# 初代超新星元素合成と金属欠乏星の表面組成


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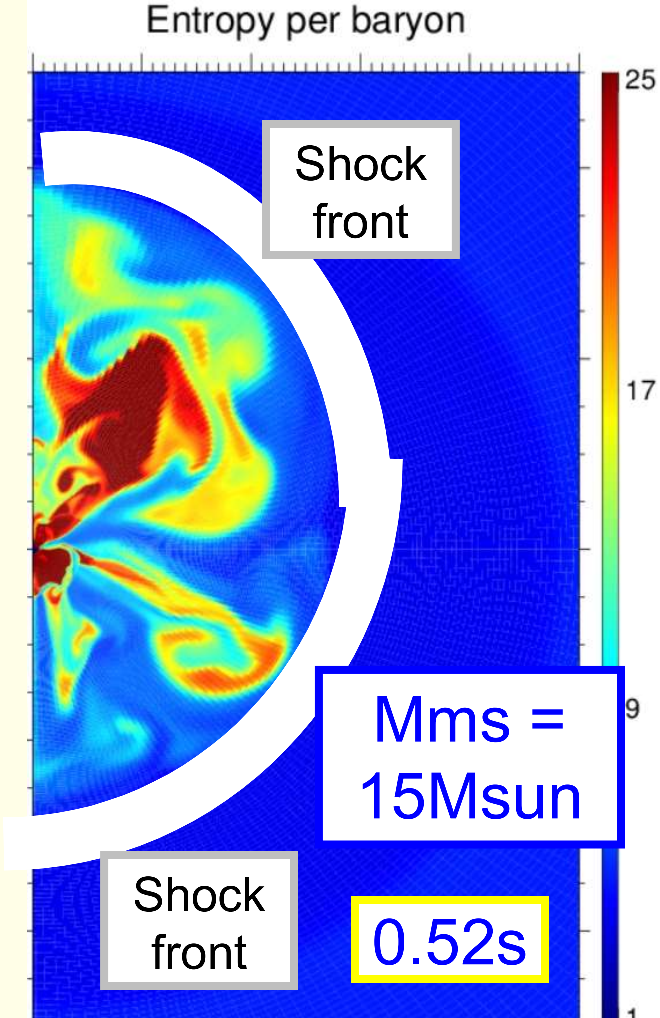



5000km x 10000km

# Summary

We have investigated nucleosynthesis in core-collapse supernovae (SNe) of 19 first stars (10-40Msun), based on 2D simulations from the core collapse to the explosion

We estimate time evolution of neutrino luminosities and temperatures from mass accretion rates, employed with a ν-core model,
whose parameters are set to induce early phase explosion
← For Z=Zsun progenitors, we have shown (Fujimoto+18)
- ~20Msun progenitor with SN1987A-like explosion
- reproduce to the solar abundances

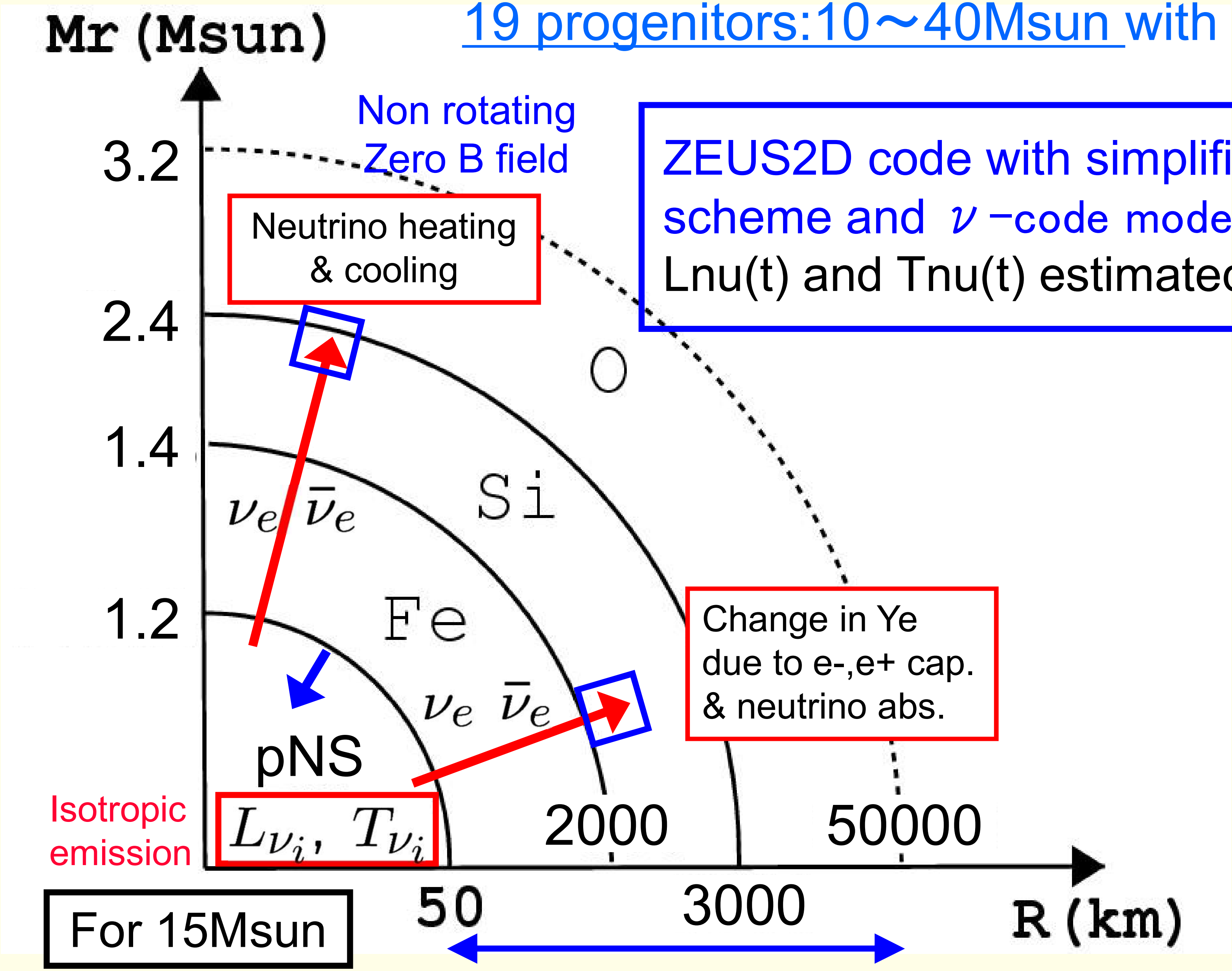
For the $\nu$−core model, we find that
IMF-averaged abundances from SN ejecta of (10-40)Msun first stars
- well reproduce averaged abundances of metal poor stars (MPSs).
- are greater than spherical models for K, Sc, and Mn.

Abundances of an individual SN
- reproduce observed abundances of a MPS.
- Reproduce observed abundances of extremely Carbon-enhanced MPs ([C/Fe]>1.5), if fallback is taken into account.

# 2D Simulations of Supernovae

19 progenitors:10～40Msun with Z=0 (HW10)

ZEUS2D code with simplified-ν light-bulb scheme and ν−code model
Lnu(t) and Tnu(t) estimated from Mdot(t)




Computational region (0-π in θ direction)

# ν −Core model

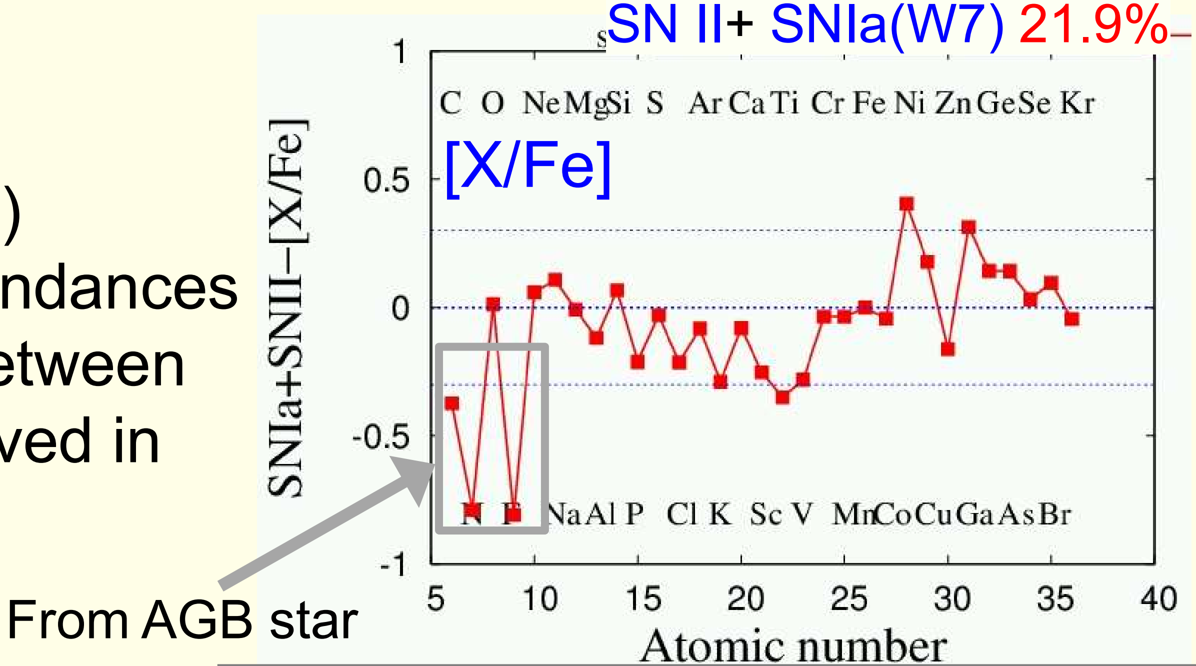
Time evolution of neutrino luminosities and temperatures,
estimated from mass accretion rates with ν −Core model
(similar to Ugliano+12, Sukhbold+16)

Two parameter of ν −core model: Γ & f_surf

Adopted parameters in this study: (Γ =1.7 & fsurf=0.5)
which induce early phase explosion (0.2-0.4s after the core bounce)

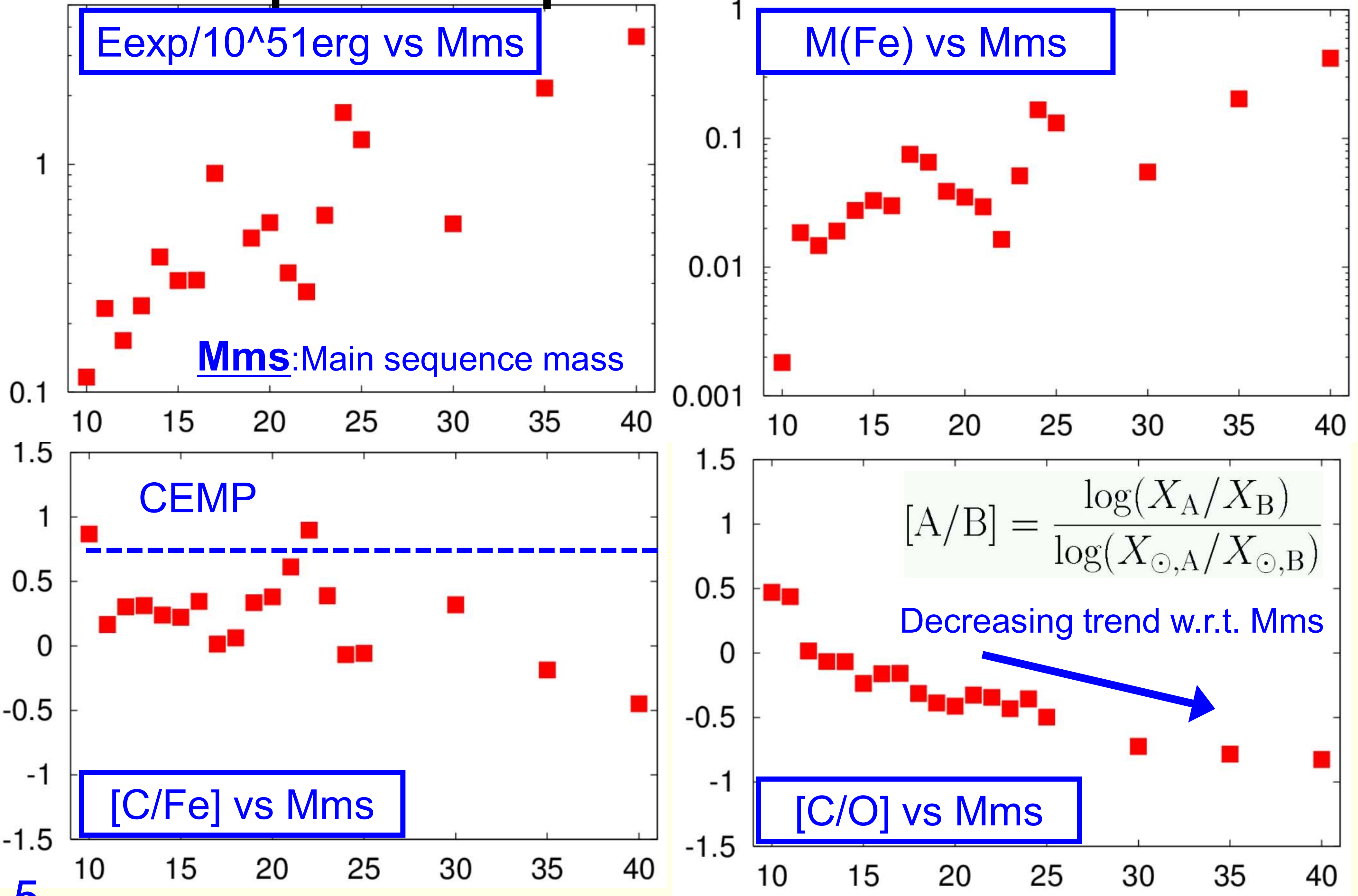
For Z=Zsun progenitors
(Fujimoto+18)

- SN1987A-like(～20Msun)
- Reproduce the solar abundances
- Reproduce correlation between M(56Ni) and Eexp observed in Type IIp SNe



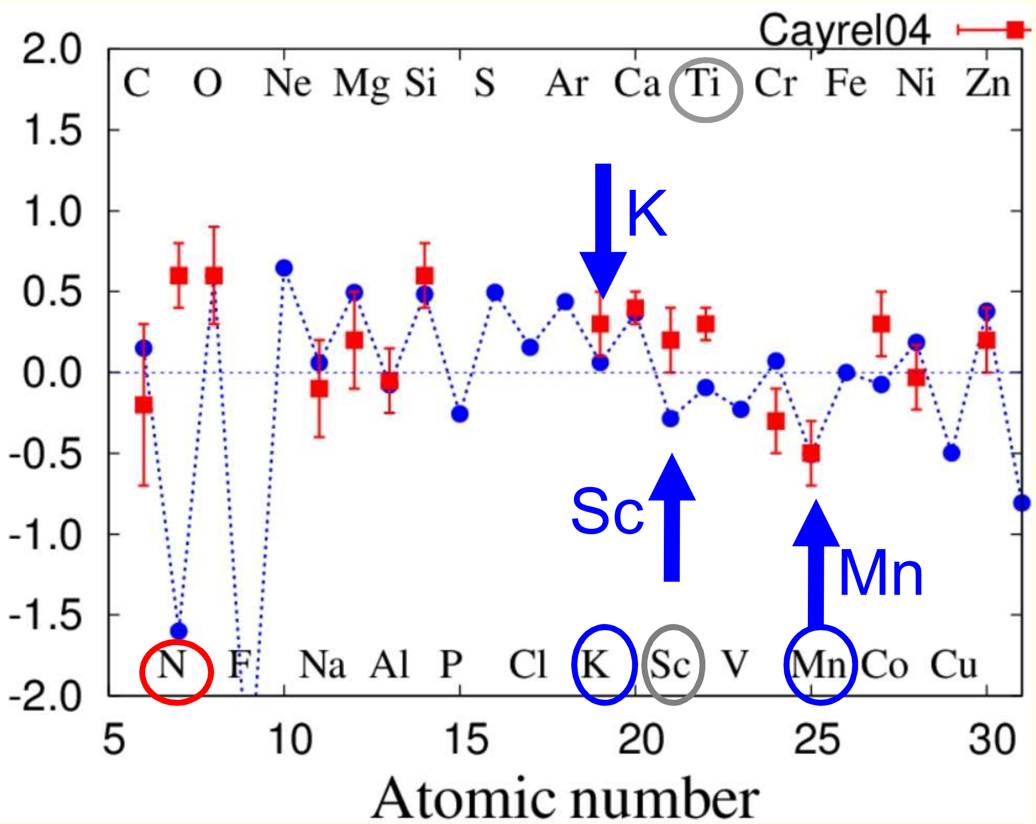

Observed SNIa rate: (19.0±8.2)% (Li+11)

# Complex dependences on Mms



# Comparison to averaged abundances of Metal Poor Stars

IMF averaged [X/Fe] of our 2D model




■: Observed abundances (Cayrel+04)

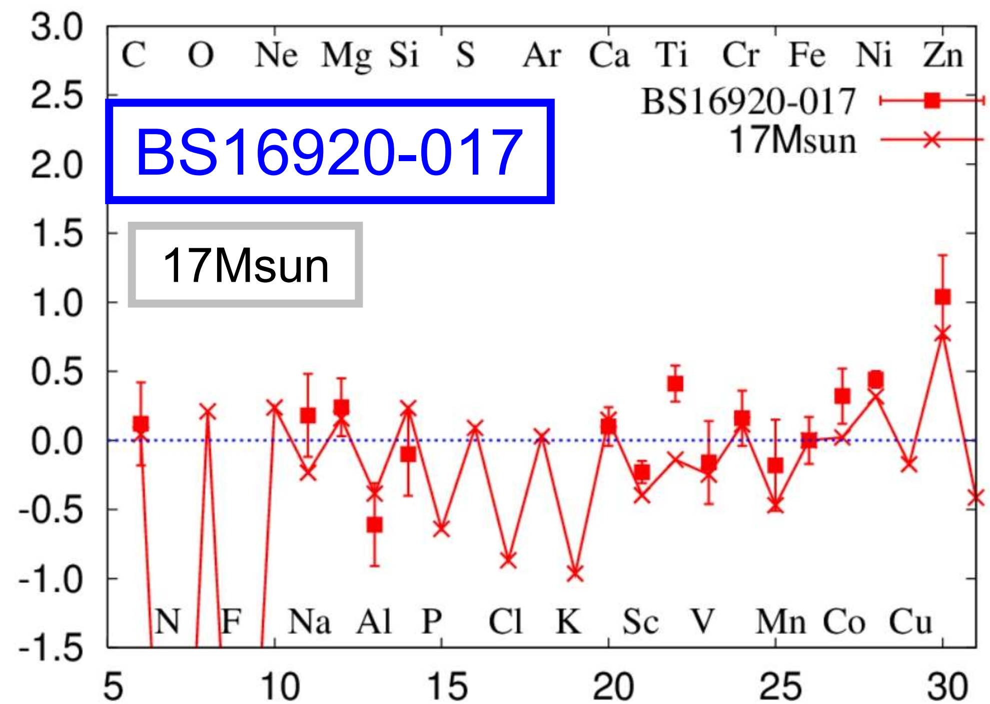
●: Our Z=0 2D model IMF average of (10–40) SNe

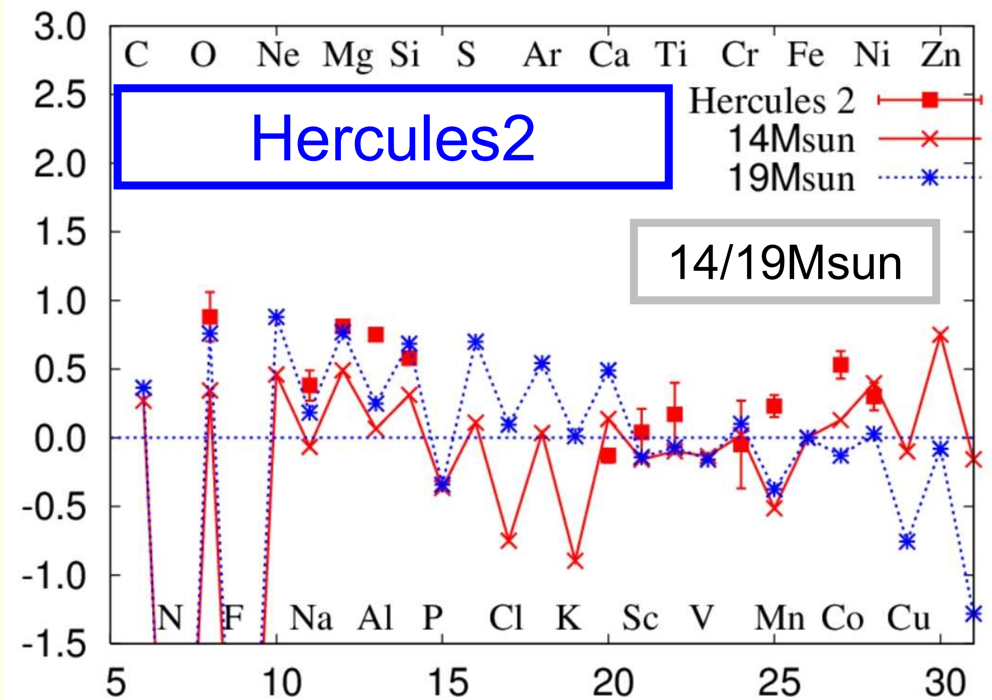
$$[A/B] = \frac{\log(X_A/X_B)}{\log(X_{\odot,A}/X_{\odot,B})}$$

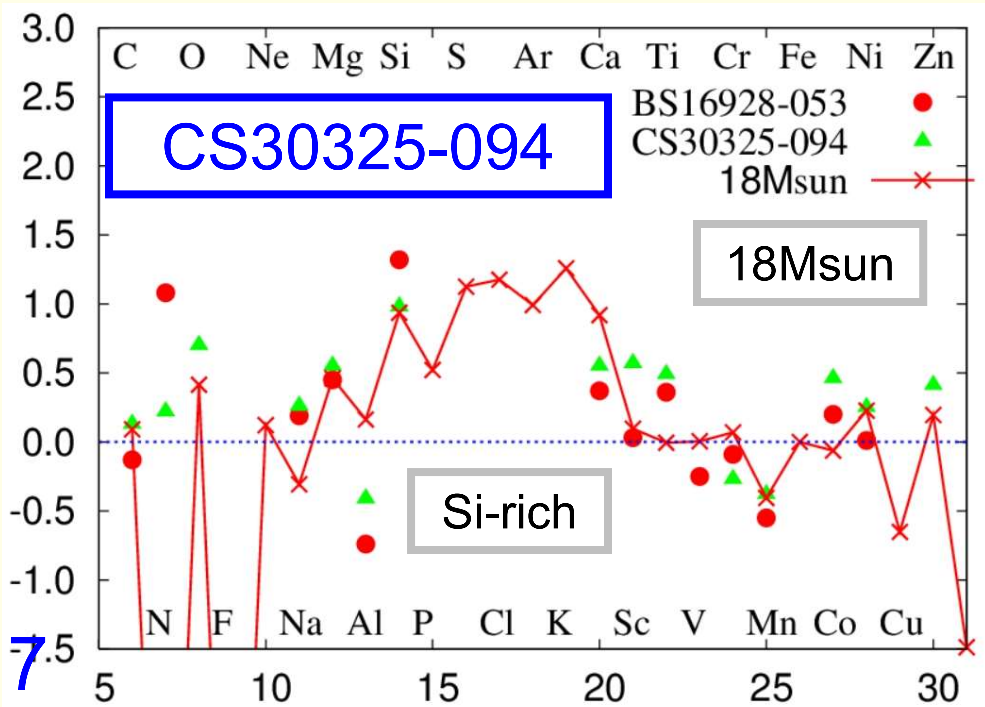
Reproduce averaged abundances of metal poor stars (MPSs)

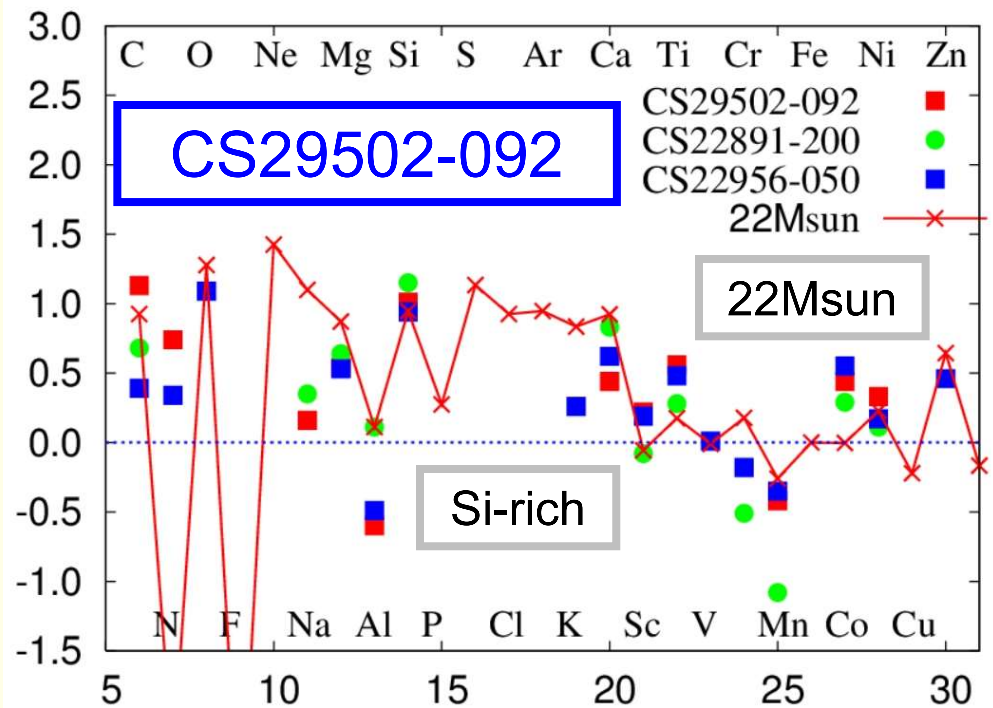
- K: Good. Produced in Si-rich layer
- Mn: Good. enhanced via $\nu$ reactions
- Sc: Greater than 1D, produced in high-s gases but underproduced.
- Ti: Comparable to 1D and underproduces.
- N: Highly underproduced. can enhanced if rotation is taken into account during the stellar evolution.

# Comparison to MPSs: [X/Fe]vs Z(1)

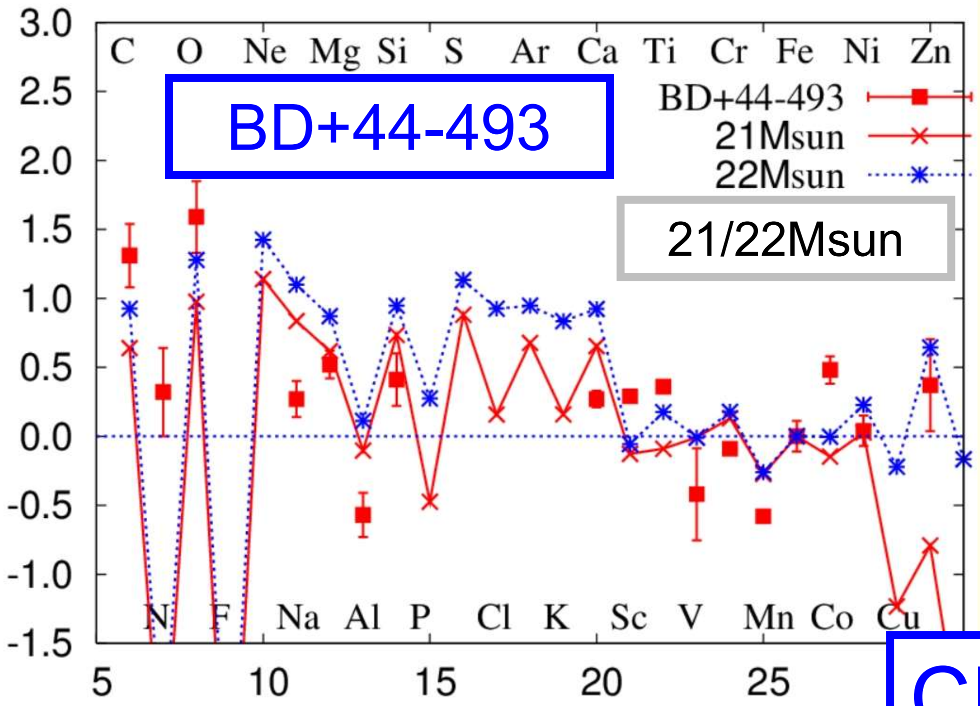


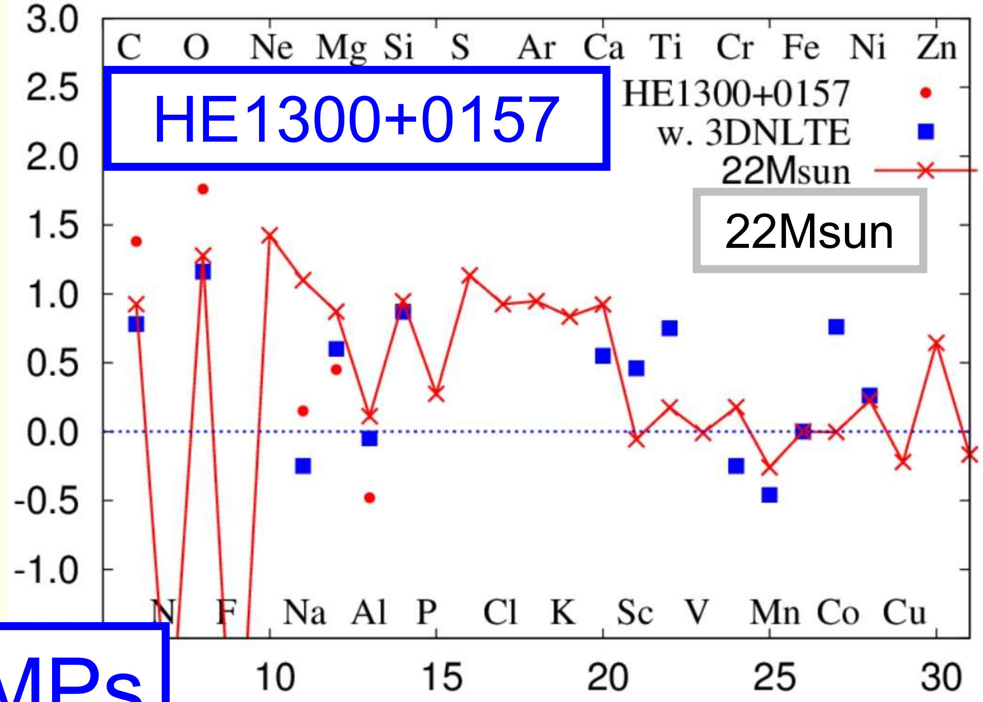



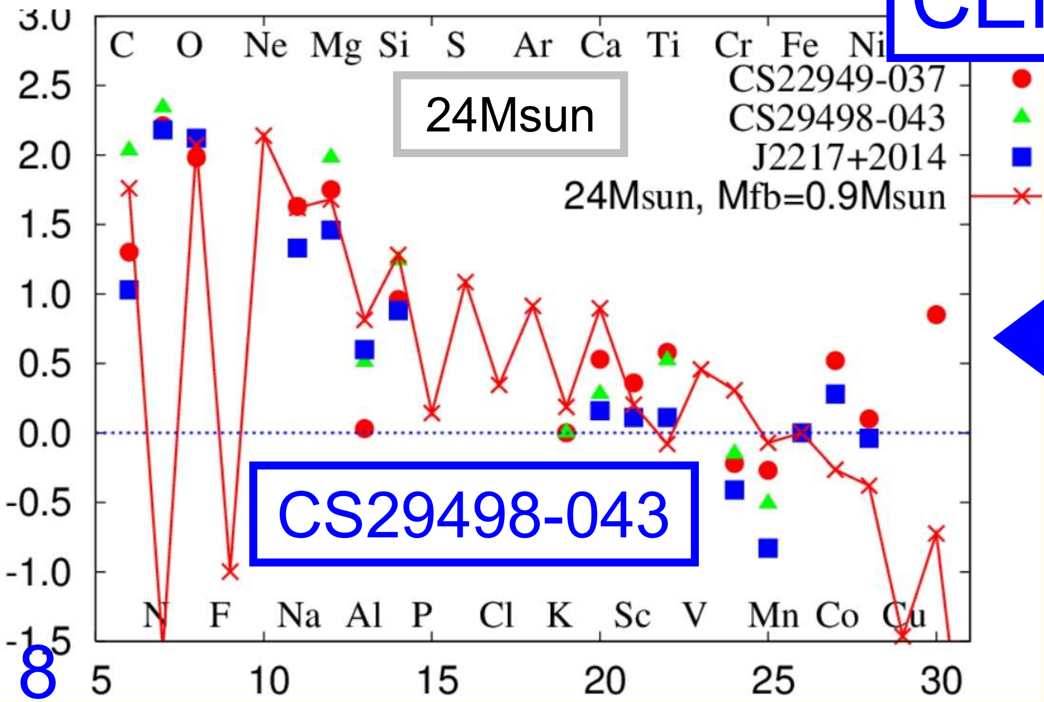



# Comparison to MPSs: [X/Fe]vs Z(2)




CEMPs




For these abundances, an arbitrarily amount (0.9Msun) of fallback is taken into account

$$[\mathrm{A}/\mathrm{B}] = \frac{\log(X_\mathrm{A}/X_\mathrm{B})}{\log(X_{\odot,\mathrm{A}}/X_{\odot,\mathrm{B}})}$$