

Type Ia supernovae: which hints can we get from nucleosynthesis?

Claudia Travaglio

INAF-Astrophysical Observatory Turin (Italy)

Computer resources

Thanks to University of Frankfurt, Westgrid (Canada) and B2FH Association

Although the observations suggest a **single-degenerate** model, other recent studies have shown evidence for explosions birthed under the **double-degenerate** model or **WD mergers**. This means that the precursors to some Type Ia supernova may host companion stars, while others pair up with white dwarfs.

Conclusion: what is a Type Ia is still under debate, who is the progenitor, how behave the binary system, which chemistry comes from there.....it is all still under debate.

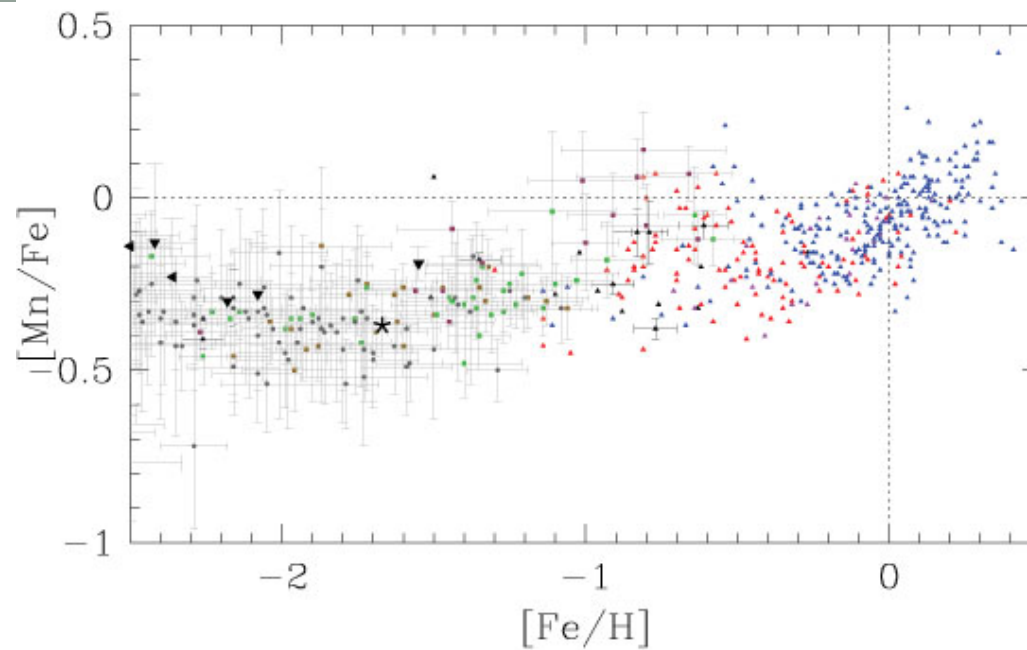
Mn and Cr

(Bravo, A&A 2012, Seitenzahl et al. A&A 2013)

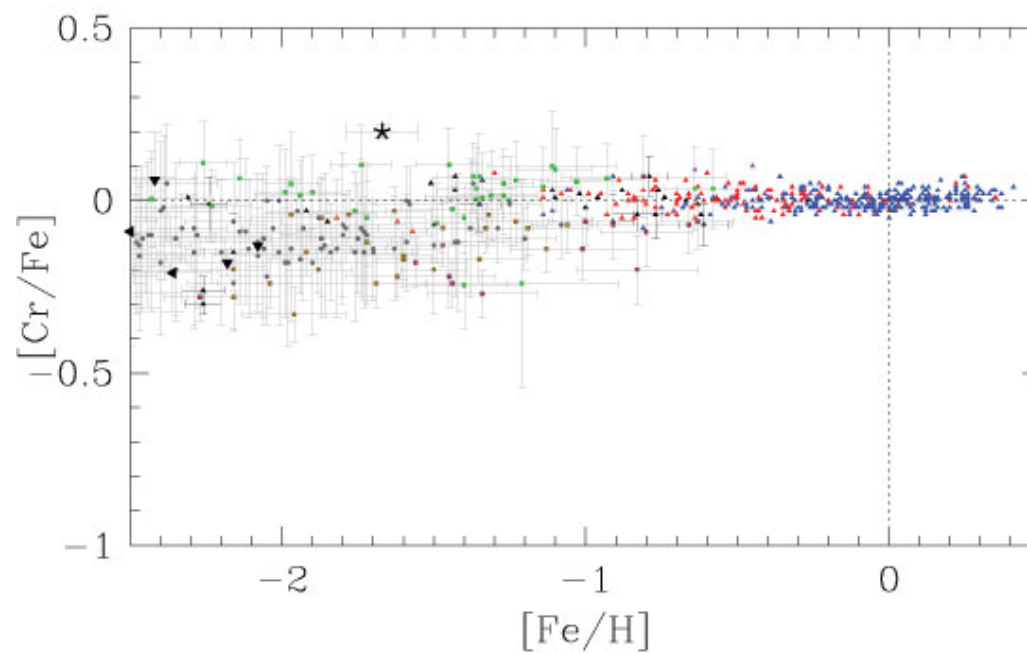
p-process

(Travaglio et al. ApJ 2015)

*Hints from
observations*



Mn

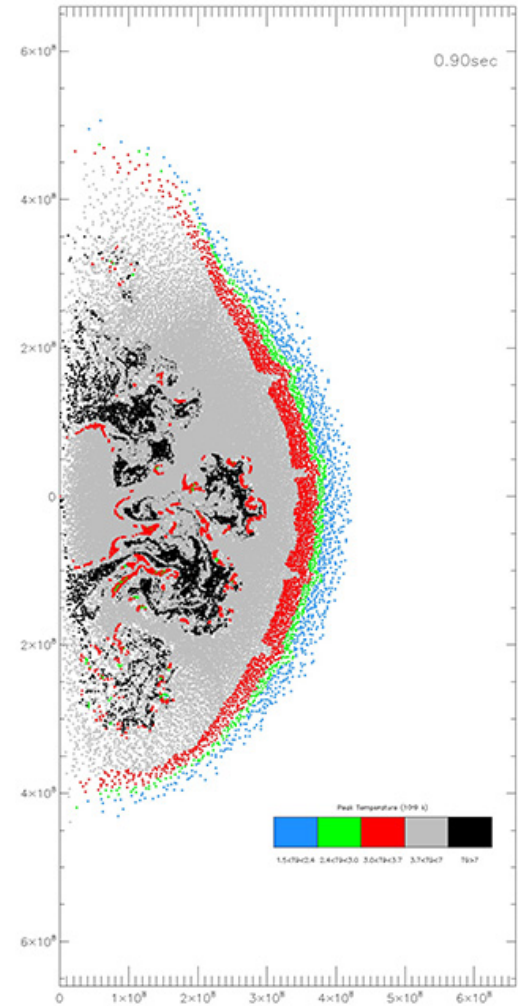
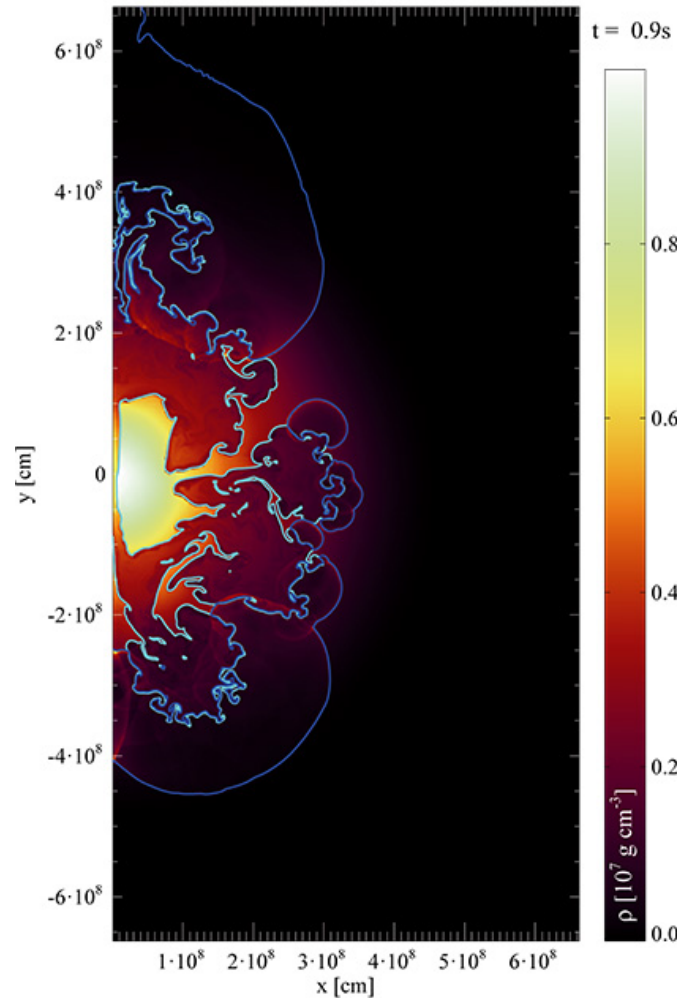


Cr

^{53}Co 240.00 ms β^+	^{54}Co 193.00 ms β^+	^{55}Co 17.53 h β^+	^{56}Co 77.23 d β^+	^{57}Co 271.76 d β^+
^{52}Fe 8.28 h β^+	^{53}Fe 8.51 m β^+	^{54}Fe 5.845 27.6 mb	^{55}Fe 2.74 a 75 mb, β^+	^{56}Fe 91.754 11.7 mb
^{51}Mn 46.20 m β^+	^{52}Mn 5.59 d β^+	^{53}Mn 3.74 Ma β^+	^{54}Mn 312.15 d β^+	^{55}Mn 100 39.6 mb
^{50}Cr 4.345 49 mb	^{51}Cr 27.70 d 87 mb, β^+	^{52}Cr 83.789 8.8 mb	^{53}Cr 9.501 58 mb	^{54}Cr 2.365 6.7 mb
^{49}V 329.05 d β^+	^{50}V 0.25 50 mb	^{51}V 99.75 38 mb	^{52}V 3.74 m β^-	^{53}V 1.60 m β^-

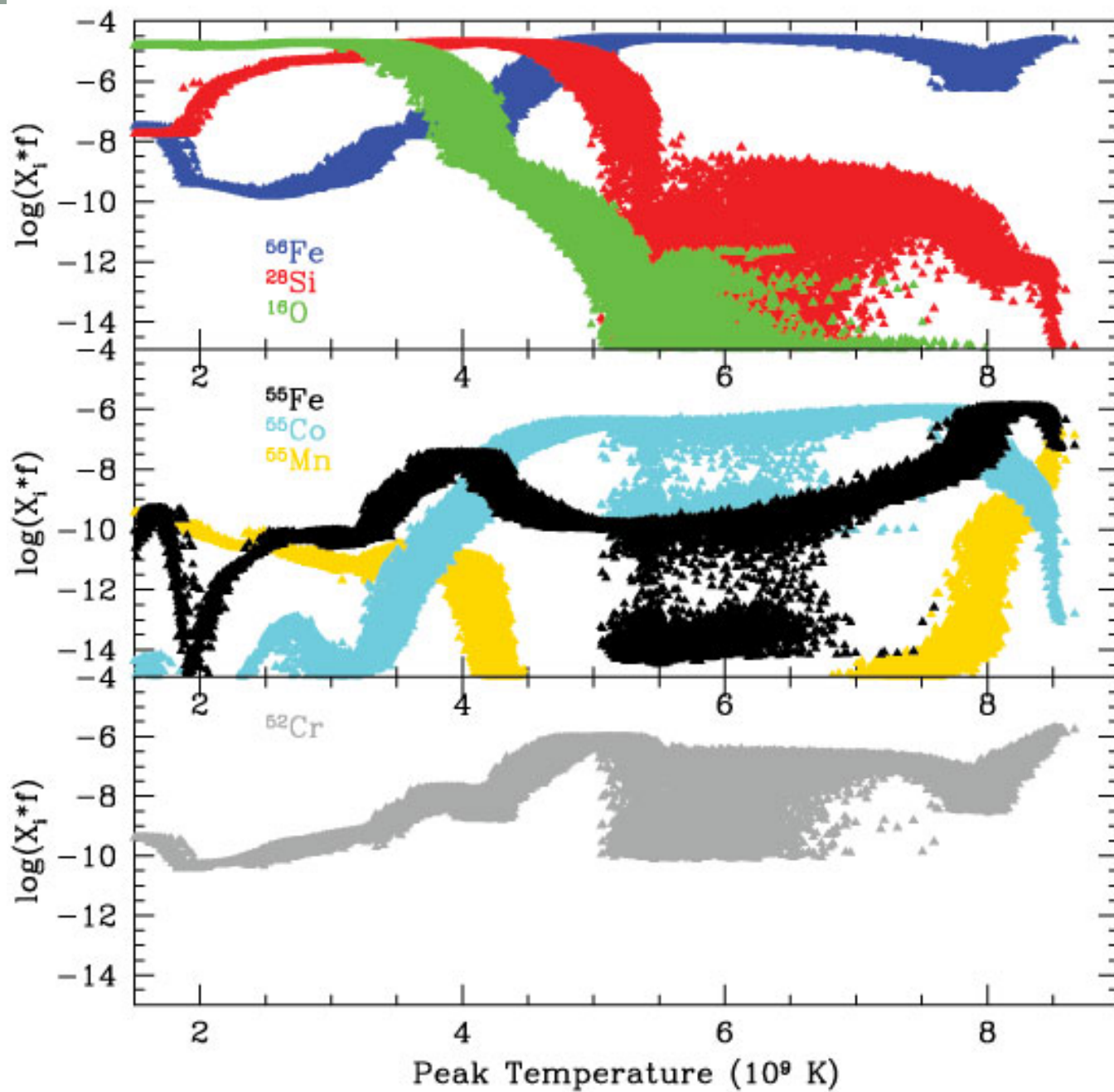
2D SNIa 51200 tracers

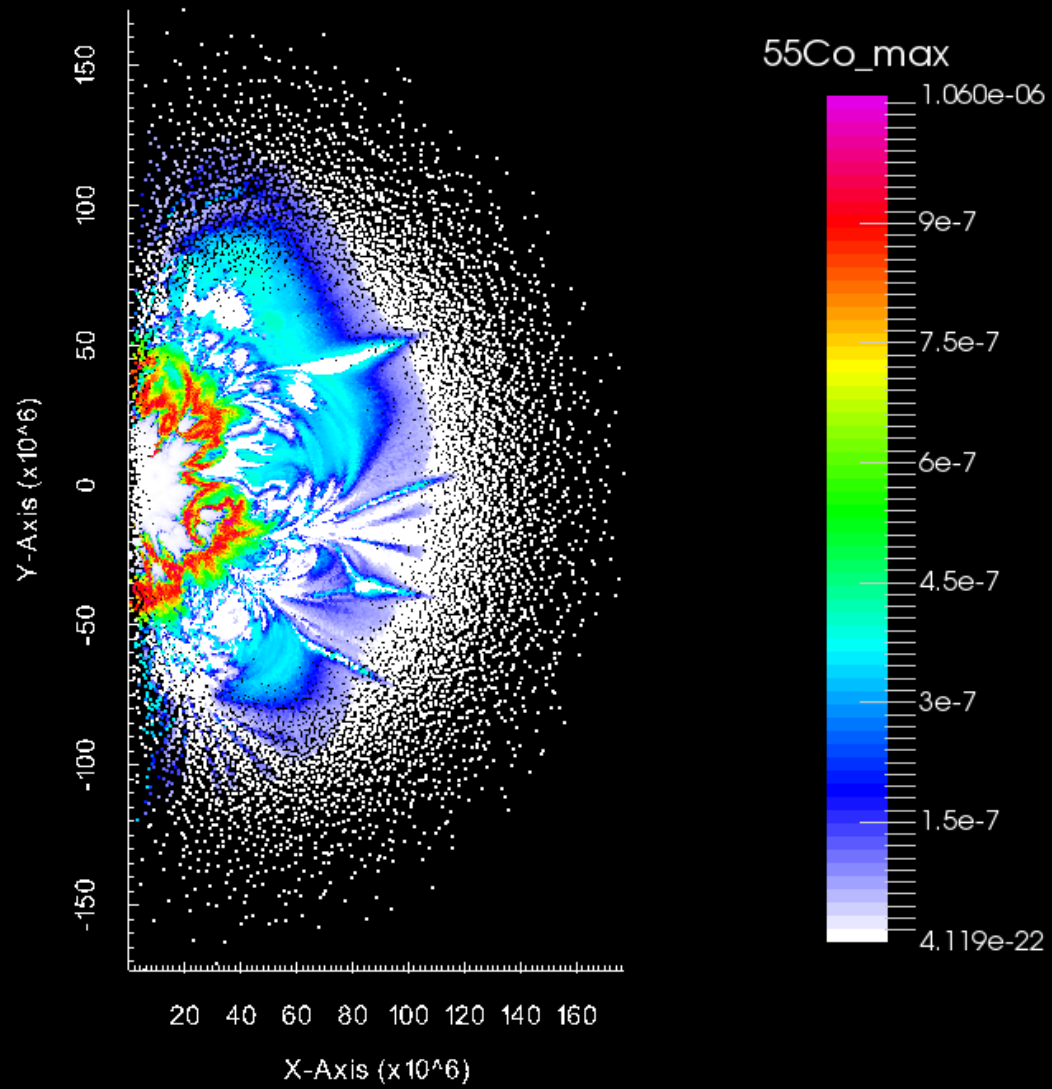
(Travaglio et al. 2011)

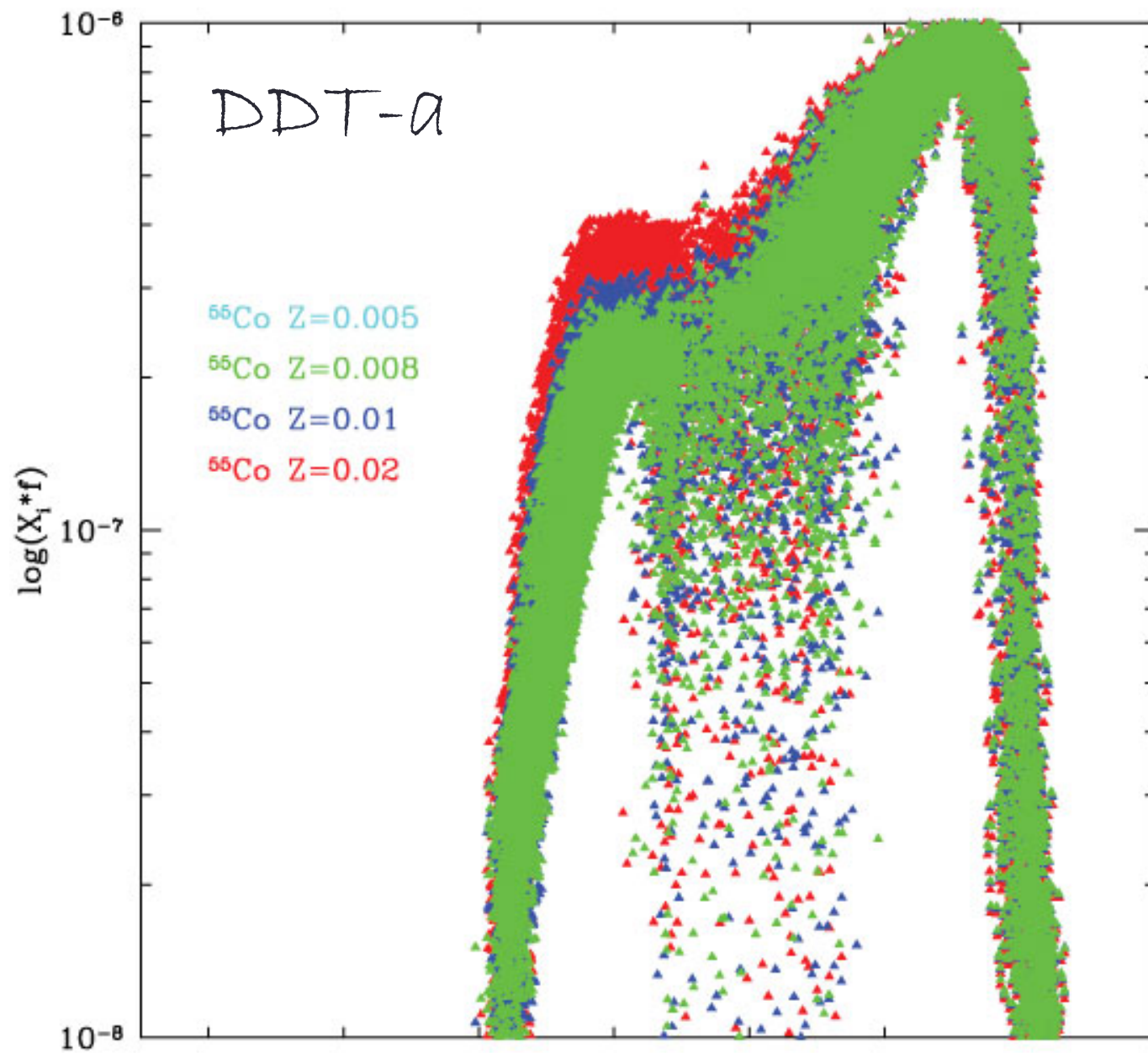


A grid of 8 metallicities is now running
4 models (DDT standard, DDT weak, DDT strong, DEF)

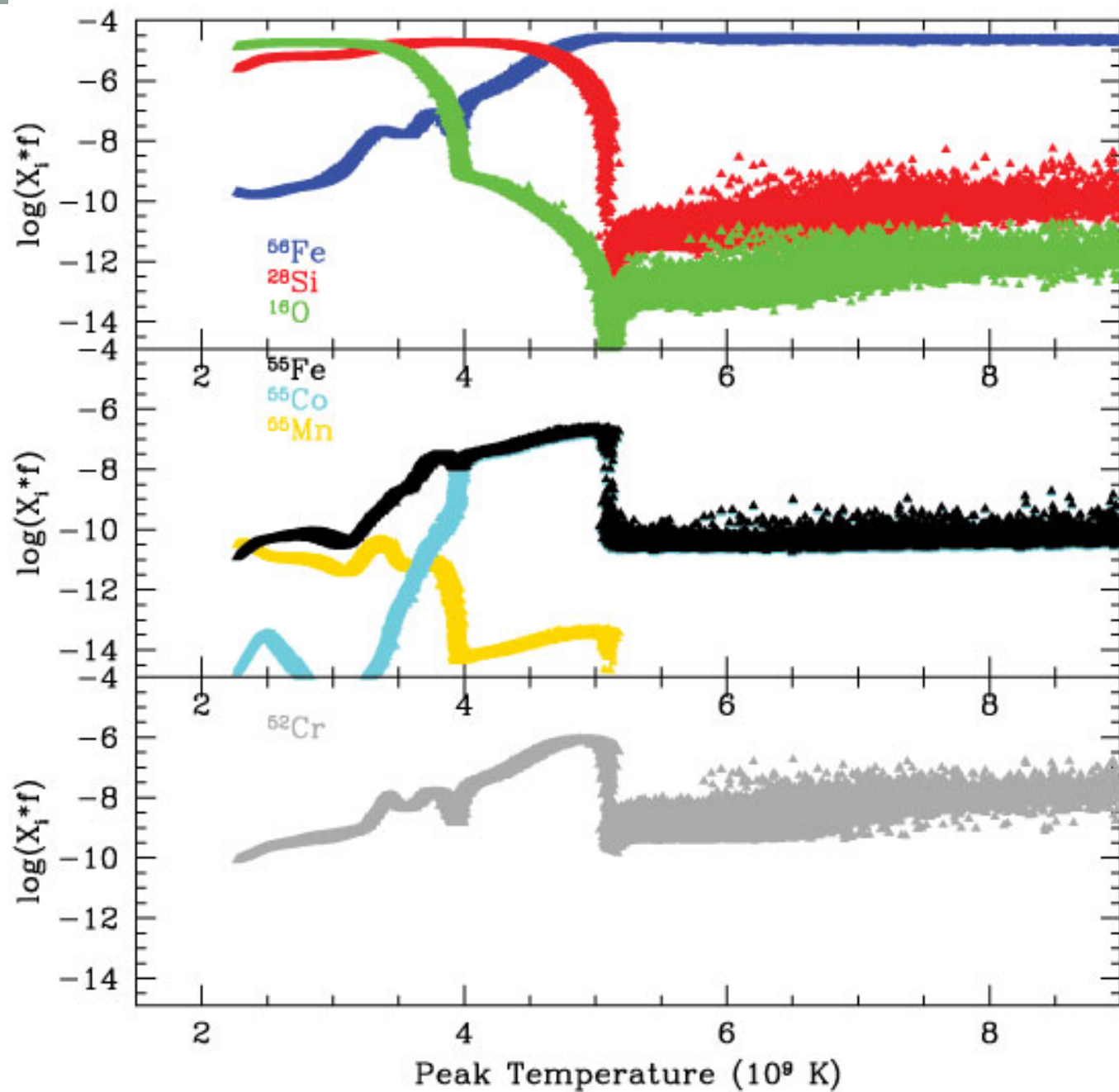
DDT-a







W15-1



Mn and Cr

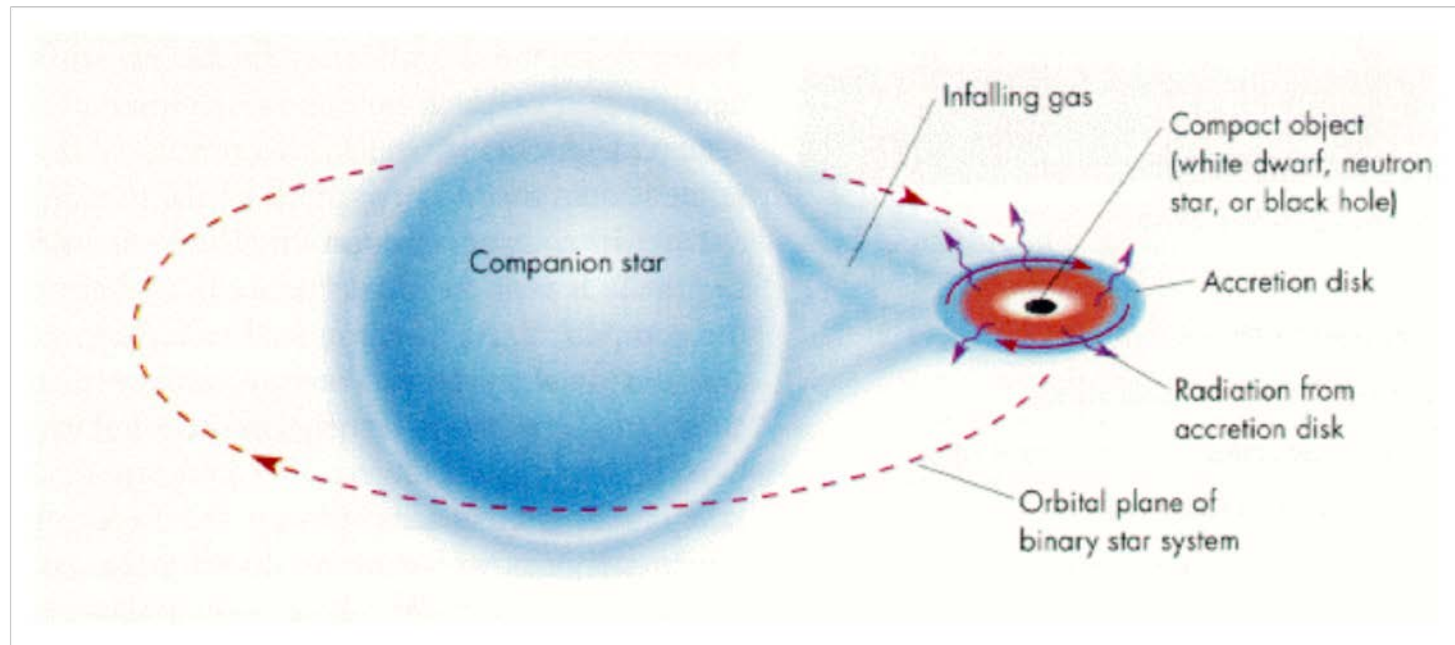
(Bravo, A&A 2012, Seitenzahl et al. A&A 2013)

p-process

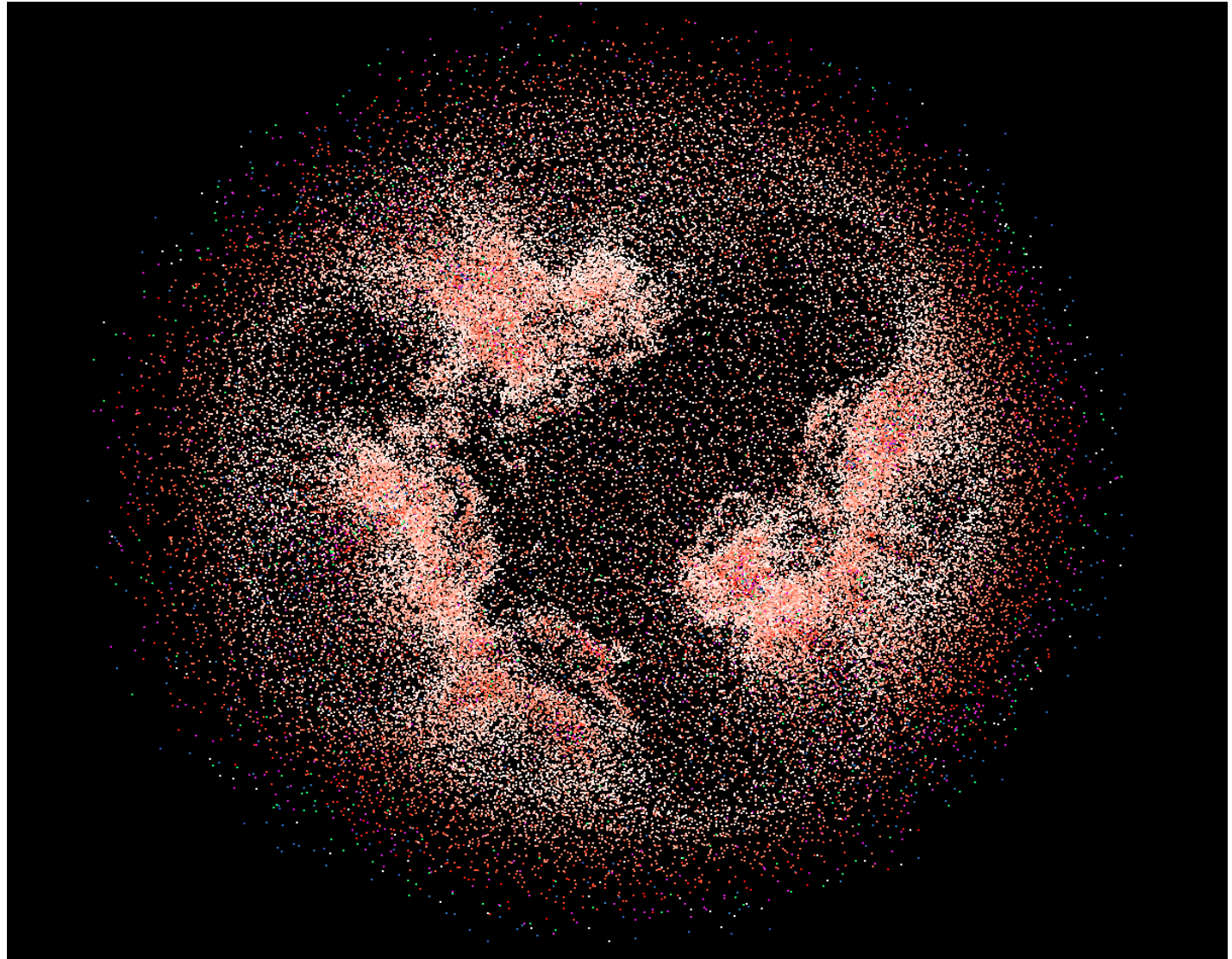
(Travaglio et al. ApJ 2015)

s-nucleosynthesis during accretion phase

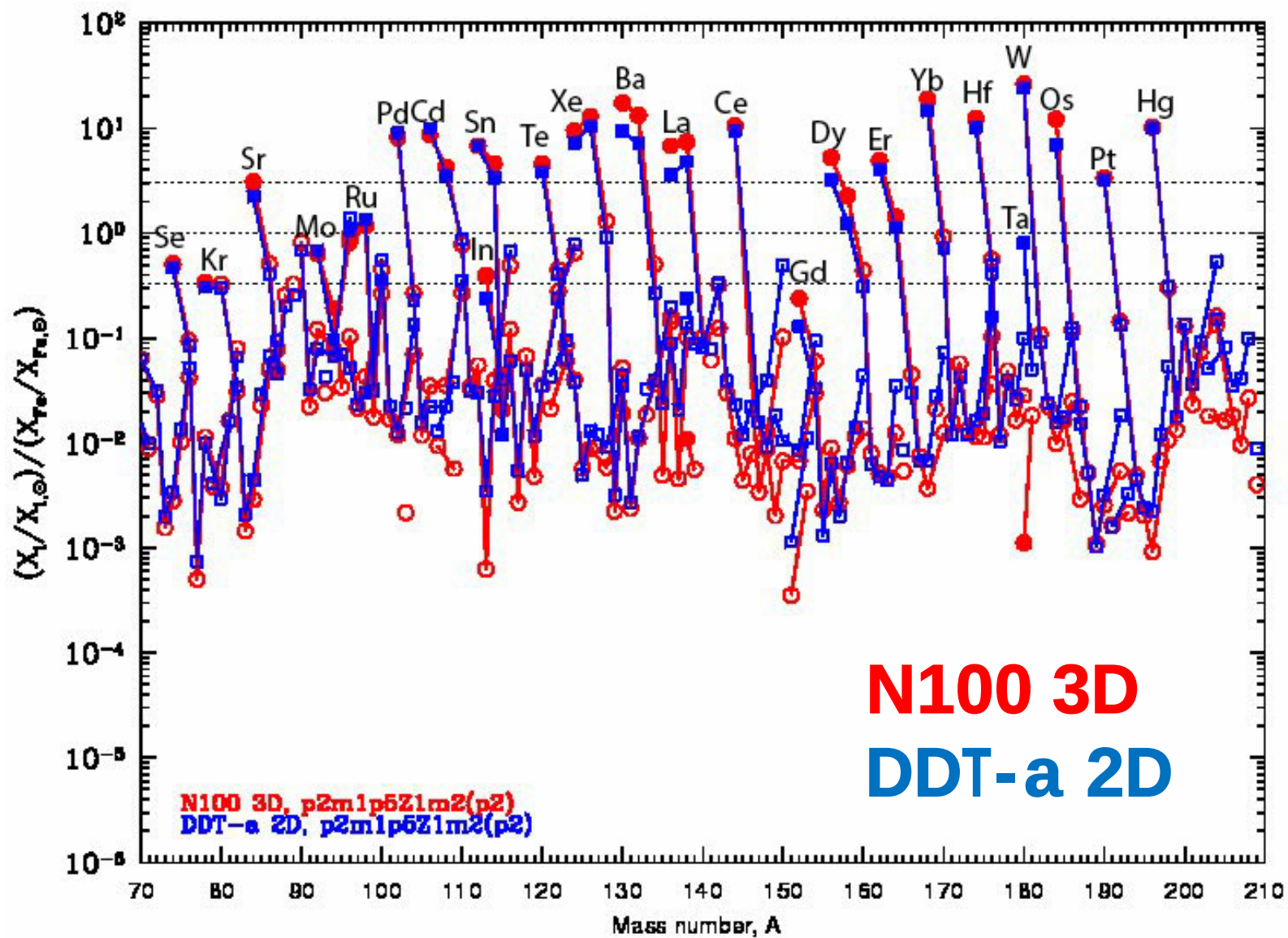
“Accreting white dwarfs as an alternate or additional source of s-process isotopes” (Iben, ApJ 243, 1981)



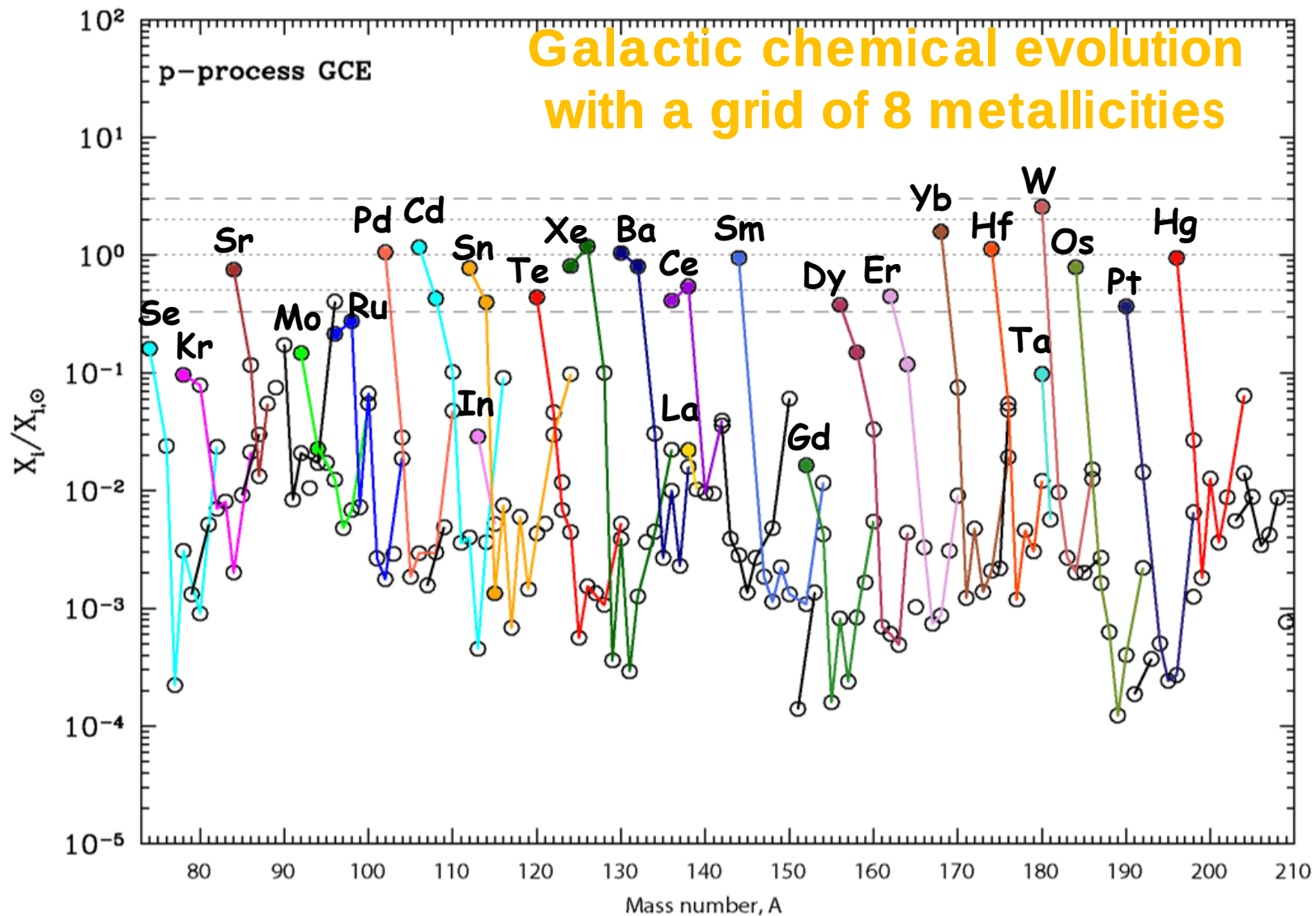
3D SNIA
1 million
tracers



Seitenzahl et al. (2013, MNRAS 429,1156)



Galactic chemical evolution with a grid of 8 metallicities



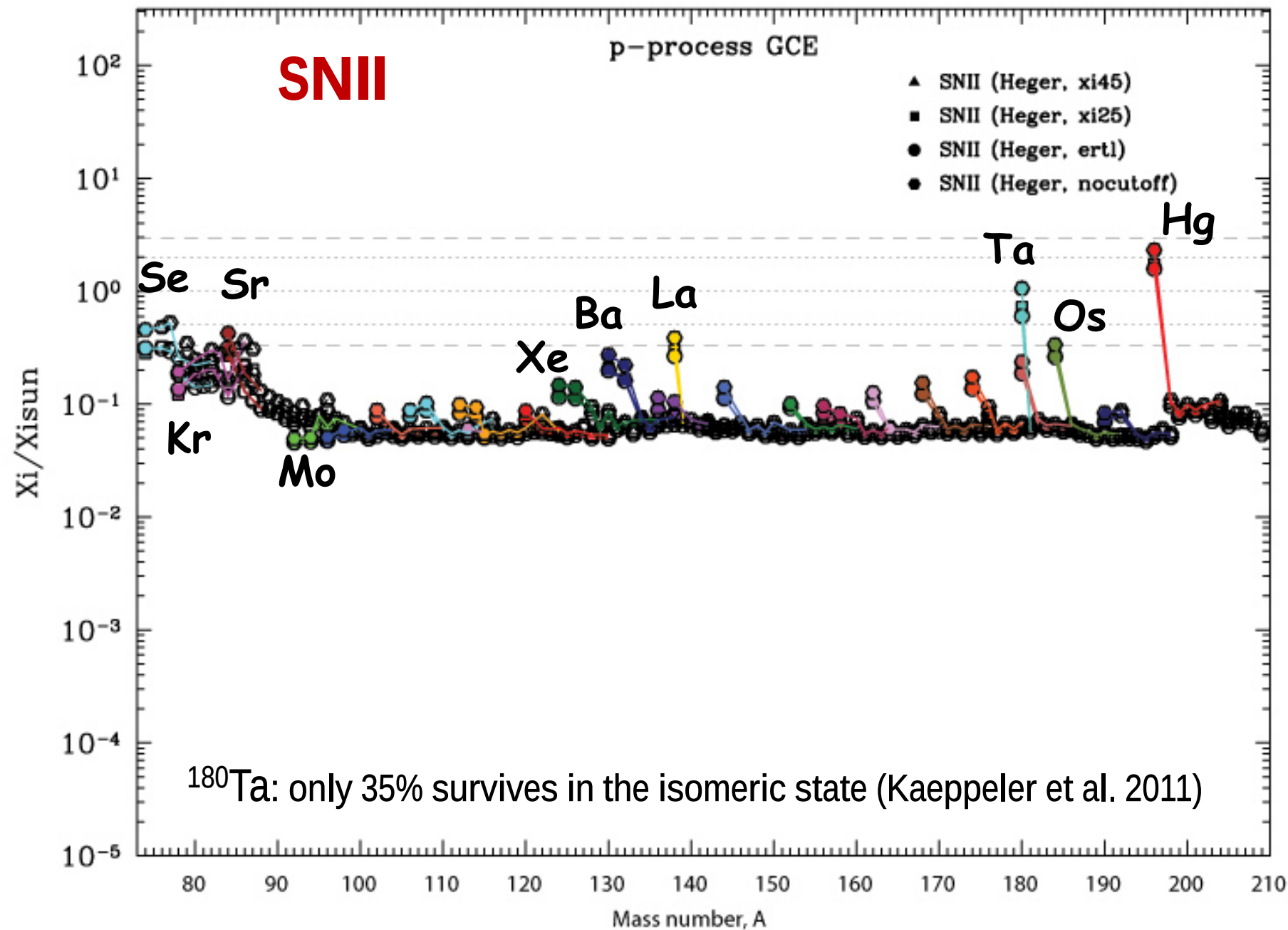
Travaglio et al. (2015, ApJ, 799, 54)

SNII: models from A.Heger

xi45,xi25,ertl,nocutoff

A grid of 14 metallicities has been used.

Masses included: $13M_{\odot}$, $15M_{\odot}$, $17M_{\odot}$, $20M_{\odot}$, $22M_{\odot}$,
 $25M_{\odot}$, $30M_{\odot}$



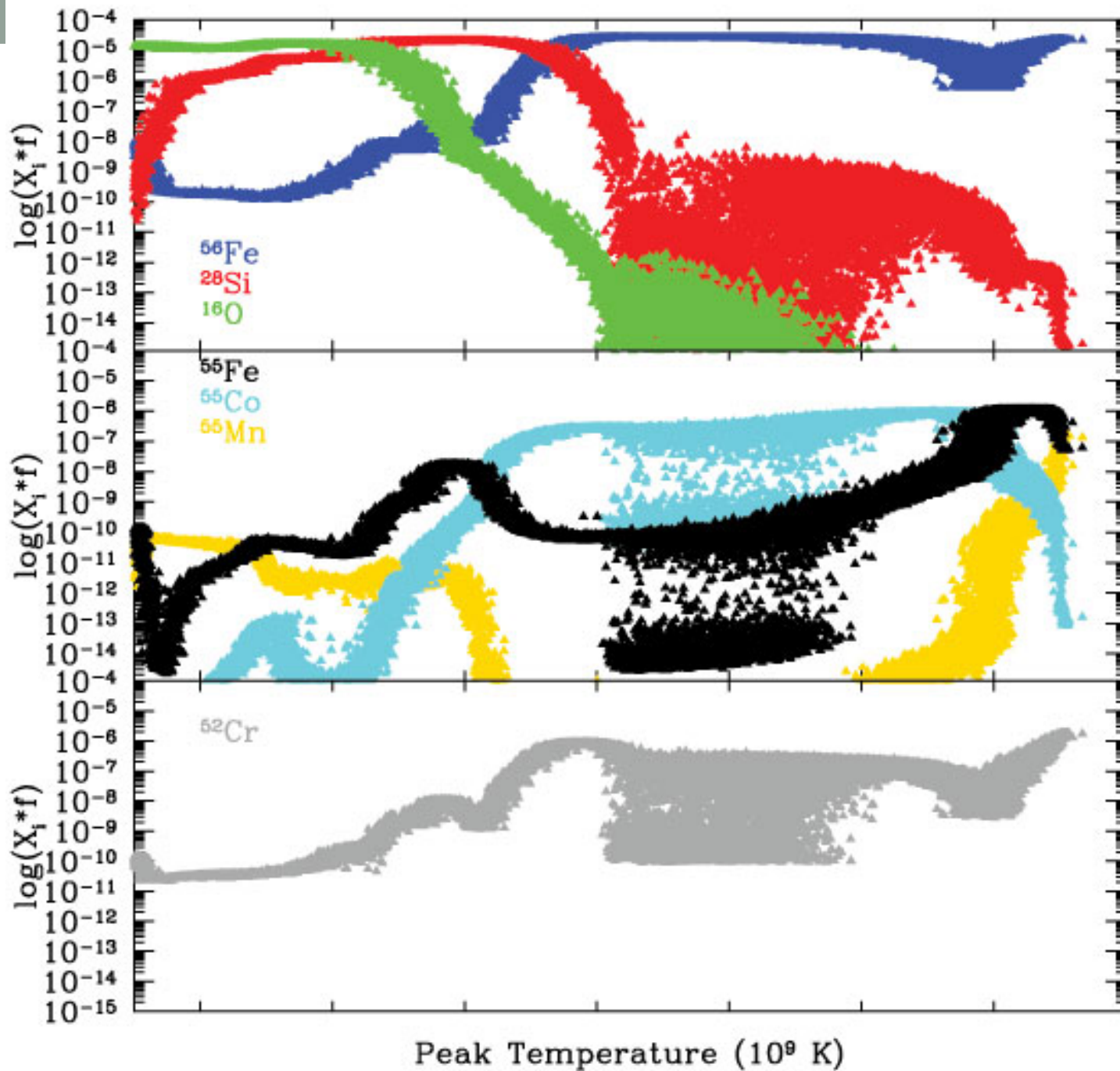




Delayed detonation DDT-a

	Z = 0.02	Z = 0.01	Z = 0.008	Z = 0.005	Z = 0.001
^{52}Cr	1.1562D-02	1.2014D-02	1.2181D-02	1.2580D-02	1.2828D-02
^{55}Mn	1.2120D-05	1.1663D-05	1.1570D-05	1.1371D-05	1.1250D-05
^{55}Co	1.1760D-02	1.0100D-02	9.5805D-03	8.2646D-03	7.3453D-03
		- 20% 			
^{55}Fe	2.8669D-03	2.7744D-03	2.7511D-03	2.7094D-03	2.6920D-03

DEF



Deflagration

	Z = 0.02	Z = 0.01	Z = 0.008	Z = 0.005	Z = 0.001
^{52}Cr	2.9410D-03	2.9431D-03	2.9485D-03	2.9592D-03	2.9655D-03
^{55}Mn	1.1327D-05	1.1249D-05	1.1171D-05	1.0969D-05	1.0844D-05
^{55}Co	6.9604D-03	6.6815D-03	6.5404D-03	6.2231D-03	6.0408D-03
^{55}Fe	2.6669D-03	2.6596D-03	2.6497D-03	2.6300D-03	2.6205D-03

