1.4. A PRECISION g-FACTOR MEASUREMENT ON $^{22}Ne(2_1^+)$

R.E. Horstman, G. van Middelkoop and P.C. Zalm

Nuclear g-factors of excited states with lifetimes in the ps range can be measured with the recoil-distance technique. For this purpose heavy-ion reactions are used to obtain a sufficiently large fraction of single-electron ions after recoil of the nuclear-excited ions through a thin target into vacuum. The strong and well known hyperfine interaction in a hydrogen-like ion can be observed time-differentially by means of a plunger [ref.[1]]. Usually non-zero fractions of (excited) two-electron and three-electron ions complicate the measured time-differential spin deorientation as was observed recently in this laboratory [2] for $^{24}Mg(2_1^+)$ and $^{20}Ne(2_1^+)$. In these measurements large fractions of excited two-electron ions were found, which yield a hyperfine interaction comparable in strength to that of hydrogenic ions in the ground state. None the less, precise values for the g-factors could be deduced as well as values for the fractions of some of the ionic configurations.

The g-factor of the 5 ps first-excited 2^+ state of ^{22}Ne at 1.27 MeV was measured with the $^4He(^{19}F,p)^{22}Ne$ reaction at $E(^{19}F)$ = 40.6 MeV on a ^{4}He(Ni) target [3]. Four independent coincidence measurements (see fig. 1) yield mutually consistent values for the g-factor. The average value is $|g|$ = 0.326 ± 0.012. The mean life of the 1.27 MeV state was determined simultaneously and was found to be τ = 5.2 ± 0.3 ps.

The fractions of single-electron ions and of excited two-electron ions were found to depend on the thickness of a carbon contaminant layer through which the ^{22}Ne ions recoiled into vacuum. Targets with a carbon layer of 5 μg/cm^2 produced a small fraction of single-electron ions and a large fraction of excited two-electron ions, whereas a target with 15 μg/cm^2 showed the opposite: a large fraction of single-electron ions and a small fraction of excited two-electron ions; see also fig. 1.

These marked differences may be attributed to the fact that the loosely bound 2s or 2p electrons of the excited He-like ions coming out of the Ni foil are stripped off in a sufficiently thick C layer.

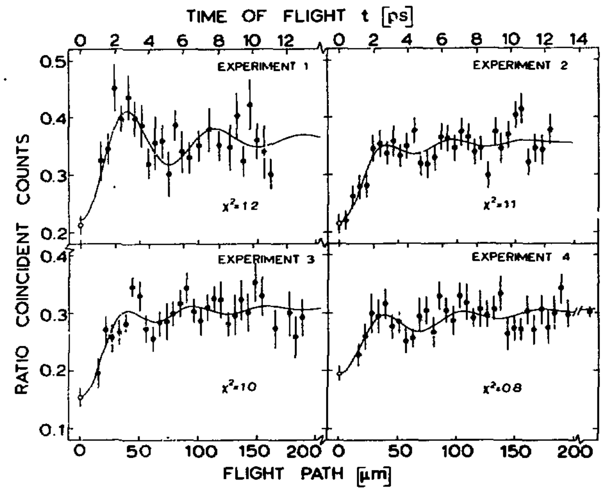

Fig. 1. Time-differential deorientation for $^{22}Ne(2_1^+)$ nuclei recoiling through a Ni foil in vacuum at v/c = 0.048. In experiment 1 the nuclei recoiled through an additional 15 μg/cm^2 C layer, whereas in experiments 2 and 3 these C layers were only 5 μg/cm^2. In the last experiment the C thickness was 10 μg/cm^2. The solid lines are least-squares fits to the experimental data.

1) W.L. Randolph et al., Phys. Lett. 44B (1973) 36
2) R.E. Horstman et al., Nucl. Phys. A248 (1975) 291
3) R.E. Horstman et al., Nucl. Phys. A275 (1977) 237.