

$^{239}\text{Pu}(\text{d,pF})$  **2001Hu12**

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, E. Browne		NDS 109, 2439 (2008)	31-Jul-2008

**2001Hu12** (also [1999Hu12,2001Th16](#)): E=12.5 MeV. Measured protons in coin with the fission fragments. FWHM=7 keV for proton spectrum. Deduced several rotational and vibrational bands in the second minimum of the potential well from the analysis of the proton spectrum in the excitation region of 3.8-5.6 MeV.

**2003Ni01**: E=13.5 MeV. Protons measured with a  $\Delta E$ -E telescope silicon detectors. The fission fragments were detected in coin mode with two silicon PIN diodes. FWHM(proton spectrum)=55 keV. Measured proton-fission fragment coin; mass distribution of  $^{240}\text{Pu}$  fission fragments following the  $\beta$ -vibrational resonance at 5.1 MeV in the second minimum of the double-humped fission barrier.

Earlier (d,pF) studies: [1976Go13](#), [1976G101](#), [1971Ba30](#), [1969Pe07](#), [1969La14](#), [1968Br32](#), [1965Br40](#).

Two vibrational resonance groups centered at 4.6 MeV and 5.1 MeV excitation energy were observed and attributed to 3-phonon and 4-phonon  $\beta$ -vibrational states. Each group was further resolved into several substates which could be assigned as the low-spin members of  $K^\pi=0^+$  SD rotational bands on the basis of regular pattern of triplet ( $0^+$ ,  $2^+$  and  $4^+$ ) of states for each substructure.

 $^{240}\text{Pu}$  Levels

E(level) <sup>†</sup>	$J^\pi$	Comments
2184+x <sup>‡</sup>	(0 <sup>+</sup> ) <sup>‡</sup>	
2276+x <sup>‡</sup>	(0 <sup>+</sup> ) <sup>‡</sup>	E(level): 2380 200 relative to g.s. of the second minimum.
2375+x <sup>‡</sup>	(0 <sup>+</sup> ) <sup>‡</sup>	
2435+x <sup>‡</sup>	(0 <sup>+</sup> ) <sup>‡</sup>	
2453+x <sup>‡</sup>	(0 <sup>+</sup> ) <sup>‡</sup>	
2483+x <sup>‡</sup>	(0 <sup>+</sup> ) <sup>‡</sup>	
2800+x <sup>#</sup>	(0 <sup>+</sup> )	E(level): 2800 200 relative to g.s. of the second minimum.

<sup>†</sup> x=energy of the g.s. in the second minimum (3.6-ns fission isomer) is deduced as 2250 200 from the resonance structure.

<sup>‡</sup> Probable bandheads of 3-phonon  $\beta$ -vibration ([2001Hu12](#)) in the second minimum. The structure shows a picket-fence type pattern of possibly the  $0^+$ ,  $2^+$  and  $4^+$  states of the SD rotational band.

<sup>#</sup> Attributed to 4-phonon  $\beta$ -vibration ([2001Hu12](#)) in the second minimum. This resonance may be composed of 13 rotational bands as shown in the fit of the proton spectrum. See also [2003Ni01](#) for mass distribution measurements.