# THE LOW-LYING STATES OF $^{19}F$, $^{21}Ne$, $^{23}Na$ AND $^{25}Mg$ BY THE GENERATOR COORDINATE METHOD

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In calculations of the structure of nuclei the generator coordinate method offers a possibility of generating a small physically relevant subspace of the generally much larger model space. It was shown ([1]) for some light nuclei with even number of particles that with the generator coordinate method one can obtain a good approximation to the complete diagonalisation working in a part of the subspace of the dimension like five or seven only.

We shall present here the results of the generator coordinate method when applied it to some light nuclei with odd number of particles: $^{19}F$, $^{21}Ne$, $^{23}Na$ and $^{25}Mg$.

Our attention was to test the applicability of the method by comparing the results with the results of the method of complete diagonalisation and to try to interpret the nature of some excited states of these nuclei. Since in the generator coordinate method one is looking for those degrees of freedom which have some physical meaning, the interpretation of the nature of the states is much easier than in the case of the complete diagonalisation method.

We used the trial function

$$\Psi^{J}_{M}(\vec{r}) = \sum_{k} \sum_{i} f^{J}_{k}(\beta_i)\, \hat{P}^{J}_{M}\, \phi_k(\underset{\sim}{\beta}_i, \vec{r}), \qquad (1)$$

where $\underset{\sim}{\beta}$ is a set of generator coordinates with appropriate chosen discrete values $\underset{\sim}{\beta}_i$ and k means different configurations of single particle functions of Slater determinants $\phi_k(\underset{\sim}{\beta}_i, \vec{r})$. For the nuclei $^{19}F$, $^{21}Ne$, $^{23}Na$ and $^{25}Mg$ we have used as single particle functions in Slater determinant $\phi_k(\beta, r)$ the eigenfunctions of the potential:

$$\hat{h} = \hbar\omega_0 \tfrac{1}{2}(-\nabla^2 + r^2) + \hbar\omega_0 \beta r^2 Y_{20} + c\vec{l}\vec{s} + \mu c l^2 , \qquad (2)$$

and the two parameters $\beta$ and $\mu$ as generator coordinates. We have used a few configurations - never more than three - of the above single particle functions. The results are very encouraging.

References: N.Mankoč-Borštnik, F.Brut, S.Jang, to be published, ICTP Proceedings of the conference on Hartree-Fock and field theories in nuclei, Eds.G.Ripka and M.Porneuf, North Holland 1975, p.81

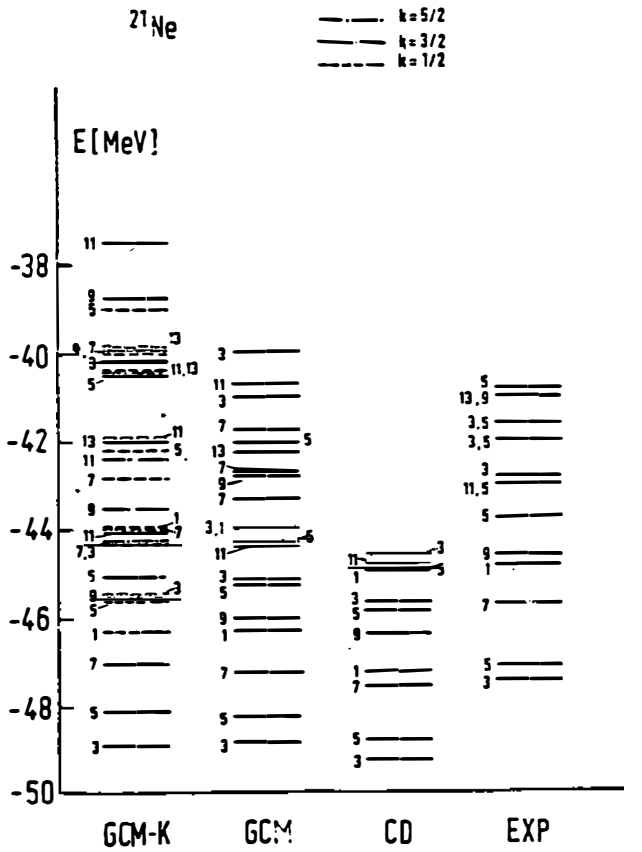


Fig 1

The low-lying states of the nucleus $^{21}$Ne, calculated with the generator coordinate method. For the first column (GCM-K) the calculation has been done without mixing different configurations, in the next column (GCM) the mixing of different configurations is included. The results are compared with the results of complete diagonalisation method (CD) and with experimental data (EXP).