

**A NOTE ON THE LEVEL STRUCTURE OF Pb<sup>210</sup>**

RECENTLY Redlich,<sup>1</sup> from a detailed analysis of the energy level spectrum of Pb<sup>210</sup> with the use of several types of interactions between the two extra-core neutrons, has found that the Gaussian singlet-even (SE) interaction leads to the best agreement with the experimental data<sup>2</sup> available so far. Weinzierl *et al.*<sup>2</sup> (WUPE) while reporting the measurement of some of the energy levels of this nucleus have also reported some simple shell-model calculations for these levels by using zero-range forces operative only in singlet-spin states. But since our results for the Gaussian SE case with slightly different parameters are a little different from those of references 1 and 2, we should report them briefly as they may be of some interest to the experimentalists.

But first, we write the final expression for the matrix elements of a two-body interaction for the central forces, which we need for evaluating the various shell-model states of Pb<sup>210</sup>

$$\langle j_1 j_2 : JM | H_{12} | j_1' j_2' : JM \rangle = \sum_{\substack{LL'S \\ N\lambda n l n'}} A \begin{pmatrix} l_1 & s_1 & j_1 \\ l_2 & s_2 & j_2 \\ L & S & J \end{pmatrix} A \begin{pmatrix} l_1' & s_1' & j_1' \\ l_2' & s_2' & j_2' \\ L & S & J \end{pmatrix} B_{N\lambda n l}^{n_1 l_1 n_2 l_2} (L) B_{N\lambda n' l'}^{n_1' l_1' n_2' l_2'} (L') S_{LL'} \langle n l, S | H_{12} | n' l', S \rangle.$$

Here A( ) are the 9-j symbols and B's are the transformation brackets. Further, in these calculations, we neglect the roles played by configuration interaction and fix the potential strength parameter from the observed spacing of the 2<sup>+</sup> and 0<sup>+</sup> levels of the ground-state configuration and the single particle energies from the data on Pb.<sup>209</sup> Thus here, we fix our parameters from the experimental splitting of the lowest two levels in comparison to Redlich who uses SE Gaussian effective interaction with parameters determined from low-energy proton-proton scattering data.

Table I lists our levels for the best fit with Gaussian SE interaction for the choice of

TABLE I  
Experimental (\*) and calculated (\*\*) energy levels of Pb<sup>210</sup> for the configuration (2g<sub>9/2</sub>)<sup>2</sup>. Values are in MeV

Authors J	0 <sup>+</sup>	2 <sup>+</sup>	4 <sup>+</sup>	6 <sup>+</sup>	8 <sup>+</sup>
Weinzierl <i>et al.</i> <sup>2</sup> (*)	G.S.	0.795	1.09	1.17	..
Redlich <sup>1</sup> (**)	..	0.802	1.041	1.123	1.153
Weinzierl <i>et al.</i> <sup>2</sup> (**)	..	0.795	1.090	1.220	1.252
This work (**)	..	0.795	1.087	1.192	1.224

parameters V<sub>0</sub> = -40 MeV and λ = (r<sub>0</sub>/√2 r<sub>i</sub>) = 0.74 in comparison to Redlich's values of V<sub>0</sub> = -31.6 MeV and λ = 0.80. This table clearly shows that our low-lying 6<sup>+</sup> level is in much better agreement with the experimental value and on the basis of our general agreement between the calculated and observed values, we suggest the 8<sup>+</sup> state to be near 1.224 MeV. The levels due to the configuration (1 i<sub>11/2</sub>)<sup>2</sup> come out in MeV's to be 1.390 (0<sup>+</sup>), 2.012 (2<sup>+</sup>), 2.530 (4<sup>+</sup>), 2.696 (6<sup>+</sup>), 2.788 (8<sup>+</sup>) and 2.860 (10<sup>+</sup>). Here also we find that our 4<sup>+</sup> level at 2.530 MeV corresponds more correctly to the probable 4<sup>+</sup> experimental level at 2.40 MeV in comparison to WUPE and Redlich's values at 2.581 and 2.596 MeVs respectively. But the close agreement between these values of WUPE and Redlich might lead one to think that the experimental state at 2.58 MeV could be a 4<sup>+</sup> state. The major difference in the excited levels due to the (2g<sub>9/2</sub> 3d<sub>5/2</sub>) configuration and the odd-spin levels of the (2g<sub>9/2</sub> 1 i<sub>11/2</sub>) configuration worked out by us and those by WUPE is that our levels are not coming out to be degenerate as those predicted by them. While the

comparison of our levels with those of Redlich for the configurations (2g<sub>9/2</sub> 1 i<sub>11/2</sub>) and (2g<sub>9/2</sub> d<sub>5/2</sub>) shows that our levels are somewhat raised up though the ordering is the same. Only in a few cases the cross-over of the levels takes place and that is shown in Table II.

TABLE II  
Comparison showing the cross-over of levels. Values are in MeV.

Configuration	Redlich <sup>1</sup>	This work
(2g <sub>9/2</sub> 1i <sub>11/2</sub> )	2 <sup>+</sup> (1.964), 4 <sup>+</sup> (1.966) 4 <sup>+</sup> (2.165), 2 <sup>+</sup> (2.180) 9 <sup>+</sup> (2.983), 7 <sup>+</sup> (1.993) 7 <sup>+</sup> (2.102), 9 <sup>+</sup> (2.117)	
(2g <sub>9/2</sub> 3d <sub>5/2</sub> )	6 <sup>+</sup> (2.564), 3 <sup>+</sup> (2.694) 3 <sup>+</sup> (2.828), 6 <sup>+</sup> (2.852)	

Our levels for these configurations may also be made to fit with those of Redlich in case we either reduce the potential strength or the range parameter. But our low-lying levels for the (2g<sub>9/2</sub>)<sup>2</sup> and (1 i<sub>11/2</sub>)<sup>2</sup> configurations do not permit us to do so. It would thus be interesting to have more experimental information on this nucleus since it would help us in computing these parameters and in deciding about the operating effective two-body nuclear interaction.

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### CIS-STABILISATION OF o-CHLOROPHENOL AND o-CHLOROANILINE

THE presence of intramolecular hydrogen bonds in *ortho*-disubstituted benzene derivatives<sup>1</sup> and the consequent stabilisation of *cis*-molecules have been postulated on the basis of studies dealing with physical properties of pure *ortho*, *meta* and *para*-substituted chlorophenols and chloroanilines. In the course of studies on thermodynamic properties of binary liquid mixtures, the author noticed that volume change on mixing in the mixture, *o*-chlorophenol-dioxan, differs appreciably from that in *p*-chlorophenol-dioxan mixture. A similar difference in the values of volume change on mixing was observed between the binary mixtures of dioxan with *o*-chloroaniline and *m*-chloroaniline. The observed differences in volume change on mixing provide evidence for the presence of intramolecular hydrogen bonds in *o*-chlorophenol and *o*-chloroaniline, which stabilise the *cis*-isomers. The values of fluidity difference ( $\Delta\phi$ ) calculated using Bingham relation<sup>2</sup> also support the contention that intramolecular hydrogen bonds in *o*-chlorophenol and *o*-chloroaniline stabilise *cis*-molecules.

Volume change on mixing was calculated from precision density values of pure liquids and liquid mixtures obtained by Pycnometric method at  $35.0^\circ \pm 0.01^\circ$  C. as described earlier.<sup>3</sup> Fluidity difference was evaluated from viscosities of pure liquids and liquid mixtures measured with the use of an Ostwald viscometer at  $35.0^\circ$  C.

Volume changes on mixing and fluidity differences of equimolar mixtures of the four systems studied are given in Table I.

TABLE I

Mixture	$V^M$ ml./mole	$\Delta\phi$ Centipoise <sup>-1</sup>
<i>o</i> -Chlorophenol-dioxan ..	-1.35	-0.375
<i>p</i> -Chlorophenol-dioxan ..	-0.59	-0.304
<i>o</i> -Chloroaniline-dioxan ..	-0.72	-0.229
<i>m</i> -Chloroaniline-dioxan .	-0.65	-0.224

The observed values of volume change on mixing and fluidity difference are made up of

three contributions: (a) a positive one due to break up of polymers of the phenols and the anilines, (b) a positive change due to rupture of intramolecular hydrogen bonds in *o*-chlorophenol and *o*-chloroaniline and (c) a negative one due to hydrogen bond association between the phenols and the anilines with the diluent, dioxan. The net volume change on mixing (negative) and fluidity difference (negative) show a strong tendency for hydrogen bond association between the solute and solvent in all the four mixtures. The difference in the values of volume change in mixing and fluidity difference in *o*-chlorophenol-dioxan and *p*-chlorophenol-dioxan is attributable to the presence of intramolecular hydrogen bond in *o*-chlorophenol which stabilises the *cis*-molecules, *cis*-stabilisation leading to a relatively large concentration of *cis*, *o*-chlorophenol molecules. The chloroaniline-dioxan systems follow the same pattern, as is to be expected the *cis*-stabilisation is more strongly evident in chlorophenol than in *o*-chloroaniline.

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### HISTAMINE RELEASING EFFECTS OF A FEW INDIAN MEDICINAL PLANTS USED IN BRONCHIAL ASTHMA

*Solanum xanthocarpum* and *Clerodendron serratum* have been popular Ayurvedic remedies for the treatment of bronchial asthma.<sup>1</sup> A glucoalkaloid isolated from the berries of *S. xanthocarpum* and a crystalline polyhydric alcoholic fraction isolated from the roots of *C. serratum* have been found to cause a delayed secondary fall in blood pressure accompanied with bronchoconstriction which was inhibited by pretreatment with the antihistaminic drugs.<sup>2,3</sup> After repeating the doses the hypotensive and bronchoconstrictor response of both drugs, as well as that of compound 48/80 recorded as per technique of Konzett and Rossler,<sup>4</sup> was found to diminish significantly though response to histamine was not found to be altered.

Further the anaphylactic bronchoconstrictor response in sensitised isolated guineapig lung was found to be inhibited after continuous