Decay Scheme of $^{212}$Pb.

M. GIANNINI, D. PROSPERI and S. SCIUTI

Centro Studi Nucleari della Casaccia - Roma

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Summary. — Some experimental results concerning $^{212}$Pb $\rightarrow$ $^{212}$Bi decay are reported. The investigation of the $^{212}$Pb decay scheme is of some interest because until now it is not known whether or not the shell model holds in the lead region boundary. Coincidence spectra and $\gamma$, $\gamma$ angular correlations have been employed in order to measure the intensities of weakest transitions, and to make spin assignments. A decay scheme has been proposed. Further, the doubtful existence of a 177 keV $\gamma$-ray has been unambiguously demonstrated.

1. — Introduction.

The lead region is particularly interesting as far as nuclear structure is concerned. In the middle of this region there is $^{208}$Pb whose core is particularly stable, due to the fact that it has a double closed shell ($Z = 82$, $N = 126$).

By adding or subtracting one or two nucleons from this core, nuclear structures can be obtained for which the first levels are due to the excitation of the added particles (or holes). For such nuclei the shell model holds quite correctly, if one takes into account—by means of a perturbation theory—both the interactions between nucleons outside the closed shells and the coupling to the collective oscillations of the nuclear surface. This argument has already been treated in a theoretical work by BLOMQVIST and WAHLBORN (1) and in a review article by BERGSTROM and ANDERSSON (2).

By adding three or four particles (or holes) to \(^{208}\text{Pb}\), the following difficulties arise:

1) the configuration mixings cannot be neglected;

2) the strength of the coupling increases and makes possible collective vibrations characterized by phonon energies of 1 MeV or less. In this case the presence of motions of the nuclear surface produces remarkable perturbations to the single particle levels.

By adding to \(^{208}\text{Pb}\) more than four particles or holes, it is not generally possible to employ the shell model. It is not yet clear whether nuclei with \(|\Delta Z| + |\Delta N| = 4\) can be described. Of those, just a few have been theoretically studied (\(^{204}\text{Pb}, \text{Bi}\)) \(^{206}\)). Furthermore, the experimental work on these nuclei is still incomplete. In order to obtain more data for theoretical investigations, we decided to improve the experimental knowledge of excited levels belonging to some of these nuclei. In the present work, some experimental results concerning the decay scheme of \(^{212}\text{Pb}\) are described. The essential characteristics of \(^{212}\text{Bi}\) levels were known \(^{21}\)), while the spins and the intensities of the weakest transitions were not yet well known.

2. – Intensity and conversion coefficients of \(\gamma\)-transitions in \(^{212}\text{Bi}\).

A chemically pure source was obtained at the beginning of each measurement by separating \(^{212}\text{Pb}\) from a RaTh solution by means of the dithizone method \(^{21}\)). In all measurements no source has been employed for more than 15 minutes in order that the \(^{212}\text{Bi}\) formed was not more than 25\% of the \(^{212}\text{Bi}\) content at equilibrium.

The experimental set up (Fig. 1) consists of a fast-slow spectrometer to which a Hoogenboom sum-circuit can be added \(^{21}\)). The detectors are two (1\(\frac{1}{2}\) x 1) in. NaI(Tl) crystals, coupled to 56 AVP Philips photomultipliers. Anode and dinode outputs are provided for coincidence and proportional pulses. The coincidence resolving time was \(\tau = 10\) ns. The proportional outputs were fed, through non-overloading amplifiers, to the analysis circuits. The spectra were displayed on a 200 channel pulse height analyser (LABEN).

\(^{21}\) L. A. HADDICK: Analyst, 163, 59 (1934).