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The Interaction of Neutrons With 7Be: Lack of Standard Nuclear Physics Solution to the "Primordial 7Li Problem"

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\long\def\TITLE#1{{\Large{\bf#1}}}\long\def\AUTHORS#1{ #1\\[3mm]}
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{\small \it Nuclear Physics in Astrophysics 8, NPA8: 18-23 June 2017, Catania, Italy}

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\TITLE{The Interaction of Neutrons With ^{7}Be: Lack of Standard Nuclear Physics Solution to the "Primordial ^{7}Li Problem" * }\\[3mm]
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%%% Authors and affiliations are next. The presenter should be
%%% underlined as shown below.
%%%
\AUTHORS{Moshe Gai [1]}

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{\small \it
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}
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% Enter contact e-mail address here.

\centerline{Contact email: {\it moshe.gai@uconn.edu}}

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%%% Abstract proper starts here.
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The accurate measurement of the baryon density by WMAP renders Big Bang Nucleosynthesis (BBN) a parameter free theory with only inputs from measurements of the relevant (12 canonical) nuclear reactions. BBN predicts with high accuracy the measured abundance of deuterium, helion and helium relative to hydrogen, but it over-predicts the abundance of ^{7}Li relative to hydrogen by a factor of approximately three and more than three sigma difference from the observed value. This discrepancy was observed early on (more than thirty years ago) and is known as the Primordial ^{7}Li Problem". Several attempts to reconcile this discrepancy by destroying ^{7}Be with deuterons and helions or a conjectured d + ^{7}Be resonance were ruled out as solutions of the ^{7}Li problem. But the interaction of ^{7}Be with neutrons that are also prevailing during the epoch of BBN, was not directly measured thus far in the BBN window. Also a hitherto unknown n + ^{7}Be narrow resonance in ^{8}Be at energies relevant for the BBN window was not yet ruled out. A worldwide effort for measuring the interaction of neutrons with ^{7}Be is currently underway [1] with ^{7}Be targets prepared at the Paul Scherrer Institute (PSI) [2] and the ISOLDE at CERN. Measurements were performed by the n_TOF collaboration [3], at the ILL in Grenoble [4], and in the new neutron facility at the Soreq Applied Research Accelerator Facility (SARAF) in Israel [5], as well as the time reversed measurement of ^{4}He(α,n)^{7}Be in Kyoto [6]. Only the SARAF measurement covers theBBN energy window" with T = 0.5 - 0.8 GK and kT = 43 - 72 keV. We will discuss the world wide effort to measure the interaction of neutrons with ^{7}Be [3-6] with an emphasize on our measurement at the SARAF [5]. We measured a significantly small upper limit on the ^{7}Be(n,α) reaction and the first measurement of the ^{7}Be(n,γ_1)^{8}Be*(3.05 MeV) $\rightarrow\ \alpha + \alpha$ reaction (E$_\alpha$ = 1.5 MeV). Our measurement allow us to re-evaluate the so designated ^{7}Be(n,α) reaction rate" first derived by Wagoner in 1969 and still used in BBN calculations. Our evaluated new rate demonstrates that the last possible avenue (of the n + ^{7}Be interaction) for a standard nuclear physics solution of the ^{7}Li problem does not solve the problem. We conclude on lack of standard nuclear physics solution to thePrimordial ^{7}Li problem". \\
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\bigskip
{\small

\noindent [1] Dorothea Schumann, Massimo Barbagallo, Thierry Stora, Ulli Koester and Moshe Gai, \\ \indent Nuclear Physics News, {\bf 26:4}, 20 (2016).

\noindent [2] Emilio Andrea Maugeri {\em et al.}, in press, Journ. Instr. (2017).

\noindent [3] Massimo Barbagallo {\em et al.}, and the n_TOF collaboration, Phys. Rev. Lett. {\bf 117}, 125701 (2016).

\noindent [4] Ulli Koester, private communication, 2016.

\noindent [5] Emily Elizabeth Kading {\em et al.}, Bull. Amer. Phys. Soc. {\bf 61, \#13}, 28 (2016). \\ \indent Also E.E. Kading {\em et al.} contribution to this conference with a complete list of the collaboration.

\noindent [6] Takahiro Kawabata {\em et al.}, Phys. Rev. Lett. {\bf 118}, 052701 (2017).

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Presenter: Prof. GAI, Moshe (University of Connecticut)

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