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Configuration Mixing in ^{208}Bi from ^{209}Bi($\vec{d}$,t) at E_d = 23 MeV+)

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The low lying states of ^{208}Bi arise from the coupling of a single proton with a neutron hole outside the ^{208}Pb core. The observed clean multiplet structure[1,2] results from an especially weak mixing of the single particle configurations. Structure calculations[3] have been compared with transfer data, especially with ^{209}Bi(d,t)[1] and (p,d)[2] reactions with unpolarised particles. Evidence for configuration mixing was very restricted, the (lj) assignments of the admixed transfered configurations tentative.

We remeasured the ^{209}Bi(d,t) reaction with vector polarized deuterons at E_d = 23 (and 20) MeV. With 1 µA polarised deuteron beam on the target (0.25 mg/cm² Bi foils) of the Q3D magnetic spectrograph the energy resolution and counting statistics were sufficient to study the multipletts arising from the coupling of the lj = 3p1/2, 2f5/2 and 3p3/2 neutron hole with the 1h9/2 proton. Their angular distributions $\sigma(\theta)$ and $iT_{11}(\theta)$ are displayed in figs. 1 to 3.

For the analysis we assume direct neutron pick up and neglectable spin forces on the target spin j' (the h9/2 proton) as in DWBA. Then $\sigma(\theta)$ and $iT_{11}(\theta)$ are incoherent sums of pure (lj) transitions,

$$\sigma^{\lambda I}(\theta) = \sum_{\ell j} S^{\lambda I}_{\ell j} \frac{(2I+1)}{(2j'+1)(2j+1)} \sigma_{\ell j}(\theta)$$

$$iT_{11}{}^{\lambda I}(\theta) = \sum_{\ell j} S^{\lambda I}_{\ell j} \frac{(2I+1)}{(2j'+1)(2j+1)} \sigma_{\ell j}(\theta) \cdot iT_{11\,\ell j}(\theta)/\sigma^{\lambda I}(\theta)$$

weighted with spectroscopic factors $S^{\lambda I}_{\ell j}$. They are squares of the mixing coefficients $a^{\lambda I}_{\ell j}$ expanding the state λ with angular momentum I in pure single particle configurations

$$|\lambda\rangle_I = \sum_{\ell j} a^{\lambda I}_{\ell j} |(n^{-1}_{\ell j} \otimes p_{\ell' j'})\rangle_I$$

The $\sigma_{\ell j}(\theta)$ and $iT_{11\ell j}(\theta)$ for pure transitions can be taken either from DWBA, from measurements from ^{207}Pb (and correcting perhaps for Coulomb and mass differences) or from those ^{208}Bi transitions, which are assumed to have neglectable admixtures ("reference transitions"). The latter procedure has the advantage that experimental uncertainties should cancel.

For the analysis shown in figs. 1 to 3 we took the transitions with the highest angular momentum I of each multiplet lj as references and obtain in a χ^2 fit procedure[4] spectroscopic factors $S^{\lambda I}_{\ell j}$ with errors. Their percent values are indicated in the figures and compared with values from Kuo's calculation[3] (in parenthesis).

For the p1/2 and p3/2 multiplets (Figs. 1 and 2) we have no evidence for admixtures, within the fit errors of 4% for p-admixtures and of 10% for f5/2 admixtures (at E_d = 20 MeV the latter quantity increases to 20%).

For the f5/2 multiplet (Fig. 3) we have evidence for admixtures within a 2% error for the independent determination of the p1/2 and the p3/2 configuration.

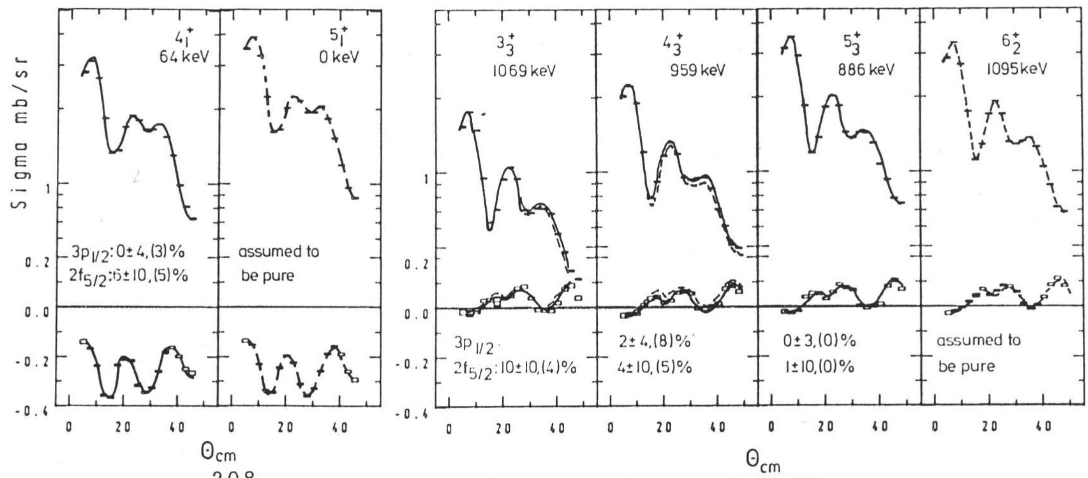

Fig. 1 and 2. ^{208}Bi p1/2 and p3/2 multipletts with fit curves, dashed: contribution of the pure p1/2 and p3/2 configuration

To summarize, we observe deviations from Kuo's predictions for the 4_2^+ (603 keV) state: 5% ± 2% (instead of 2%) p1/2, and 6% ± 2% (instead of 12%) p3/2 admixture, for the 4_3^+ (959 keV) states: 2% ± 4% p1/2 (instead of 8%) p1/2 admixture and for the 4_4^+ (1033 keV) state (not shown in the figures): 12% ± 2% (instead of 0%) p3/2 admixture.

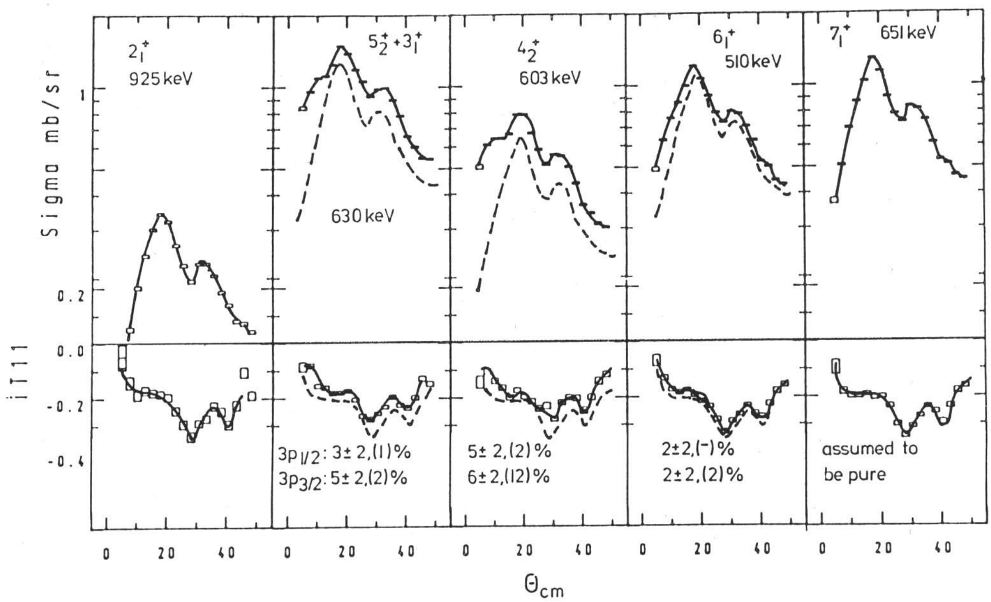

Fig. 3. The ^{208}Bi f5/2 multiplett with fit curves, dashed: pure f5/2 configuration

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