The Van de Graaff Era 2

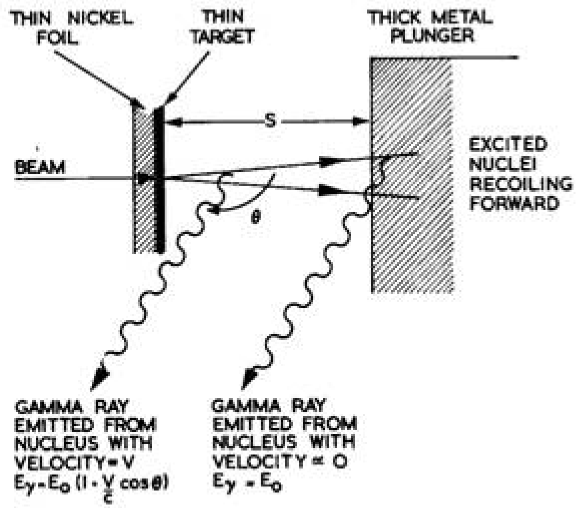

Fig. 9.2. Principle of the recoil-distance method using Ge(Li) detectors. From ALEXANDER and ALLEN [1965].

The Recoil Distance Method was used extensively in Oxford to measure the life-times of short-lived nuclear excited states produced in nuclear reactions and decaying radiatively.

It was first used by T.K.Alexander and K.W.Allen when the latter was on leave from Oxford at the Chalk River laboratory (Canadian Journal of Physics **43** (1965) 1563**.**)

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LIFETIMES IN ^{22}Ne, ^{22}Na, ^{30}Si, ^{30}P AND ^{35}Cl USING THE RECOIL-DISTANCE METHOD

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Abstract: Levels in ^{22}Ne, ^{22}Na, ^{30}Si, ^{30}P and ^{35}Cl were excited in the following reactions: ^{19}F(α, p)^{22}Ne, ^{19}F(α, n)^{22}Na, ^{27}Al(α, p)^{30}Si, ^{27}Al(α, n)^{30}P and ^{32}S(α, p)^{35}Cl. The recoil-distance method was used to measure lifetimes of excited states in the residual nuclei. The measured values are: ^{22}Ne(1275) = 5.40±0.40 ps, ^{22}Na(1984) = 2.40±0.25 ps, ^{30}Si(3788) = 6.8±2.0 ps, ^{30}P(709) = 54±5 ps and ^{35}Cl(3163) = 53±6 ps. These values are compared to previous measurements by the recoil-distance technique, as well as by different techniques, and are also compared to theoretical predictions.

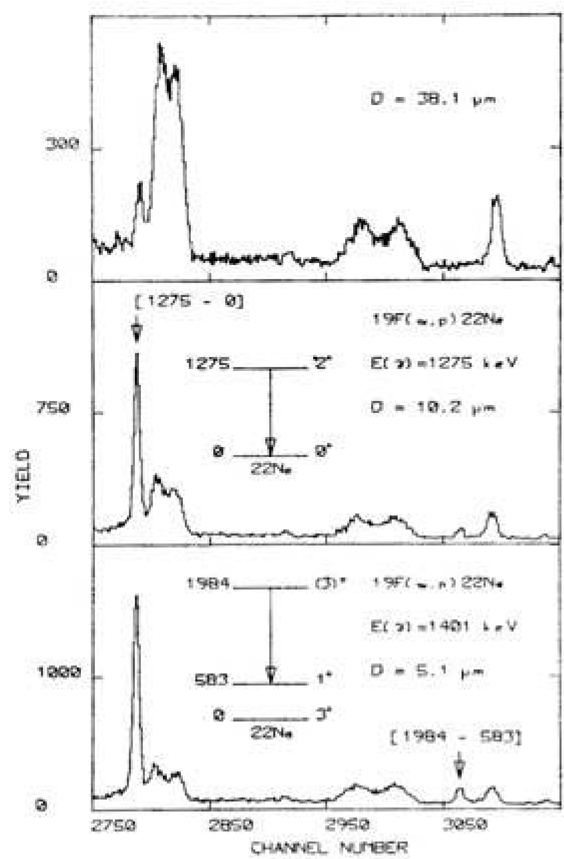

Fig. 2. Spectra from the ^{19}F(α, n)^{22}Na and ^{19}F(α, p)^{22}Ne reactions, taken at three target to plunger separations. Of interest are the two lines at 1274 keV (^{22}Ne) and at 1041 keV (^{22}Na).

THE RADIATIVE WIDTH OF THE 3.09 MeV STATE OF ^{13}C

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The mean life of the 3.09 MeV state of ^{13}C has been found to be less than 20 fs in disagreement with a recently reported measurement of 55 fs. The new limit is consistent with expectations based on the mean life of the 2.37 MeV mirror state in ^{13}N.

The Doppler-shift Attenuation Method can be used for lifetimes less than ~ 20 fs. In this case the lifetime is compared to the slowing-down time as the excited ion is brought to rest in a thin layer of copper or other backing to the target. The figure shows that the γ-ray peaks at 0° are fully Doppler shifted, ie the ion has not stopped before it decays. This allows the lifetime limit of 20fs to be set.

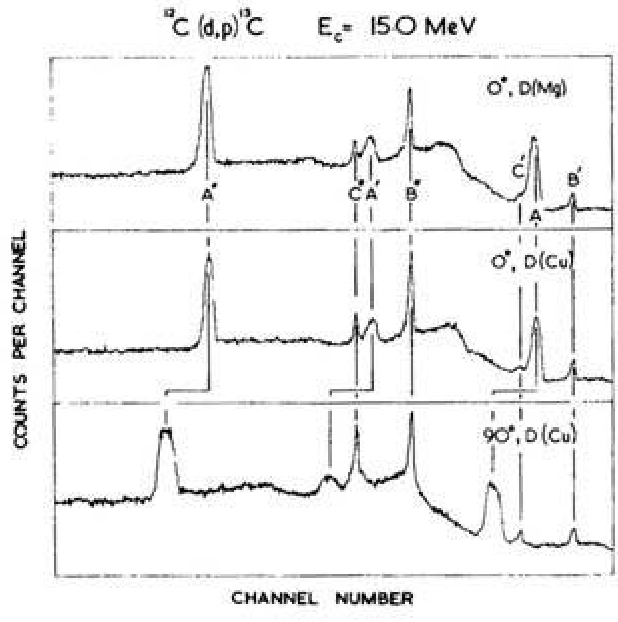

Fig. 1. Gamma-ray energy spectra from the bombardment of deuterium targets (Cu and Mg backed) by a 15 MeV ^{12}C beam. The full-energy (A), single-escape (A') and double-escape (A") peaks of the 3.09 MeV γ ray can be seen in both 0° and 90° spectra. Single (B', C') and double (B", C") escape peaks of the 3.85 MeV γ rays are also clearly visible.

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g-FACTOR MEASUREMENTS IN THE MERCURY ISOTOPES

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Abstract: The *g*-factors of the first 2^+ states of ^{198,200,202,204}Hg have been measured using the thin-foil transient field technique. Relative *g*-factors were obtained and absolute values were deduced by calibrating the field with the known magnetic moment of ^{198}Hg. A pronounced dip was seen for the ^{200}Hg 2_1^+ *g*-factor when compared with the other three isotopes. *g*-factors of some low-lying states in ^{199}Hg were obtained in the same experiments. The sign of the *g*-factor of the $\frac{3}{2}^-$ (208 keV) level appeared to be negative and this was confirmed by an IMPAC measurement in iron. The low transient field strength previously observed for Pt in iron occurs also for Hg in iron.

1. Introduction

In the last decade the thin-foil transient field (TF) technique has been established as a reliable method for studying the systematic trends of magnetic moments of excited nuclear states. The strength of the technique lies in the fact that excited states of a nucleus with lifetimes longer than a few picoseconds experience the same integrated field when measured in the same experiment.

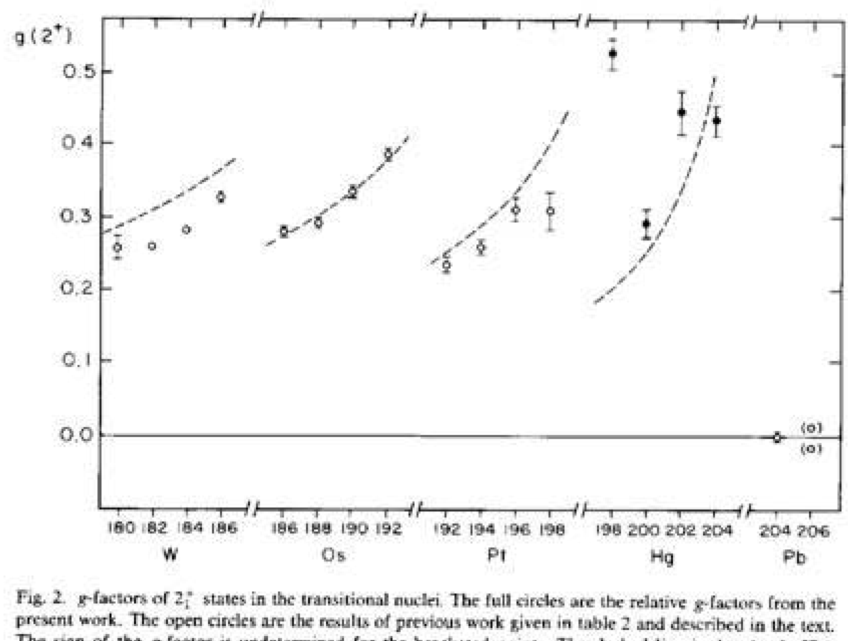

Fig. 2. *g*-factors of 2_1^+ states in the transitional nuclei. The full circles are the relative *g*-factors from the present work. The open circles are the results of previous work given in table 2 and described in the text. The sign of the *g*-factor is undetermined for the bracketed points. The dashed line is the simple IBA model prediction described in the text.