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Comment on "Nuclear structure of ^{195}Pt"

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We show that the introduction of a $U^{B+F}(6)$ group into the multi-j supersymmetric scheme permits a better agreement with the energy spectrum of ^{195}Pt and suggest two other possible supersymmetric classifications.

[NUCLEAR STRUCTURE Interacting boson-fermion model; multi-j supersymmetric scheme.]

In a recent paper,[1] Warner *et al.* have made a detailed analysis of the low-lying negative parity states of ^{195}Pt that shows an apparent one-to-one correspondence between these levels and the predictions of the SO(6) multi-j supersymmetry (SUSY) scheme,[2] recently proposed by Balantekin *et al.* More recently, Casten *et al.*[3] have carried out a similar analysis in ^{197,199}Pt, which further supports the conclusions of Ref. 1. These are important accomplishments since, besides providing a new systematics for this region, they increase the motivation to further investigate the SUSY scheme. However, there is a striking discrepancy between the experimental and theoretical levels, pointed out by Warner *et al.*[1] for ^{195}Pt, namely, the relative excitation energy of the two major predicted families of levels. In this Comment we show that this particular problem can be solved by considering a slightly different chain of groups than the one used in Refs. 1, 2, and 3.

Referring for more details on the theoretical framework to the original paper,[2] we limit ourselves to writing down the relevant chain of groups,

$$\underset{[N+m]}{U(6/12)} \supset \underset{[N]}{U^B(6)} \times \underset{\{1^m\}}{U^F(12)} \supset \underset{[N]}{U^B(6)} \times \underset{\{2^{m/2-S},1^{2S}\}}{U^F(6)} \times \underset{\left\{\frac{m}{2}+S,\frac{m}{2}-S\right\}}{U^F(2)} \supset \underset{[\Sigma 00]}{SO^B(6)} \times \underset{\{\Sigma_1'\Sigma_2'\Sigma_3'\}}{SO^F(6)} \times \underset{S}{SU^F(2)}$$
$$\supset \underset{\langle\sigma_1\sigma_2\sigma_3\rangle}{SO^{B+F}(6)} \times \underset{S}{SU^F(2)} \supset \underset{(\tau_1\tau_2)}{SO^{B+F}(5)} \times \underset{S}{SU^F(2)} \supset \underset{L}{SO^{B+F}(3)} \times \underset{S}{SU^F(2)} \supset \underset{J}{\mathrm{Spin}(3)} \supset \underset{Mj}{\mathrm{Spin}(2)} \ , \quad (1)$$

where below each group we indicate the quantum numbers that label their irreducible representations. The basic trends of the energy spectrum are determined by $SO^{B+F}(6)$ and its subgroups since all low-lying states for a given nucleus will sit in a fixed irreducible representation of each of the previous groups. For $m=1$ (one uncoupled fermion), the group structure (1) gives rise to the simple energy formula (3) of Balantekin *et al.*, which cannot properly describe the relative energy spacing between the lowest $SO^{B+F}(6)$ irreducible representation.

This problem can be solved by introducing the boson-fermion group $U^{B+F}(6)$, i.e., we delete in (1) the subgroup $SO^B(6)\times SO^F(6)\times SU^F(2)$ and replace it by $U^{B+F}(6)\times SU^F(2)$. All other groups remain the same. This change is not trivial, since (again for $m=1$) two possible irreducible representations of $U^{B+F}(6)$ are present, namely, $[N+1,0,0,0,0,0]$ which contains the $\langle N+1,0,0\rangle$, $\langle N-1,0,0\rangle, \ldots,$ and $[N,1,0,0,0,0]$, which contains the $\langle N,1,0\rangle$, $\langle N-2,1,0\rangle, \ldots,$ and the $\langle N-1,0,0\rangle$, $\langle N-3,0,0\rangle, \ldots$ irreducible representations of $SO^{B+F}(6)$, respectively. Introducing the new Casimir operator into the picture, one obtains the new energy formula

$$E[h_1h_2;\sigma_1\sigma_2;\tau_1\tau_2;L;J] = A[h_1(h_1+5)+h_2(h_2+3)] - \frac{A''}{4}[\sigma_1(\sigma_1+4)+\sigma_2(\sigma_2+2)] + \frac{B}{6}[\tau_1(\tau_1+3)+\tau_2(\tau_2+1)] + CL(L+1) + C''J(J+1) \ , \quad (2)$$

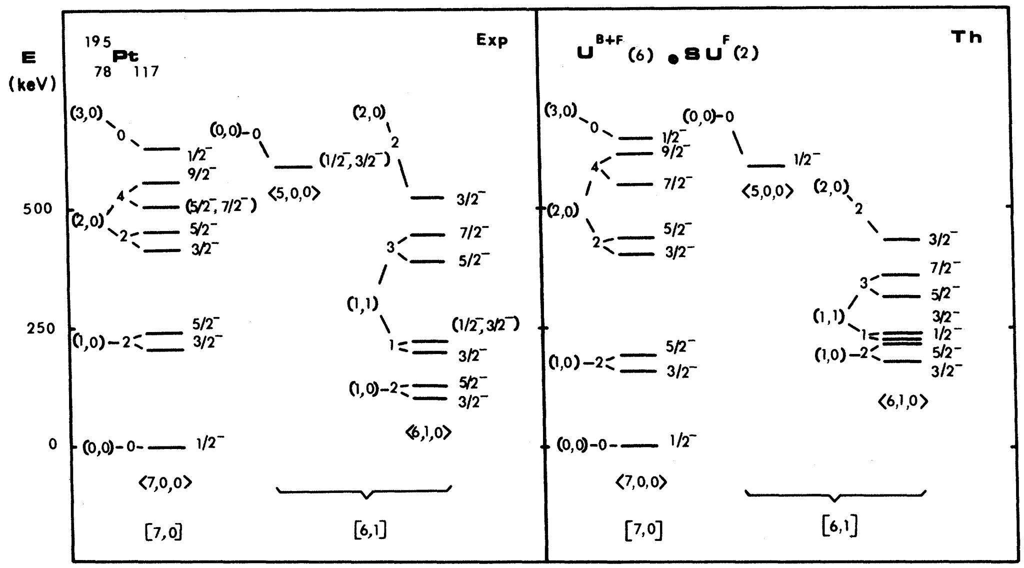

FIG. 1. Comparison between the experimental low-lying spectrum (Ref. 1) of ^{195}Pt and that obtained using Eq. (2) with $A=29.9$ keV, $(A''/4)=31.5$ keV, $(B/6)=35.9$ keV, $C=4.8$ keV, and $C''=6.4$ keV. The number of bosons is $N=6$. We indicate the two possible irreducible representations of $U^{B+F}(6)$, namely, $[N+1,0,0,0,0,0]$ and $[N,1,0,0,0,0]$, by $[7,0]$ and $[6,1]$, respectively.

where $[h_1h_2]$ labels the $U^{B+F}(6)$ irreducible representations, which for $m=1$ are either $[N+1,0]$ or $[N,1]$. In the figure we show the result for ^{195}Pt, obtained with Eq. (2), to be compared with Fig. 7 of Ref. 1. Note that both the $\langle 500\rangle$ bandhead and the $\langle 610\rangle$ centroid energy are now well reproduced.

Besides giving a better agreement with experiment in $^{195-199}$Pt, the introduction of $U^{B+F}(6)$ could conceivably be exploited by considering, instead of $SO^{B+F}(6)$, also $U^{B+F}(5)$ or $SU^{B+F}(3)$ in the chain of groups, and thus provides a possible extension of the multi-j supersymmetry scheme.

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[1]D. D. Warner, R. F. Casten, M. L. Stelts, H. G. Borner, and G. Barreau, Phys. Rev. C 26, 1921 (1982).

[2]A. B. Balantekin, I. Bars, R. Bijker, and F. Iachello, Report No. YTP 82-11.

[3]R. F. Casten, D. D. Warner, G. M. Gourdy, N. Rofail, and K. P. Lieb, Report No. BNL-31983.