III–15 The Magnetic Moments of the First Excited States of ^{207}Pb and ^{208}Pb

F. J. Schroeder and H. Toschinski

Institut fuer Strahlen-und Kernphysik der Universitaet Bonn, Germany

It was recently shown by Maier *et al.*[1] and by Nagamiya and Yamazaki[2] that the measured magnetic dipole moments in the region around the doubly magic nucleus ^{208}Pb can be described quite consistently within the shell model by use of an effective magnetic dipole operator. In the comparison of 13 calculated and measured magnetic moments in ref. 1 the first excited state of ^{207}Pb is one of the cases with the largest deviation.

We have remeasured this case and also the magnetic dipole moment of the 3^- vibrational state of ^{208}Pb by the $\gamma\gamma$-IPAC-technique. For our measurements we used the 1063 keV–570 keV $\gamma\gamma$-cascade in the case of ^{207}Pb and the 583 keV–2615 keV $\gamma\gamma$-cascade in the case of ^{208}Pb, shown in the decay schemes of Figs. 1 and 2. The rotated angular correlations were measured at nine angles between 60° and 180° using our recently installed three detector apparatus with a 100 kG superconducting magnet.[3] The accuracy could be increased considerably compared to earlier investigations, because of the larger rotational angles observed in our experiments.

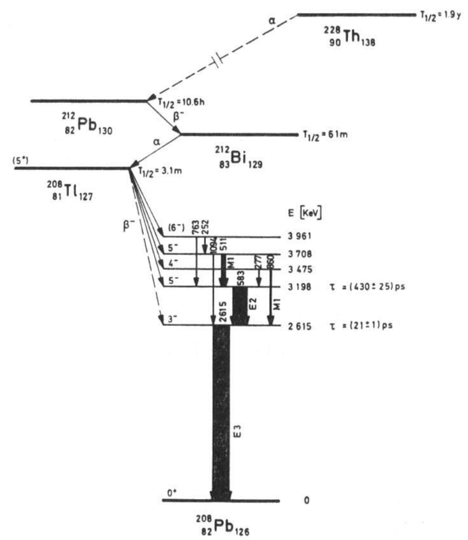


Fig. 2. Partial decay scheme of ^{228}Th.

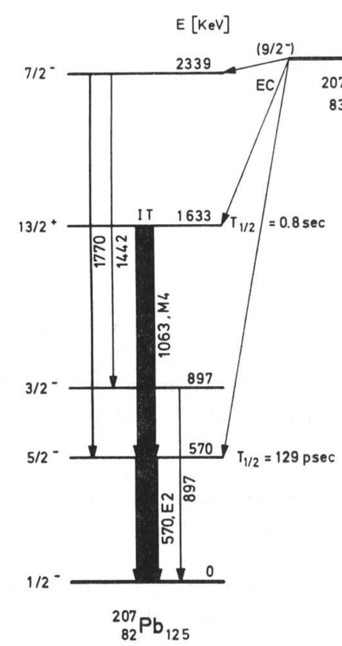


Fig. 1. Decay scheme of ^{207}Bi.

In Figs. 3 and 4 are shown the integral rotated angular correlations for both field directions. The actual magnetic field was 94.4(5) kG in both cases. Since the rotational angles are small, it was advantageous[5] to determine the Larmor precession angle $\omega_L\tau$ by a least squares fit to the difference $W(\theta, +B) - W(\theta, -B)$. The results of these fits are shown in Figs. 5 and 6. The fits gave for the rotational angles the values:

$\omega_L\tau = 0.0266(9)$ rad for the 570 keV level of ^{207}Pb

and

$\omega_L\tau = 0.00597(79)$ rad for the 2615 keV level of ^{208}Pb

With the lifetimes of refs. 5 and 8 we obtain the magnetic moments shown in Table I together with the recently published values of other authors.

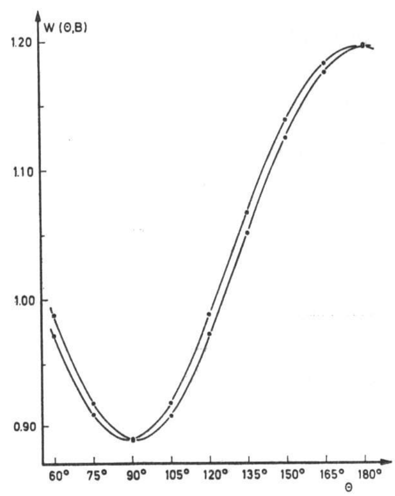


Fig. 3. Integral rotation of the 1063 keV-570 keV angular correlation of ^{207}Pb in an external magnetic field.

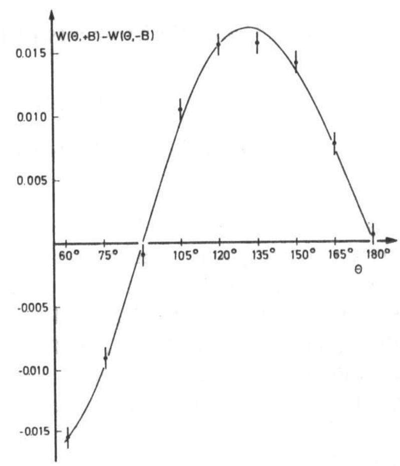
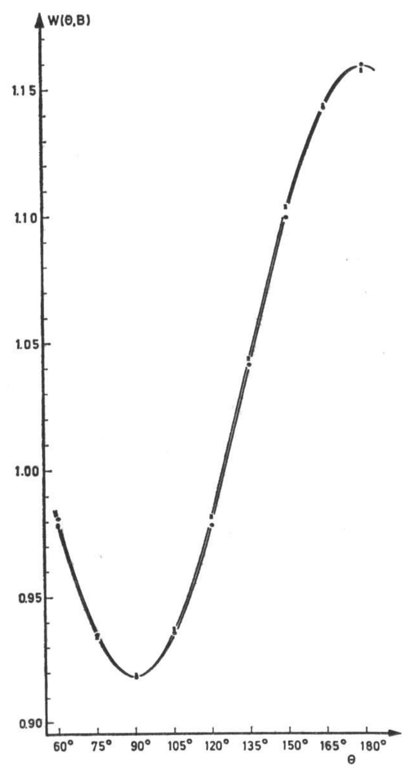


Fig. 5. Determination of the magnetic moment of the 570 keV level of ^{207}Pb from the normalized differences of coincidence counting rates due to reversal of the external magnetic field.



Eig. 4. Integral rotation of the 583 keV–2615 keV angular correlation of ^{208}Pb in an external magnetic field.

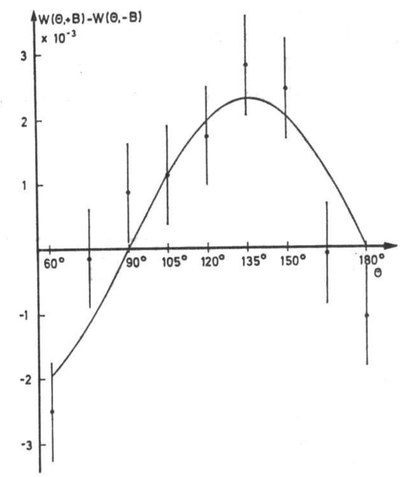


Fig. 6. Determination of the magnetic moment of the 2615 keV state of ^{208}Pb from the normalized differences of coincidence counting rates due to reversal of the external magnetic field.

Our new value for the magnetic moment of the $f_{5/2}^{-1}$-state of ^{207}Pb is remarkably high which makes the discrepancy with the effective moment model even larger. We have compared our values also with microscopic calculations of magnetic dipole moments in this region by use of the Migdal theory which was performed by Speth and coworkers.[6] Our

Table I. The magnetic moments of the first excited state of ^{207}Pb and ^{208}Pb.

	μ_{exp} (n.m.)			$\mu_{theor.}$ (n.m.)	
^{207}Pb	ref. 4 0.72(7)$^{+}$	ref. 5 0.65(5)	this work 0.79(3)	ref. 1 0.49	ref. 6 0.84
^{208}Pb	ref. 7 0.51(45)$^{++}$	ref. 8 1.74(42)	this work 1.89(29)	refs. 8, 9 1.56	ref. 10 1.50

+) recalculated for the new half life[5]
++) recalculated for the new half life[8]

value is quite close to this prediction. Our measurement of the magnetic moment of the 3^- state of ^{208}Pb is in good agreement with the previous result of Bowman *et al.*,[8] but larger than the theoretical predictions.[8~10]

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