Lithium abundance dispersion in metal-poor stars

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Introduction

The observations of light elements in the Universe act as important cosmological constraints. For this purpose, their evolution over time must be precisely reconstructed through modelling. Among these elements, lithium plays a special role. It is observed in the oldest stars of the Galaxy, and for a long time this was assumed to be the primordial abundance. On the other hand, the abundance determined through CMB observations is 3 to 4 times larger than the presently observed one in metal poor stars. This is qualitatively consistent with stellar modelling, as the surface lithium abundances decrease over time due to various transport processes inside the stars. Some problems do remain however. In the past, the absence of dispersion of the lithium abundances in the so-called « lithium plateau » seemed incompatible with lithium depletion. More recently, the evidence of a large lithium dispersion in the extremely metal-poor stars modified the landscape. All these observations have to be reconciled, by deep studying of the possible lithium abundance evolution inside these stars.

Aim of the study

- We focused our study on the case of Carbon Enhanced Metal Poor stars, for which many data are available. The abundance variations observed in these stars are generally explained in terms of accretion of the wind of stellar companions, especially Asymptotic Giant Branch stars, taking into account the stellar structure and the thermohaline convection that take place after accretion.
- We study how such accretion processes modify the surface Li abundance of these stars. We take into account the stellar parameters of the primary star, the parameters of the AGB companion, the wind composition, the stellar diffusion processes and hydrodynamics including element diffusion in the primary before accretion, which has important consequences on the final results.

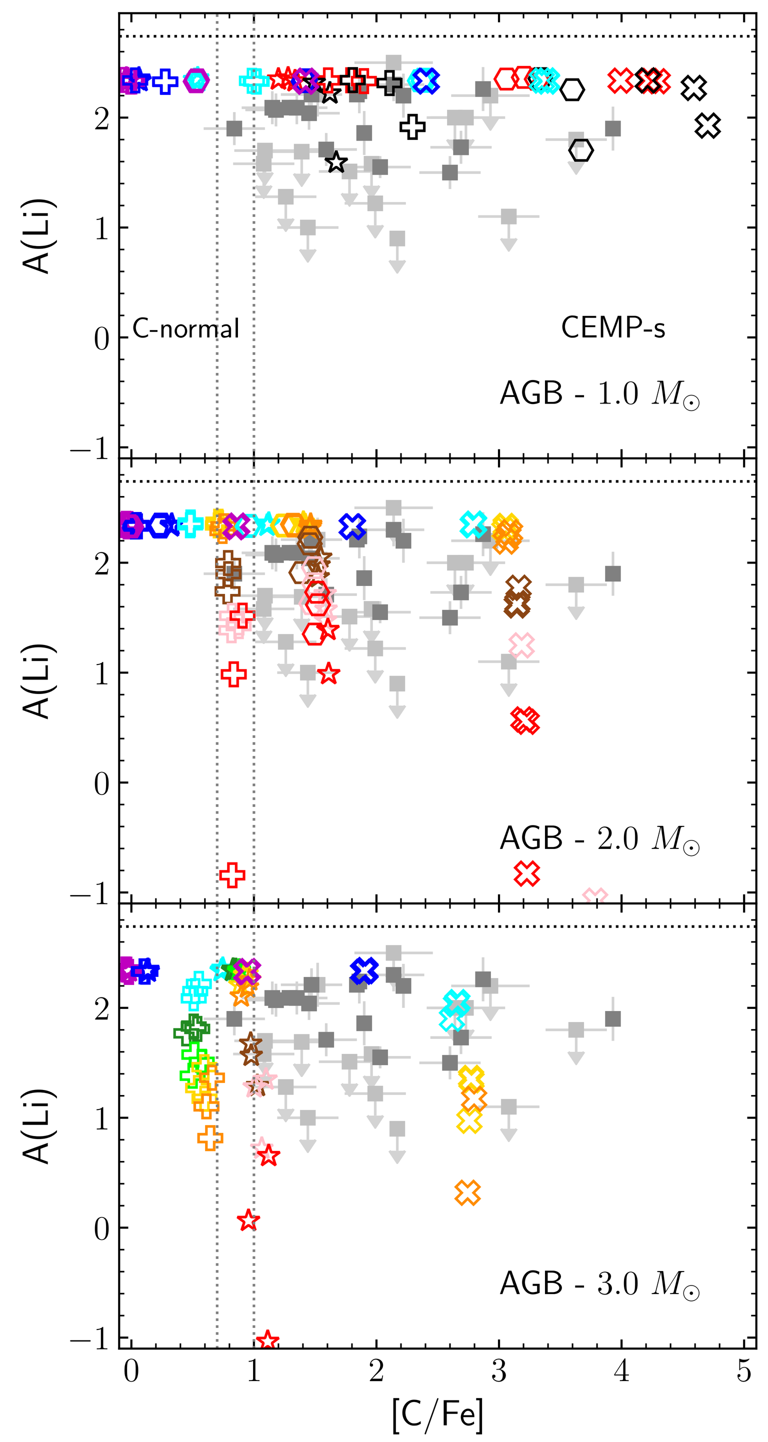
Method

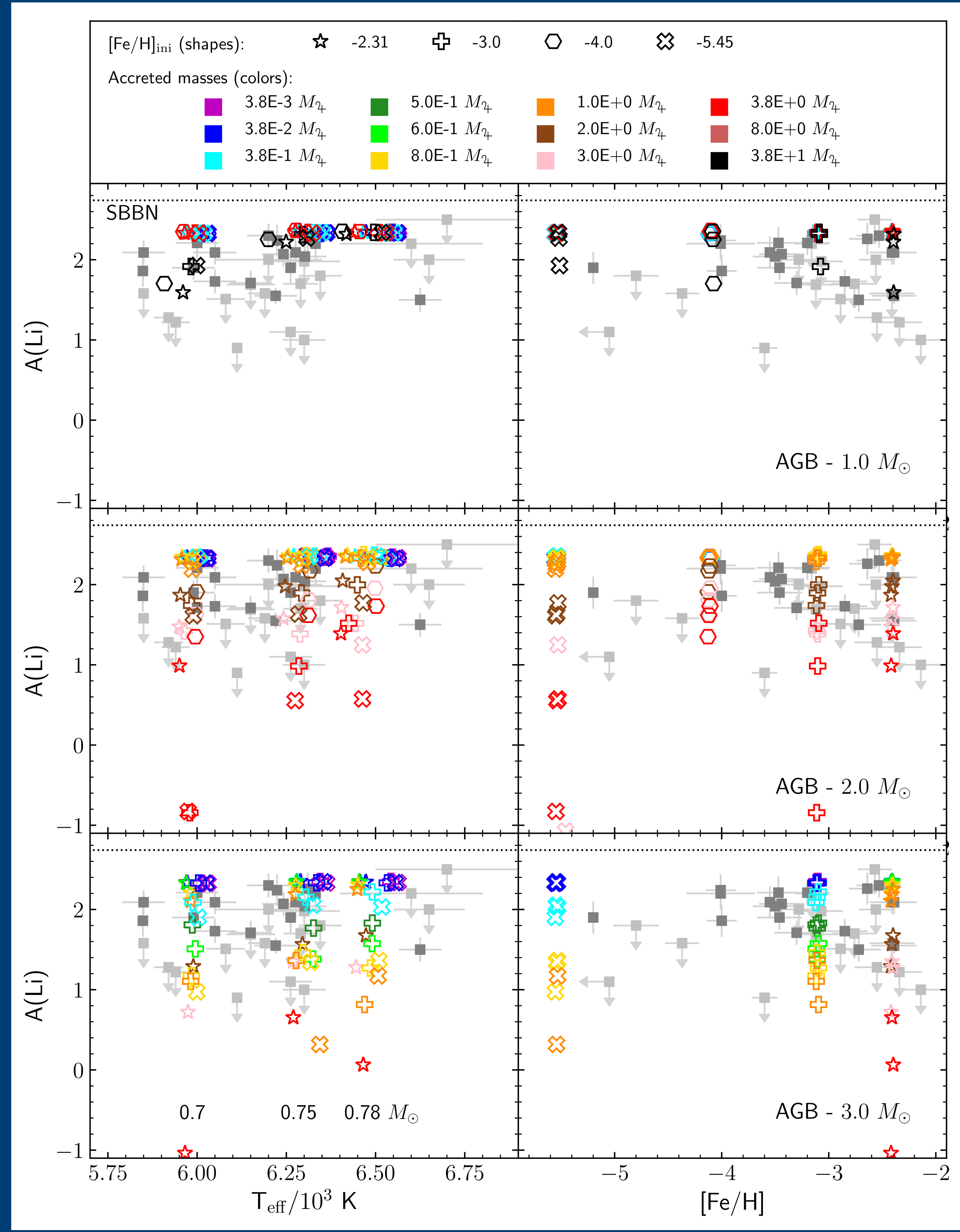
The stellar models, computed with the Montréal/Montpellier stellar evolution code, include:

- initial [Fe/H] between -2.31 and -5.45 dex and masses of 0.7, 0.75 and 0.78 $M_\odot$
- atomic diffusion, including radiative accelerations
- a parametrized turbulent diffusion coefficient calibrated to reproduce the Li plateau
- thermohaline convection from recent 3D simulations
- accreted masses between 0.0038 and 3 $M_♃$ from AGB winds of 1, 2 and 3 $M_\odot$ companions

Li abundances in CEMP-s stars

Comparison of the models with the observations of lithium in main-sequence CEMP-s stars (see Fig. below and on the right column):





Conclusion

Li abundances in CEMP-s stars can be explained by **transport processes** of chemical elements **induced by accretion**, with the cosmic abundance as initial value.

Link to the article

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