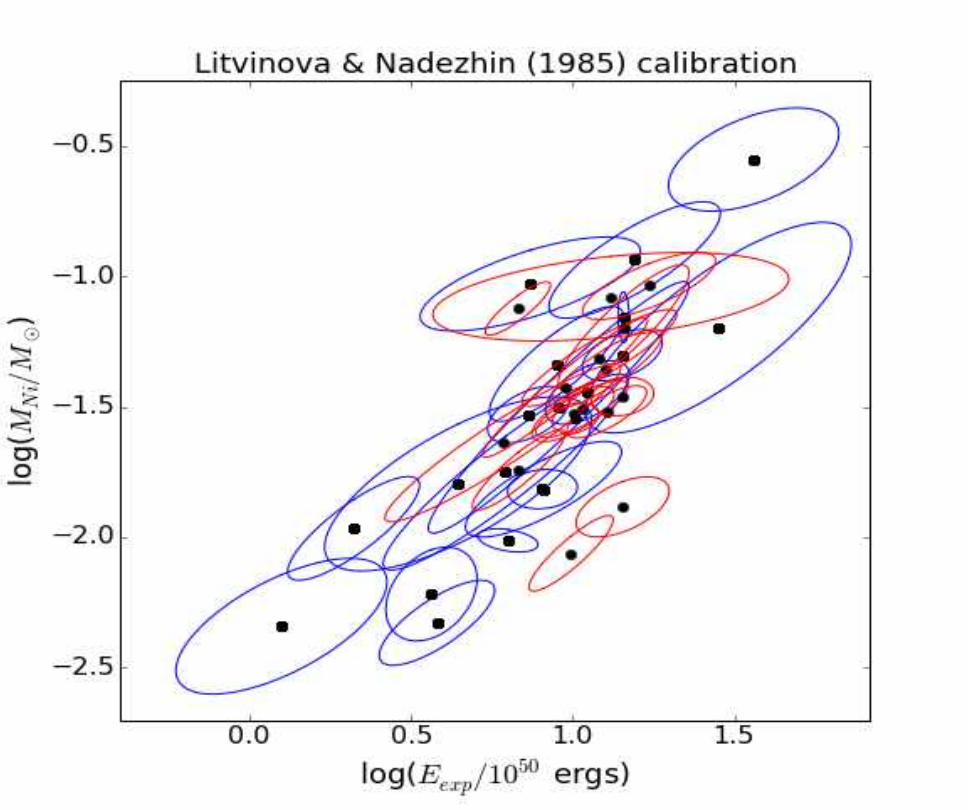


Derived Parameters



Derived Parameters





Theoretical Nickel Mass Distribution

Sukhbold et al. (2016)
1D hydrodynamical models:

Prometeus Hot Bubble (P)

Kepler (K)

$M_{prog} \rightarrow M_{Ni}$

$IMF*M_{prog} \rightarrow M_{Ni}$ Distribution

IMF lower limit: 9 $M_{\odot}$

IMF upper limit: 15 – 30 $M_{\odot}$

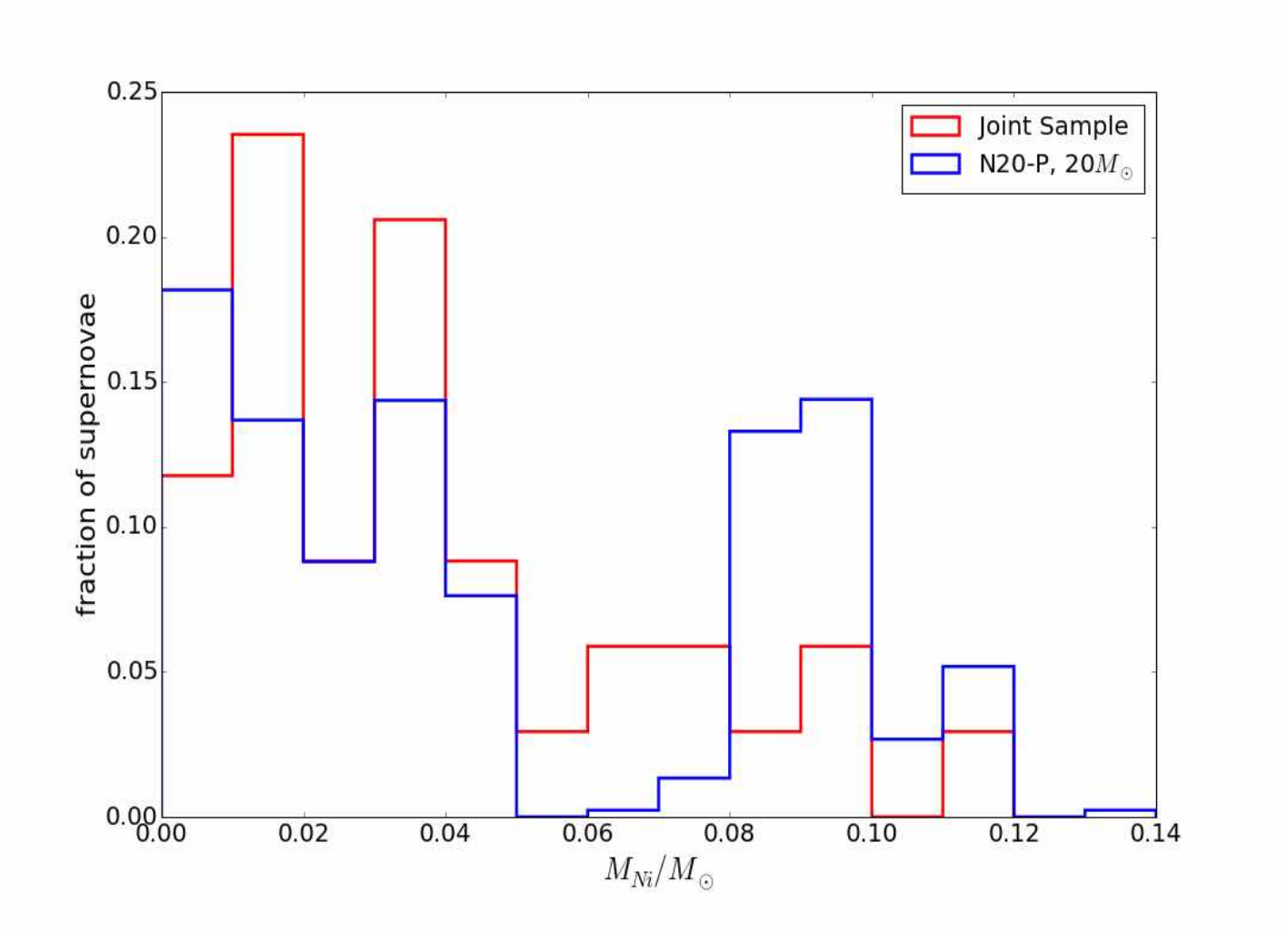
Neutrino mechanism

TABLE 8. EXPLOSION RESULTS FOR THE N20 AND W18 ENGINES

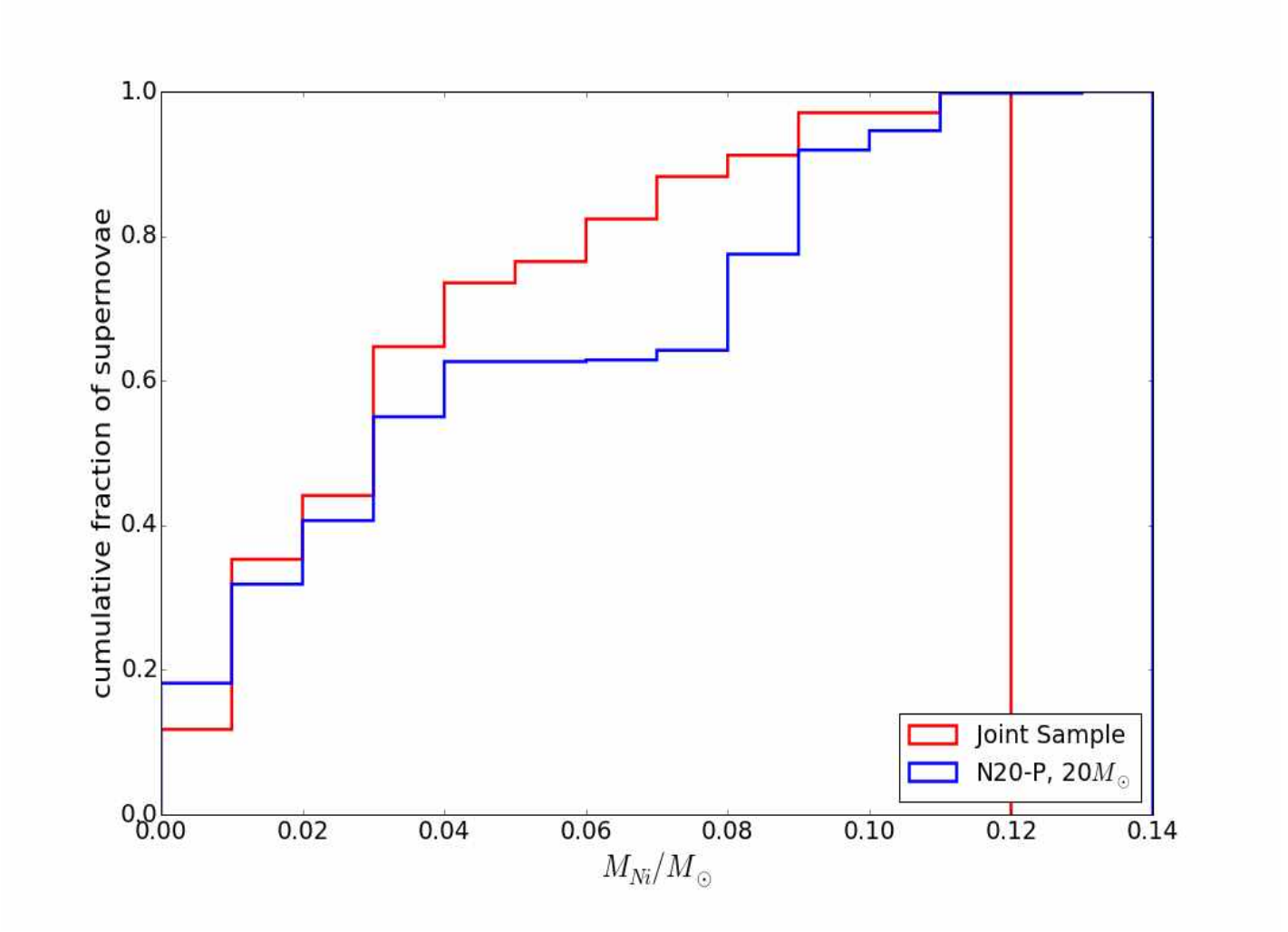
Progenitor	M_{Ni} [$M_\odot$] N20 K.	N20 P.	W18 K.	W18 P.	$E_{expl.}$ [B] N20 K.	N20 P.	W18 K.	W18 P.	$M_{remnant}$ [$M_\odot$] N20 P.	W18 P.
12.25	0.055	0.089	0.063	0.086	1.44	1.44	1.36	1.36	1.56	1.56
12.5	0.059	0.092	0.059	0.088	1.44	1.44	1.35	1.35	1.58	1.58
12.75	0.062	0.087	0.060	0.082	1.29	1.29	1.20	1.20	1.63	1.64
13.0	0.070	0.094	0.065	0.083	1.32	1.32	1.18	1.18	1.66	1.68
13.1	0.061	0.086	0.058	0.080	1.22	1.22	1.11	1.11	1.59	1.60
13.2	0.061	0.088	0.058	0.082	1.26	1.26	1.14	1.14	1.59	1.60
13.3	0.061	0.086	0.059	0.081	1.22	1.22	1.12	1.12	1.60	1.61
13.4	0.063	0.086	0.061	0.081	1.21	1.21	1.12	1.12	1.61	1.62
13.5	0.064	0.093	0.062	0.087	1.33	1.33	1.23	1.23	1.61	1.62
13.6	0.073	0.104	0.070	0.097	1.51	1.51	1.38	1.38	1.62	1.64
13.7	0.071	0.103	0.068	0.096	1.48	1.48	1.35	1.35	1.63	1.64
13.8	0.072	0.101	0.069	0.096	1.43	1.43	1.33	1.33	1.65	1.66
13.9	0.071	0.097	0.069	0.091	1.36	1.36	1.27	1.27	1.66	1.67
14.0	0.070	0.097	0.068	0.091	1.36	1.36	1.27	1.27	1.67	1.68
14.1	0.069	0.094	0.067	0.089	1.30	1.30	1.24	1.23	1.69	1.69
14.2	0.067	0.090	0.066	0.086	1.25	1.25	1.20	1.19	1.69	1.70
14.3	0.072	0.096	0.068	0.089	1.31	1.31	1.21	1.21	1.70	1.71
14.4	0.070	0.090	0.069	0.088	1.22	1.22	1.19	1.19	1.72	1.72
14.5	0.077	0.089	0.077	0.088	1.09	1.09	1.07	1.07	1.76	1.76
14.6	0.072	0.090	0.071	0.086	1.17	1.17	1.13	1.13	1.75	1.75
14.7	0.079	0.089	0.078	0.086	1.07	1.07	1.01	1.01	1.77	1.78
14.8	0.072	0.085	0.071	0.083	1.07	1.07	1.05	1.05	1.78	1.78
14.9	0.076	0.088	0.075	0.085	1.07	1.07	1.04	1.04	1.78	1.78
15.2	0.070	0.082	0.071	0.079	0.94	0.94	0.83	0.83	1.55	1.57
15.7	0.075	0.086	0.075	0.081	0.95	0.95	0.81	0.81	1.57	1.59
15.8	0.085	0.097	0.074	0.074	1.06	1.06	0.65	0.65	1.56	1.64
15.9	0.079	0.079			0.70	0.70			1.67	
16.0	0.094	0.110	0.075	0.079	1.26	1.26	0.78	0.78	1.54	1.62
16.1	0.075	0.084	0.078	0.087	0.89	0.89	0.97	0.97	1.59	1.59
16.2	0.095	0.111	0.076	0.081	1.23	1.23	0.79	0.79	1.55	1.62
16.3	0.097	0.113	0.078	0.083	1.23	1.23	0.80	0.80	1.55	1.62

Sukbold et al. 2016

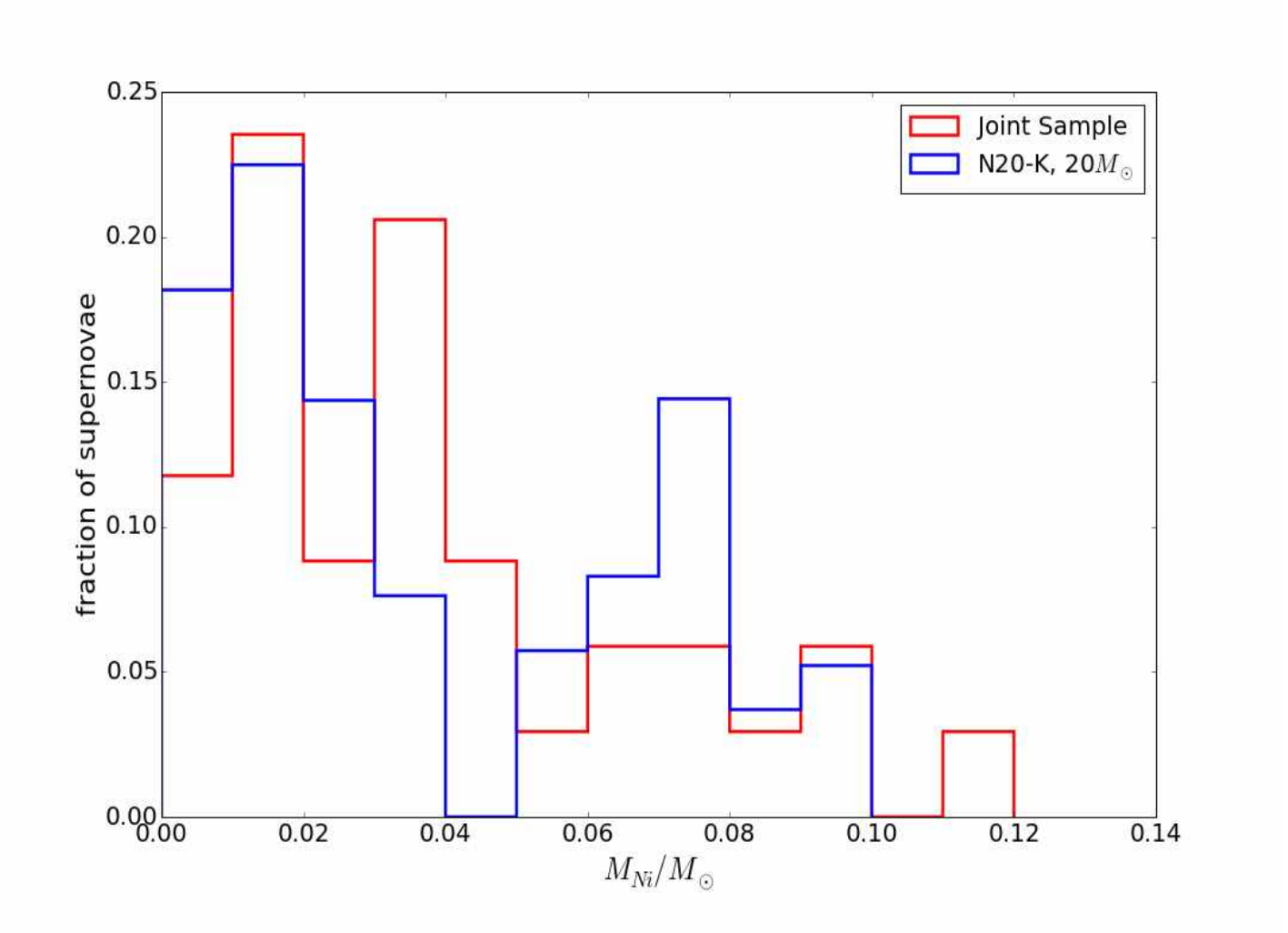
Nickel Mass Distributions



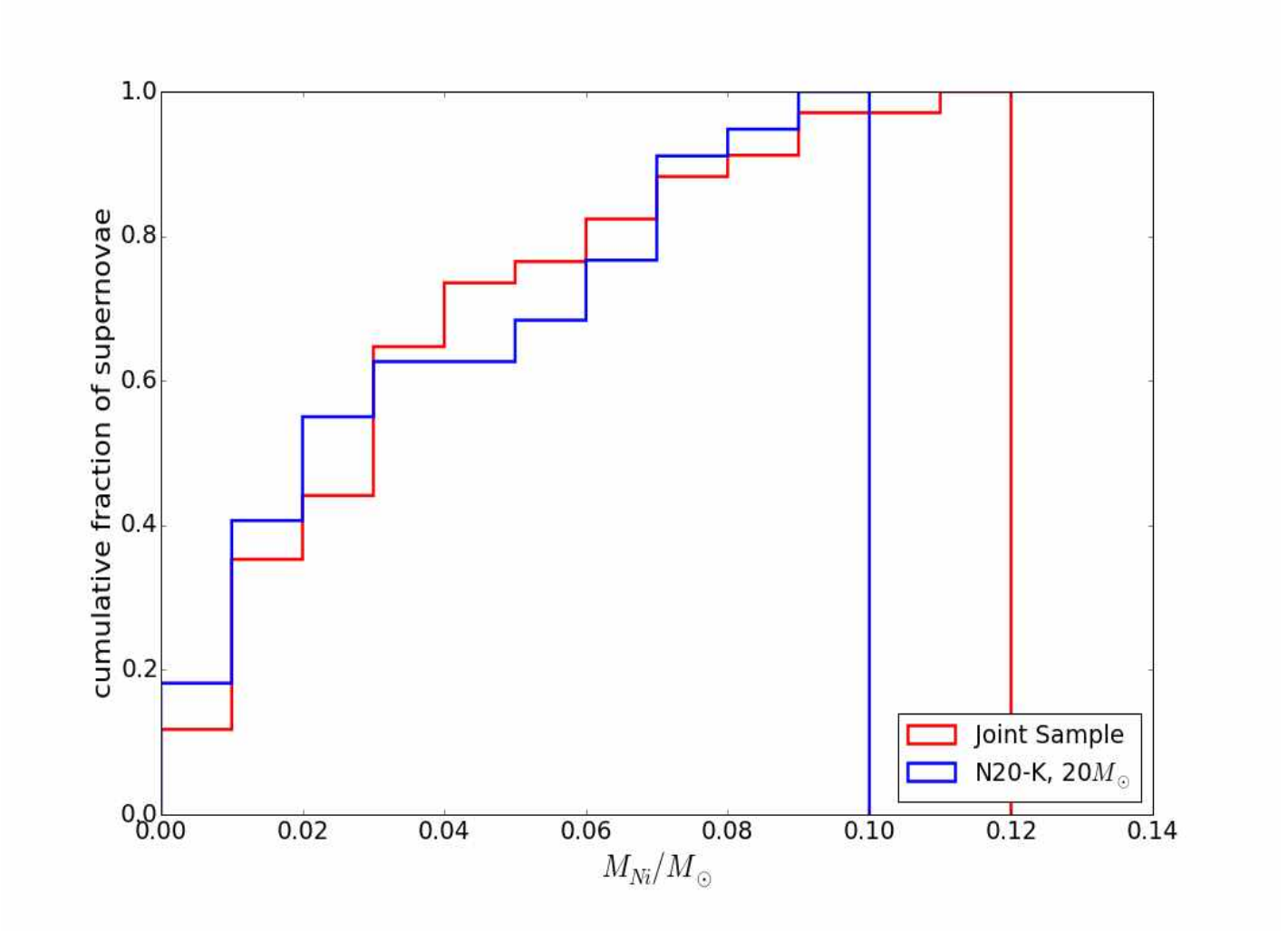
Nickel Mass Distributions



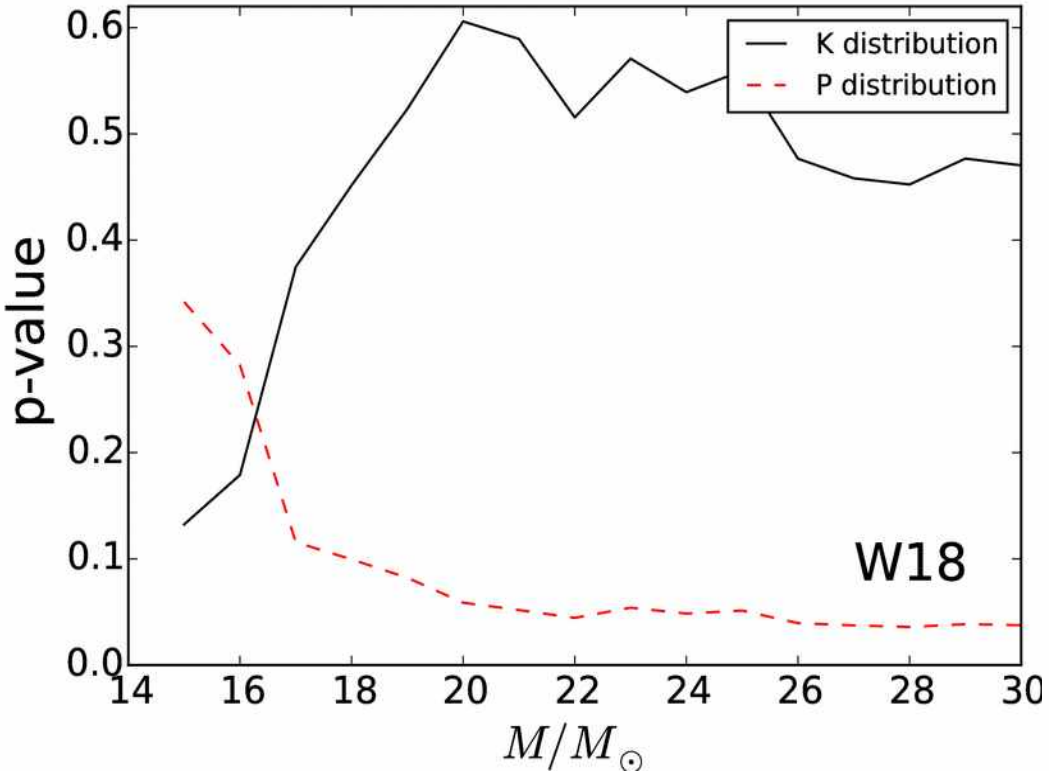
Nickel Mass Distributions

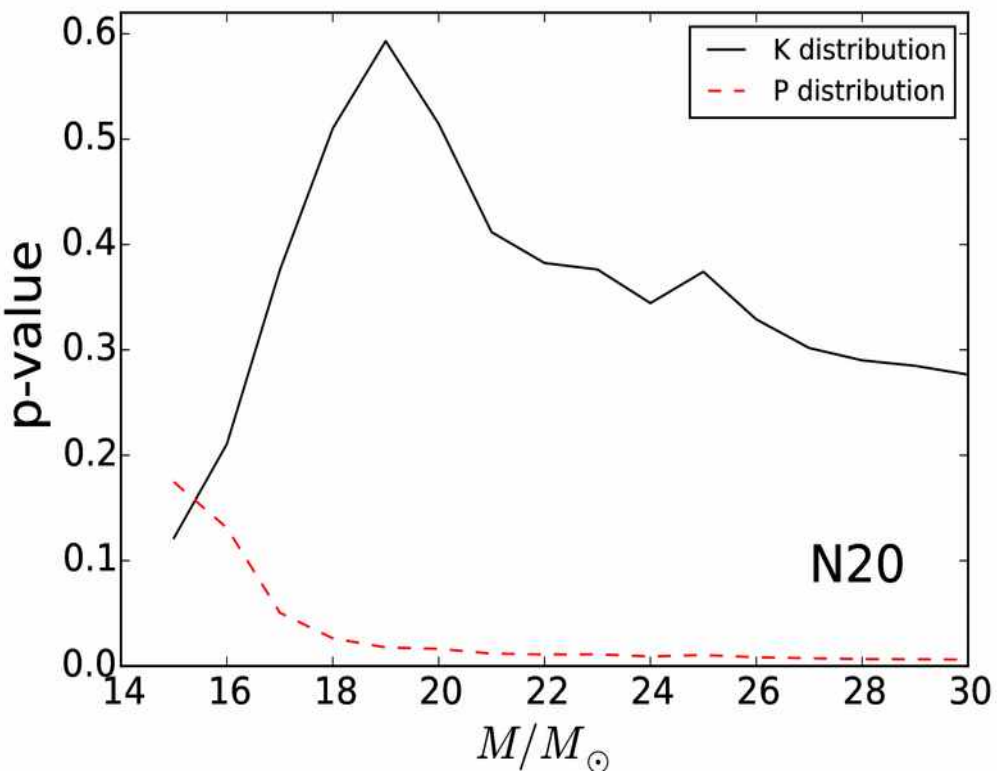


Nickel Mass Distributions



Comparing Models





Summary

- We retrieved known correlations between niquel mass and bolometric luminosity, and nickel mass and explosion energy
- Comparison of observations with neutrino mechanism models (nickel mass)
- The KEPLER model seems to adjust better the observations than the Prometeus Hot Bubble model
- We would like to shed more light into the conclusion by Pejcha & Thompson (2015) and 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