Unraveling the non-monotonicity of preSN evolution and its implications

by

Tuguldur Sukhbold

(UC Santa Cruz)

Collaborators:

Justin Brown

Stan Woosley

Thomas Ertl

Thomas Janka

MAX-PLANCK-GESELLSCHAFT

The core compactness parameter

$$\xi_M = \left. \frac{M/M_\odot}{R(M_{\rm bary} = M)/1000\,{\rm km}} \right|_{t_{\rm bounce}}$$

O'Connor & Ott (2011)

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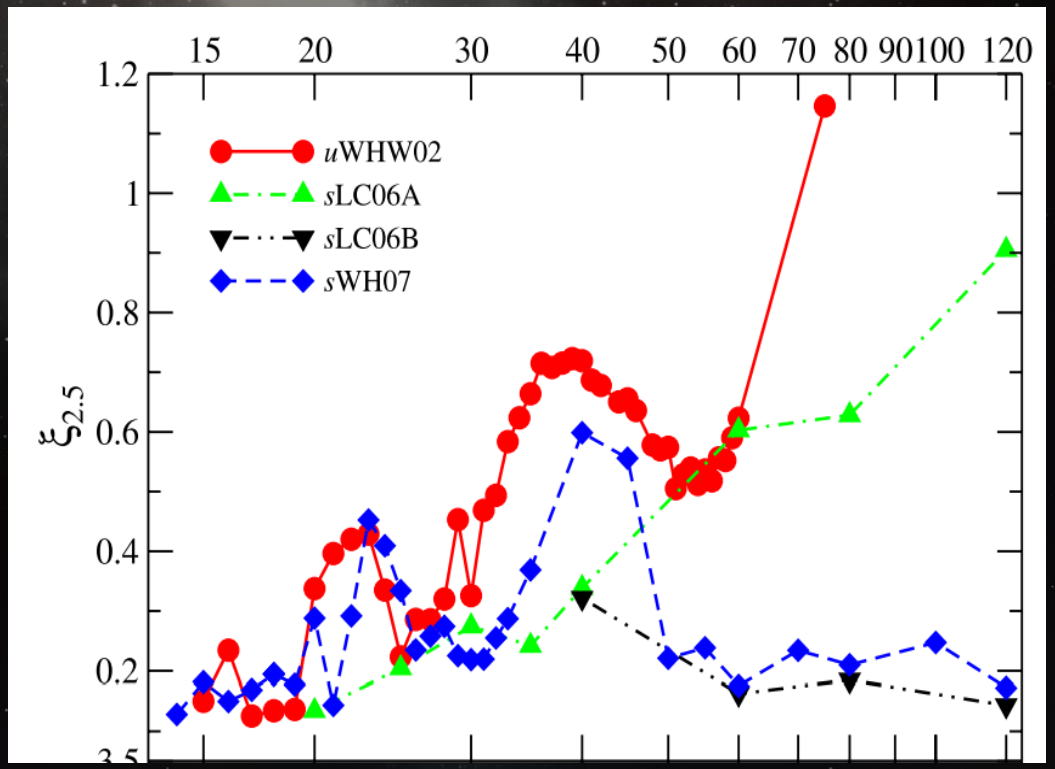
ZAMS mass

@preSN enclosing Inner 2.5Msun



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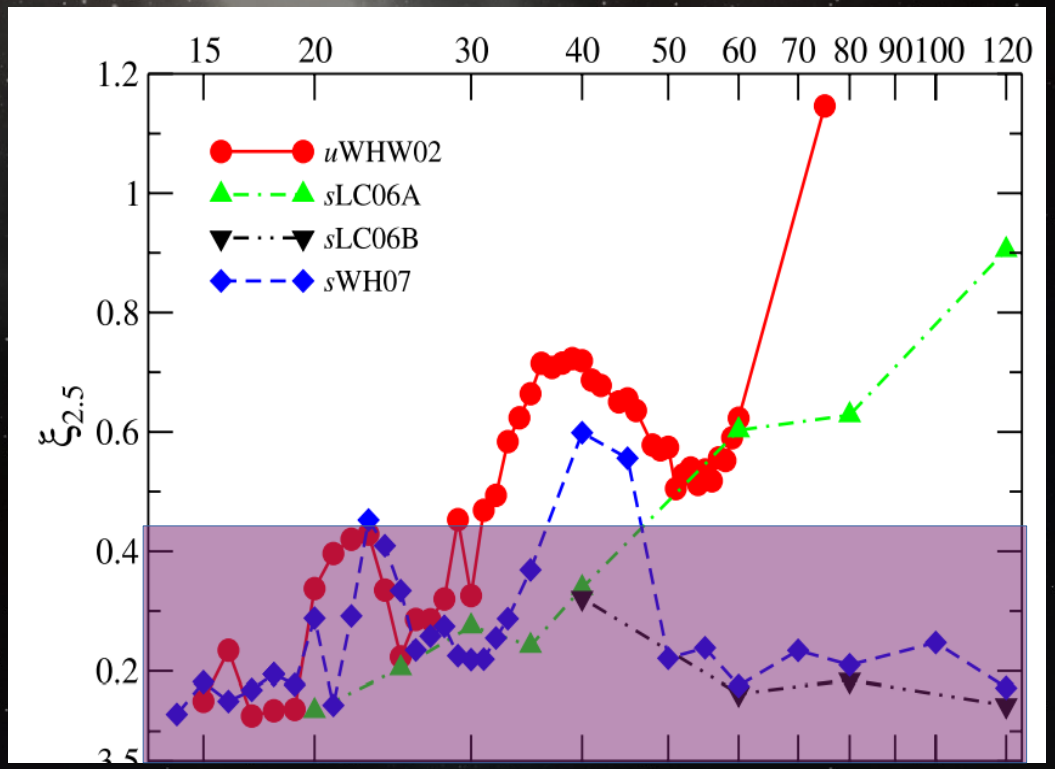
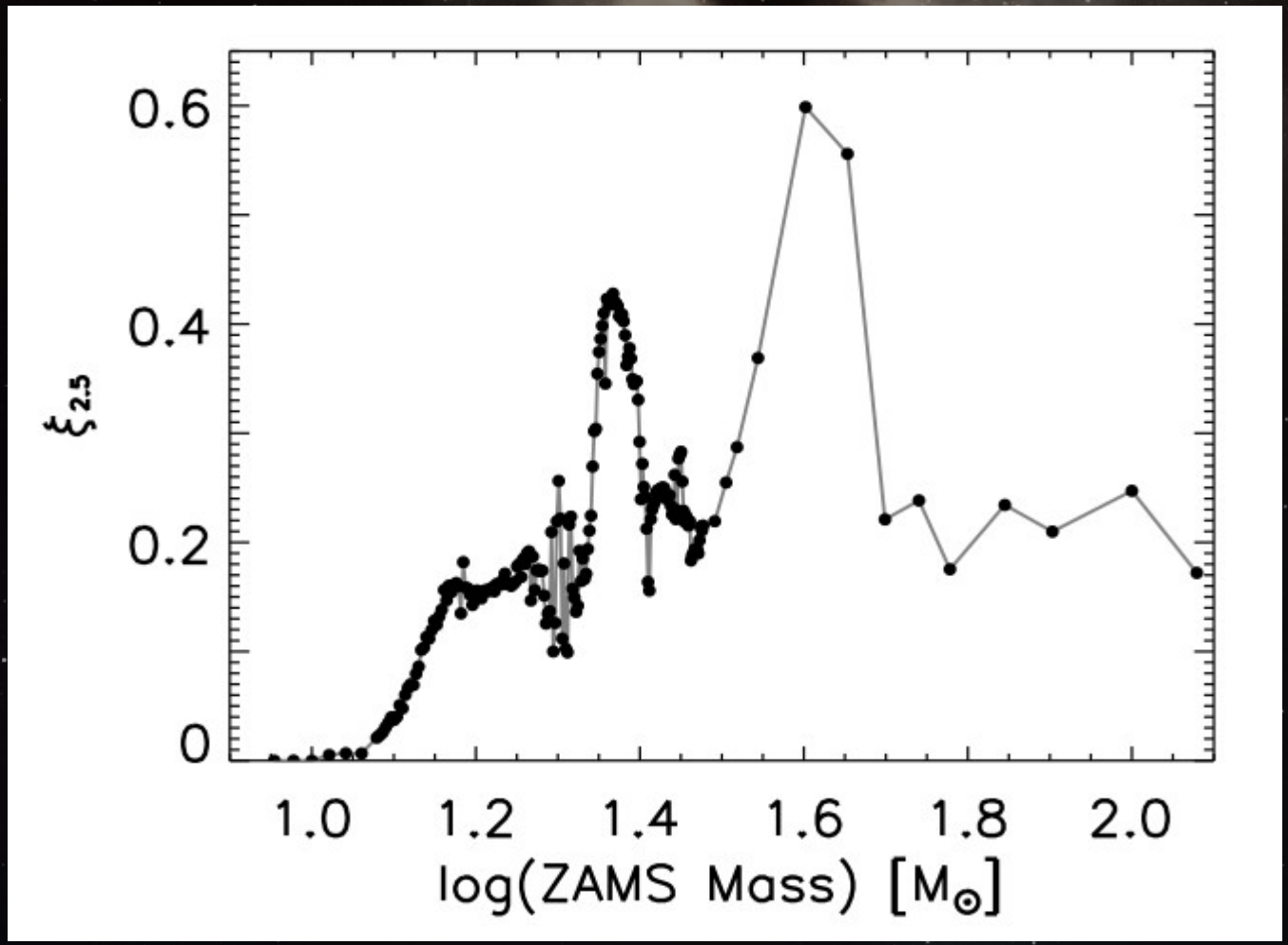


O'Connor & Ott (2011)

Is this robust? Why its non-monotonic?



- Convection
- Nuclear
- Mass-loss
- Resolution
- Code

...

Everything is in:

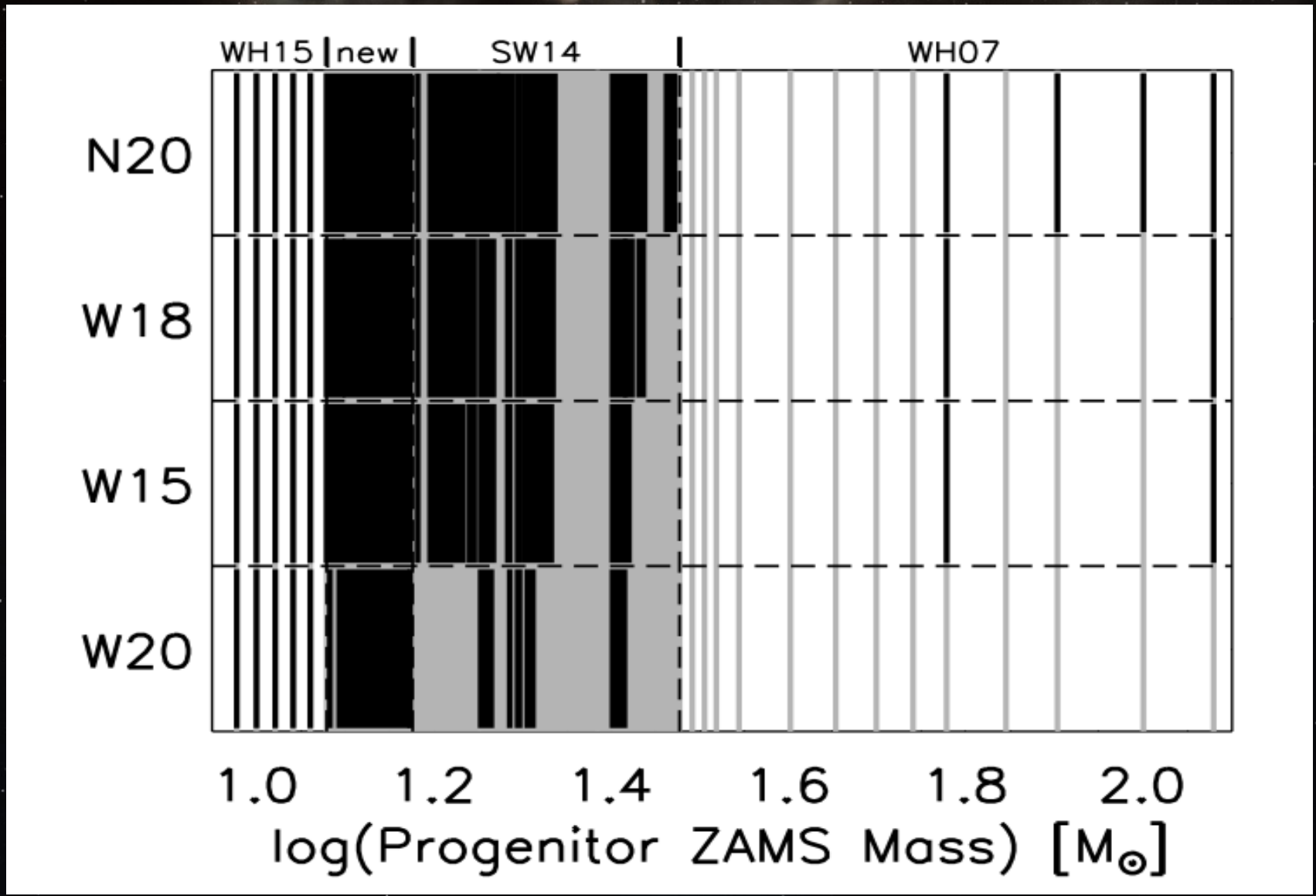
Sukhbold & Woosley (2014)

Neutrino-Transport Calculation & 87A calibrated 'engines'

Neutrino-Transport Calculation & 87A calibrated 'engines'

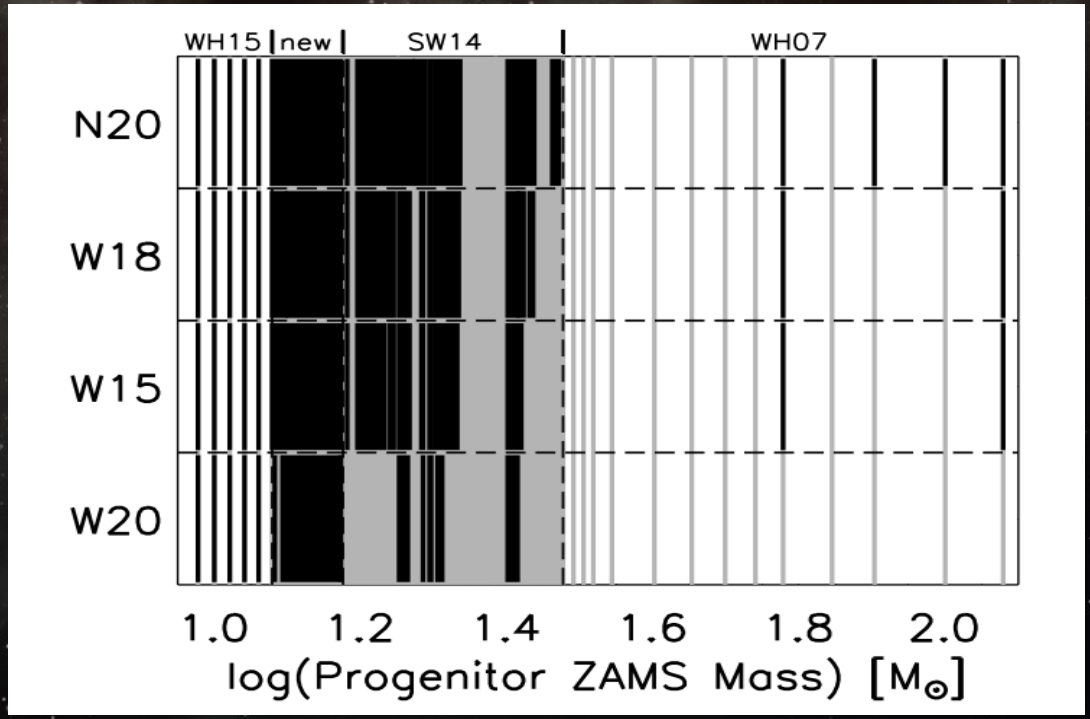
model	M_α	M_H	Structure	$Z/Z_\odot$	R/B	Rotation	Reference
W18	7.55	9.36	full	low	B	Y	unpublished
N20	6	10	core+env.	-	B	N	SN90,NH88
S19.8	6.12	9.73	full	1	R	N	SW14
W15	-	-	core+env.	-	B	N	W88
W20	5.86	13.5	full	low	B	N	W97

Explosion Results



Sukhbold et. al. (2015, in prep.)

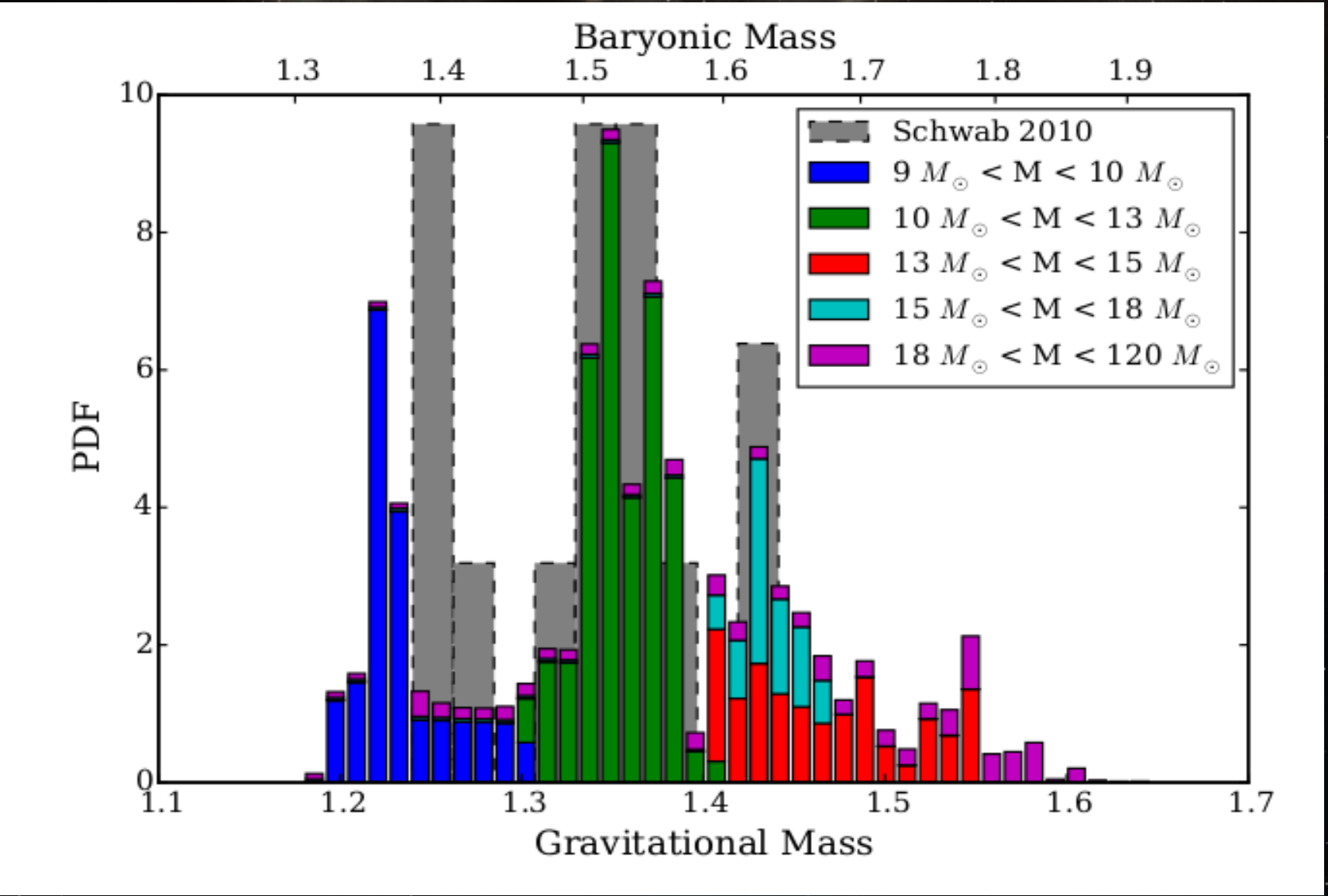
Explosion Results



Cal.	$\overline{E}$ (erg)$\times 10^{51}$	$\overline{M_b}$ ($M_\odot$)	$\overline{M_g}$ ($M_\odot$)	$M_{\rm Ni,l}$ ($M_\odot$)	$M_{\rm Ni,u}$ ($M_\odot$)	SN%	(SN>20)%
W18	0.74×10^{51}	1.544	1.368	0.046	0.058	64	10.0
N20	0.89×10^{51}	1.543	1.368	0.052	0.070	71	14.8

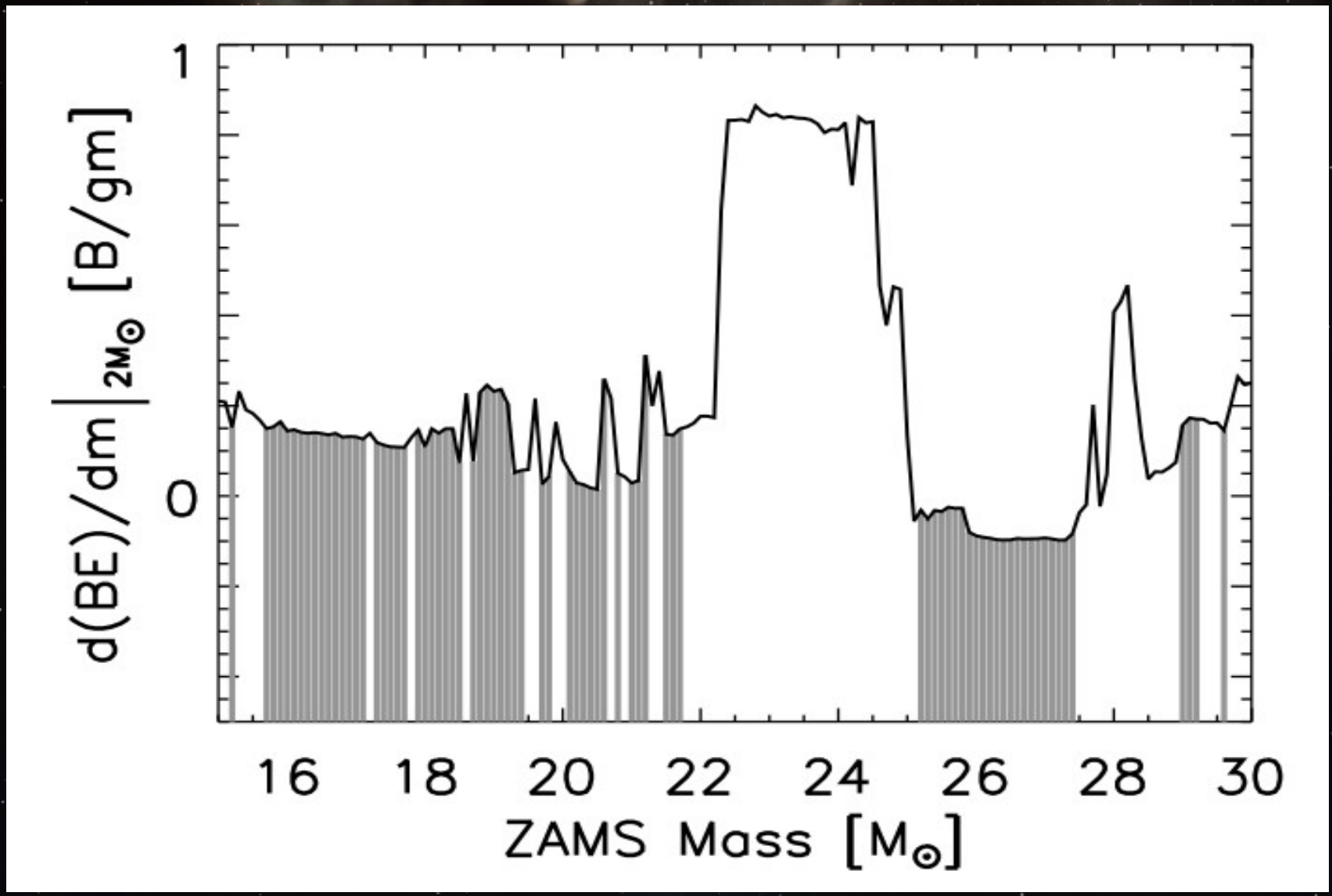
Sukhbold et. al. (2015, in prep.)

Remnant Mass Distribution



Sukhbold et. al. (2015, in prep.)

Explodability: 1-parameter



Sukhbold et. al. (2015, in prep.)

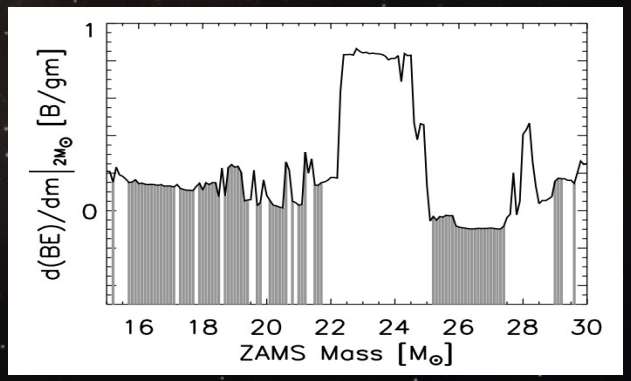
Explodability: 2-parameters

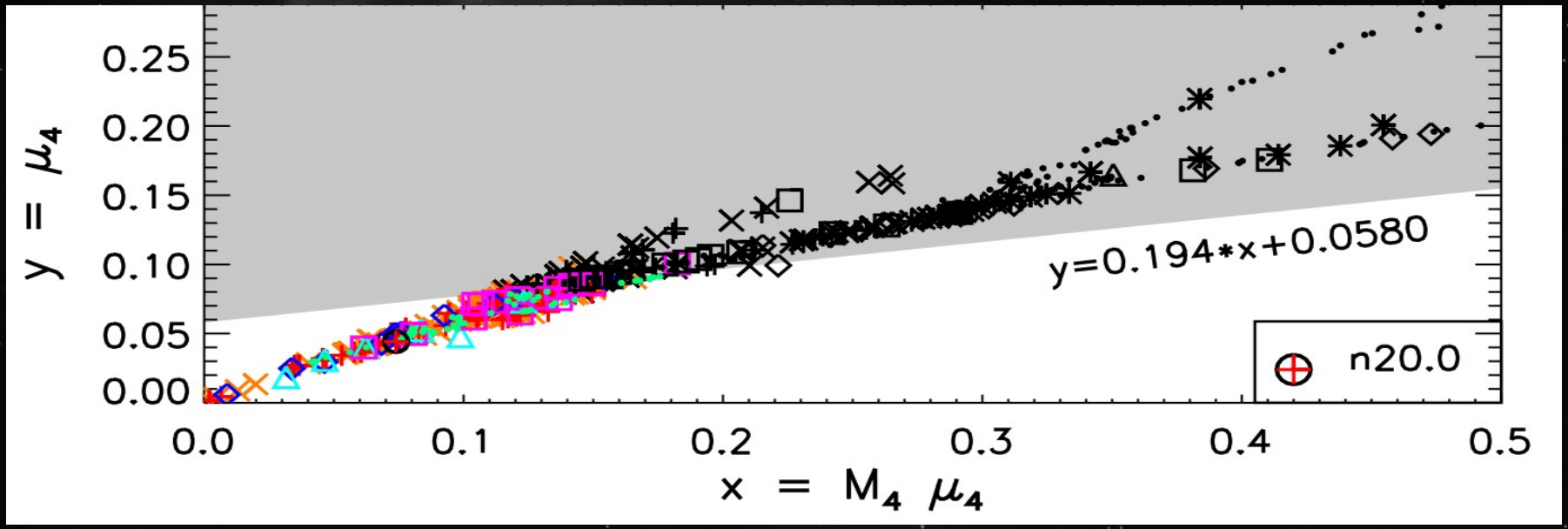
<85% ⟶ 1-parameter

>97%

↓

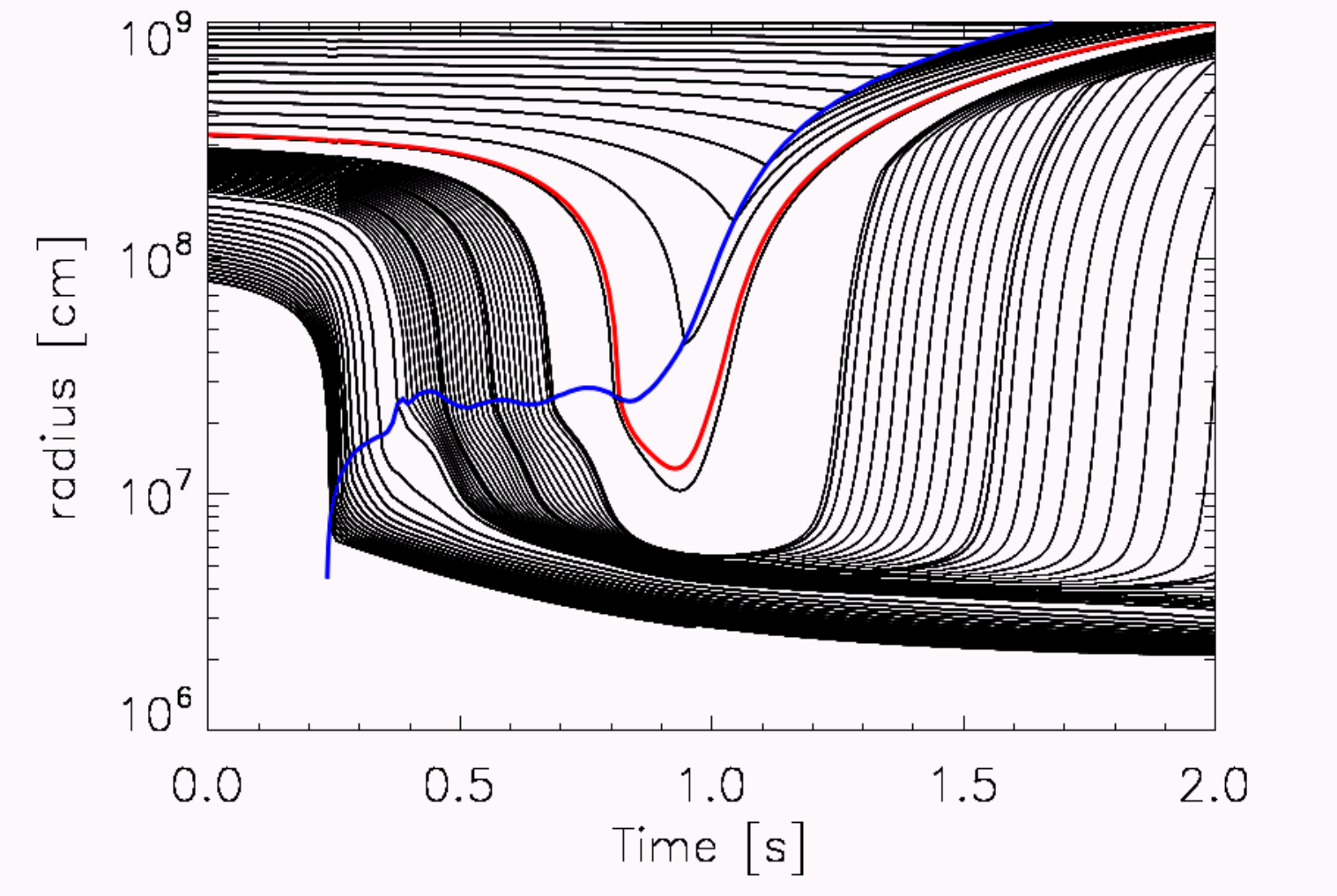
2-parameters





Ertl et. al. (2015)

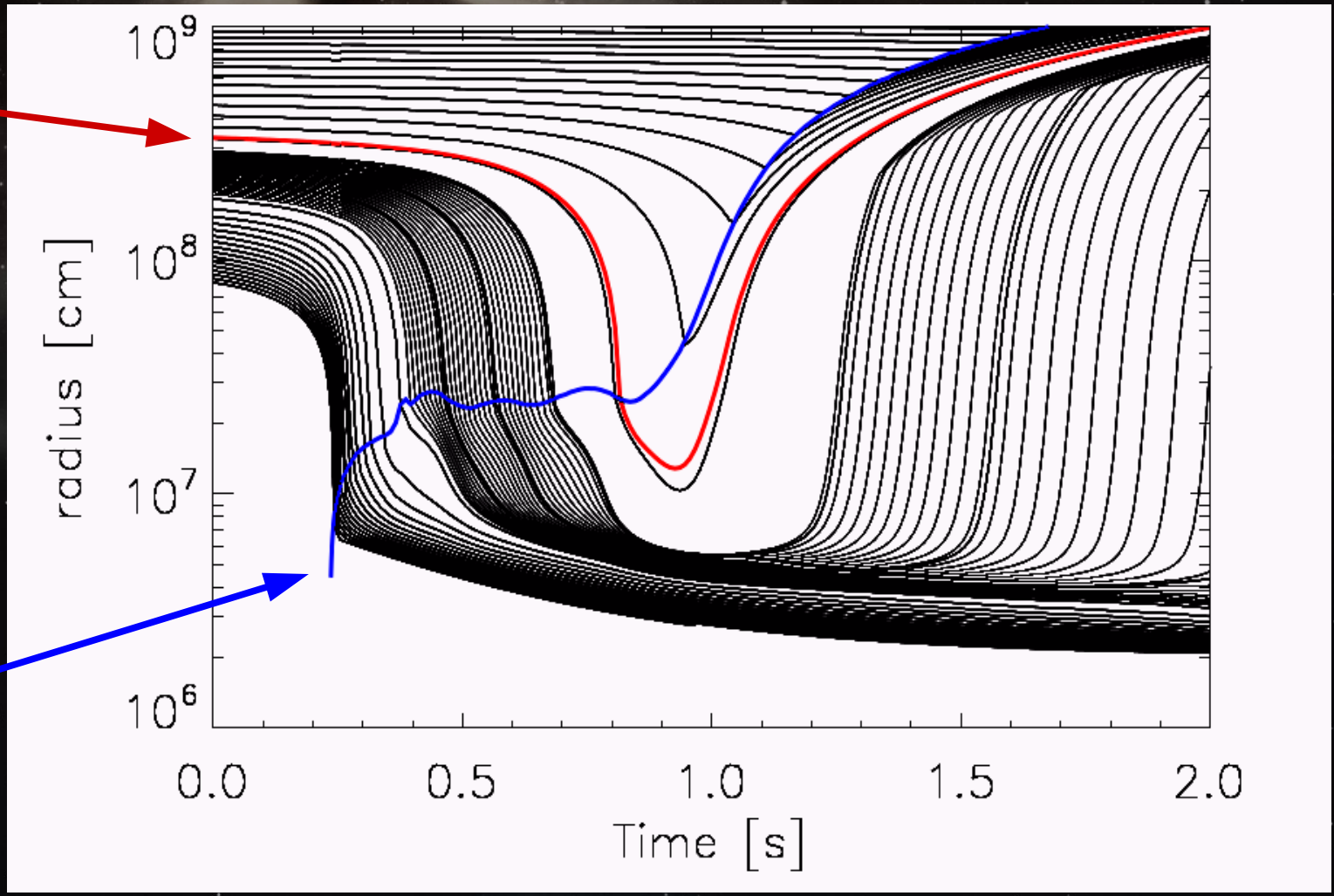
Translating between P.-HOTB → KEPLER



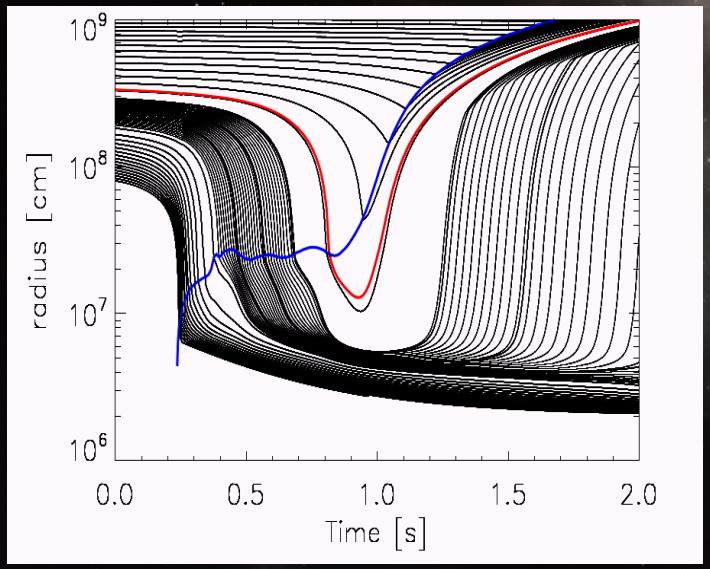
Translating between P.-HOTB ⟶ KEPLER

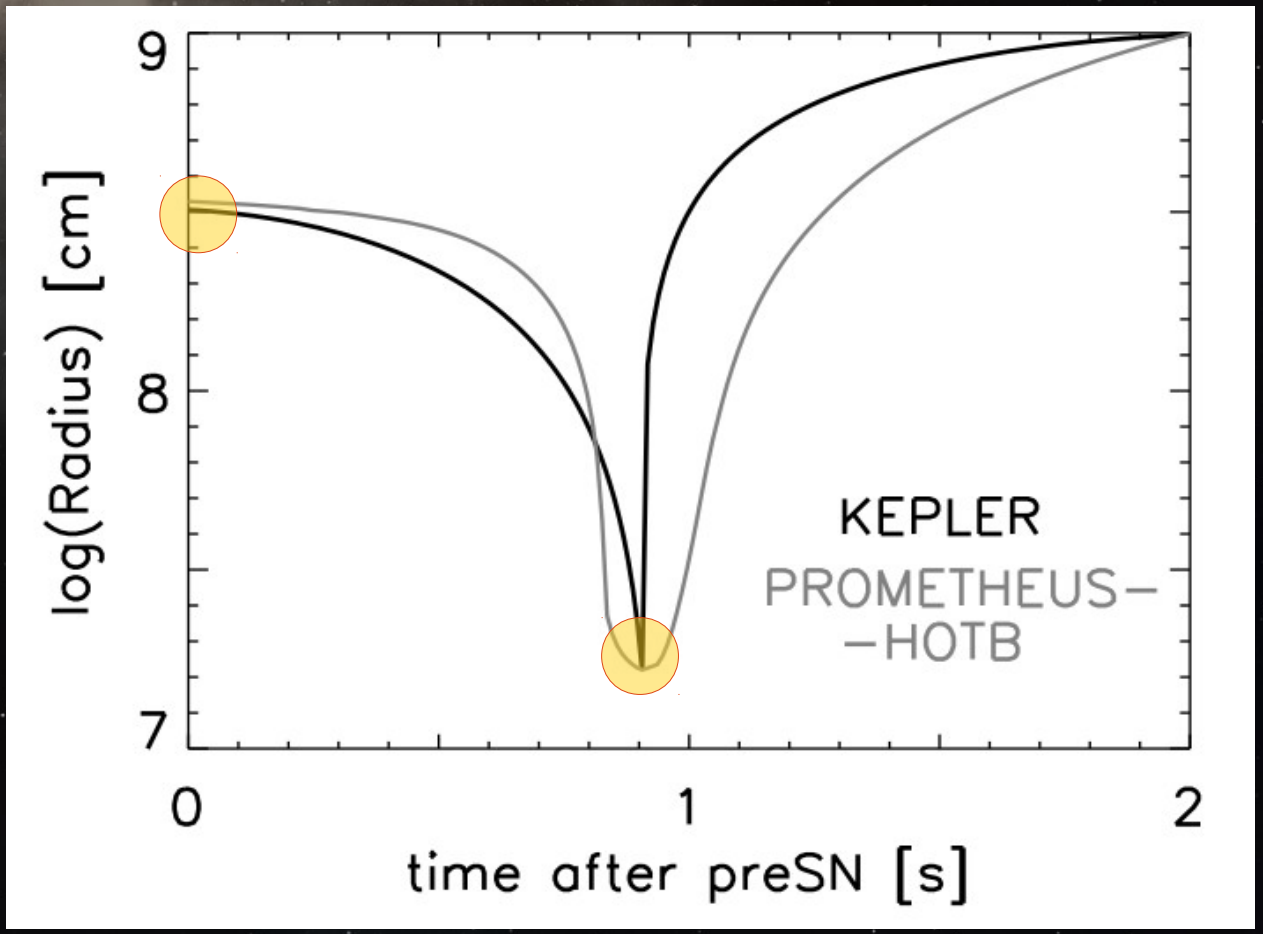
'special' trajectory

shock



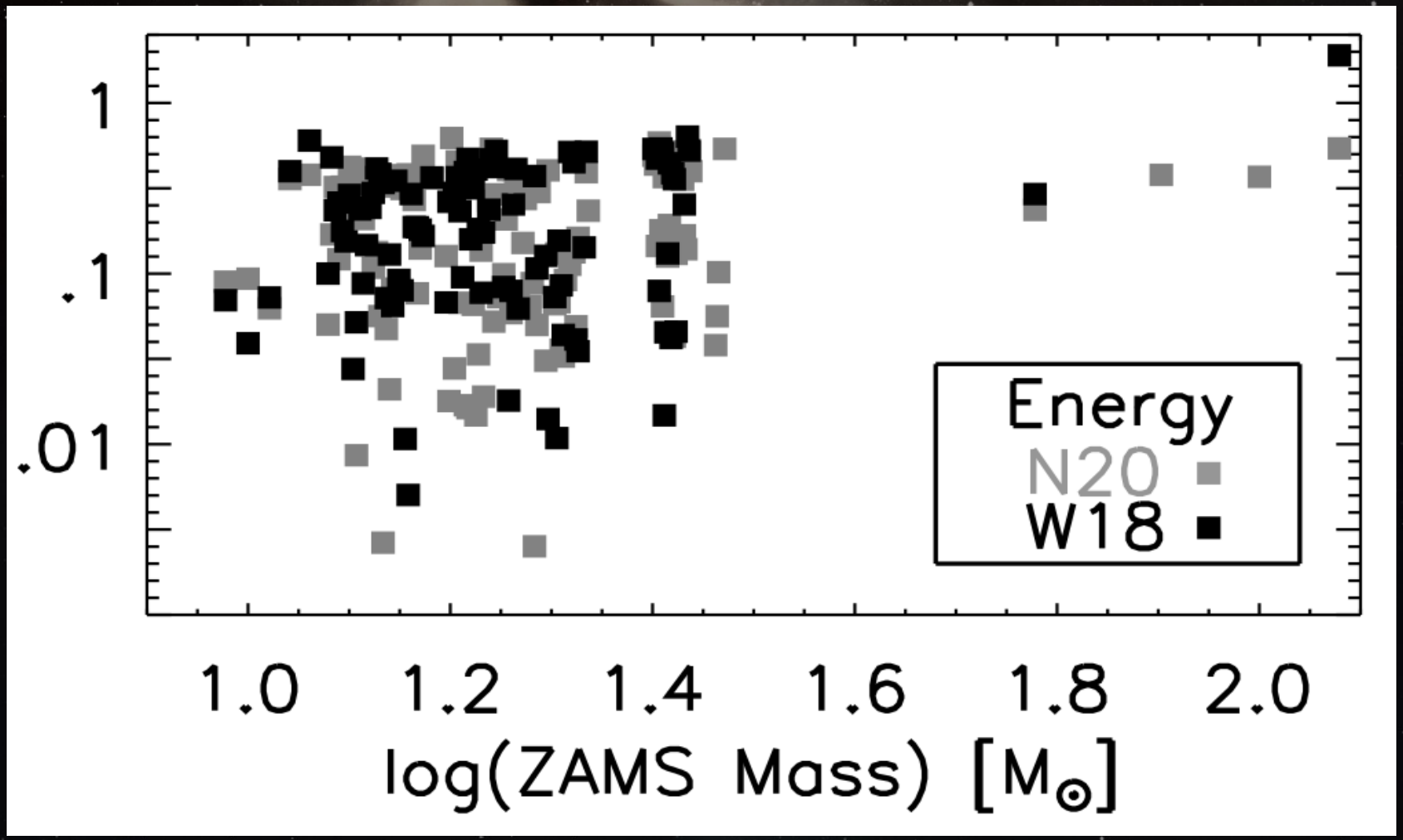
Translating between P.-HOTB ⟶ KEPLER





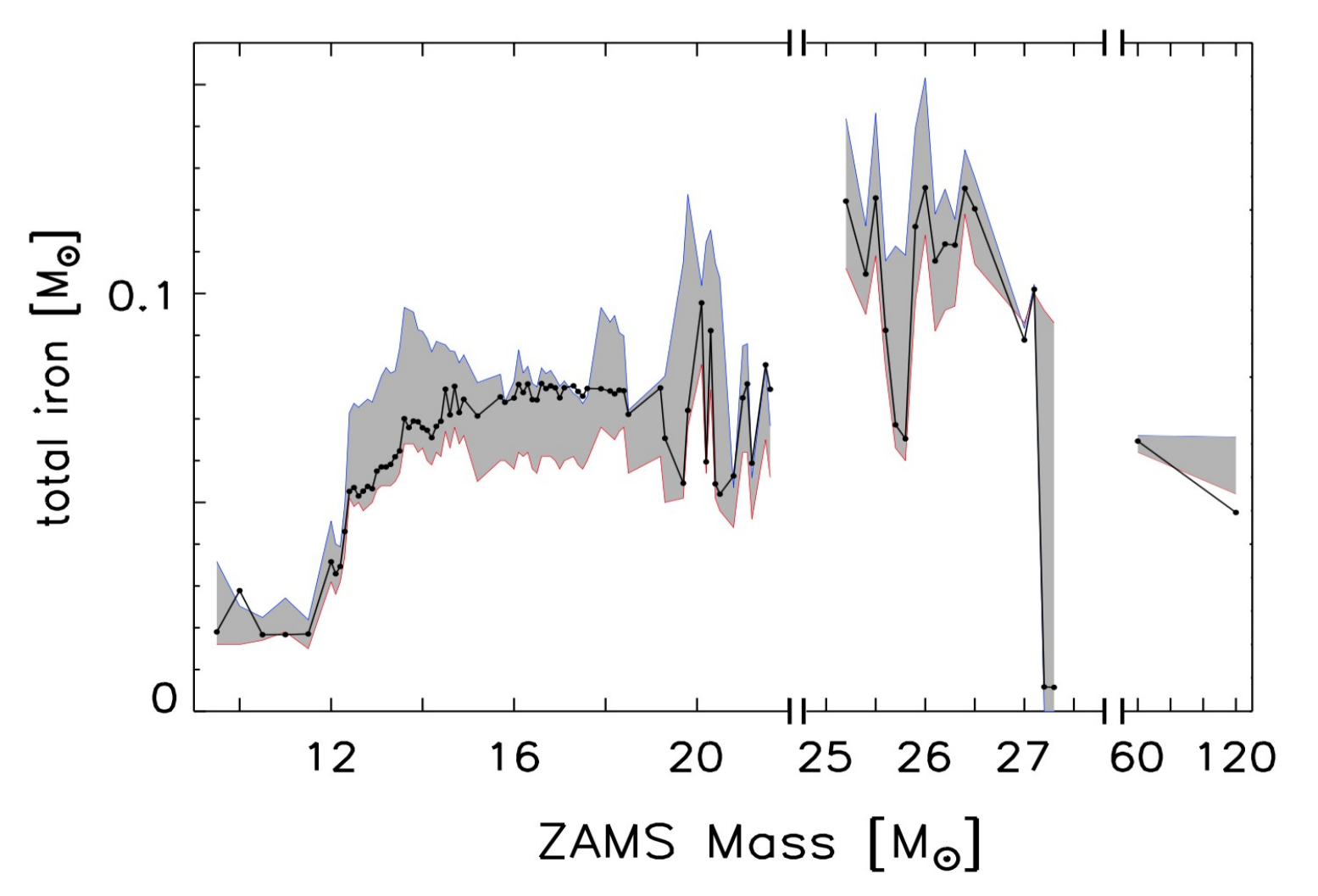
Sukhbold et. al. (2015, in prep.)

Convergence between P.-HOTB ——— KEPLER



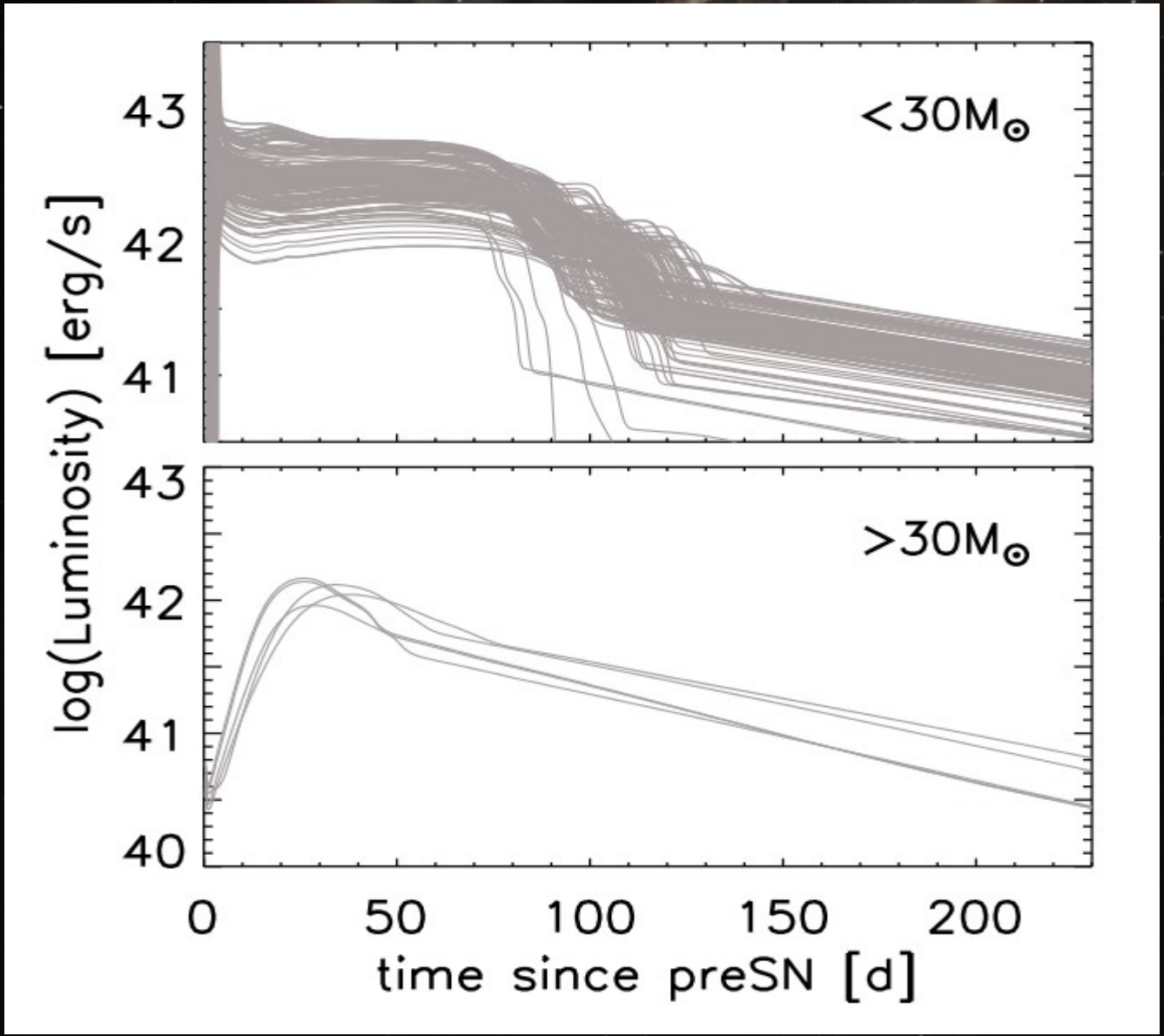
Sukhbold et. al. (2015, in prep.)

Convergence between P.-HOTB KEPLER



Sukhbold et. al. (2015, in prep.)

Lightcurves

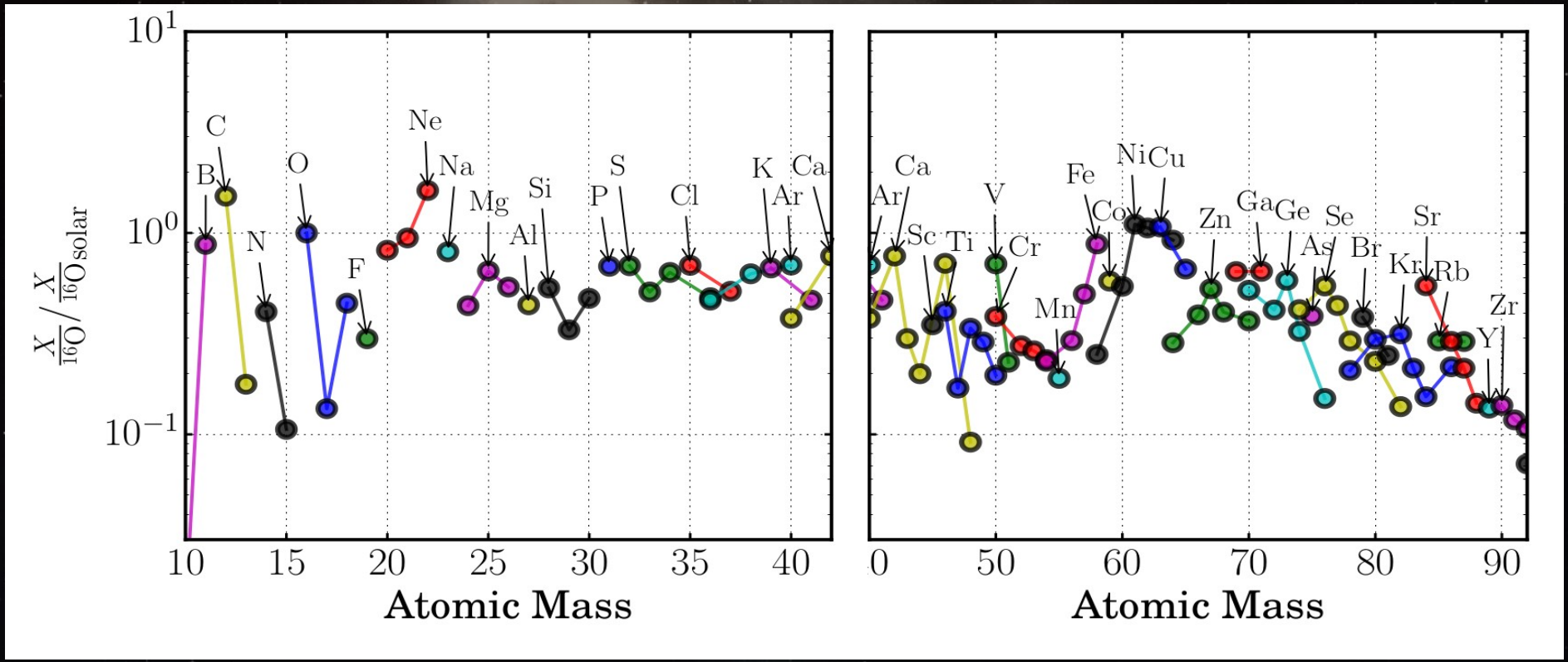


Type-IIP

Very broad Type-Ib

Sukhbold et. al. (2015, in prep.)

Nucleosynthesis



Sukhbold et. al. (2015, in prep.)

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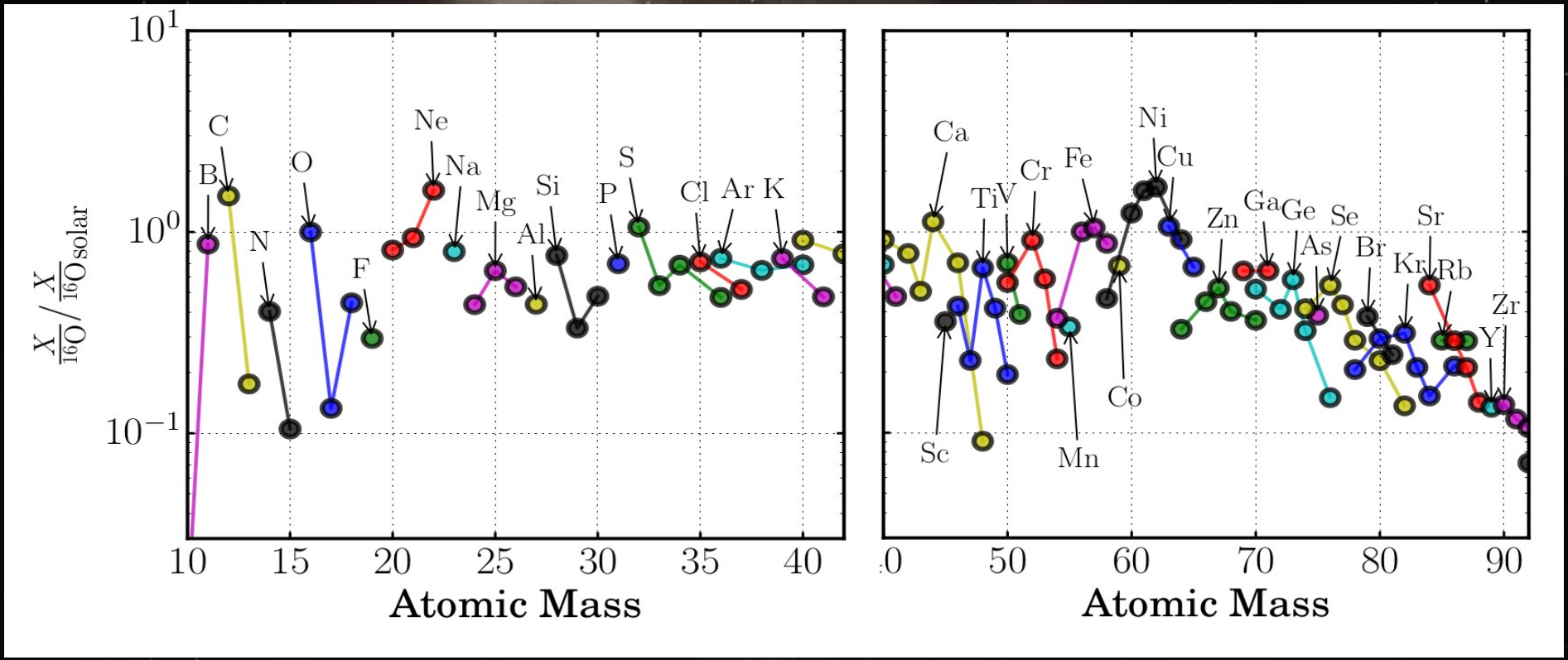
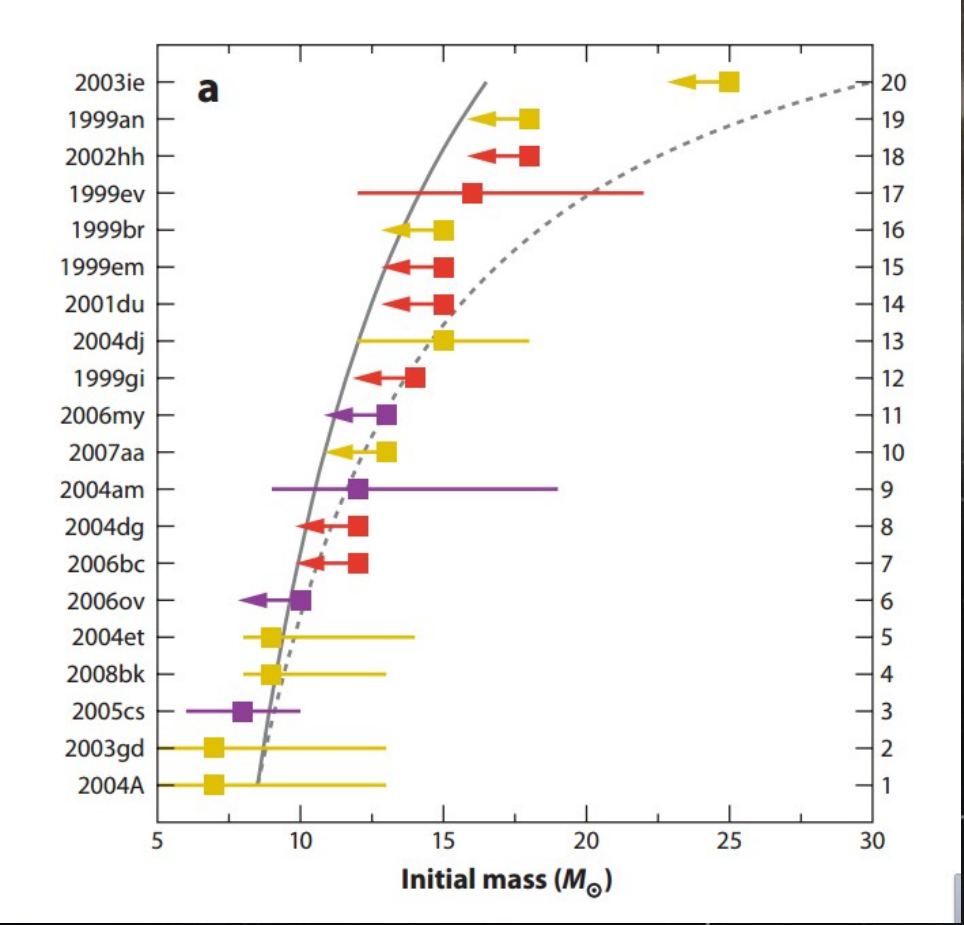


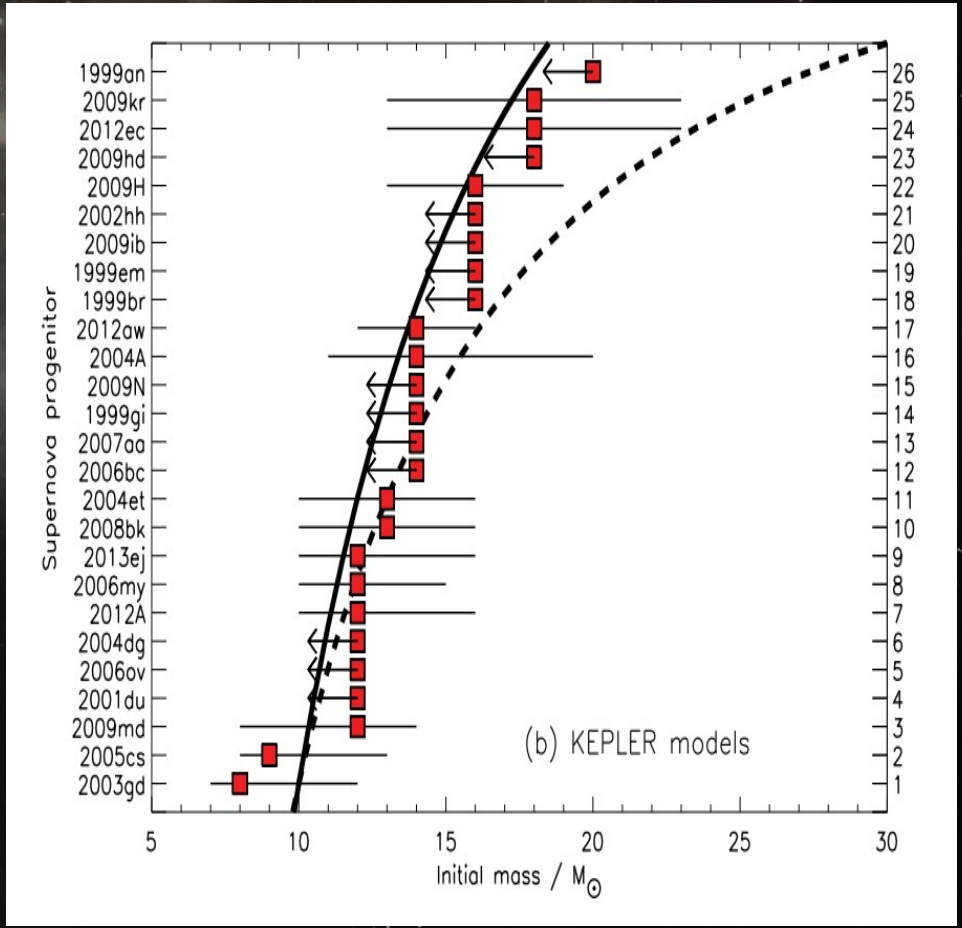
With typeIa contribution

Sukhbold et. al. (2015, in prep.)

Direct Progenitor Observations



Smartt (2009)



Smartt (2015)

References

Ertl et al. (2015) submitted	[arXiv:1503.07522]
O'Connor & Ott (2011)	ApJ,730,70O
Sukhbold et al. (2015, in prep)	
Sukhbold & Woosley (2014)	ApJ,783,10S
Ugliano et al. (2012)	ApJ,757,69U
Woosley & Heger (2007)	PhR, 442, 269
Woosley & Heger (2015) submitted	[arXiv:1505.06712]
Woosley, Heger & Weaver (2002)	RvMP, 74, 1015

Acknowledgements

Background image credit: ESO/L. Calçada