Half-lives of some levels in ^{131}Xe

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Half-lives of some levels in ^{131}Xe have been measured by the delayed coincidence method. Analysis of the data by the slope method gave the following values: 416±20 ps, 1.34±0.04 ns, 67.5±1.4 ps, and <75 ps for the 80.2-341.1-, 364.5-, and 404.8-keV levels, respectively.

[RADIOACTIVITY ^{131}I[from ^{130}Te$(n,\gamma)^{131}$Te$\xrightarrow{\beta^-}$]; measured $\beta\gamma(t)$, $\gamma\gamma(t)$; deduced ^{131}Xe level $T_{1/2}$.]

Half-life measurements of the 80.2-, 341.1-, 364.5-, and 404.8-keV levels in ^{131}Xe populated in the β^- decay of ^{131}I ($T_{1/2}$ = 8.06 d) have been carried out by the delayed coincidence method. This note gives the results of such measurements. The present measurements were undertaken because there existed variation between the published[1-5] values of the half-lives of the levels, except for the 341.1-keV level where only one measurement is available, in the literature.[6]

The ^{131}I activity was obtained from Bhabha Atomic Research Centre, Bombay. The sources were prepared by depositing a few drops of the radioactive solution on thin Mylar foils and then the solution was dried off. The experimental setup used for recording the delayed coincidence spectra was a conventional fast-slow coincidence system. Fast plastic NE111 scintillators coupled to XP1021 photomultipliers and constant fraction time derivation devices have been used in all the measurements. The time calibration of the time-to-amplitude converter–analog-to-digital converter (TAC-ADC) system was performed by observing the shift of the centroid of the prompt time distribution curves by introducing an accurately calibrated GR 874-L30 air dielectric coaxial delay line (delay: 1.0036±0.0002 ns). The differential nonlinearity of the system was checked by the random pulse generator method and found to be <1%.

The (284-keV γ) (80-keV γ) delayed coincidences were recorded for the measurement of the half-life of the 80.2-keV level by setting suitable energy gates on the Compton energy distributions. Aluminum absorbers of 1 mm thickness were used between the source and the detector on each side

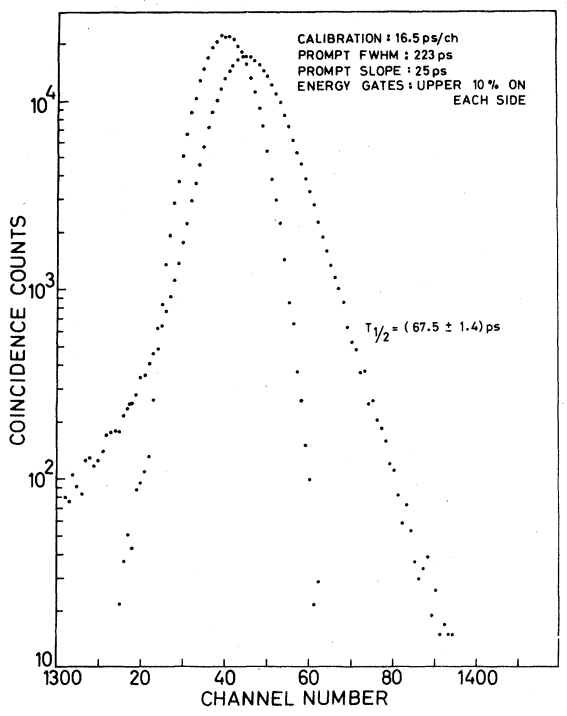

FIG. 1. The chance coincidence corrected (606-keV β^-) (364-keV γ) delayed coincidence curve together with the normalized prompt curve.

TABLE I. Half-life values of some of the levels in ^{131}Xe.

E (level) (keV)	$T_{1/2}$ (ps)	Reference
80.2	290±60[a]	1
	500±21[b]	2
	416±20[b]	Present work
341.1	2.15±0.07 ns[b]	6
	1.34±0.04 ns[b]	Present work
364.5	47±5[a]	3
	51±4[a]	4
	67.5±1.4[b]	Present work
404.8	<500	6
	<100	5
	<75[b]	Present work

[a] Centroid shift method.
[b] Slope method.

to cut off the β's. The system time resolution with ^{60}Co γ rays at the actual energy settings was found to be full width at half maximum (FWHM) 776 ps with a right side slope ($\frac{1}{2}$) of 125 ps. The data were analyzed by the slope method and the least squares fitting of the data gave a value of $T_{1/2} = 416 \pm 20$ ps for this level.

The half-life for the 341.1-keV level was measured by recording the (326-keV γ) (177-keV γ) delayed coincidences. Suitable energy gates were chosen and aluminum absorbers of 1 mm thickness were used. The prompt time resolution at the actual energy settings using a ^{60}Co source was FWHM 474 ps with a right side slope ($\frac{1}{2}$) of 76 ps. The delayed coincidence curve analyzed in the manner described above yields $T_{1/2} = 1.34 \pm 0.04$ ns.

The (606-keV β^-) (364-keV γ) delayed coincidences were recorded for the half-life measurement of the 364.5-keV level by selecting the upper 10% of the energy spectrum on each side. A 1 mm thick aluminum absorber was placed between the source and the γ detector to cut off the β's. The time calibration was 16.5 ± 0.3 ps/channel using 2048 channels of the multichannel analyzer. The prompt time resolution of the system at the actual energy settings was FWHM 223 ps with a right side slope ($\frac{1}{2}$) of 25 ps. A typical chance coincidence subtracted delayed curve together with the normalized prompt curve is shown in Fig. 1. Least squares fittings of the data outside the prompt region gave a half-life value $T_{1/2} = 67.5 \pm 1.4$ ps for the level.

An upper limit of 75 ps was obtained for the half-life of the 404.8-keV level when the (318-keV γ) (404-keV γ) delayed coincidence data were analyzed. The results of the present measurements are compared with the previous measurements in Table I.

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