Letters to the Editor

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Width of 985-Kev Al (p, γ) Resonance

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A CYLINDRICAL electrostatic analyzer[1] has been constructed for use with the Wisconsin pressure generator. With this instrument, which has a radius of curvature of forty inches, and ninety degree deflection, one can obtain a steady proton beam with an energy spread as small as 0.02 percent of the proton energy. Only protons which pass through the analyzer strike the target, so that the openings of the slit system determine the energy spread of the beam. The electric field between the analyzer plates is obtained from a stack of dry batteries which can be set to any desired voltage up to plus and minus 10,000 volts, and has negligible drift. Work up to the present has been limited to examination of the width of a narrow proton-gamma resonance, the 985-kev level of aluminum.[2]

The targets were prepared by evaporating aluminum onto sheets of tantalum. It was necessary to heat the target to over 200 degrees centigrade and to use a liquid air trap to avoid deterioration of the target. The beam, about 1/20 of a microampere of protons, was integrated by measuring, by means of an electrometer, the voltage produced across a condenser. The total voltage swing of the target was less than ten volts. The thickness of the target was determined by two methods. First, one can calculate the mass per cm^2 of the film from the weight of aluminum evaporated, assuming an isotropic distribution and the inverse square law. The data of Parkinson *et al*,[3] give then the energy absorption of the target. Second, the area under the thin-target yield curve, divided by the step in the thick-target yield, gives the energy absorption thickness directly in electron volts.

The number of coincidence counts from two thin-wall glass counters placed close to the target, divided by the integrated proton beam, was plotted against the energy of the bombarding protons. Assuming a Breit-Wigner formula for the resonance and the values determined for the target thickness and energy spread of the proton beam, we computed the resonance half-width both from the peak amplitude and from the half-width of the experimental yield curve. Effects of target non-uniformity and of straggling were not taken into account. The resonance half-width, Γ, is the energy spread at half-maximum for an infinitely thin target and a monoenergetic proton beam. Results from two targets, prepared at the same time so that their relative thicknesses should be accurate, are shown in Table I. The proton energy distribution is assumed to be triangular in shape with the energy spread quoted corresponding to width at half-maximum. The same target was used for the first two sets of data.

TABLE I. Determination of the half-width (all quantities in electron volts).

Target absorption thickness by weight	Target absorption thickness by area under curve	Energy spread of proton beam	Resonance half-width by half-width of curve	Resonance half-width by peak amplitude
200	215	400	372	284
200	192	200	313	288
100	85	200	276	255

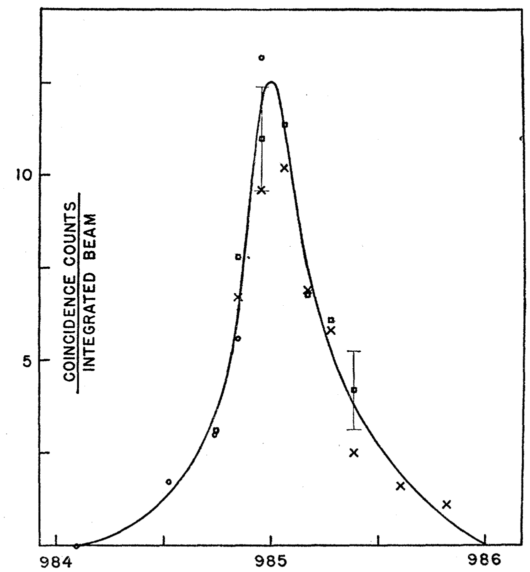

FIG. 1. Al (p, γ) yield curve covering 985-kev resonances. Three independent runs are shown by circles, crosses, and squares, respectively. Absolute voltage position taken from data of reference 1.

From these data, the value for Γ is 300 ± 50 electron volts. While there is little doubt about this value for the upper limit, great weight should not be attached to our value for the lower limit unless it is checked by further experiments which are now in progress. A typical curve (Fig. 1) showing gamma-ray yield *versus* proton energy shows the reproducibility of data obtained in three separate runs.

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[1] Description to appear soon in Rev. Sci. Inst.
[2] G. J. Plain *et al.*, Phys. Rev. **57**, 187 (1940).
[3] D. B. Parkinson *et al.*, Phys. Rev. **52**, 75 (1937).