Osservatorio Astronomico di Trieste
Astronomical Observatory of Trieste

Galactic evolution of lithium in the thin and thick disc

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AstroFIt 2
Astronomy Fellowships in Italy

ifpU

ChETEC Action

Astro-TS, 25 June 2019

Lithium
Why is a bad boy?

Several Lithium problems...

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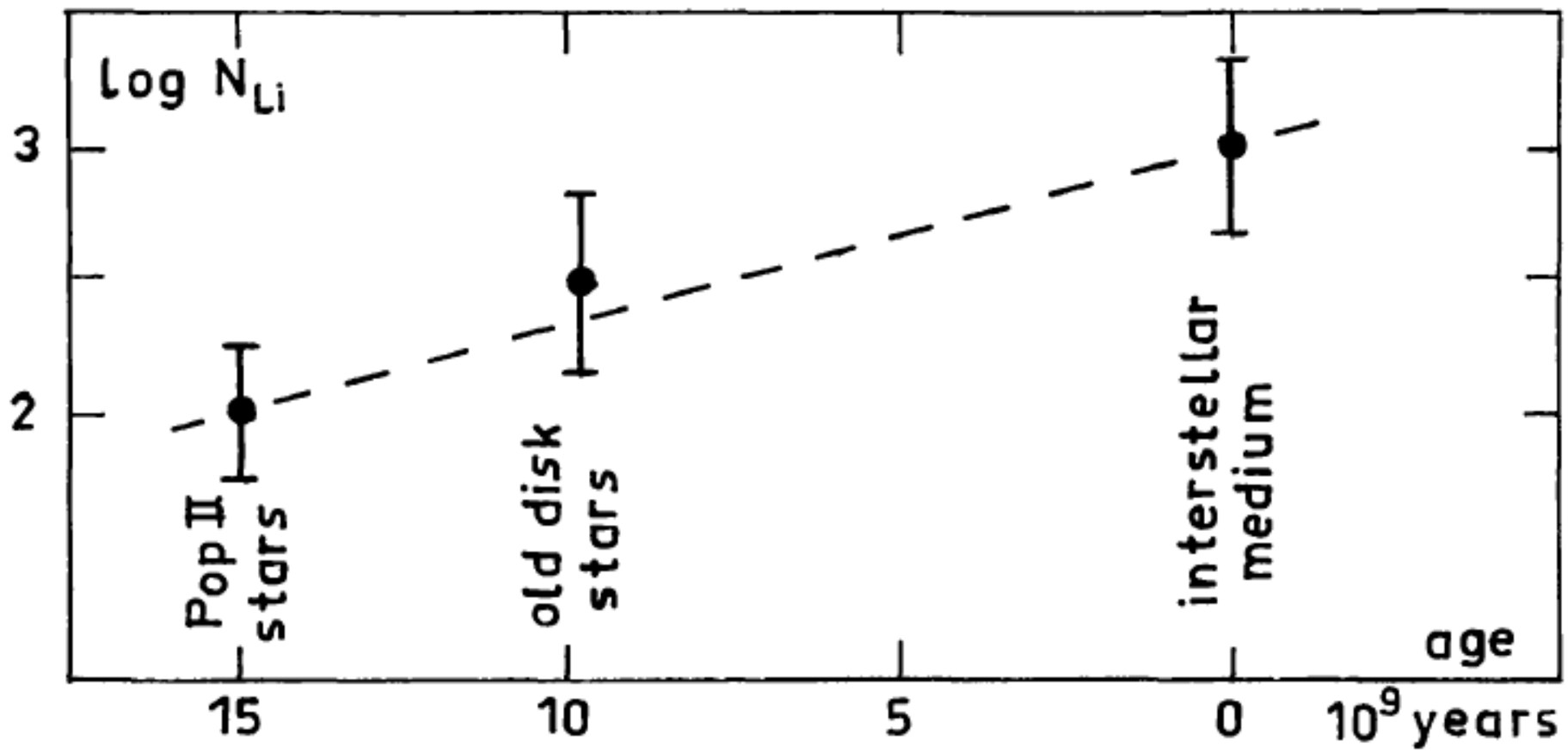
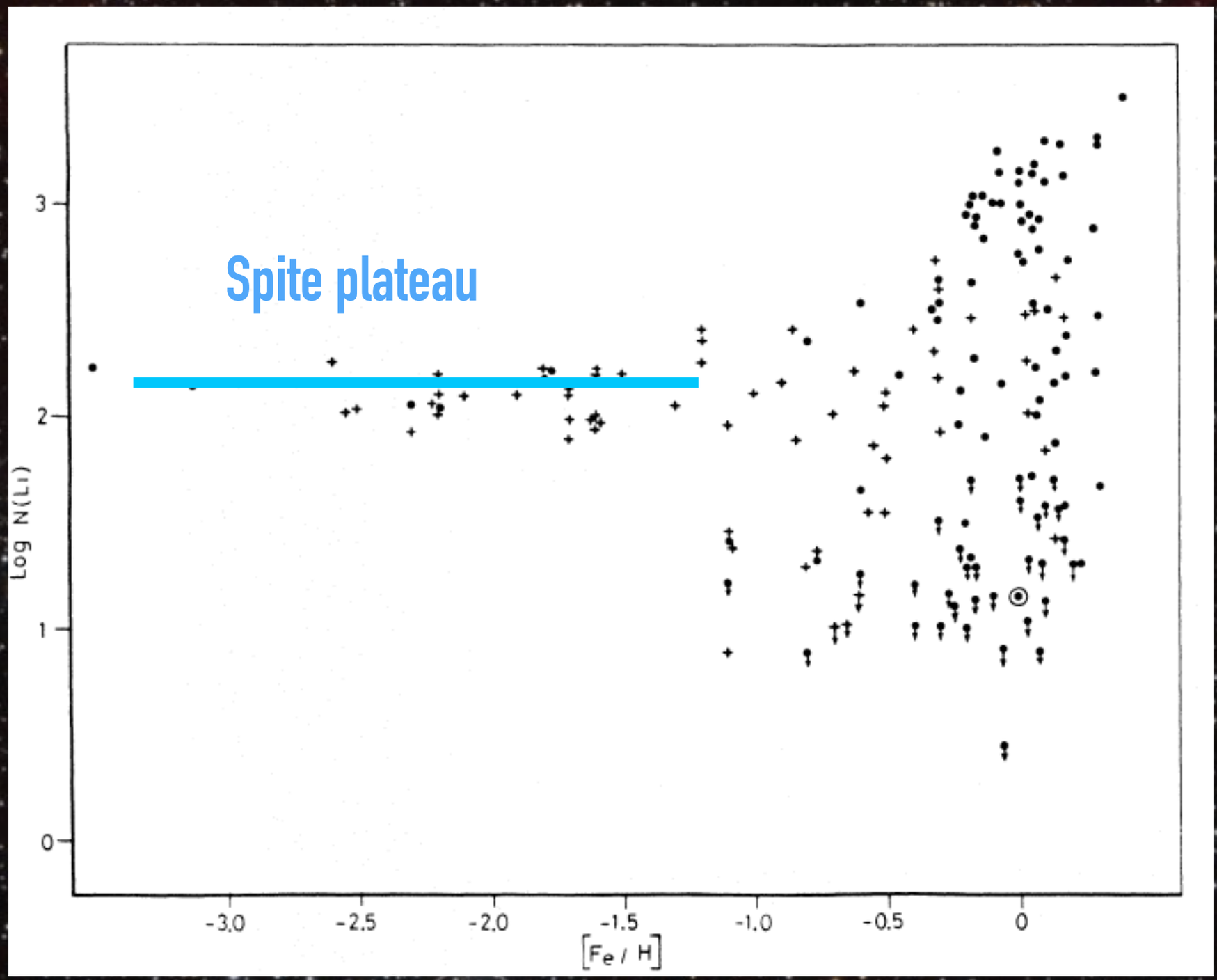
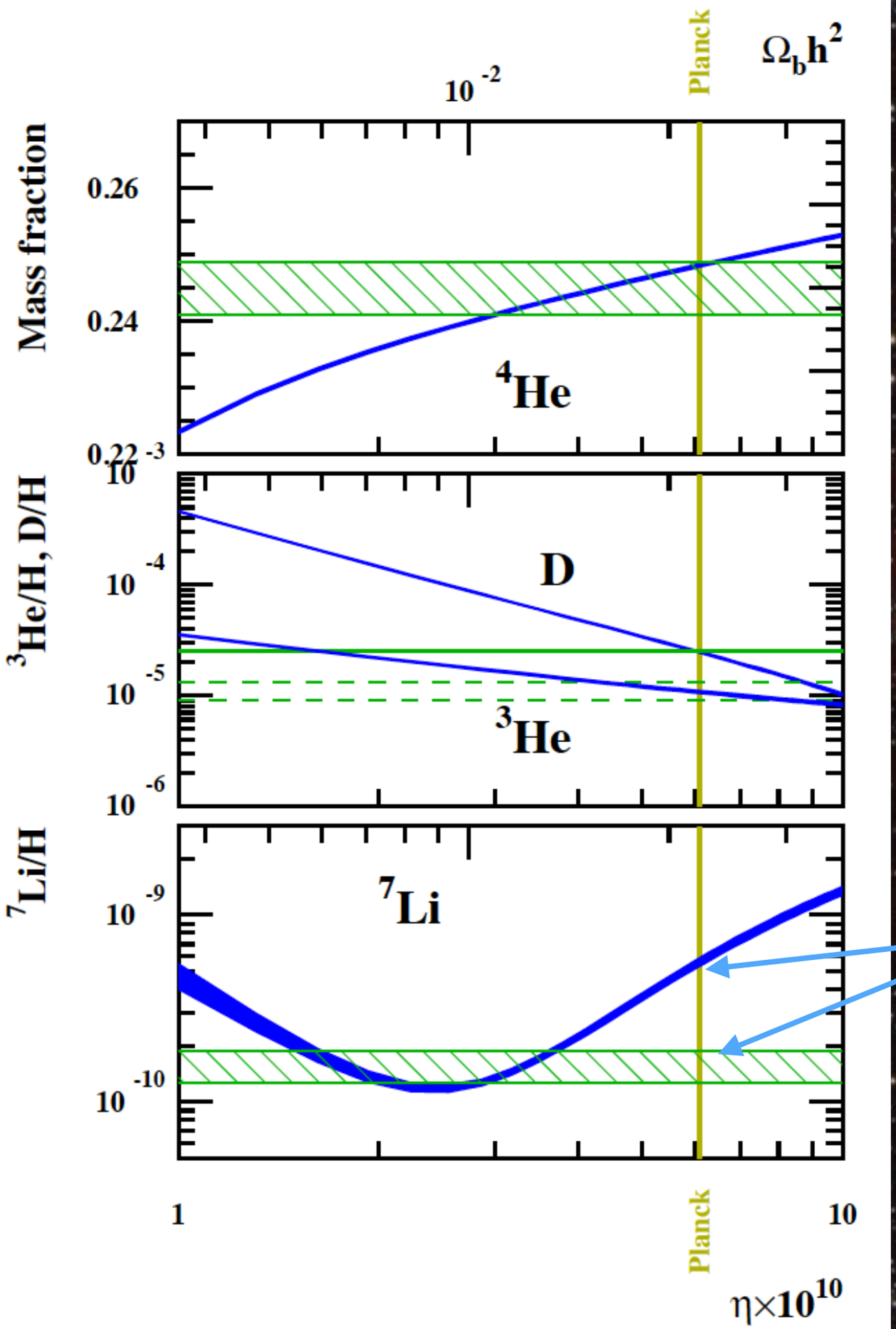


Fig. 6. Evolution of the Li abundance during the life of the Galaxy

Spite and Spite 1982



Rebolo et al. 1988



Coc & Vangioni 2017

Cosmological problem

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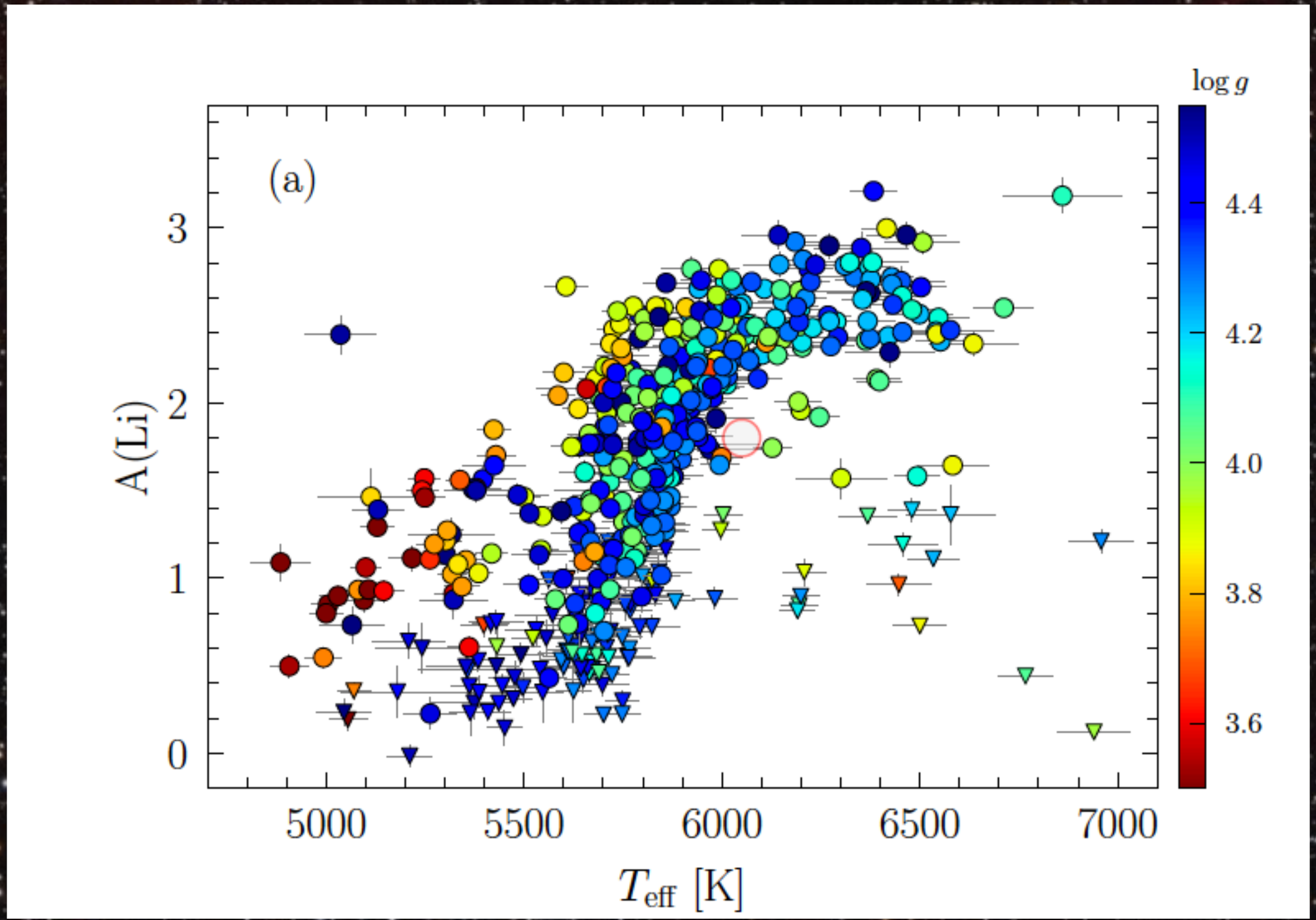
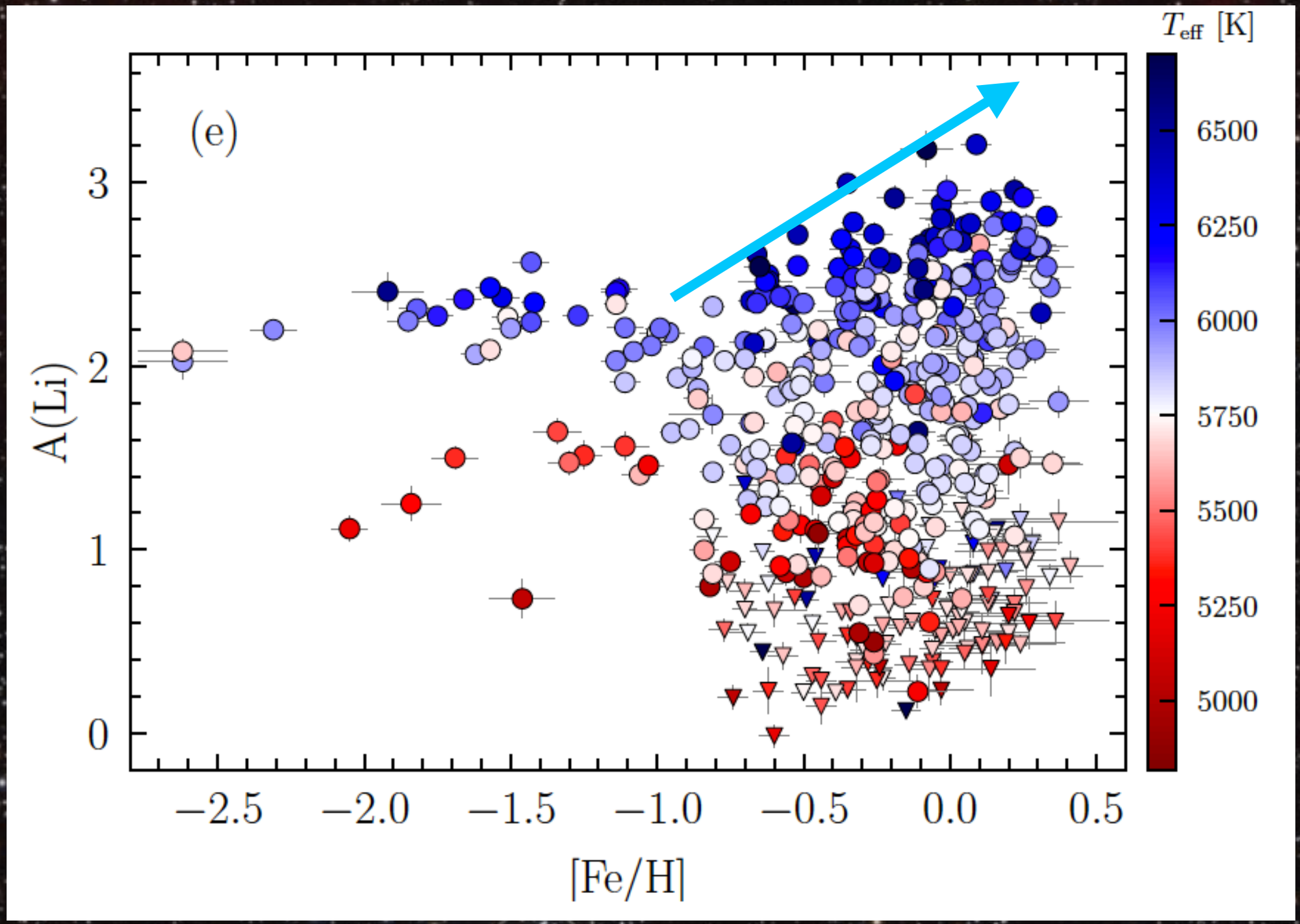
Internal Depletion



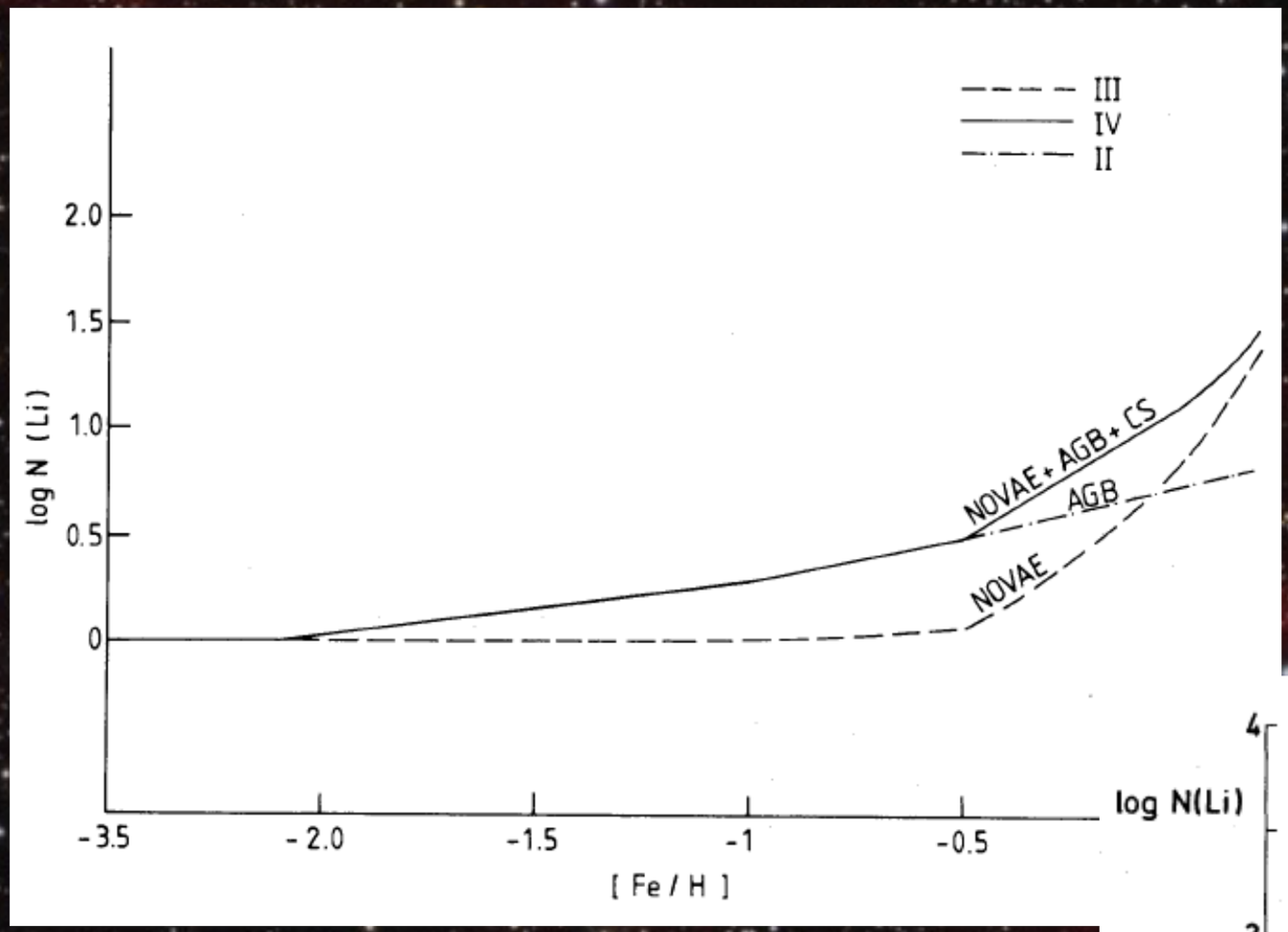
Bensby and Lind 2018

Source(s) of Lithium

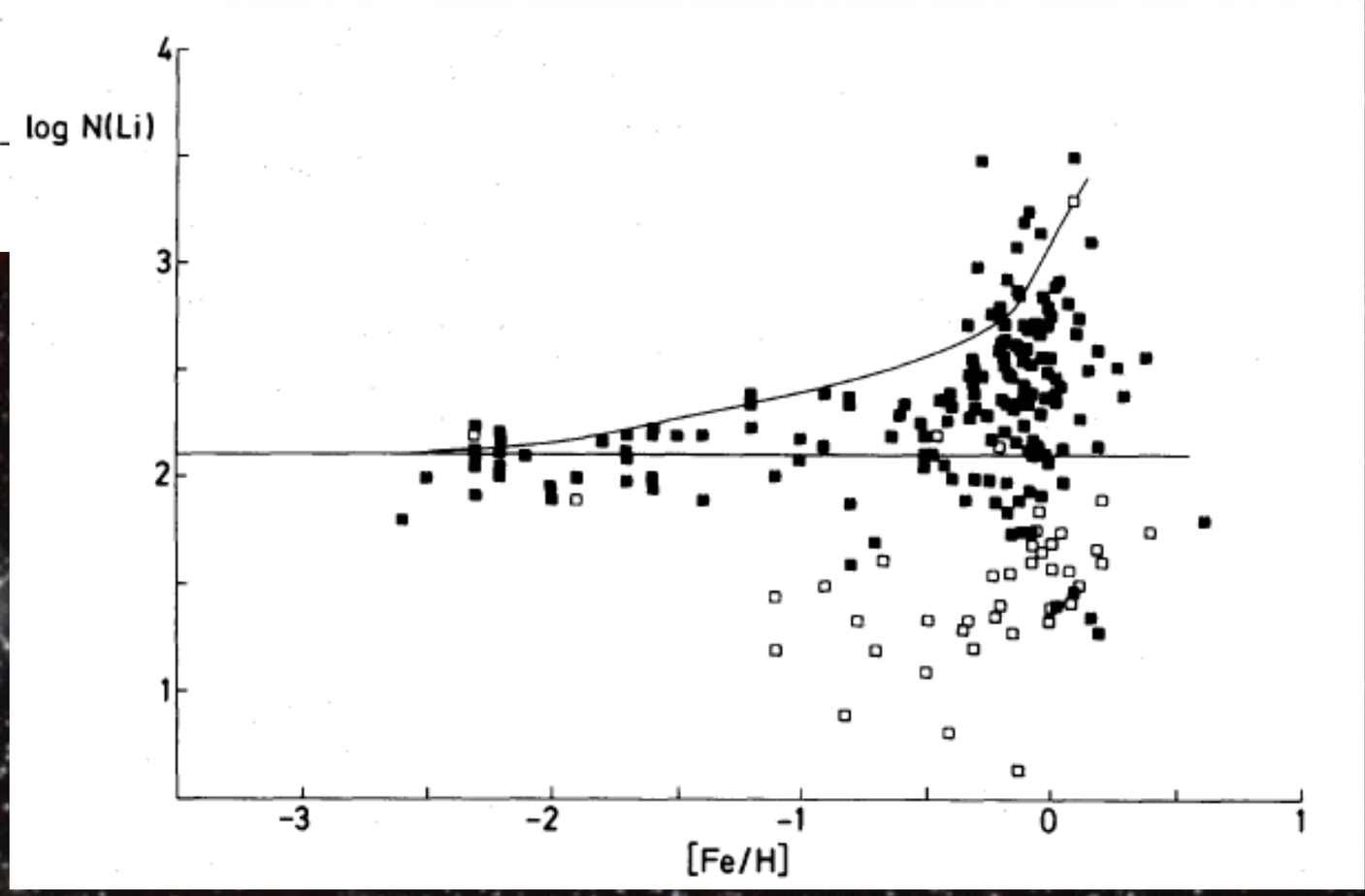


Bensby and Lind 2018

Novae: Solution since 1991



D'Antona & Matteucci 1991



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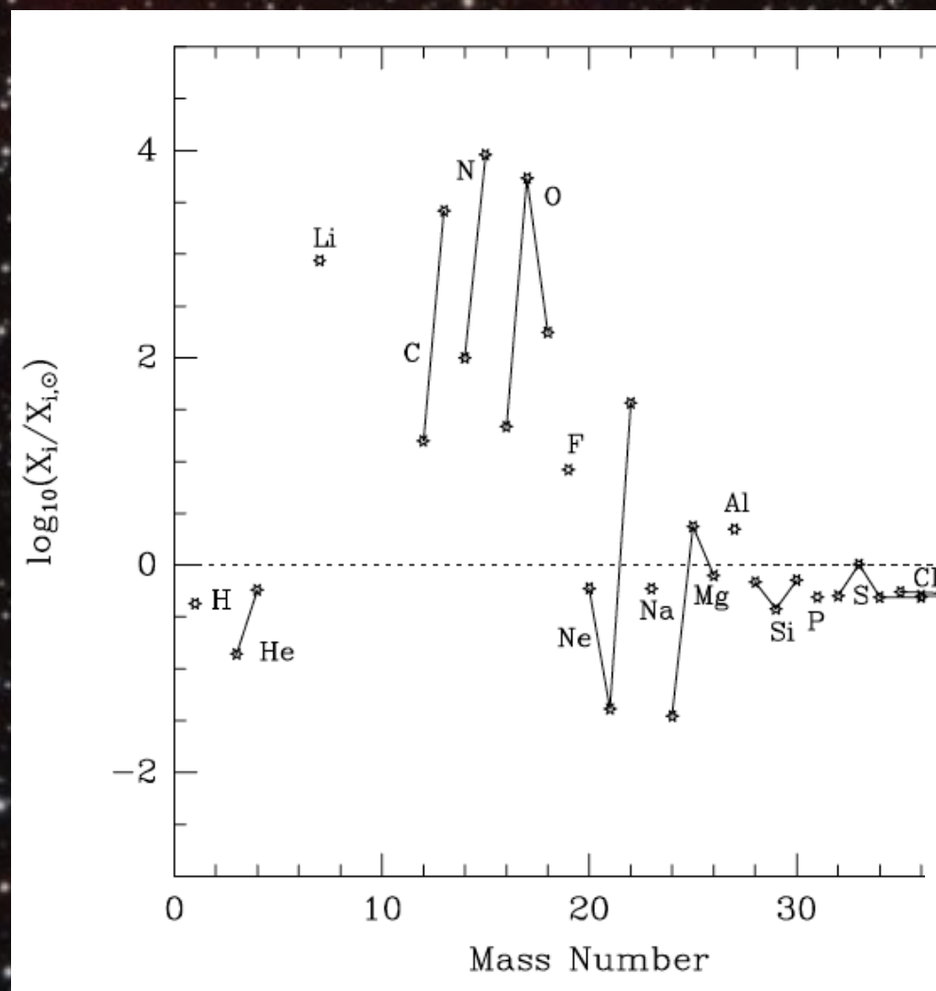
Theoretical situation

Model struggled to produce so much Lithium in novae



Josè and Hernanz 1998

Starrfield et al. 2017

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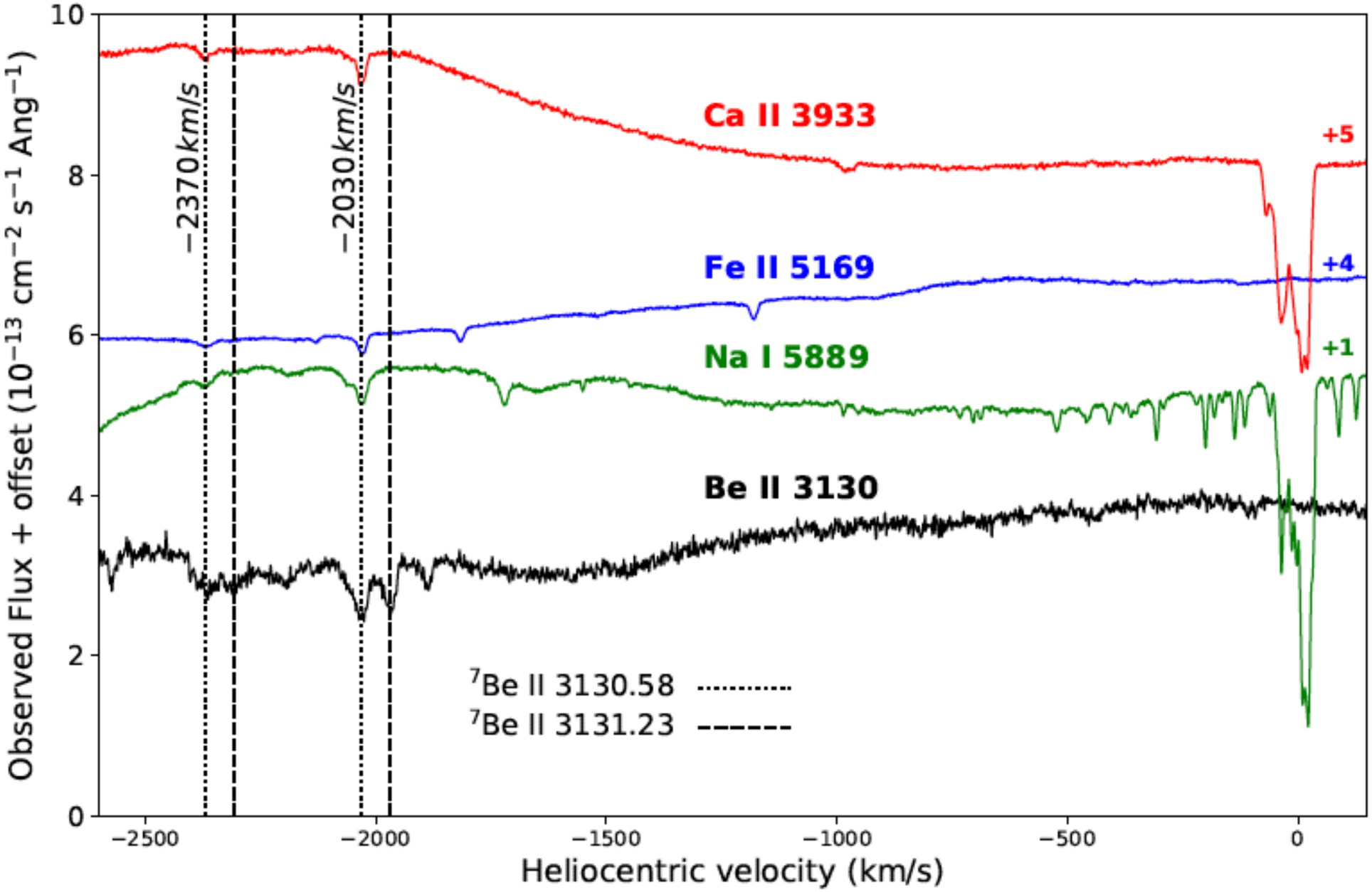
Be detections in nova spectra

Tajitsu+15+16, Molaro+15, Izzo +18 and Selvelli+18

~6 $10^{-9}M_{sun}$ of Be (—> Li) 4–5 dex higher than meteoritic

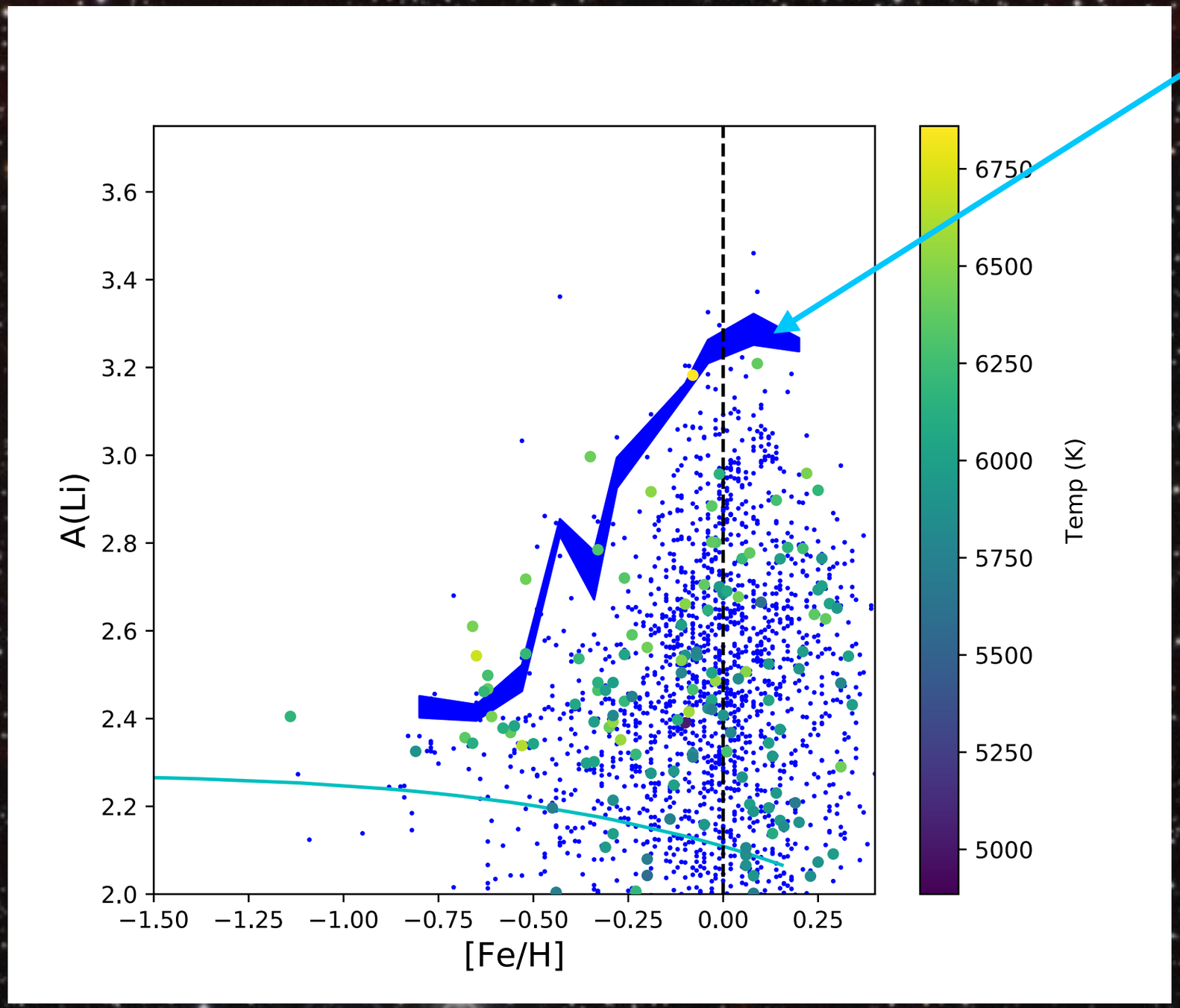


Izzo et al. 2018

No sources

Only destroyed by astration

one infall model

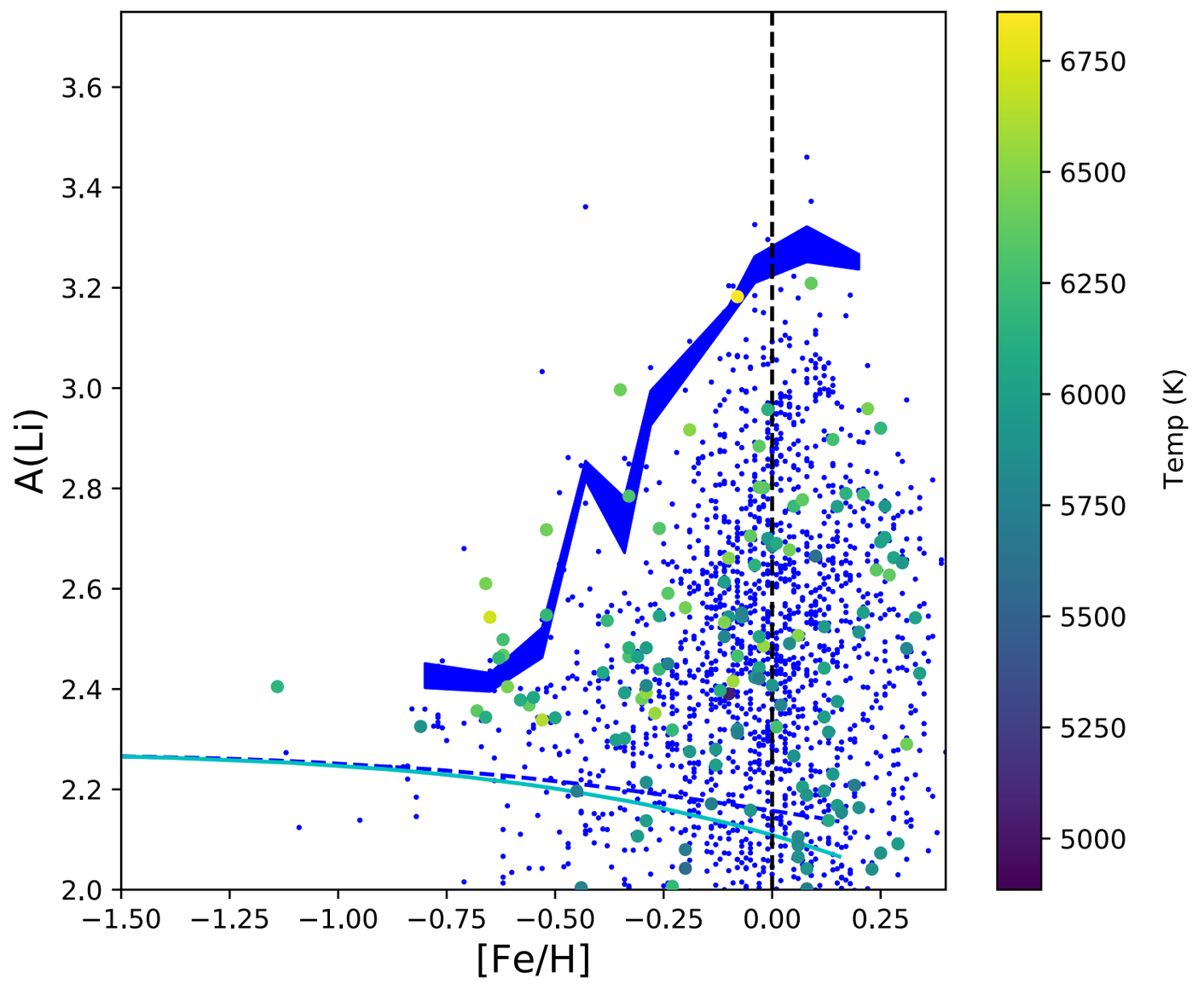


AMBRE data Guiglion+16

Bensby&Lind 2018

Cescutti&Molaro 2019

AGB stars



AMBRE data
Guiglion+16

Bensby&Lind 2018

Cescutti&Molaro 2019

AGB yields by Paolo Ventura

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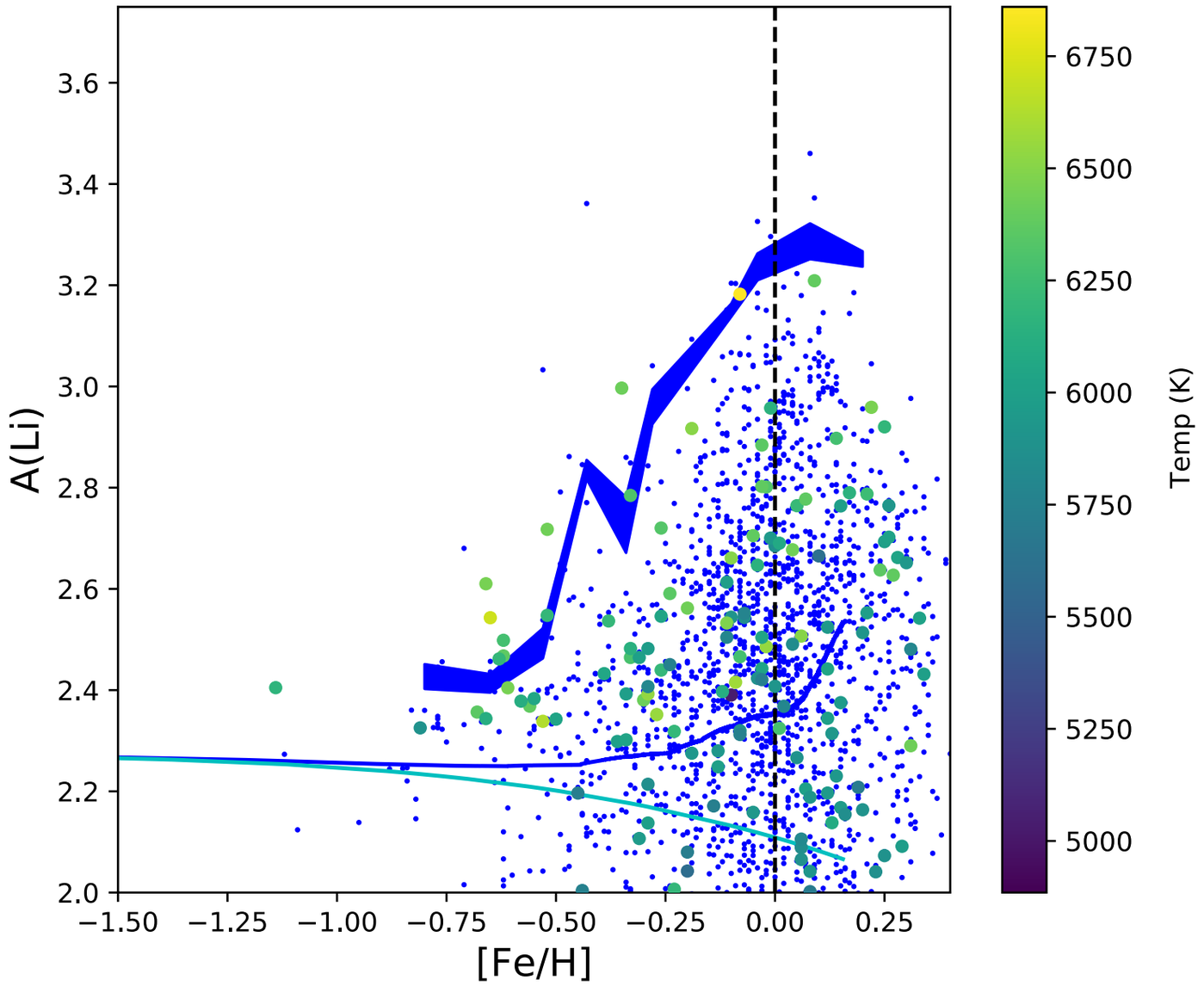
Spallation



AMBRE data
Guiglion+16

Bensby&Lind 2018

Cescutti&Molaro 2019

Spallation with cosmic rays,
scaled measurements of Be in thin disc stars by Smiljanic+09

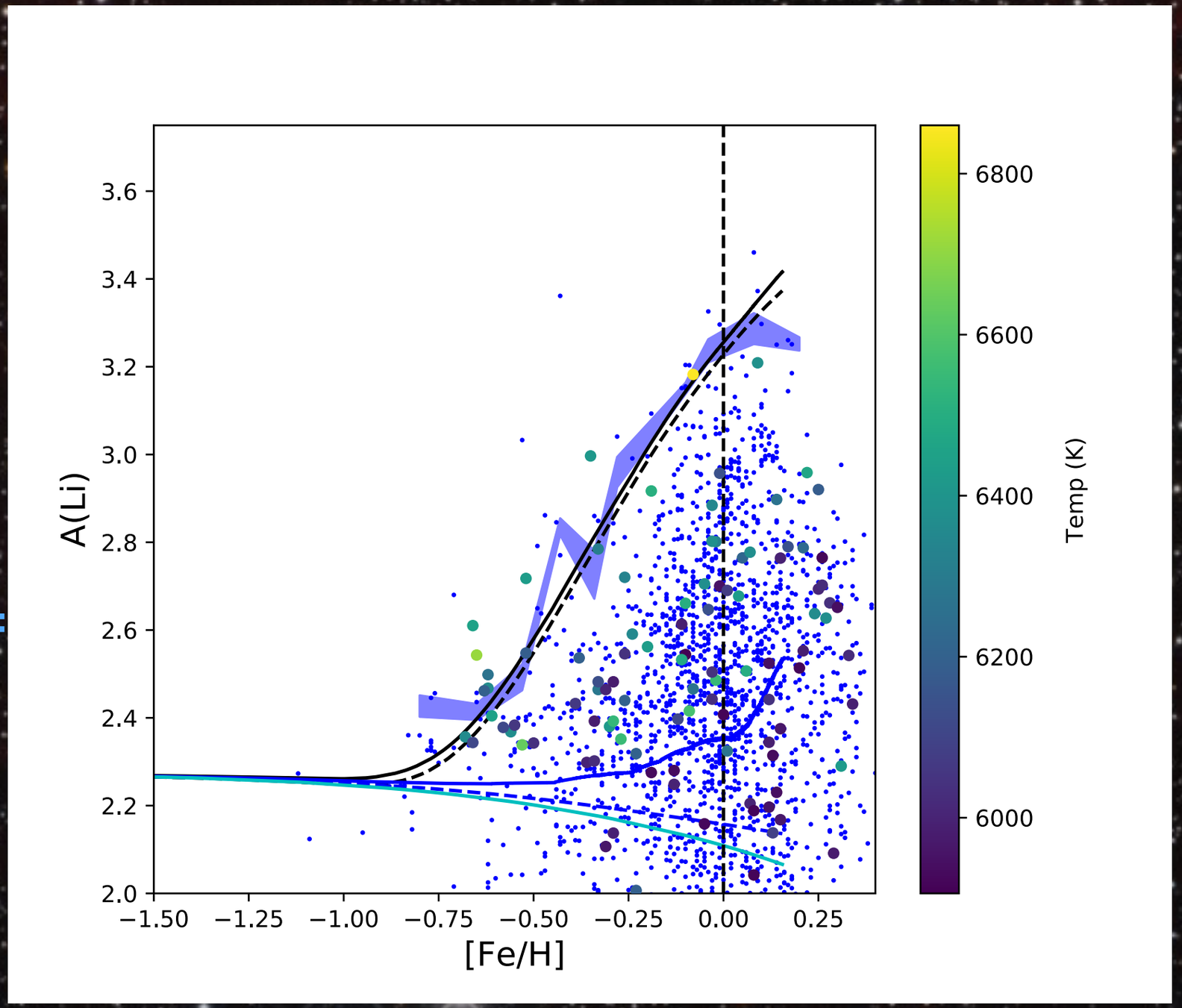
Novae

Yields:
1.8 10−5 Msun
(entire lifetime)

delay:
1 Gyr

mass range (binary):
3–16Msun

fraction:
0.03

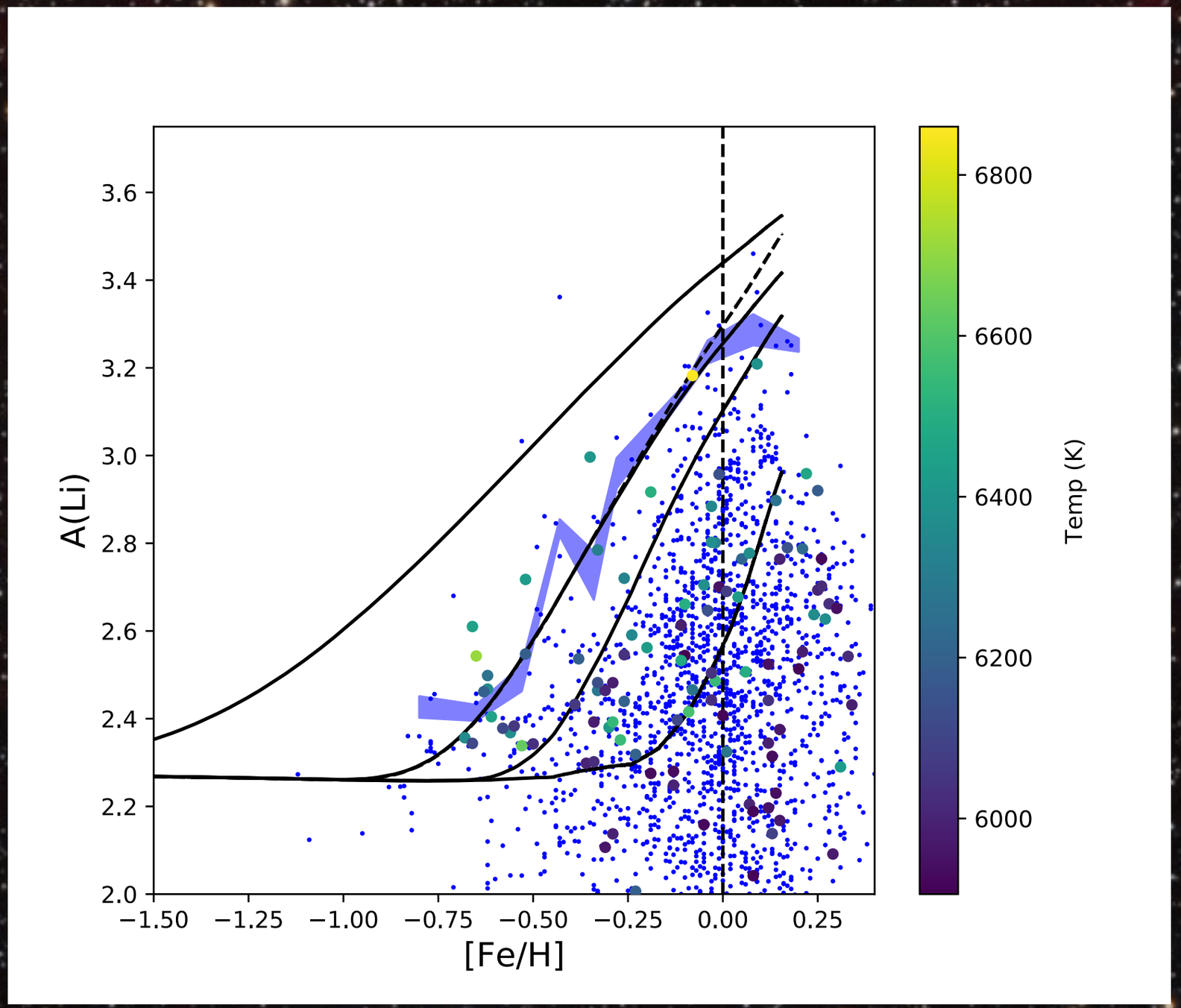


AMBRE data
Guiglion+16

Bensby&Lind 2018

Cescutti&Molaro 2019

Exploring parameters
delay: 0 – 1 – 2 – 5 Gyr



AMBRE data
Guiglion+16

Bensby&Lind 2018

Cescutti&Molaro 2019

Exploring parameters
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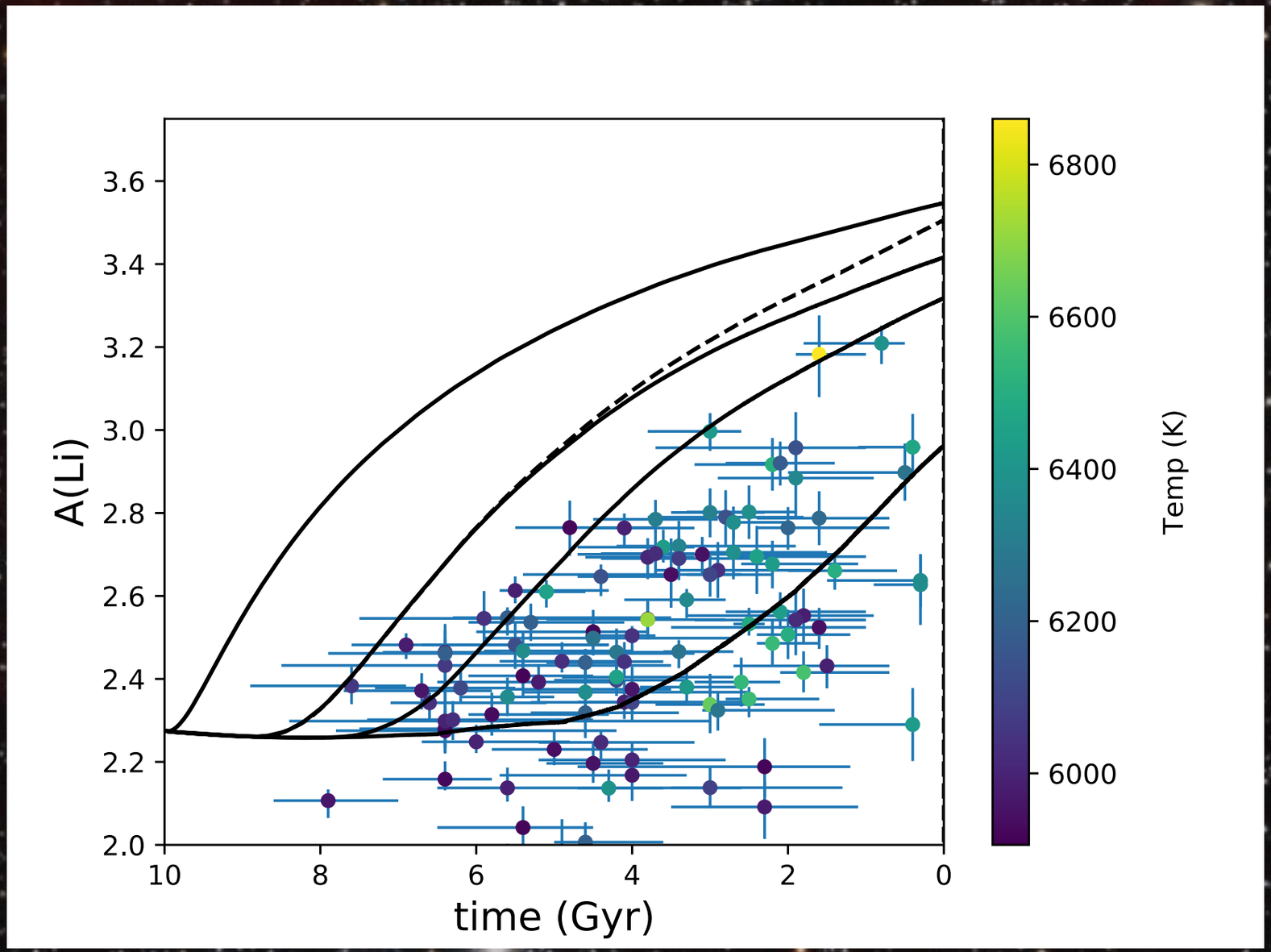
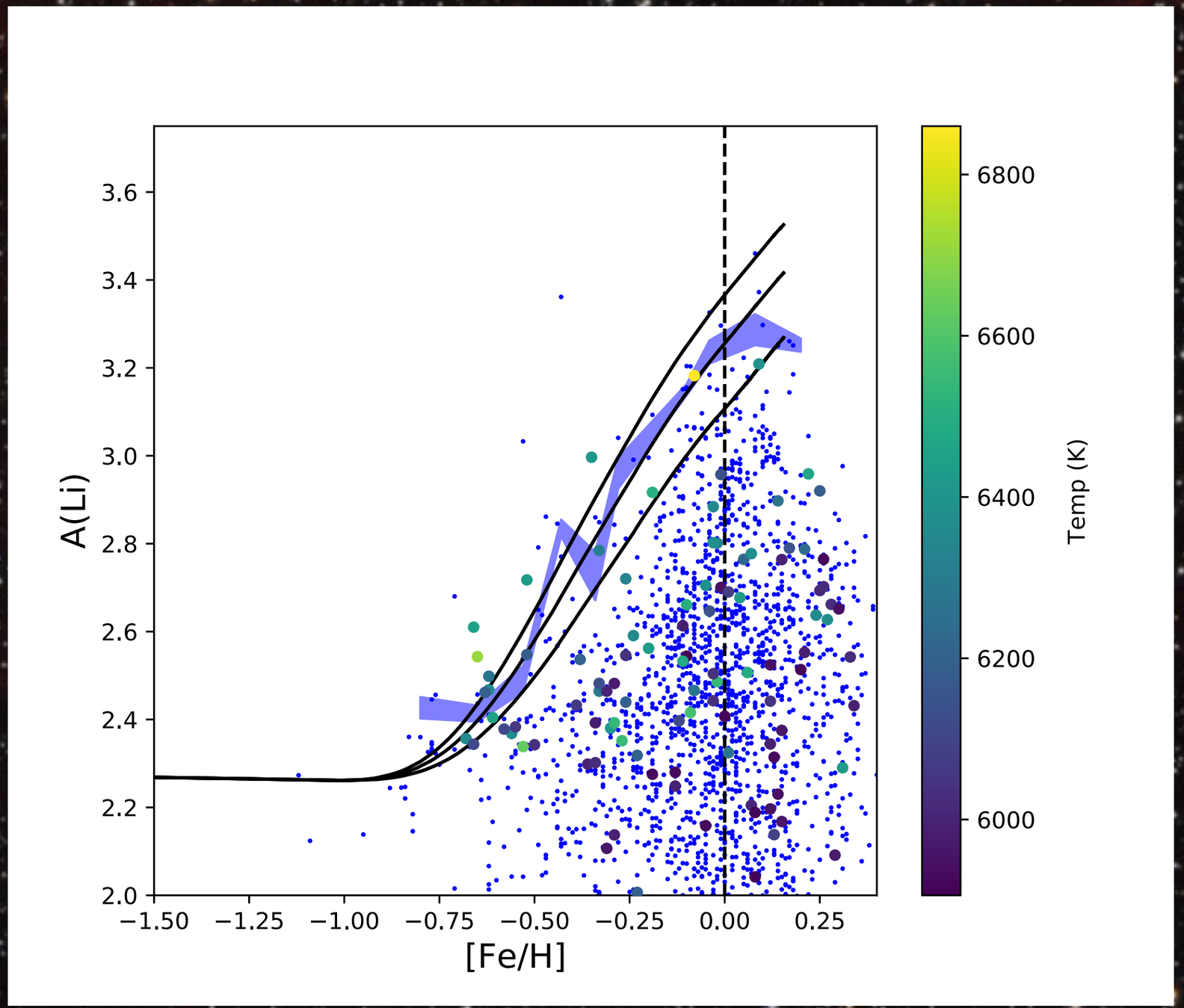


Cescutti&Molaro 2019

Exploring parameters
yields: +33% -33%

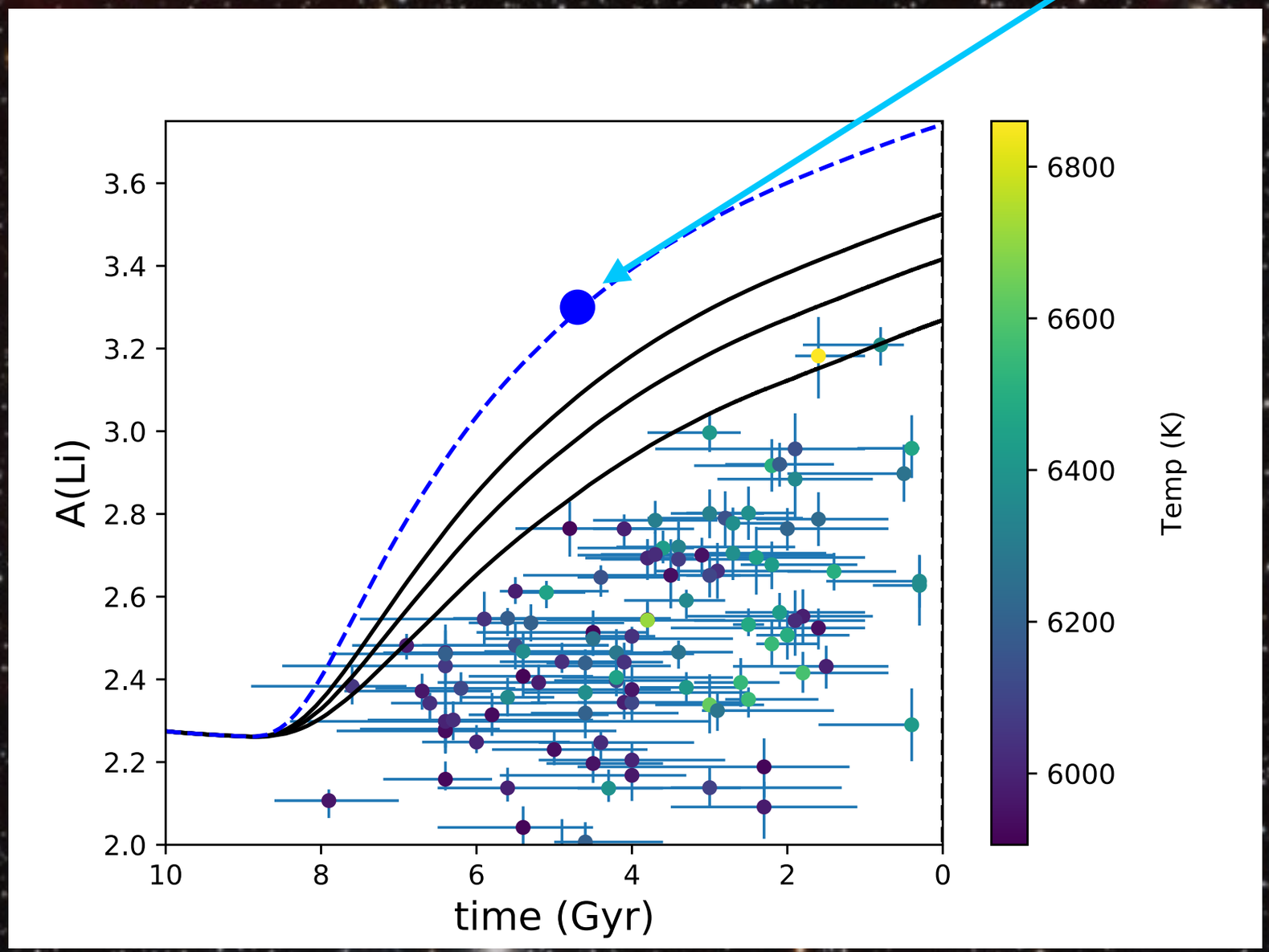


AMBRE data
Guiglion+16

Bensby&Lind 2018

Cescutti&Molaro 2019

Exploring parameters
yields: +33% -33% (and 2.3 times)



Cescutti&Molaro 2019

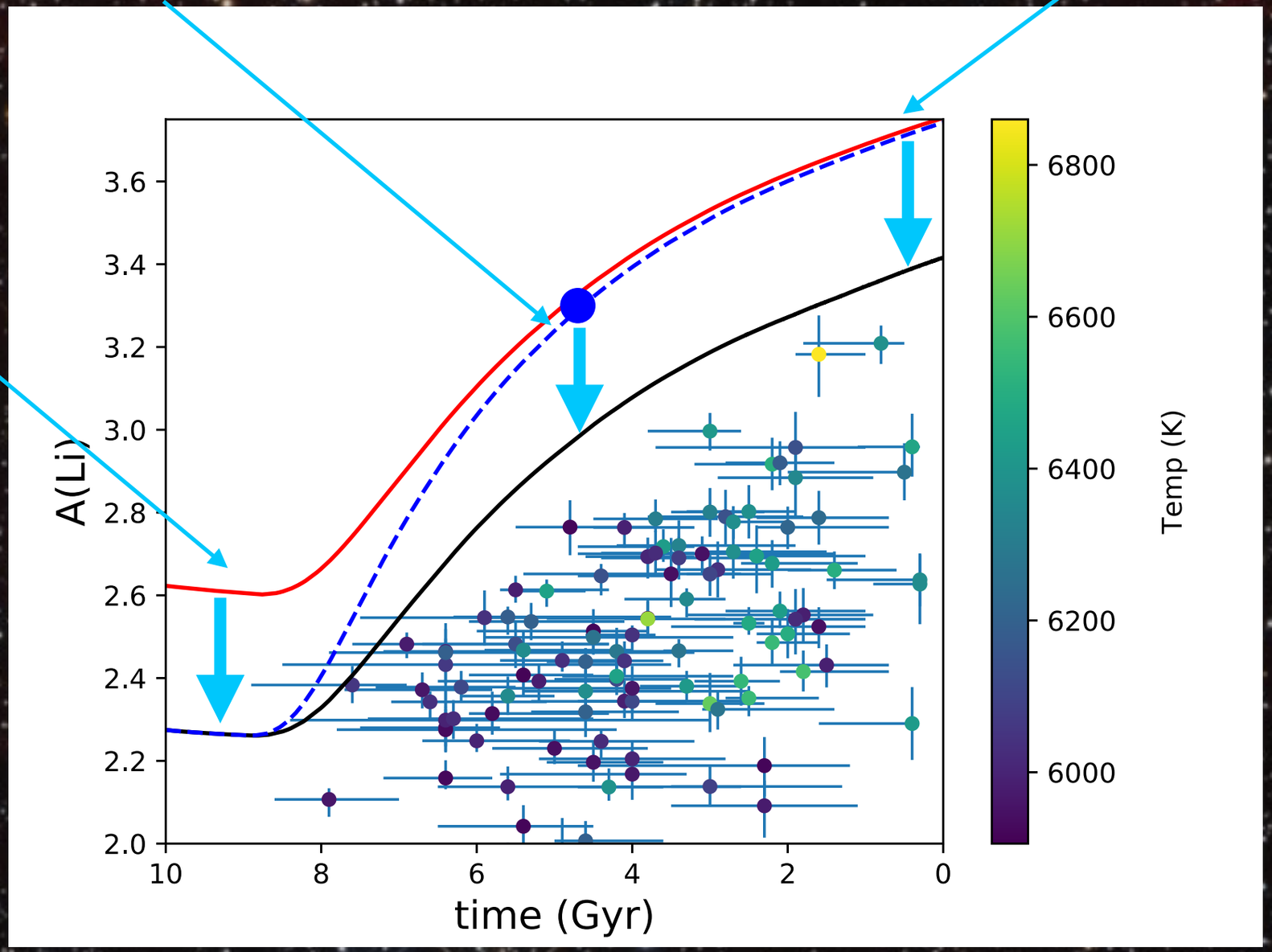
Possible explanation?

need to adopt a fix depletion −0.3dex

Meteoritic value

T Tauri

BBN nucleosynthesis



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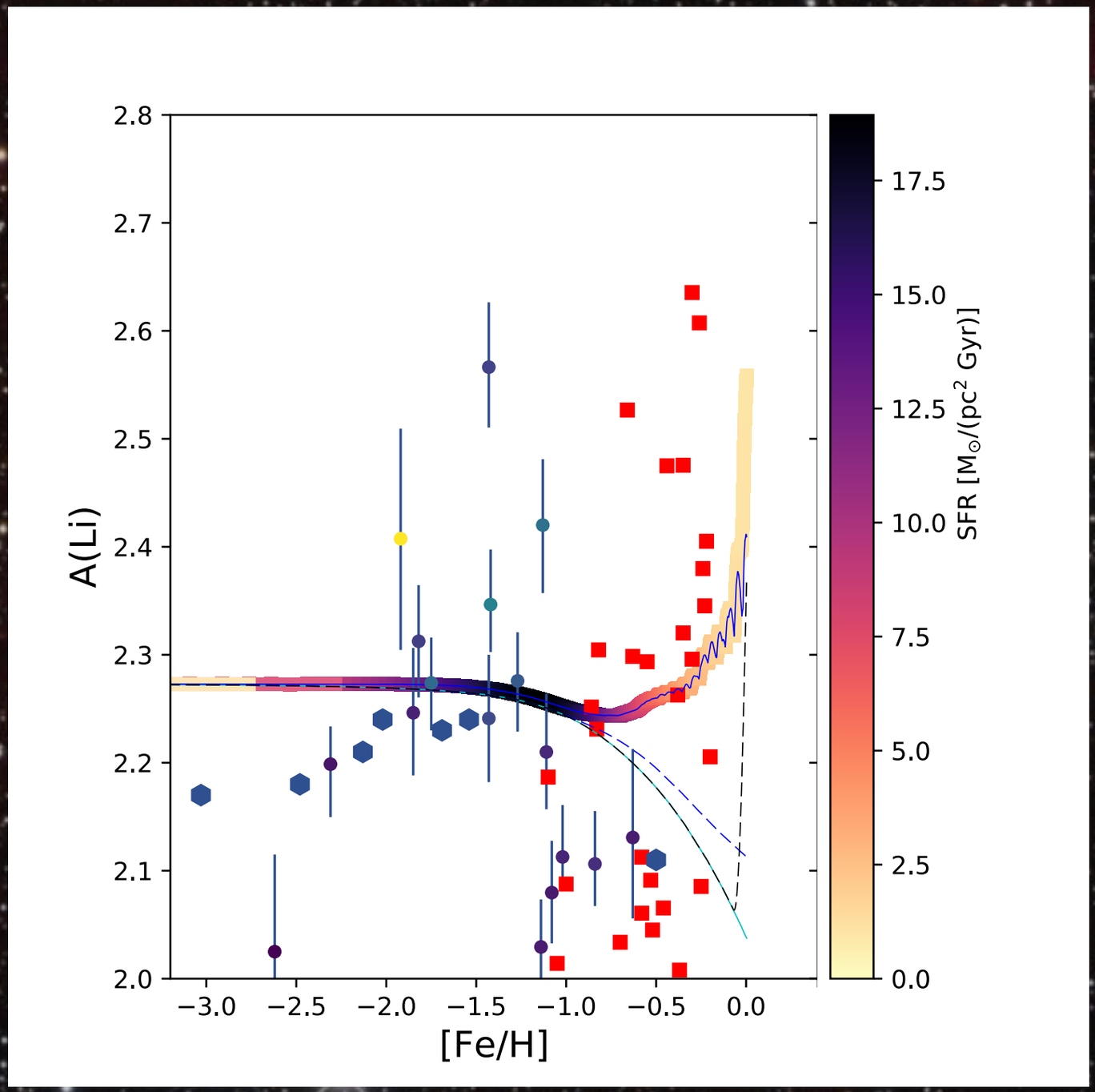
Thick disc results

short time scale
efficiency —> 3

similar to the oldest
mono-age
populations
scenario presented
in Minchev+17
see also Grisoni +17



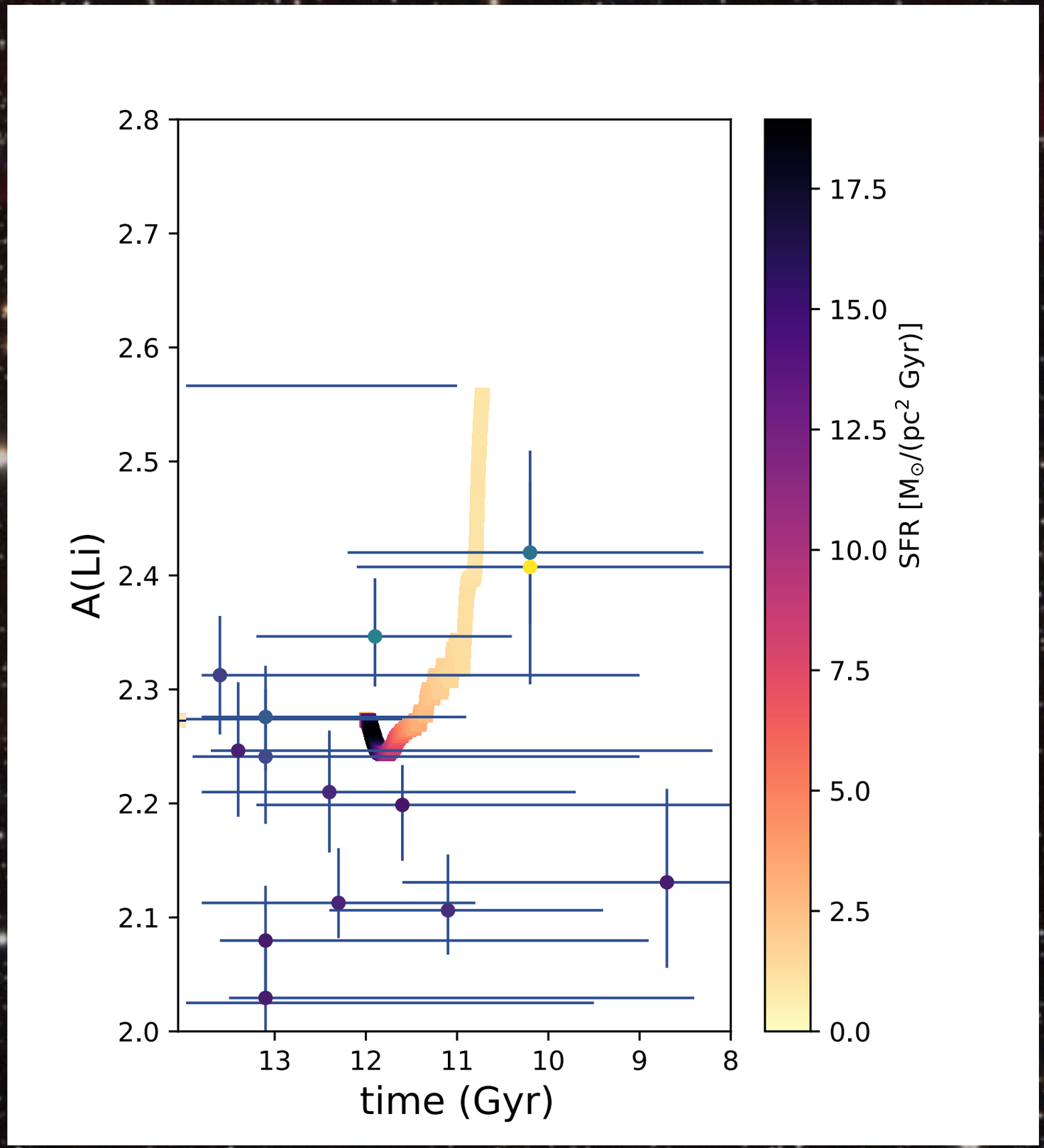
AMBRE data
Guiglion+16

Bensby&Lind 2018

Molaro+97

Cescutti&Molaro 2019

Thick disc results 2



Bensby&Lind 2018

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Conclusions

Nova systems enrich interstellar Li

Assuming:

1) Delay of about 1 Gyr.
2) Effective yield of 1.8 10^{-5} Msun
3) Fraction of binary system (3-16Msun)=0.03

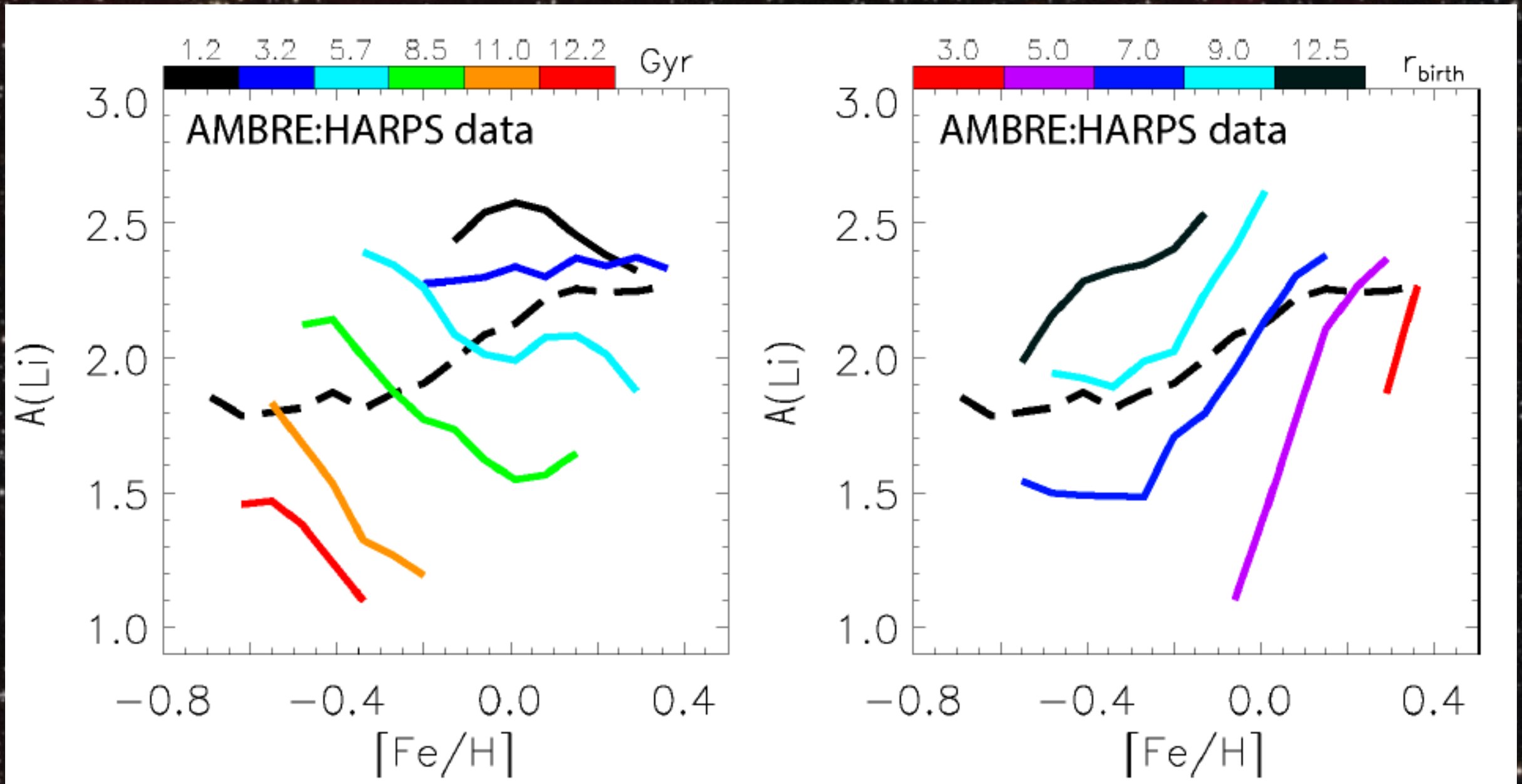
the observational data (upper envelope) are reproduced

Yields 1.8 10^{-5} Msun agrees with the detection of Be in Nova systems (and each systems produces 10'000 nova bursts)

Applying same ingredients to the thick disc model,
Lithium is flat, due to the delay lithium is not produced by novae (does not decrease thanks to spallation processes).

Associazione triestina ospedaliera per il sorriso dei bambini

Minchev+19


1.2 3.2 5.7 8.5 11.0 12.2 Gyr
AMBRE:HARPS data
A(Li)
[Fe/H]
3.0 5.0 7.0 9.0 12.5 r birth
AMBRE:HARPS data
A(Li)
[Fe/H]

Conference on Lithium

in Roma, next year
18-22 November 2019

from BBN nucleosynthesis to
Galactic surveys

SOC

co-chair: Paolo Ventura - Andreas Korn

Karin Lind, Alain Coc, Constantine Deliyannis, Ana Palacios, Margarita Hernanz, Christian Iliaidis, María Rosa Zapatero Osorio, Gabriele Cescutti