Comment on “First Observation of Ground State Dineutron Decay: $^{16}$Be”

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In a recent paper by Spyrou et al. [1], an investigation of the unbound system $^{16}$Be via single-proton removal from $^{17}$B was reported. In addition to identifying a structure some 1.5 MeV above the $^{14}$Be+$n+n$ threshold, interpreted as the $^{16}$Be ground state, significant enhancements were observed at low $n$-$n$ relative energy ($E_{n-n}$) and angle ($\theta_{n-n}$). Through a comparison with simulations based essentially on direct three-body and “dineutron” decay, Spyrou et al. concluded that only the dineutron mode was consistent with these effects. As such it was claimed that the first case of dineutron decay had been discovered. Here we point out that such an interpretation is, at best, premature as the inclusion of the $n$-$n$ interaction in the description of direct three-body decay of $^{16}$Be generates strong enhancements at low $n$-$n$ relative energy and angle, as observed, without the need to invoke dineutron decay.

An important feature of the interpretation was the treatment of the direct three-body decay mode, whereby the well-known $n$-$n$ interaction was neglected. By contrast, the dineutron decay was modeled in terms of the dineutron decay. The neglect, however, of the $n$-$n$ interaction invariably leads to a characteristic enhancement near zero relative momentum, a feature which is exploited in determinations of the $n$-$n$ scattering length [2]. More generally, this enhancement is observed in almost any final state in which two neutrons are emitted over a relatively short time scale (see, for example, Refs. [3–6]).

It would be surprising, therefore, if such effects were not present in the decay of $^{16}$Be.

To put these considerations on a more quantitative footing, we have undertaken three different calculations (Fig. 1). For all three the input is a $^{14}$Be+$n+n$ decay-energy distribution following that observed in Ref. [1]. In case (1) the energy is shared by the three particles following phase space considerations alone. In case (3), dineutron decay, it is shared through a sequential process: $^{14}$Be+$n+n$ breakup followed by $2n$+$n+n$, with the $2n$ decay energy similar to that of Ref. [1] (Fig. 1a).

![FIG. 1: (color online) Calculations of $^{14}$Be+$n+n$ decay for three-body phase space without (1) and including (2) the $n$-$n$ FSI, and for dineutron decay (3). The results have been normalized in each panel to the same integrated yield (Y).](image-url)