Contribution ID: **67** Type: **Poster**

Can the electron capture on 7Be provide a nuclear solution to the solar Li problem?

Tuesday, 20 June 2017 19:30 (2 hours)

The nucleosynthesis of 7Li represents one of the most crucial problems in nuclear astrophysics. The 7Li abundances of several atrophysical sites are hard to be reproduced: in particular, the 7Li abundance observed in the solar photosphere appears to be about 100 times lower than in meteorites.
Recently, a new model for non-convective mixing mechanism induced by magnetohydrodynamics (MHD) was developed [1] and applied to explain the 13C-pocket formation in the He-rich regions during AGB phases [2] as well as the isotopic composition of presolar oxide grains of AGB origin [3]. This new formalism can be applied only in the case where the density of the stellar layers of interest decreses rather quickly with the radius, indeed this fact ensures a quasi-ideal MHD. We found that in the Sun this condition doesn't hold and it implies that magnetic buoyancy effects (which exist, as certified by the solar activity) require a much more complex numerical formulation and have to be less effective in the abundance reorganization than found in AGB stars.
The solution of the Li problem must therefore be looked for elsewhere. Thanks to a new theoretical estimate of stellar e- capture on 7Be, and therefore of 7Li production, that has been performed in the past few years [4], we computed the lithium abundance for the Sun. Apart from possible mixing processes of different physical nature, our preliminary results indicate that a larger depletion of Li can indeed be obtained. This is a promising result, which indicates that a nuclear solution to the solar Li problem may in principle exist. In order to explore this in more detail, we are now improving the model for the mentioned rate, by introducing a fully relativistic, quantum mechanics extension.

[1] M.C. Nucci and M. Busso, The Astrophysical Journal, 787, 141 (2014);

[2] O. Trippella et al., The Astrophysical Journal, 818, 125 (2016);

[3] S. Palmerini et al., submitted to Monthly Notices of the Royal Astronomical Society (2017);

[4] S. Simonucci et al., The Astrophysical Journal, 764, 118 (2013).

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Session Classification: Poster session