Comment on: The interaction of neutrons with ^{7}Be at BBN temperatures: Lack of Standard Nuclear Solution to the "Primordial ^{7}Li Problem" by M. Gai *et al.*

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Abstract. The recently published article [1] claims to reach quantitative conclusions from a collaborative experiment dedicated to the study of the ^{7}Be(n,α)α reaction. The Authors of this Comment who were collaborators in the experi-ment categorically reject the conclusions therein.

The experiment described in [1] (see also [2]), aimed at the study of the important reaction ^{7}Be(n,α)α as possibly bearing consequences in the resolution of the so-called "Primordial Lithium Problem" [3] involved a wide collaboration of researchers from Hebrew University (HUJ, Israel), University of Connecticut (UC, USA), Soreq Nuclear Research Center (SNRC, Israel), Paul Scherrer Institute (PSI, Switzerland), Institut Laue-Langevin (ILL, France), Tri-angle Universities Nuclear Laboratories (TUNL, Duke University, USA), Weizmann Insti-tute of Science (Israel), Bar Ilan University (BIU, Israel) and CERN (Switzerland). The ex-periment itself was performed at the Soreq Applied Research Accelerator Facility (SARAF, SNRC) [4] using a ^{7}Be target prepared specifically for this purpose and the Liquid-Lithium Target (LiLiT) [5, 6].

A number of calibration experiments were designed and performed by the UC group to characterize α and proton induced pits in a CR-39 detector. Irradiation runs with quasi-Maxwellian neutrons produced at LiLiT were designed and performed on targets of ^{10}B (for proof of principle), ^{7}Be and ^{9}Be (background) targets under different experimental conditions. Etching and scanning of the CR-39 plates were performed in part at HUJ and UC and for the scanning also at BIU. In spite of the methodology described above, we are of the opinion that the calibration experiments failed to reach consistent and reliable performance and that the experiment discussed in [1] cannot result in quantitative results. This assessment was spelled out in detail in [7, 8]. We list below the severe flaws leading to our rejection of the conclusions of [1].

1. The calibration experiments for α particles detected in the CR-39 track detectors presented in [1] and in other Conference contributions [9–11] display notable discrepancies. The source of these discrepancies is not clear and the arbitrary choice of one set

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among the others, not confirmed by any additional independent calibration experiment, is unacceptable and unfit for extraction of physical information. For details see [7].

2. The authors of [1] claim to identify protons emitted in the same experiment by the ^{7}Be(n,p)^{7}Li reaction and to determine the cross section of this reaction, based on a calibration shown in Fig. 3 (bottom panel) of [12] a recently published paper by the same group of authors, describing technical details of the experiment. The spectrum of pit radii taken as calibration for protons in Fig. 3 bottom is however a steeply decreasing function of the radius, as shown in Figure 1 of this comment. In these conditions, the interval from 0.8 μm to 1.4 μm taken as the radii region of interest for protons cannot lead to a quantitative determination of the efficiency for proton-induced pits. In [12], an uncertainty of the pit radius determination of 0.2 μm, caused by temperature variations during the etching procedure, is reported. This uncertainty leads to a change of one order of magnitude in the assigned number of pits owing to the steepness of this calibration curve. A low efficiency of proton counting of 8.7%, determined with ambiguous uncertainty of 3% (relative uncertainty of 34%) [1] and 1.3% (relative uncertainty of 14%) [12], compounds the problem. The resulting spread of the detector efficiency varies from 2.2% (effective RRI 0.6–1.2 μm) to 22.6% (effective RRI 1.0–1.6 μm). Consequently, the cross section deduced for the ^{7}Be(n,p) reaction is uncertain within at least one order of magnitude as well. On a methodological point of view, the use of a detection system where small variations induce an order of magnitude change or more in the measured quantity disqualifies the method for a quantitative measurement.

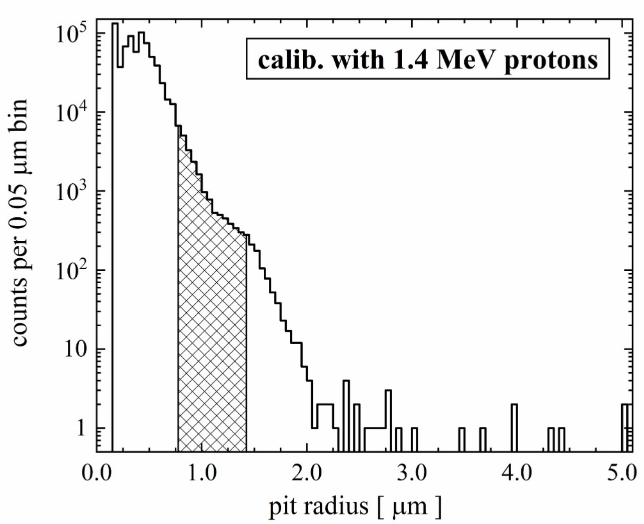

Figure 1. Calibration of solid state CR39 track detectors with 1.4 MeV protons, irradiated at the Weizmann Institute in 2016. Analysis of the solid state CR39 track detector plate used in [1], presented as a poster contribution at NIC2016 [10] and in a talk at the 2016 Fall Meeting of the APS Division of Nuclear Physics [11]. The RRI used for the cross section determination in [1] is indicated as shadowed area. (This figure is the authors artwork prepared with information and materials available in the research collaboration.)

We express again and categorically our position that the above experiment failed to achieve its goals and that in no circumstance it can be used to extract quantitative information on a physical quantity such as a reaction cross section.

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