Value of the Li(p,γ) Resonance*

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THE recent publication by Herb, Snowdon, and Sala[1] of the value of the first strong resonance in the F(p,γ) reaction now makes possible a more certain determination of the value of the Li(p,γ) resonance which is known to occur at about 440 kev. The F(p,γ) resonance occurs at 873.5 kev,[1] with an uncertainty of about 0.1 percent; we shall designate this value as V_F.

A preliminary report[2] of a comparison of the fluorine resonance and of the lithium resonance as observed with the diatomic beam (at voltage $2V_{Li}$) has been published. We have since made several additional determinations of the quantity $(2V_{Li}-V_F)$ or ΔV, originally reported as 20 ± 6 kev. In our first calculations, the value used for the relative stopping power of a target for protons of energy V_{Li} and V_F was too low; this was also called to our attention by Dr. W. A. Fowler, who has kindly sent us the results on similar measurements[3] on the quantity ΔV which were made at the California Institute of Technology.

A plot of the data of a typical run on a thin target is shown in Fig. 1, and other data are given in Table I.

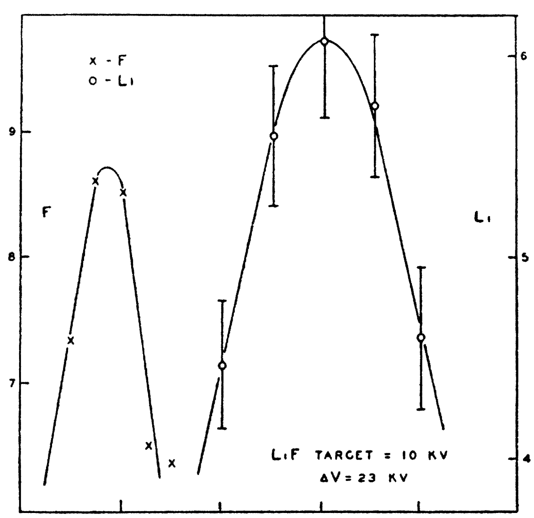

FIG. 1. Position of the first strong resonance in F(p,γ) relative to the Li(p,γ) resonance as observed with the diatomic beam. Voltmeter reading in 10 kv units.

TABLE I. Values of $\Delta V(2V_{Li}-V_F)$ for several runs.

Run No.	Target	Thickness (kev)	ΔV_0*	ΔV
1	LiF	7.5 Thick	8	11.7
2	LiF	13	26	10.8
3	LiF	10	23	11.3
4	LiF	Thick	13	13
5	MnF_2 LiCl	Thick Thick	13	13
6	LiF	15	28	11.4

* ΔV_0 = observed difference between resonance peaks.

Runs were kept as short as possible consistent with obtaining a reasonable statistical accuracy, since we wished to avoid deposition of any film or deterioration of the targets. Gamma-rays were detected by coincidence counters. In order to make certain that no gamma-rays were counted when the lithium resonance was under observation, we placed a centimeter of aluminum between the two counters.

In resolving the data for thick targets, we have measured the voltage difference at half intensity for each resonance curve. For thin target data, we have observed the width of each resonance; the true resonance widths are assumed to be 5.2 kev[4] for the fluorine resonance and 12 kev[5,6] for the lithium resonance as observed with the atomic beam (corrected for continuous radiation). Actual target thickness was then calculated, and in all cases reported this thickness was essentially the same for any pair of runs in which the same target was utilized. Targets were also weighed, and, assuming that 1 kev of equivalent thickness corresponds (at V_F) to slightly over 4 micrograms/cm^2 of LiF, target thickness was computed. The agreement between the values was always satisfactory within estimated limits of error.

The stopping power of LiF for protons at V_{Li} and at V_F was assumed to be in the same ratio as the corresponding value for air, or approximately 1.67.[7] Since the voltage scale for the diatomic beam is doubled, we may write for the true difference between the two resonances $\Delta V=\Delta V_0-1.17t$, where ΔV_0 is the observed difference and t is the thickness of the target for protons of energy V_F.

The existence of thin films[8] on targets would lead to spurious results, and in particular would increase ΔV_0. This may account for the slightly higher values observed with thick targets, which were prepared without heating, but the 1 kev[6] asymmetry correction applied to thick targets of Li compounds may be slightly low. Thin targets were prepared by evaporation. In one case, we heated a thin target to 200°C, then later to 260°C, but no shift in the position of the fluorine resonance was observed.

We tend to weight our data, therefore, to the low side of the average, and believe that $\Delta V=11.2$ kev, the average of the thin target data, is probably closest to the true value. Using $V_F=873.5$, one obtains $V_{Li}=442.4$ kev, with an estimated over-all error of about 1.5 kev.

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3 W. A. Fowler, private communication. We are indebted to Dr. Fowler for calling this to our attention and for a summary of his results. We have used the same constants (references 4–7) in evaluating our data, and our results are in agreement within about 0.5 kev.
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Disintegration of Cs^{137}

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DECAY by the emission of a single group of beta-rays with an end point of 0.550 Mev to a metastable state of Ba^{137} (156 secs.) has been reported for Cs^{137} (33 years).[1,2] From this state an internally converted gamma-ray of energy 0.663 Mev is emitted. A simple decay scheme was suggested from these results. Mitchell and Peacock[3] measured the ratio N_K/N_L for the internally converted electrons as well as the internal conversion coefficient $\alpha_K^{\,I}$. Their measurement of these quantities, as well as the known half-life for the metastable state, indicate that the transition Ba^{137} (metastable)→ Ba^{137} is electric 2^5 pole. They also pointed out certain difficulties with the proposed decay scheme.

In the present experiments the beta-ray spectrum of Cs^{137} has been measured using a 180-degree type magnetic spec-