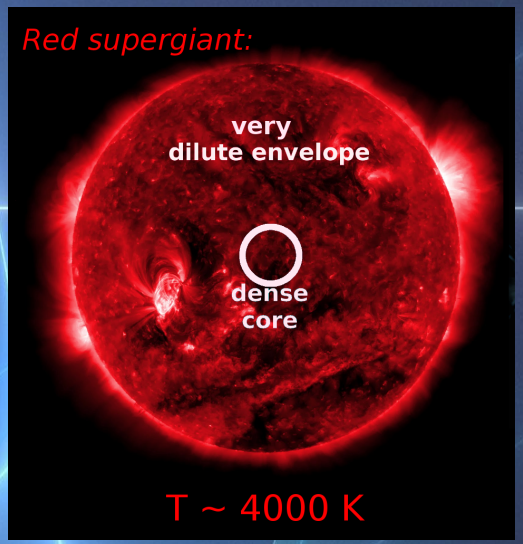
Lithium in massive stars

Dorottya Szécsi



SILCC group meeting

University of Cologne, 14th January 2020

Massive stars

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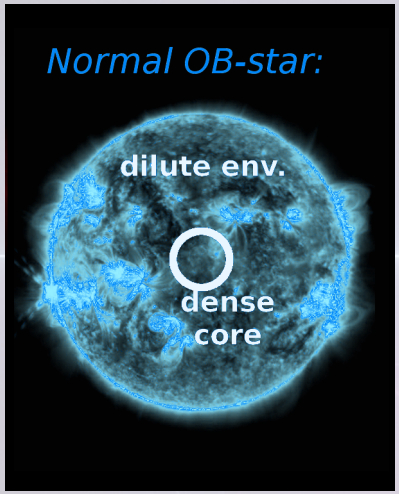
massive: > 8 times the Sun – rare but influential



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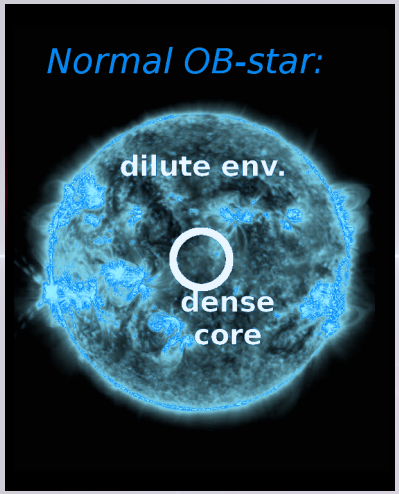
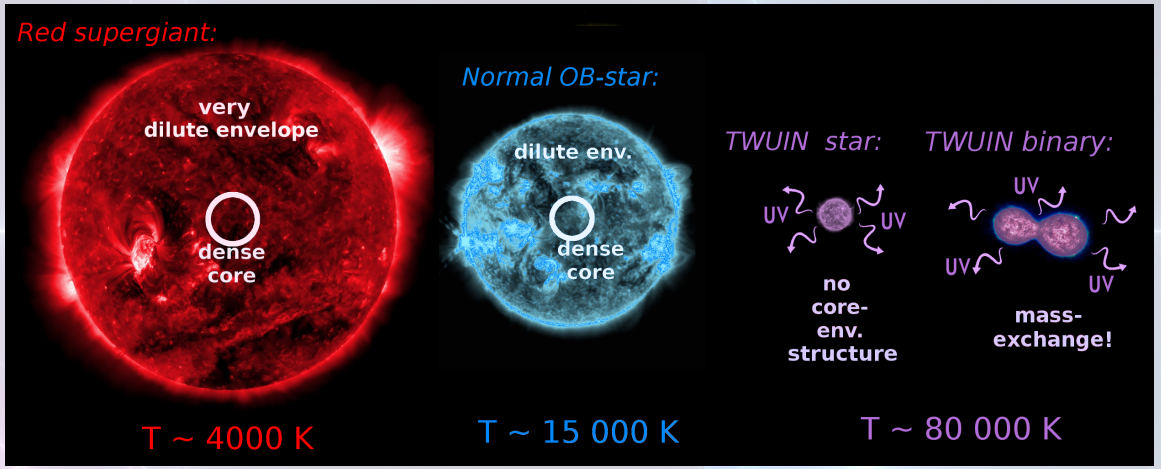


Solar $Z_{\odot}$



Metal-poor: new types predicted

e.g. Szécsi+15, Szécsi+18, Szécsi+19

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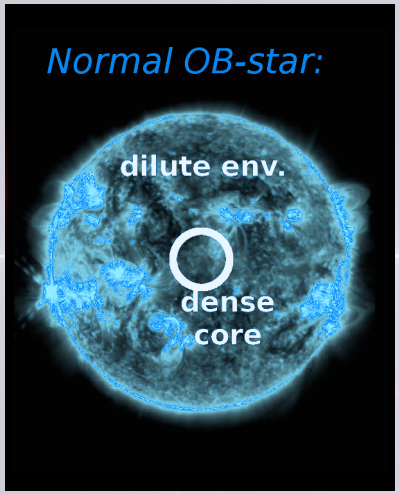

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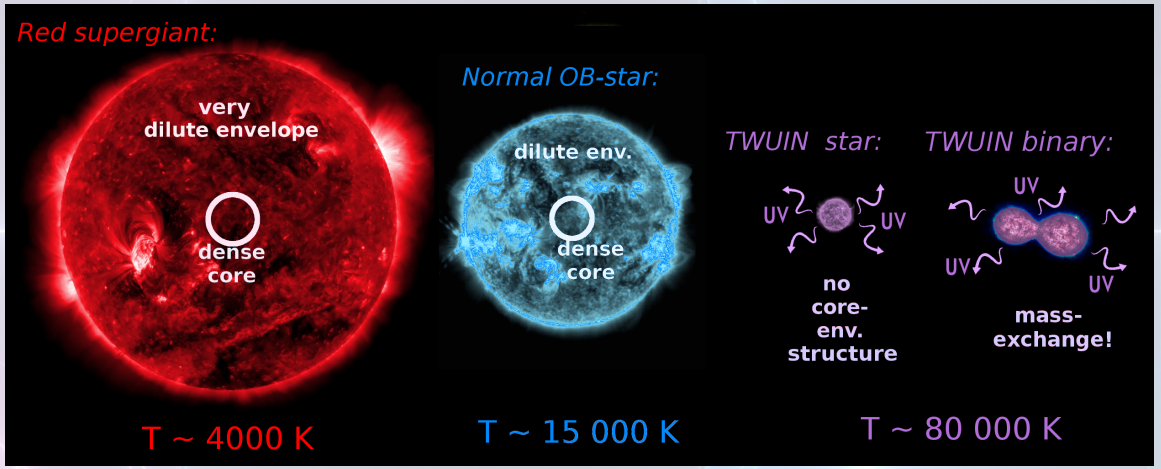

Metal-poor: new types predicted

They eject material via

- supernovae
- **stellar winds**
- binary interaction

e.g. Szécsi+15, Szécsi+18, Szécsi+19

New stars forming from the ejecta... Theories

Stellar wind's composition → nuclear burning products (hydrostatic burning! e.g. CNO-cycle, NeNa-cycle)

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- ***cool supergiants*** (e.g. Szécsi+18,19)

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Hydrostatic burning at $\gtrsim 10^6$ K $\rightarrow$ destroys Li

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HOWEVER:

e.g.
D'Orazi+10
D'Orazi & Marino'10
Shen+10
Ventura+12
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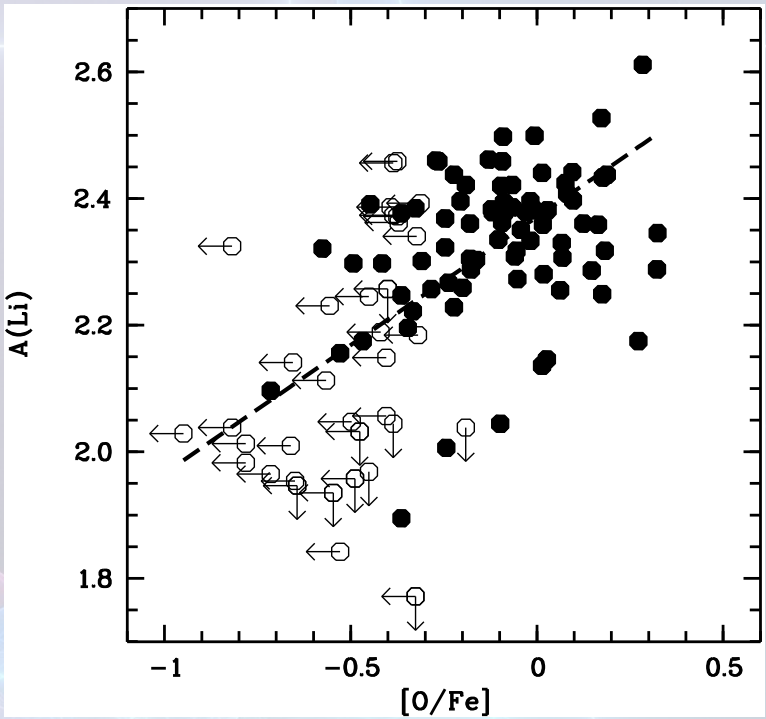

Shen+10: slope = 0.4 instead of 1.0

$\rightarrow$ polluter should *produce* it

My research on metal-poor Supergiants

Szécsi et al. (2015, A&A)
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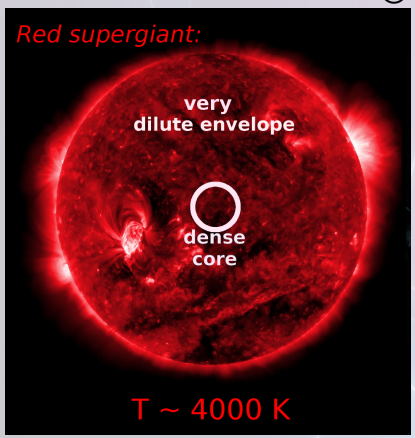

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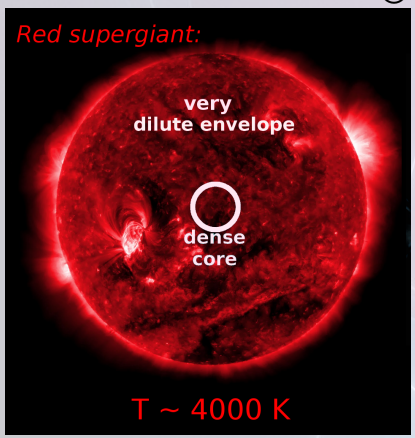

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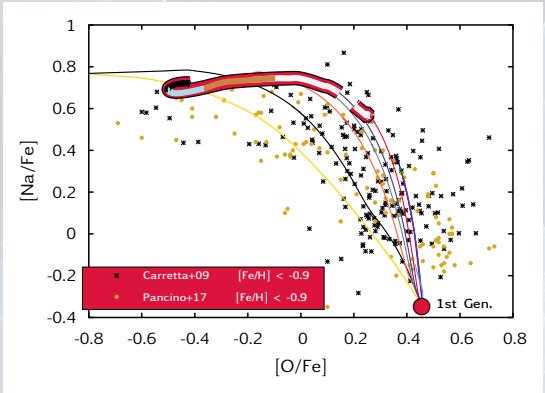

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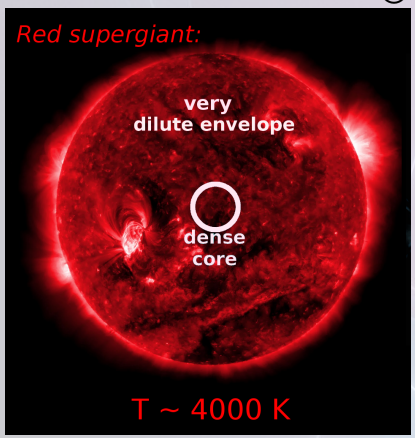

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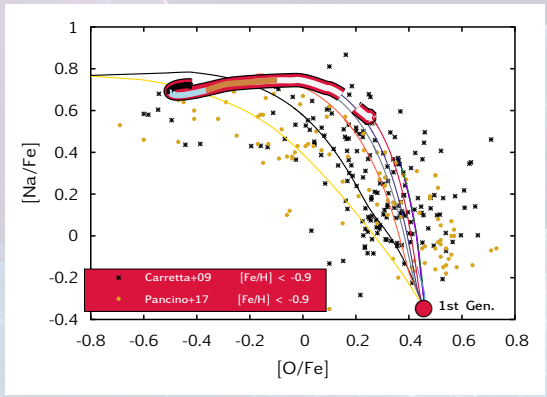
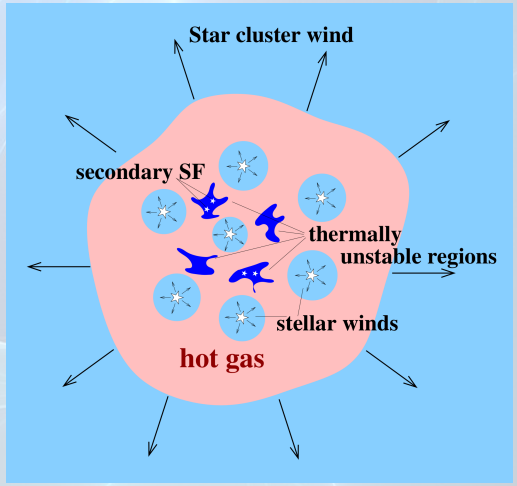


simulated populations of them forming the 2nd generation in Glob.clusters



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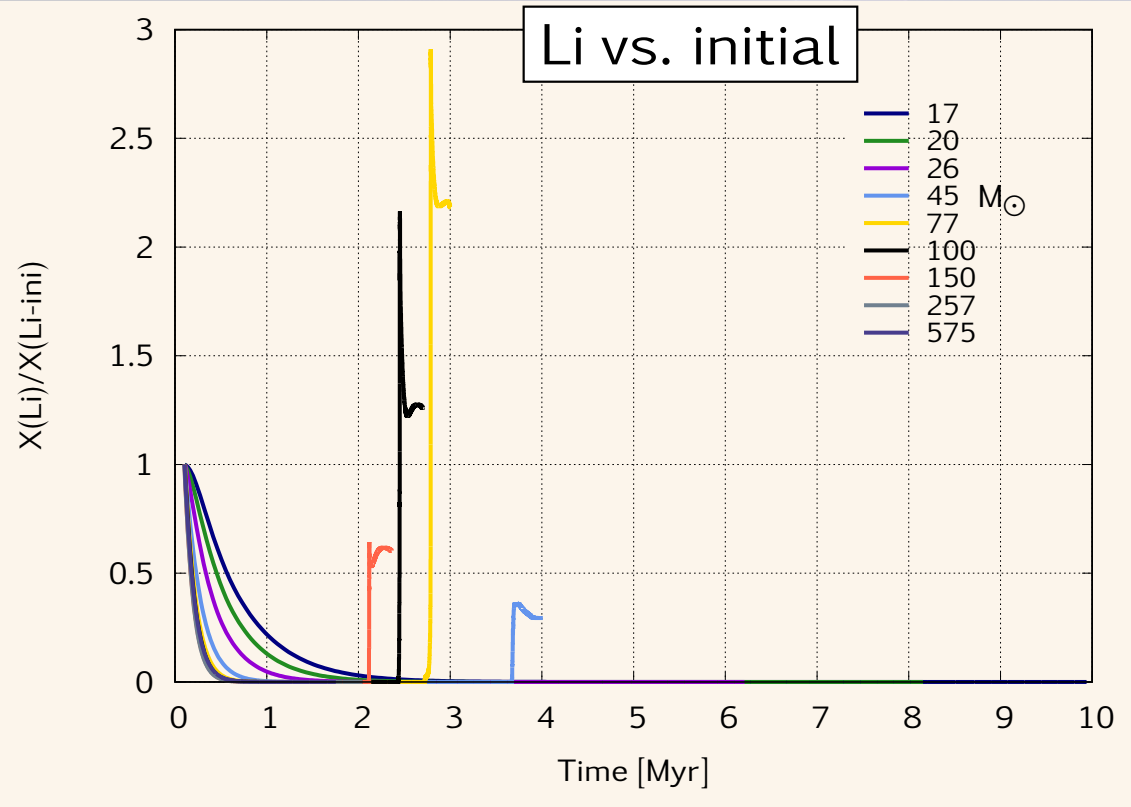

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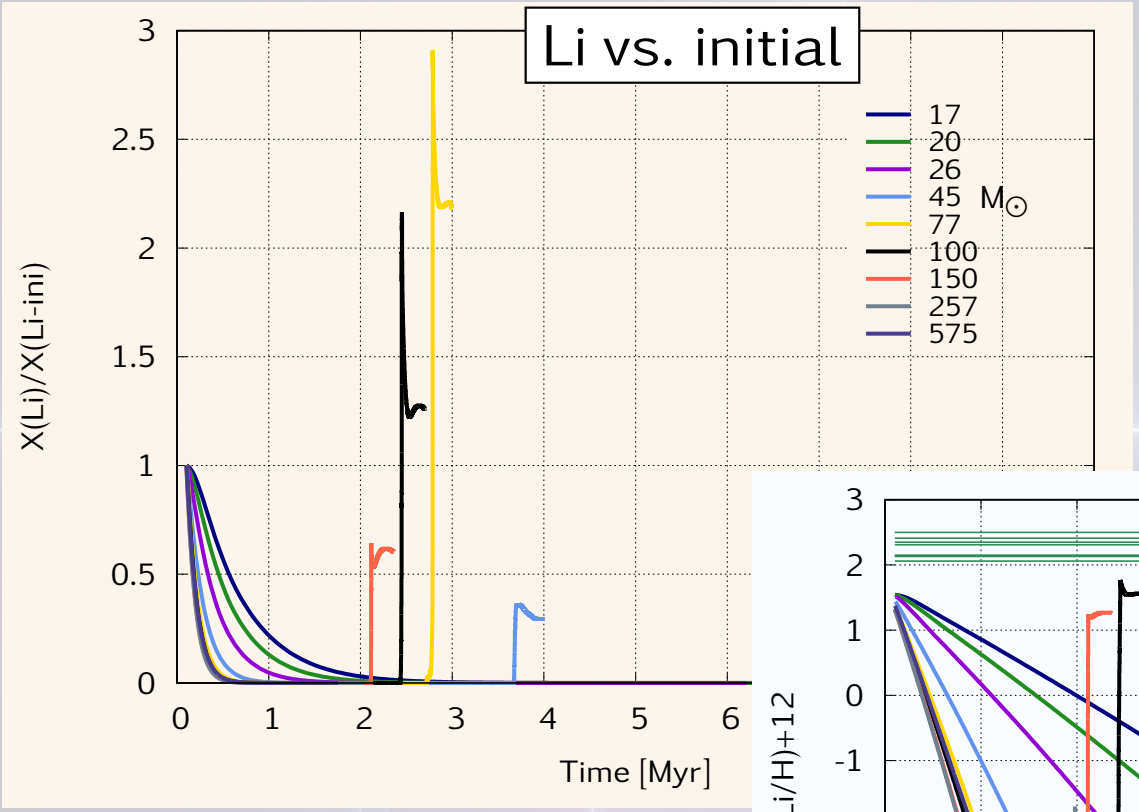

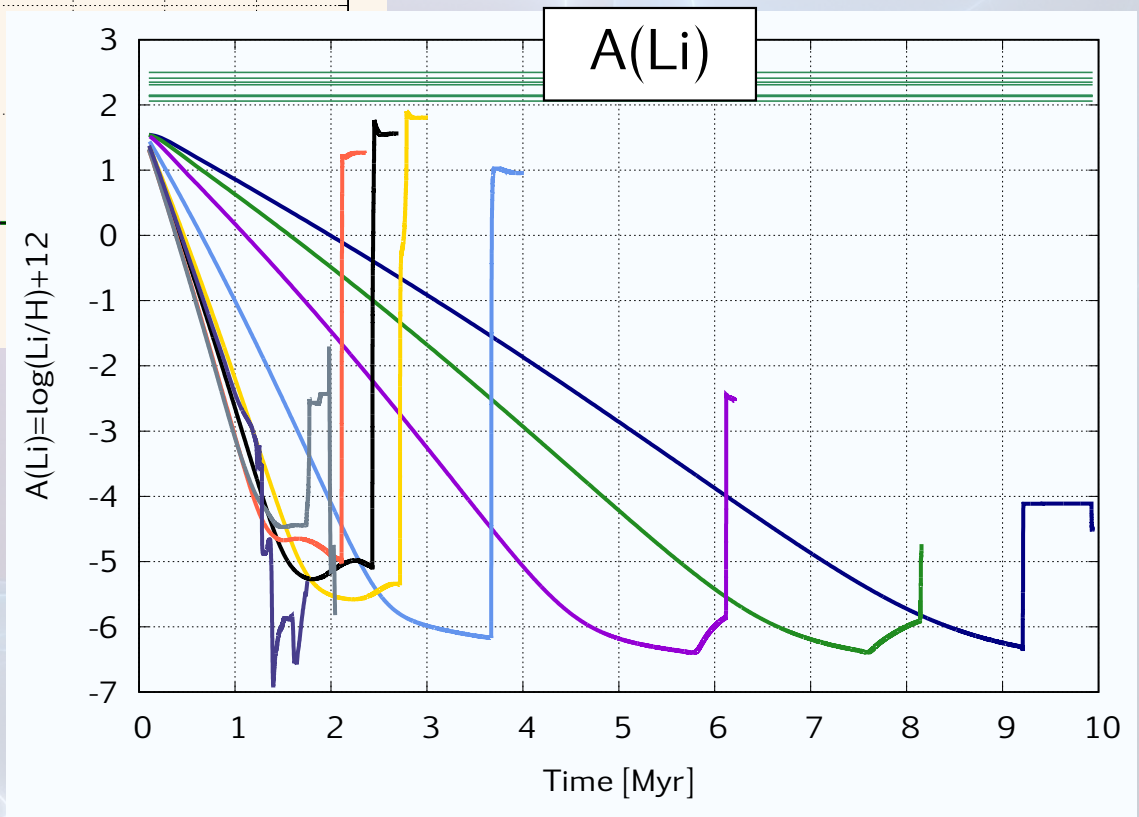

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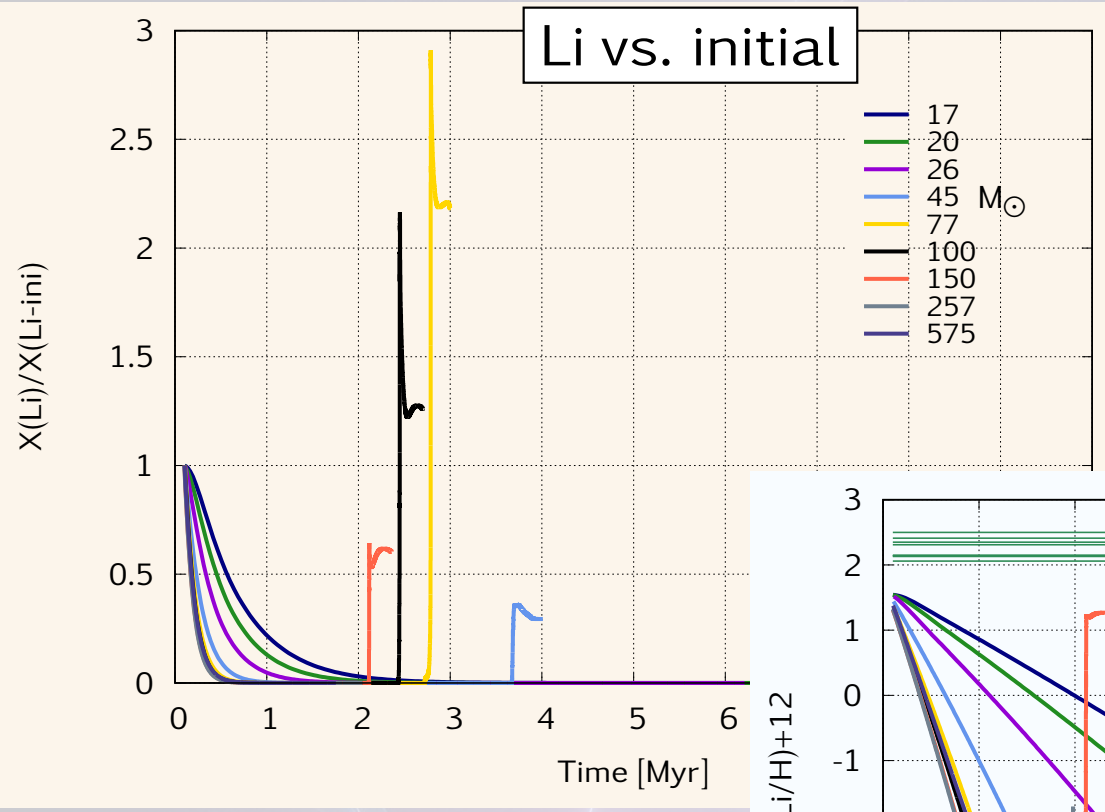


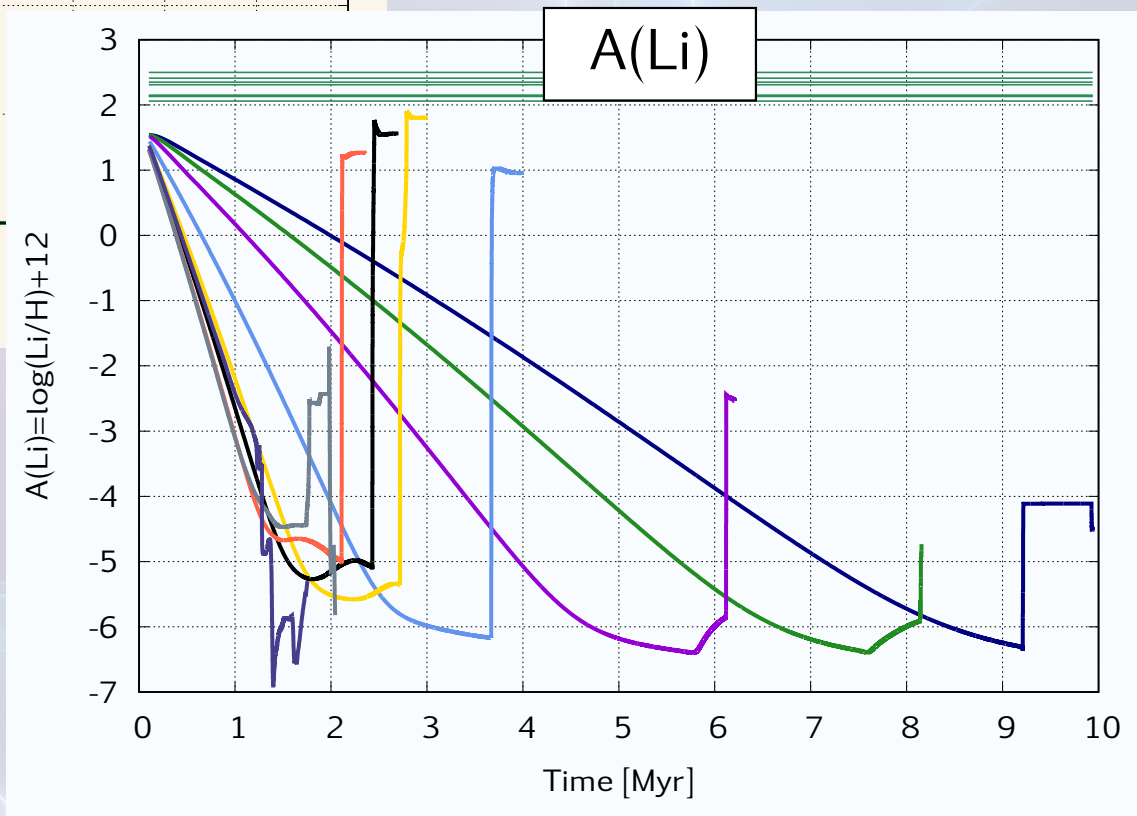
Preliminary results (Szécsi in prep.)

Mass range where it happens:
45-150 $M_\odot$

Age of cluster when it happens:
2...4 Myr

Maximal A(Li) in population: **~1.5**

Origin: *quasi* Cameron & Fowler effect



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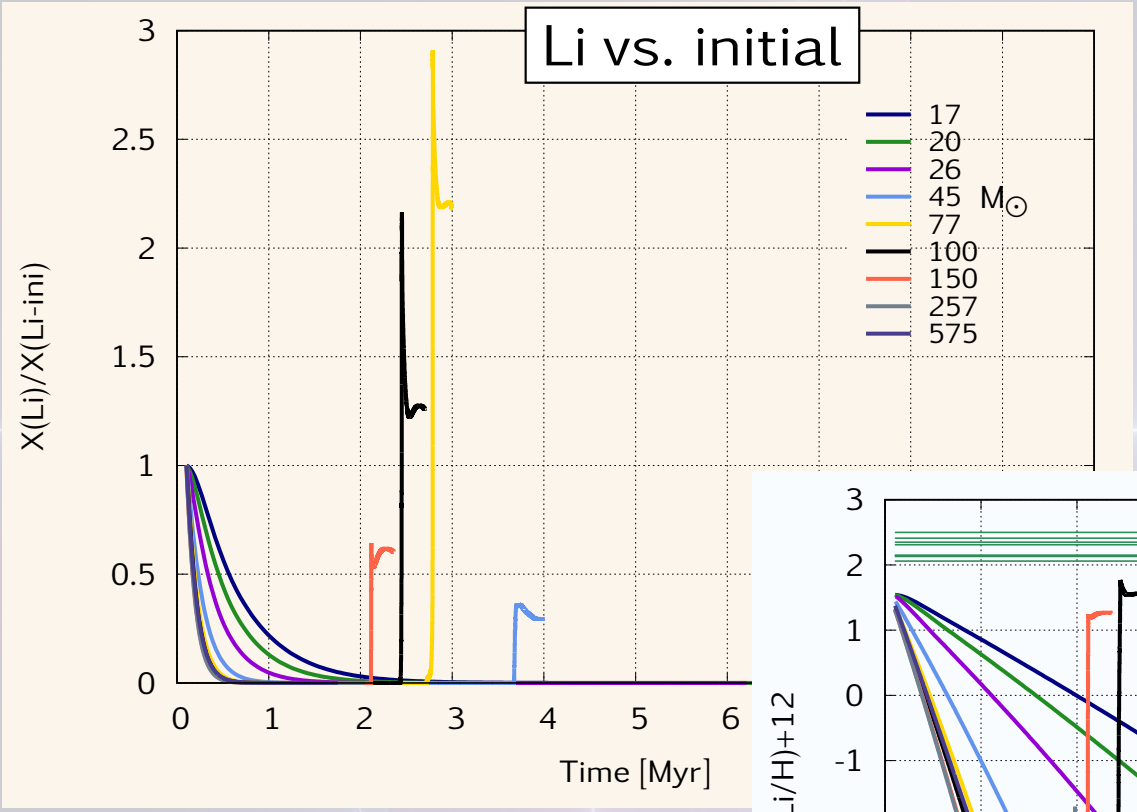

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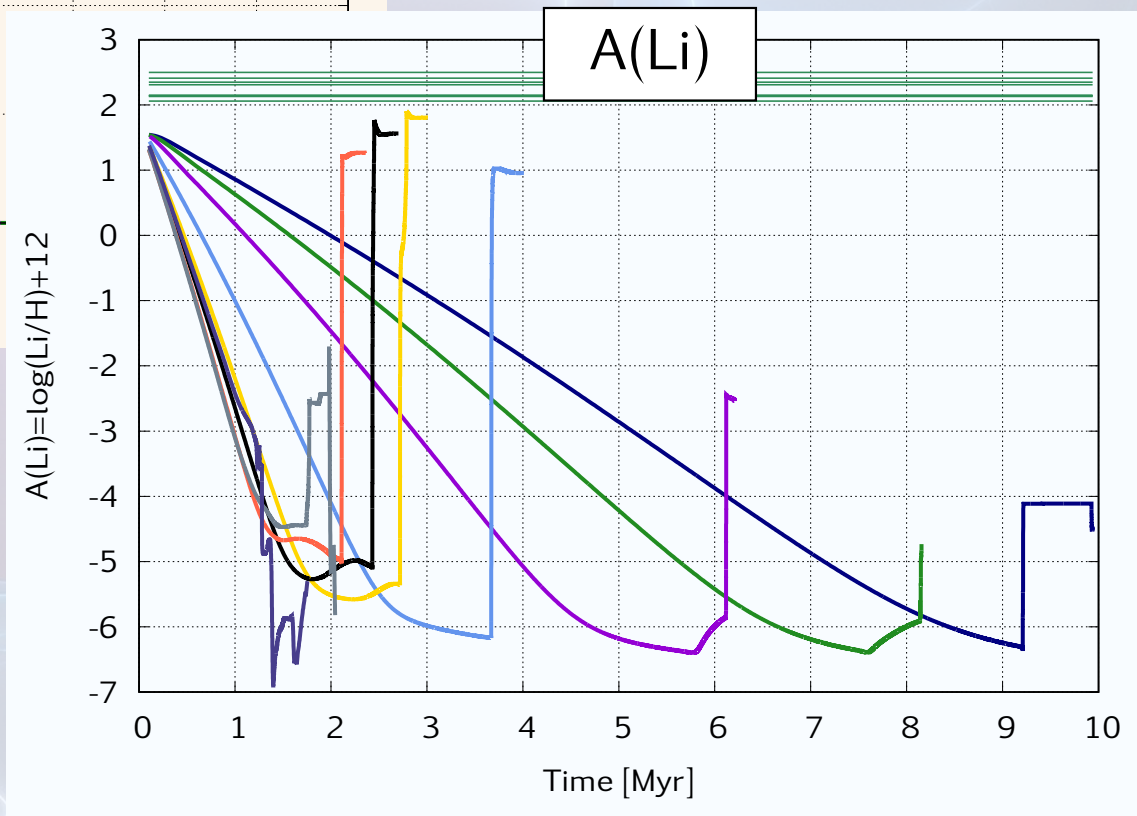

(1) H-burning shell (pp-cycle) at T ~ 50 MK

(2) convective envelope on top of it

→ dredge-up 'saves' Li

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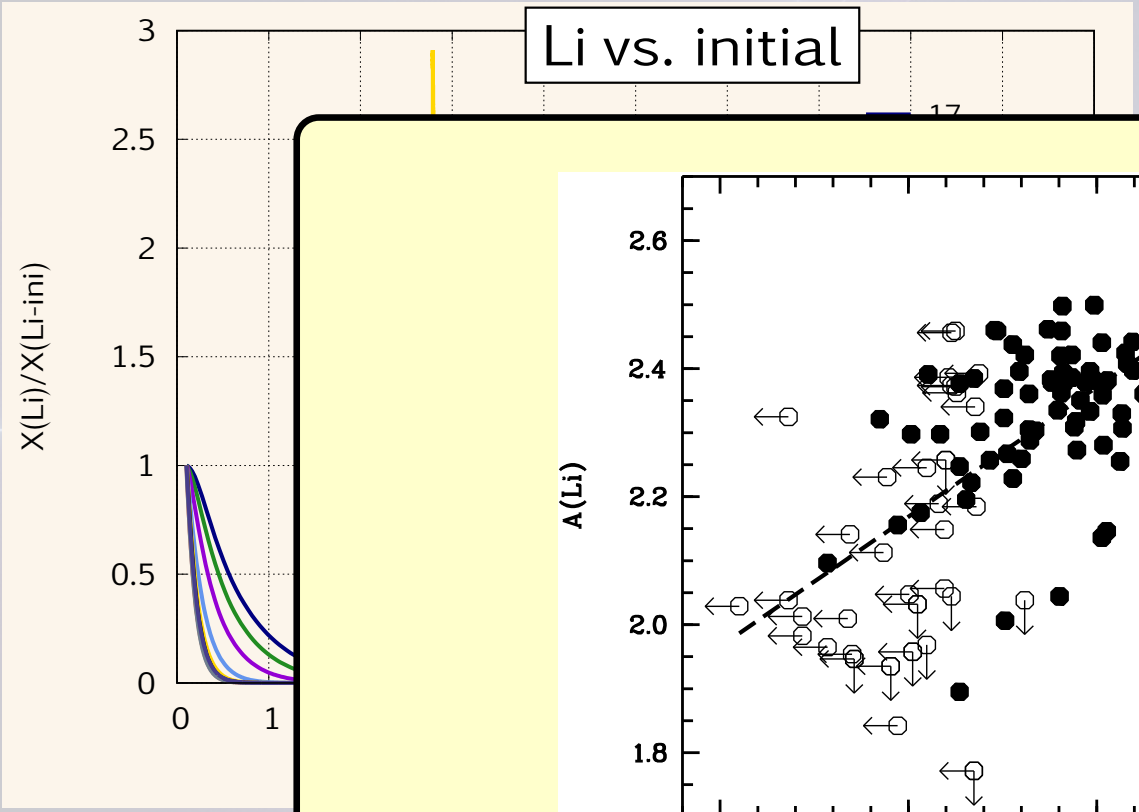

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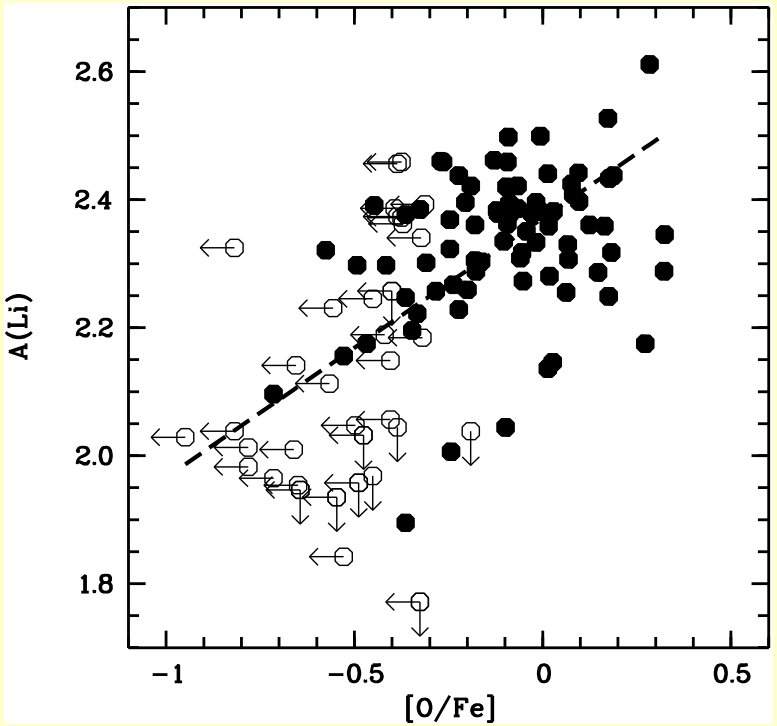

Shen+10: slope = 0.4 instead of 1.0

→ Supergiants could be responsible?

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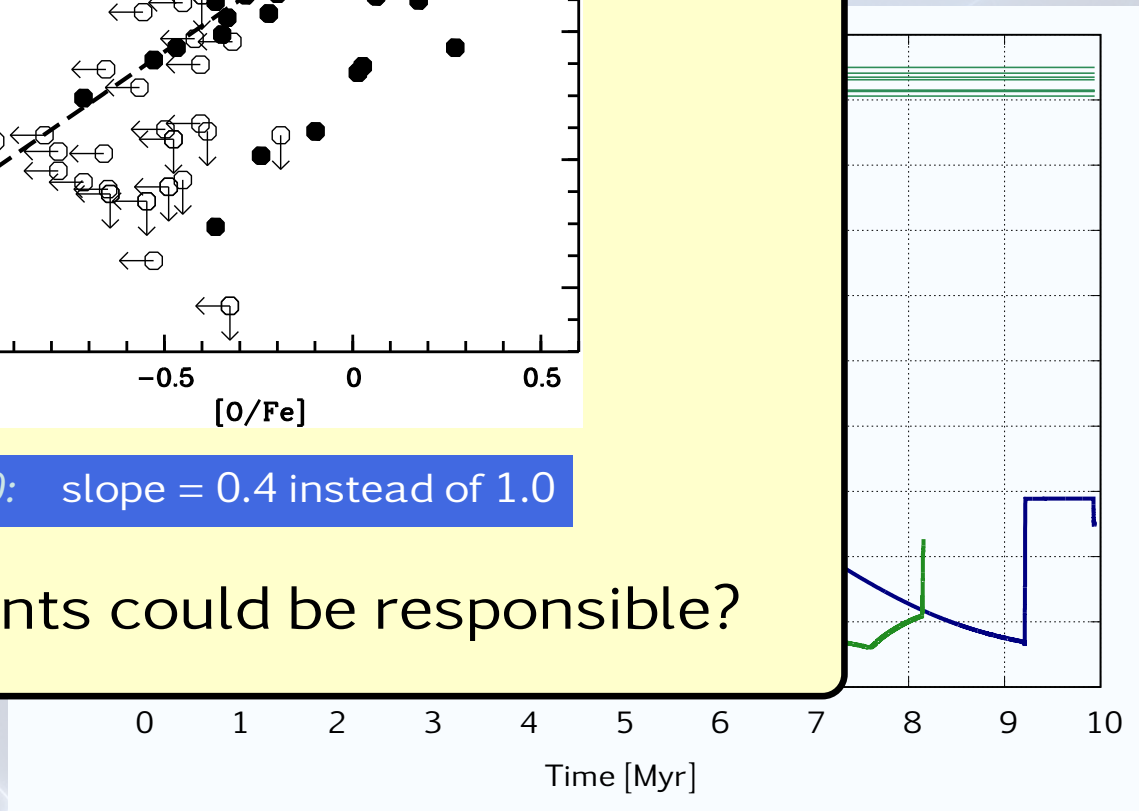

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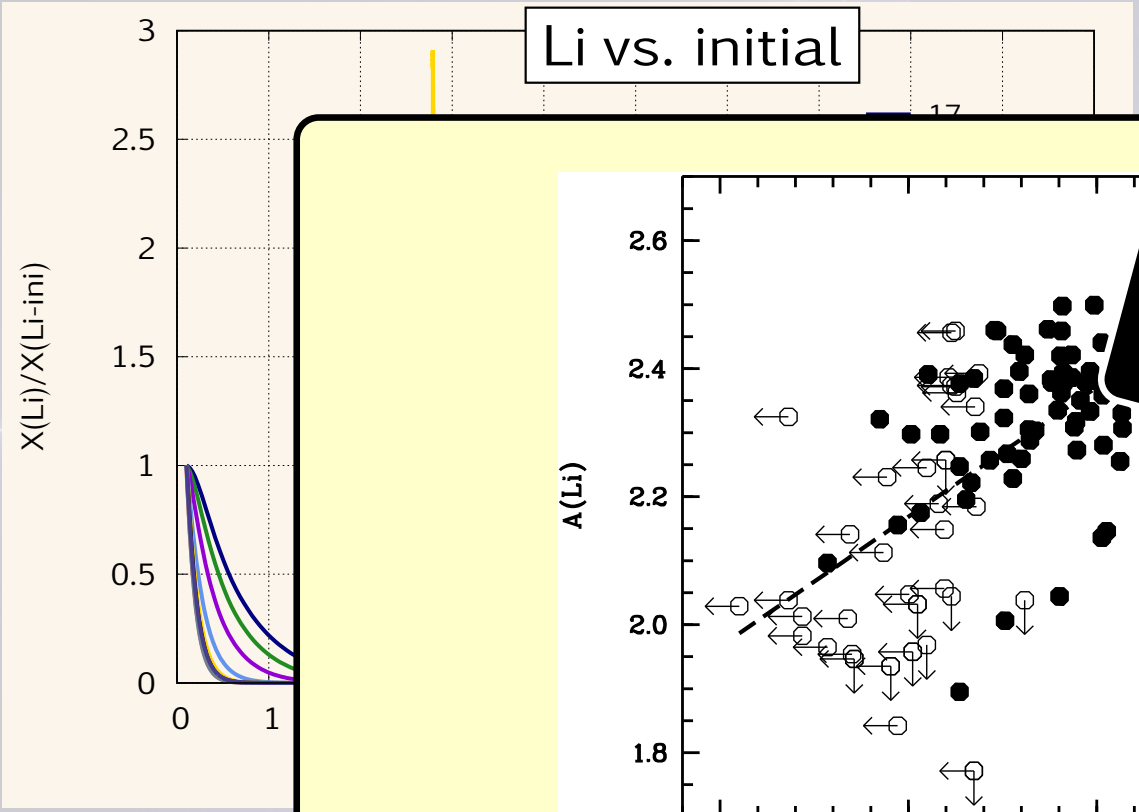

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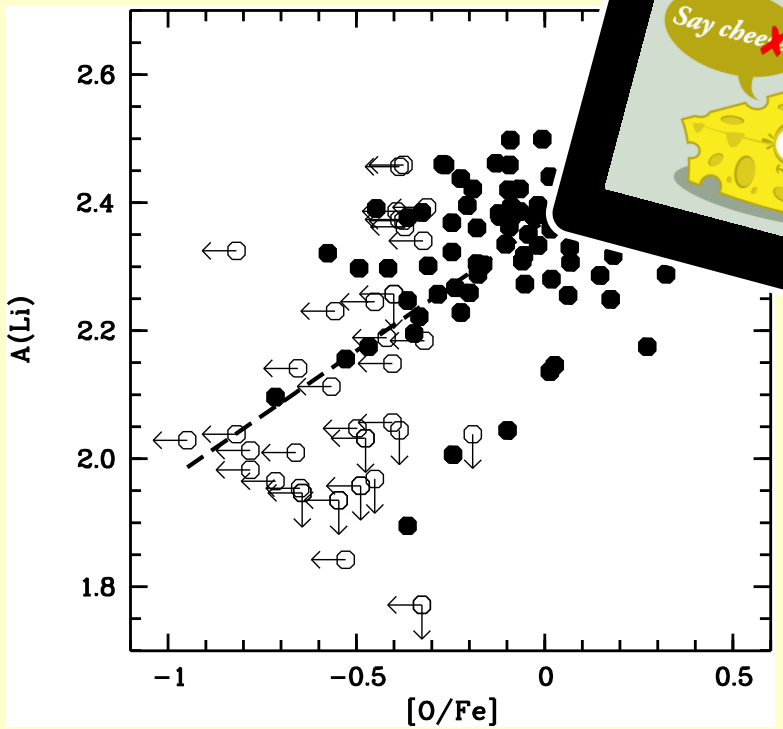

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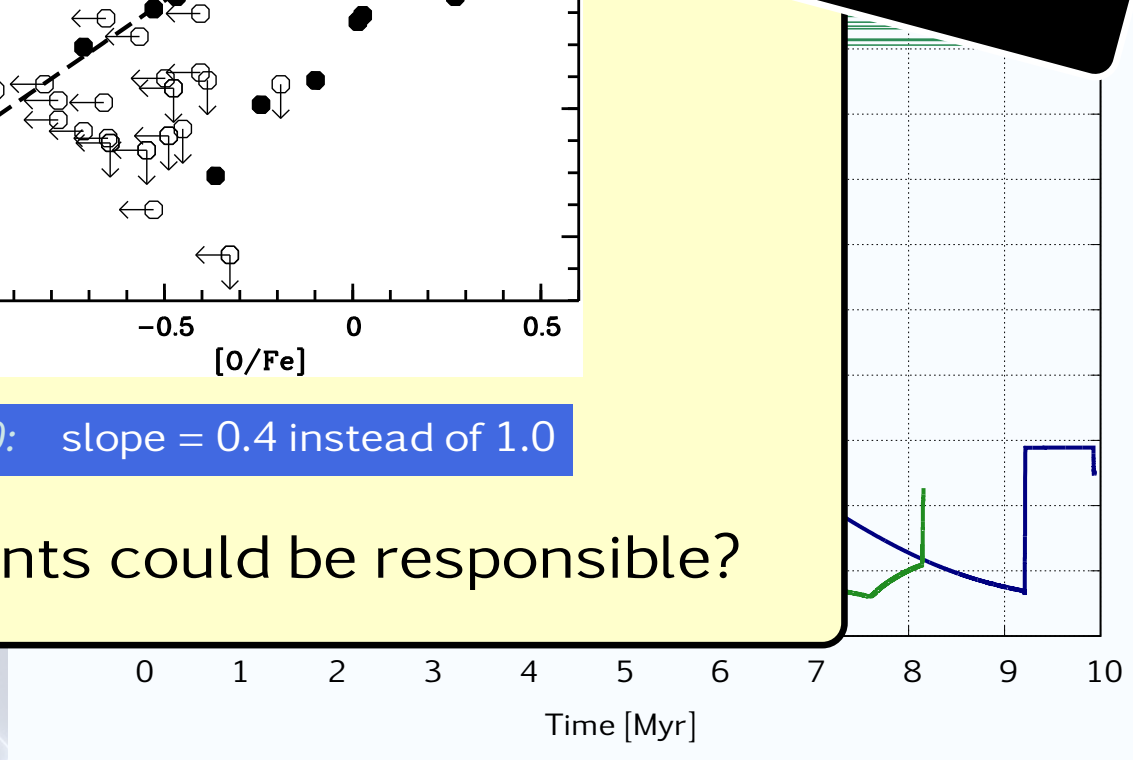
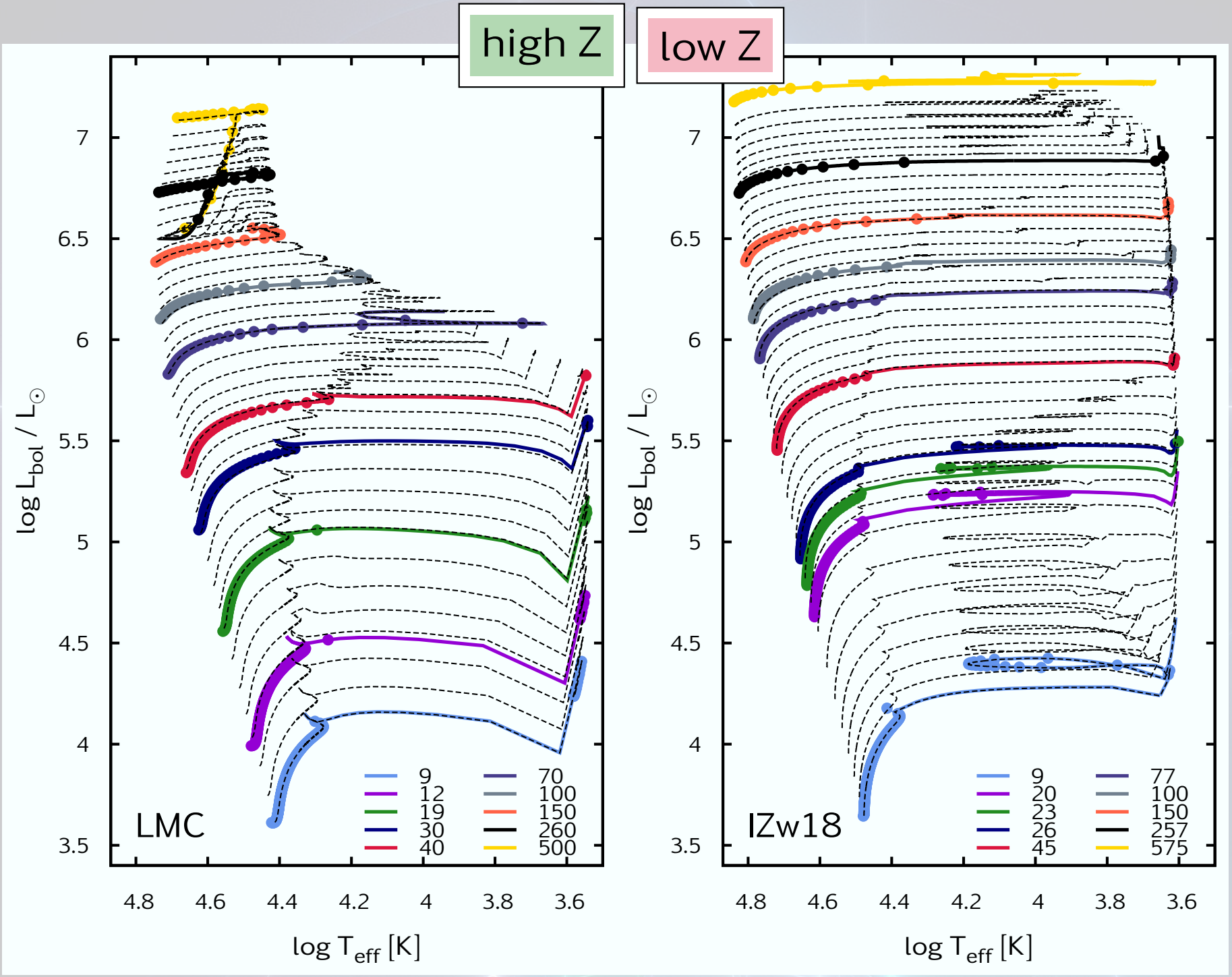
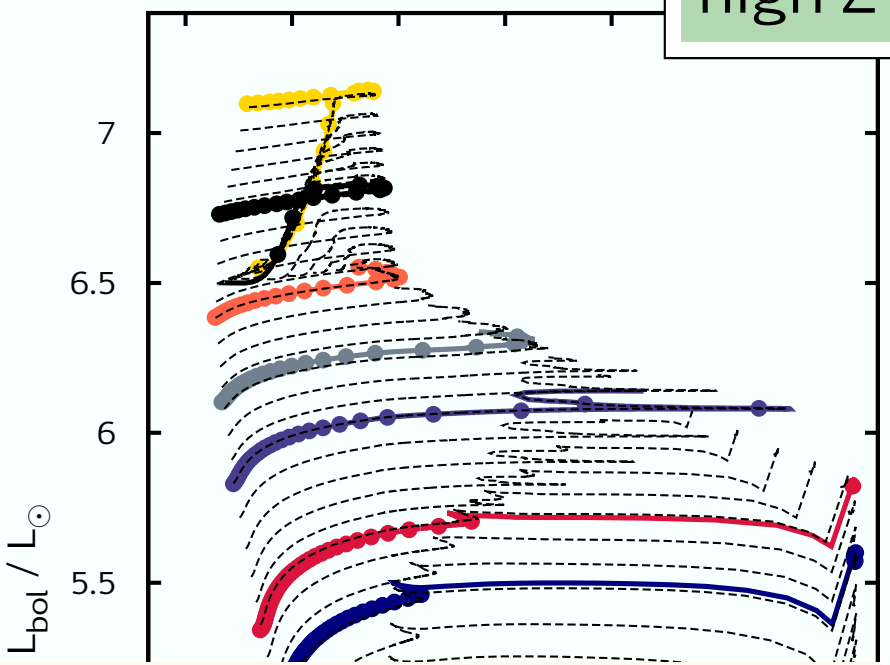



high Z
low Z
LMC
IZw18
log L_bol / L_⊙
log T_eff [K]
7
6.5
6
5.5
5
4.5
4
3.5
4.8
4.6
4.4
4.2
4
3.8
3.6
9
12
19
30
40
70
100
150
260
500
9
20
23
26
45
77
100
150
257
575

high Z

low Z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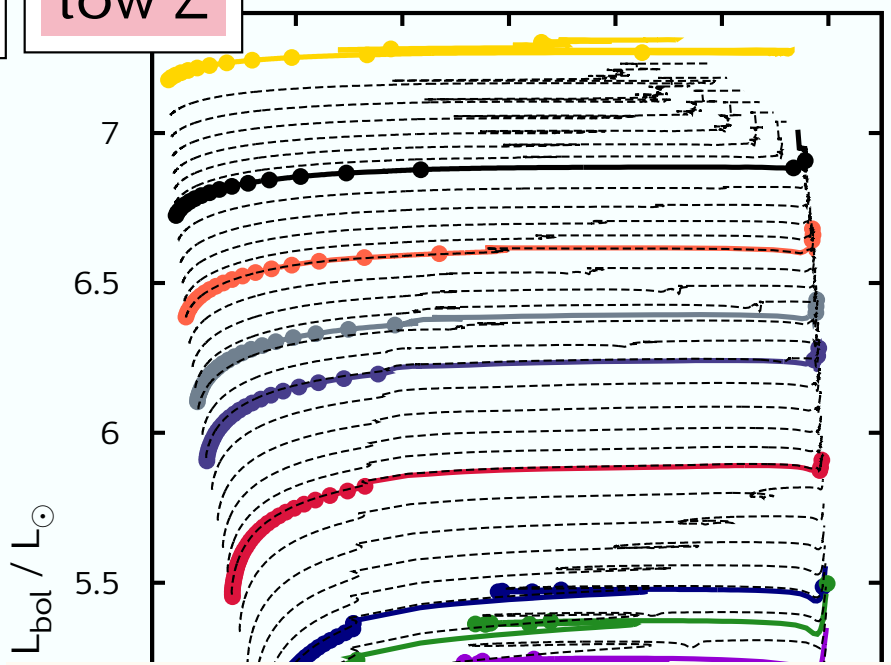
6
5.5
L_{bol} / $L_\odot$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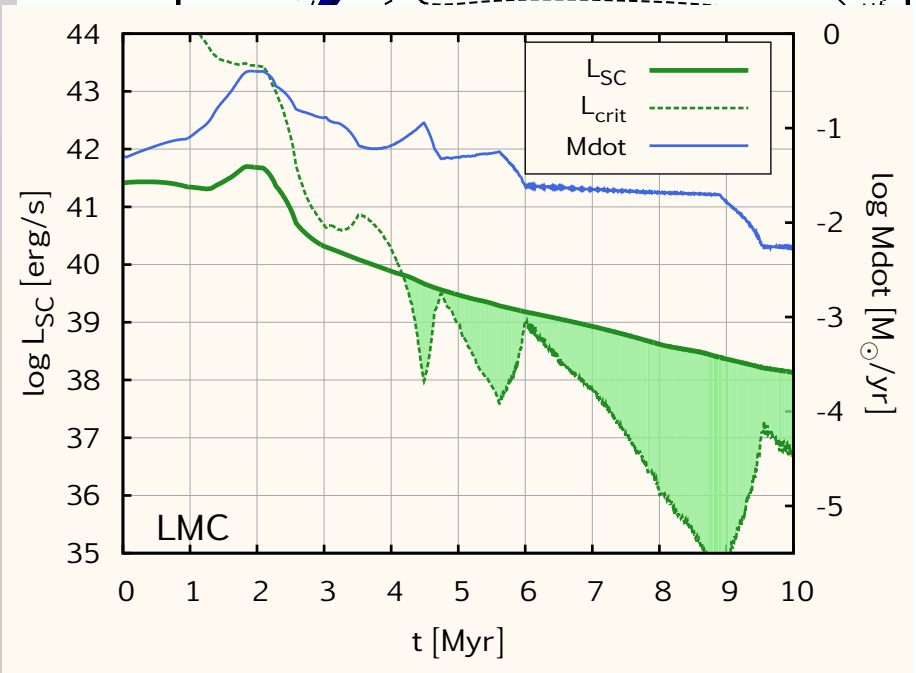
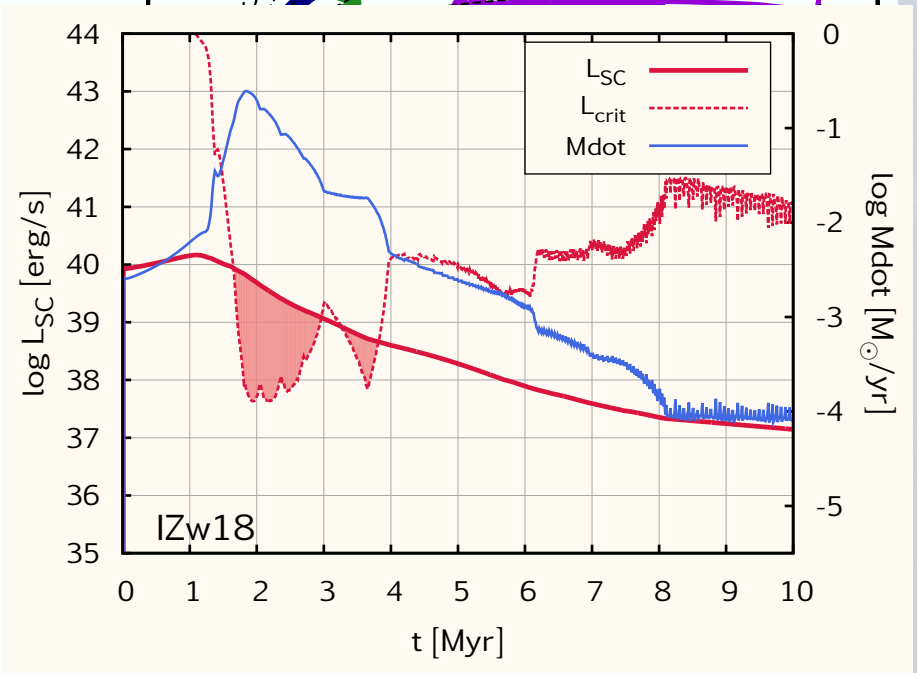

L_{SC}
L_{crit}
Mdot
LMC
log L_{SC} [erg/s]
log Mdot [$M_\odot$/yr]
t [Myr]
log T_{eff} [K]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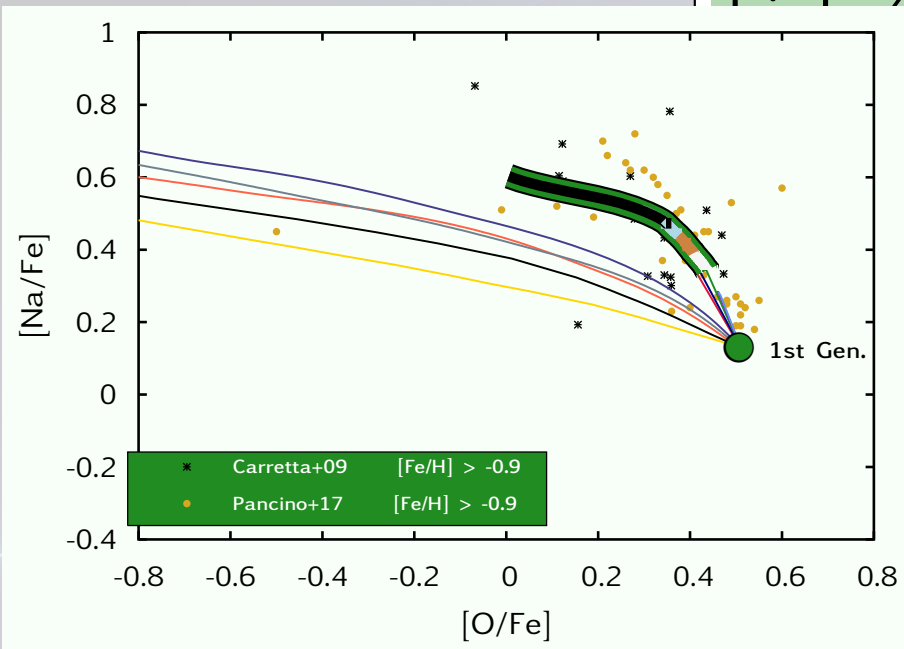
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[O/Fe]
1st Gen.
Carretta+09 [Fe/H] > -0.9
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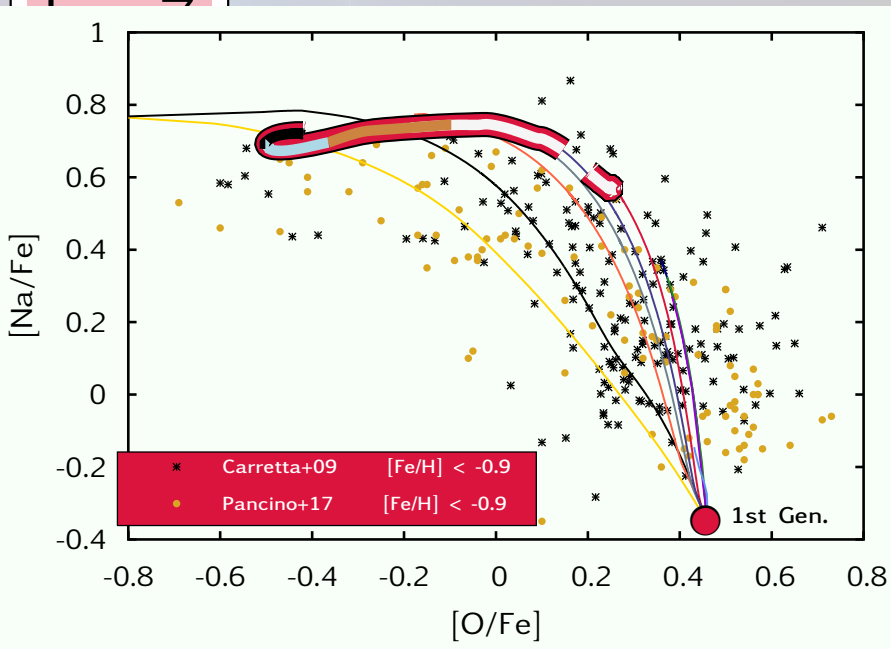
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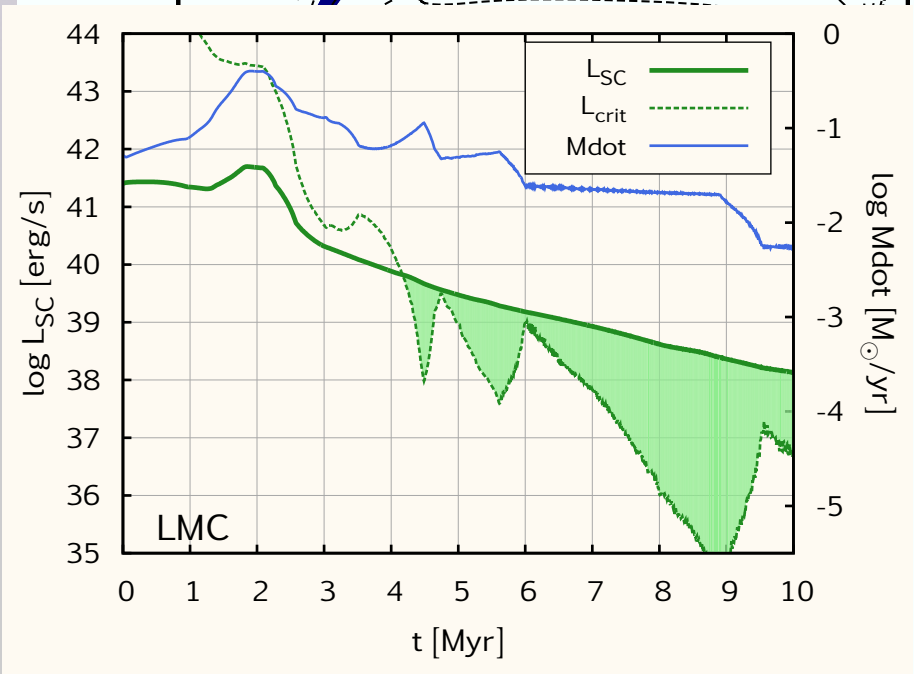
log L_SC [erg/s]
log Mdot [M⊙/yr]
t [Myr]
L_SC
L_crit
Mdot
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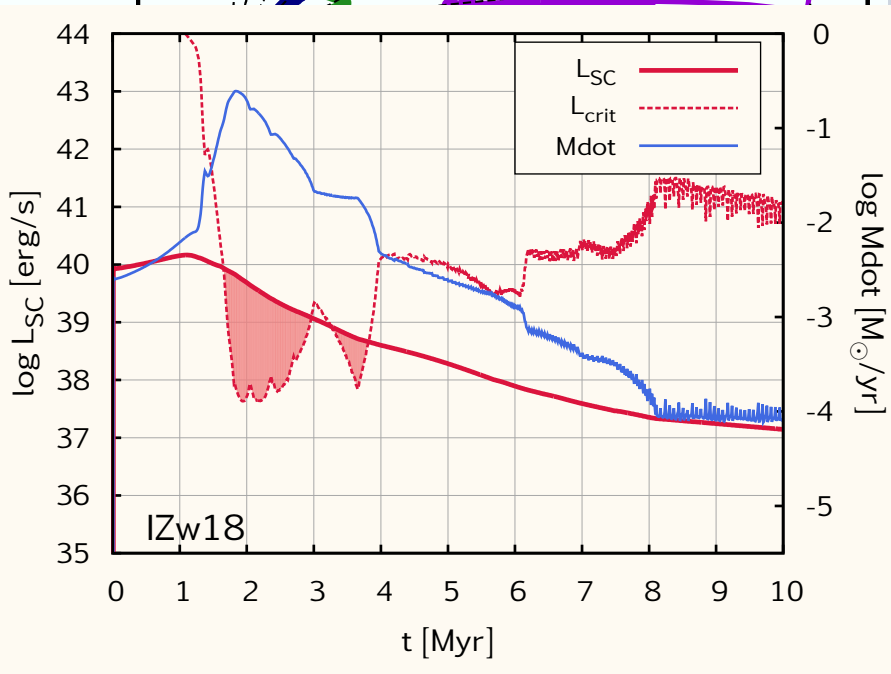
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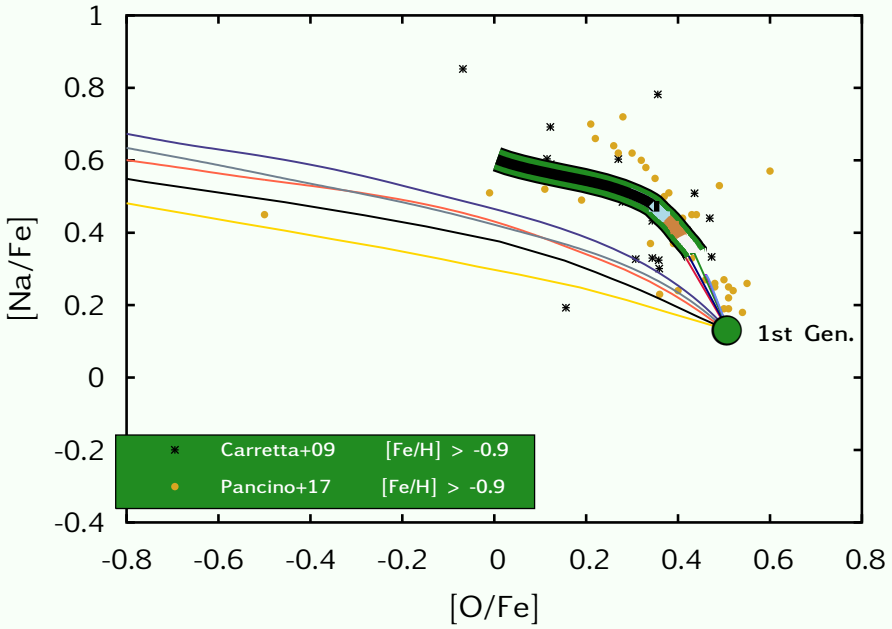
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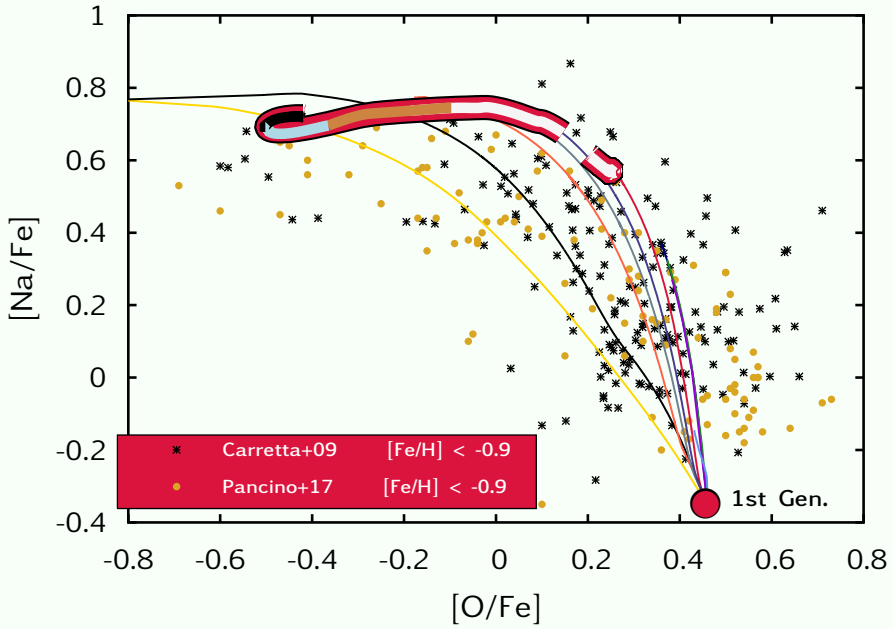
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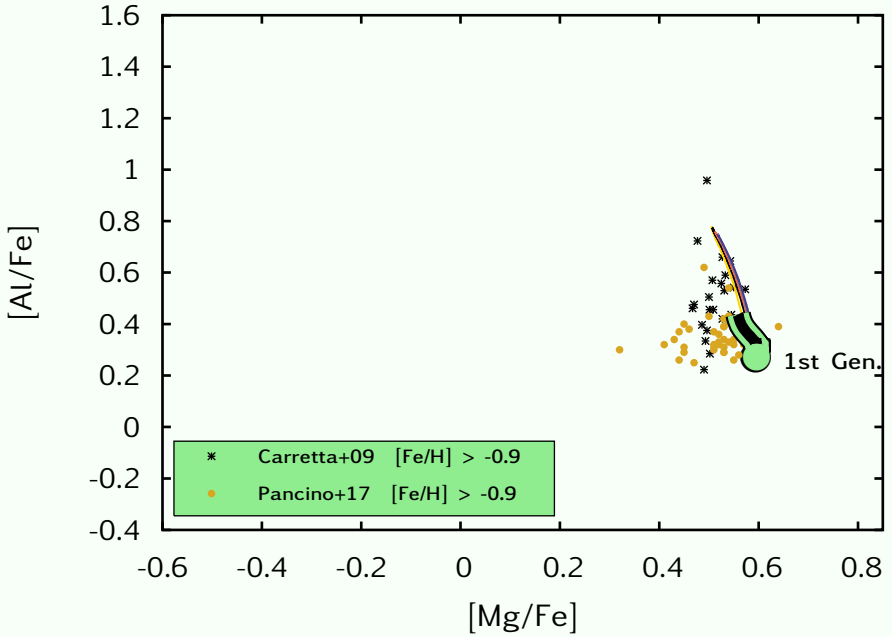
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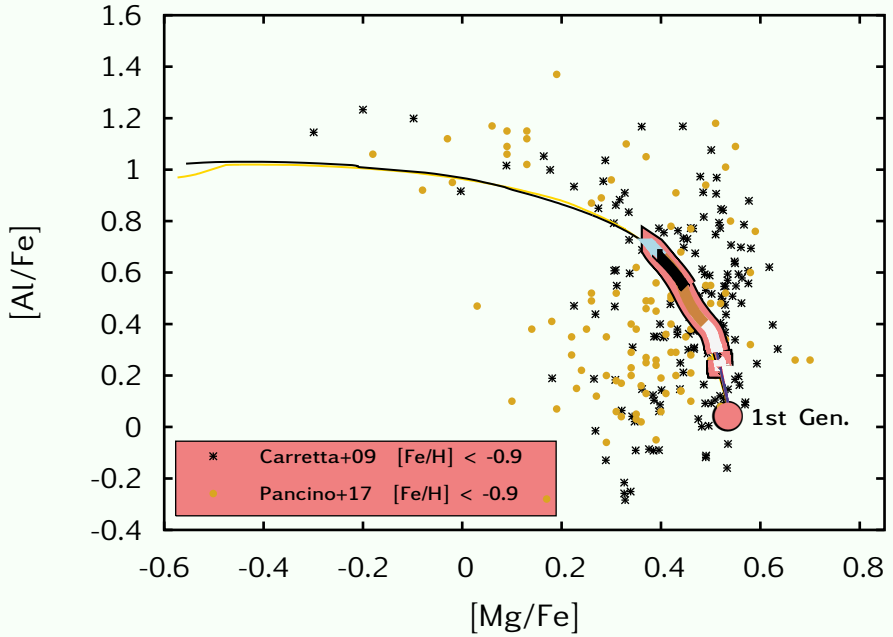
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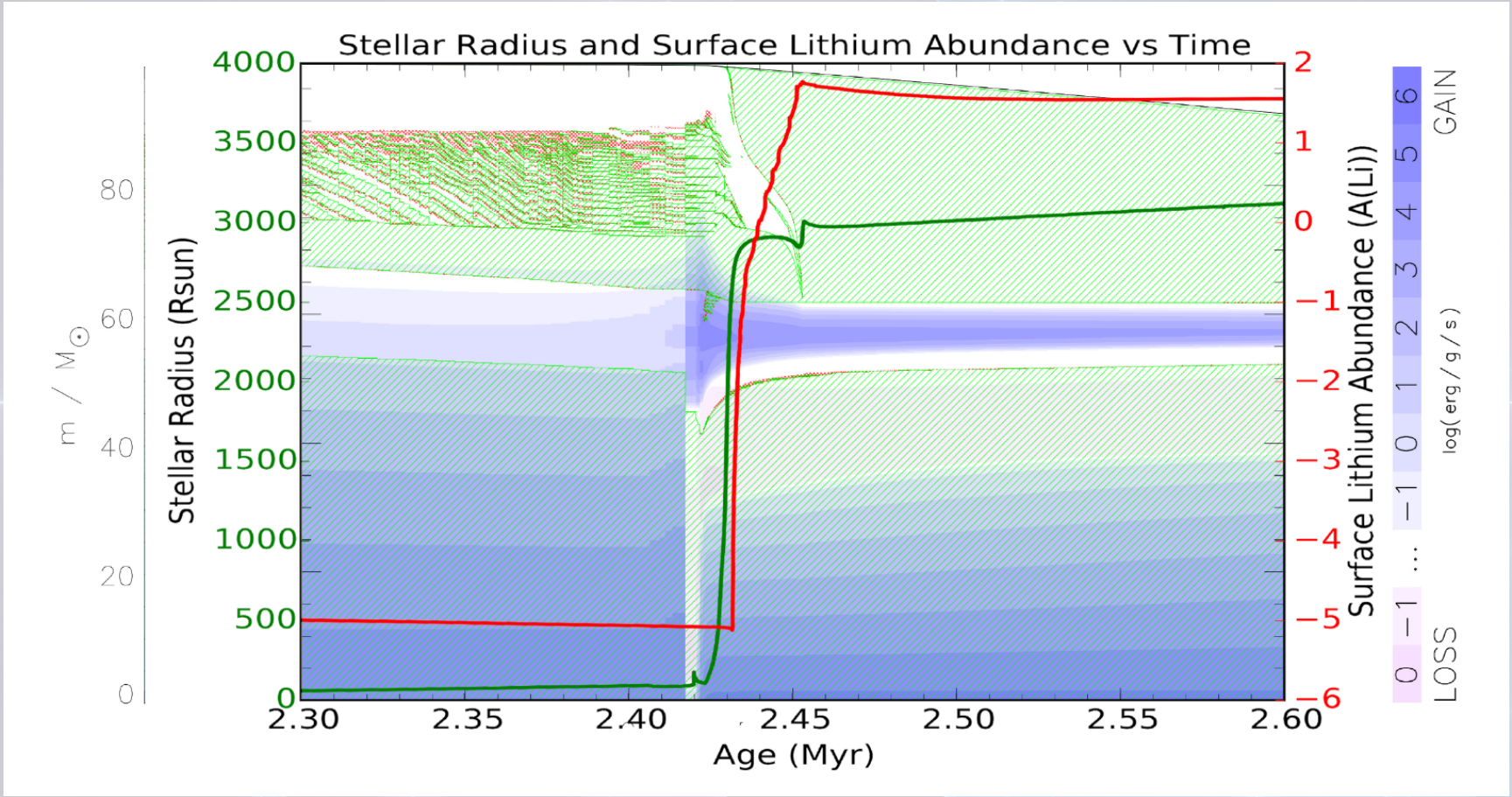

Bennett, MSc Thesis (2018)