GENERALIZED NEUTRON P-H STATES IN A UNIFIED-MODEL DESCRIPTION

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Results from elastic and inelastic proton scattering through isobaric analogue resonances (IAR), as well as from neutron transfer reactions are consistent with a weak-coupling idea of describing ground state and low-lying levels ($E_x \gtrsim 2$ MeV) in the N=81 and N=83 nuclei.

Nuclear structure information concerning higher-lying levels in the doubly-even N=82 nuclei (3.0 MeV < E_x < < 5.0 MeV) can be obtained from inelastic proton scattering through IAR, (d,t) and (d,p) reactions on the N=83 and N=81 nuclei, respectively. The negative-parity levels thus obtained in the doubly-even N=82 nuclei are fed selectively in (p,p′) reactions on separate resonances, suggesting a weak-coupling description, in which neutron hole states are coupled to the low-lying N=83 levels (generalized neutron particle-hole basis: GNP-H).

For the N=83 nuclei, a unified-model description is used, describing the low-lying levels $|J_\beta M_J>$ with a wave function $|N=83,Z;J_\beta M_J>$.

Thus, the negative-parity levels in the doubly-even N=82 nuclei can be expanded in the GNP-H basis as

$$|N=82,I_\alpha M> = \sum_{j',J,\beta} a_\alpha(j',J_\beta;I)\,[\tilde{a}_{j'}(\nu) \otimes |N=83,Z;J_\beta>]_{IM}$$

The neutron hole states considered are $2d^{-1}_{3/2}$, $3s^{-1}_{1/2}$, $2d^{-1}_{5/2}$ and $1g^{-1}_{7/2}$, whereas the low-lying N=83 levels with definite J^π assignment (i.e. $7/2^-$, $3/2^-$, $1/2^-$, $9/2^-$ and $5/2^-$) with $E_x \gtrsim 2$ MeV.

The model Hamiltonian to be diagonalized in that basis, describing these negative-parity levels in doubly-

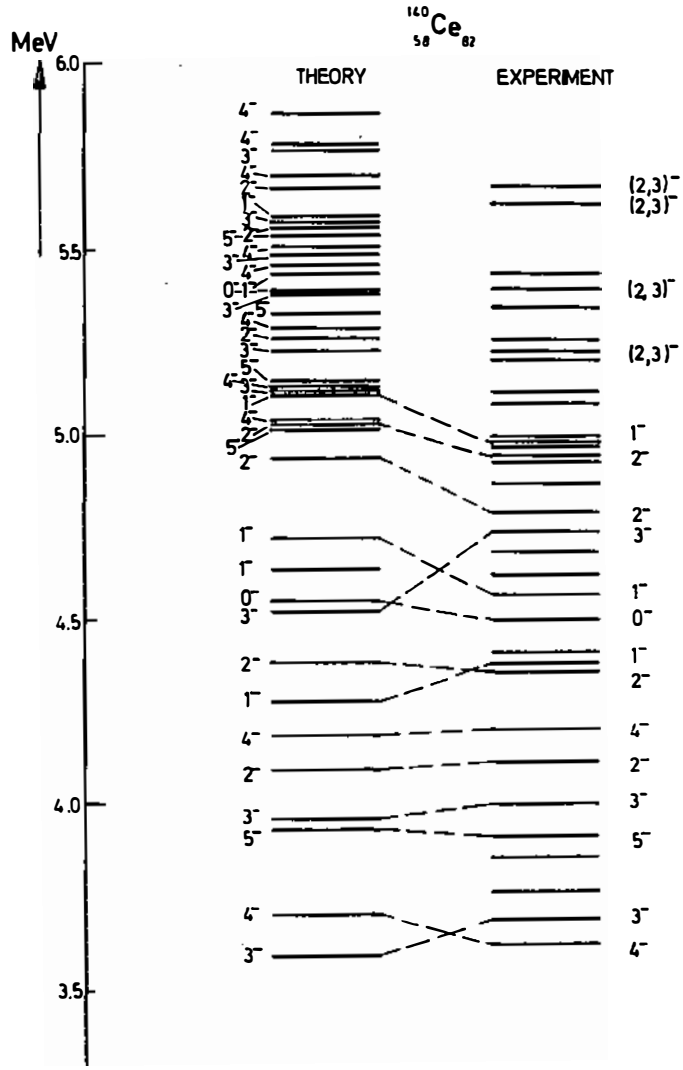

Fig. 1

even N=82 nuclei, can be written as

$$H = H_{core} + H_h + H_p + H_{p\text{-}core} + H_{h\text{-}core} + V_{p\text{-}h} \cdot$$

Here H_{core} describes the collective excitations of the N=82 core, H_p (H_h) the neutron single-particle (hole)

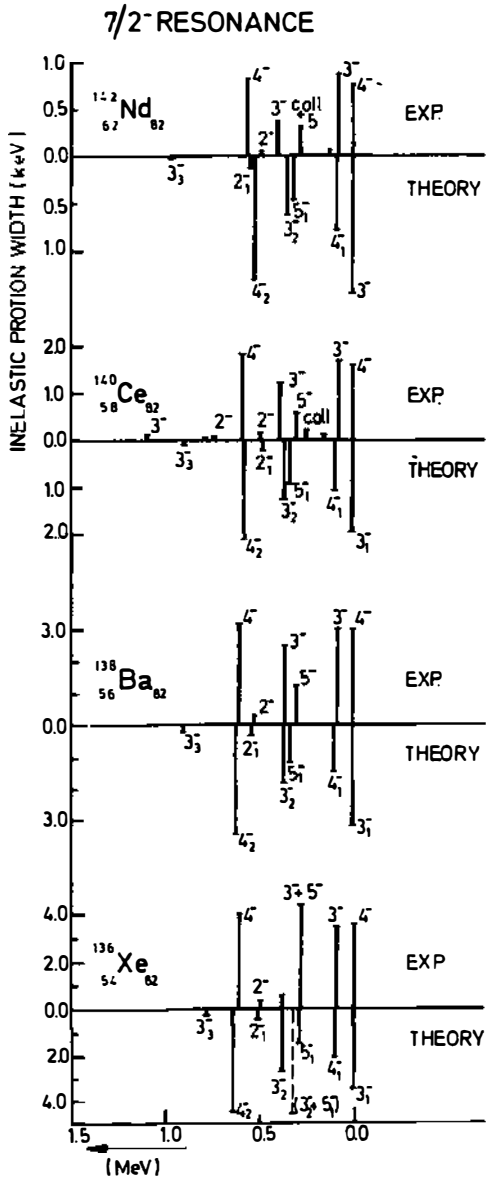

Fig. 2

states, $V_{p\text{-core}}$ ($V_{h\text{-core}}$) the residual interaction of the particle (hole) motion with the surface vibrations of the core and $V_{p\text{-h}}$ the residual two-body interaction (Sussex force).

Level schemes as well as energy systematics for all

N=82 nuclei are studied and compared with experimental data (fig. 1). Partial decay widths and angular distributions of the inelastically scattered protons through IAR, to the final negative-parity levels are calculated and compared extensively with available experimental information (fig. 2). Also, spectroscopic factors can be obtained by analyzing the (p,p´) reaction results. Thus, the possibility of experimentally determining wave-functions for some negative-parity levels in the doubly-even N=82 nuclei is possible. For the heavier isotones ^{140}Ce, ^{142}Nd and ^{144}Sm, it is also possible to locate uniquely the GNP-H multiplets based on the $7/2^-_1$ and $3/2^-_1$ parent states among the other, more complicated negative-parity levels.

This calculation scheme thus extends the possibility of describing higher-lying negative-parity levels in the energy region 3.0 MeV<E_x<5.0 MeV, in a weak-coupling picture where neutron hole states are coupled to the low-lying N=83 levels.