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LETTER TO THE EDITOR

THE ^{133}Cs(d, ^{3}He)^{132}Xe REACTION

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The ^{133}Cs(d, ^{3}He)^{132}Xe reaction was measured at the Munich Q3D magnetic spectrograph with high resolution. The spectra were obtained at beam energies of $E_\mathrm{d} = 27\,\mathrm{MeV}$ and $E_\mathrm{d} = 28\,\mathrm{MeV}$. The corresponding angles of the spectrograph were 30° and 50°, respectively. The achieved FWHM was between 7 keV and 10 keV and the energies of the levels could be determined with a precision between 0.5 keV and 1 keV.

The nucleus ^{132}Xe has been studied up to now predominantly by γ-ray spectroscopy and β-decay measurements [1]. The reason may be that most of the commonly used particle induced reactions with light ions leading to this nucleus would require gaseous or radioactive targets. One reaction avoiding these difficulties is ^{133}Cs(d, ^{3}He)^{132}Xe, which additionally has the advantage of a mono–isotopic target element.

On the other hand the measurement of this reaction needs a detector system which has not only a high energy resolution but also an advanced particle identifi-

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cation. Such a system is given by the cathode strip focal plane detector of our group [2] placed in the focal plane of the Q3D magnetic spectrograph [3] at the accelerator laboratory of the University and Technical University of Munich. The deuterons are provided by a high stability, high resolution 15.2 MV Tandem-Van-de-Graaff machine.

The results presented in this paper were measured as a by-product of the reaction ^{127}I(d, ^{3}He)^{126}Te [4]. In this reaction a CsI target had to be used for reasons of vapour pressure and melting point temperature. The total thickness of the target was $40\,\mu$g/cm^2 on a $4.4\,\mu$g/cm^2 backing of natural carbon and the geometrical dimensions were 1 mm $\times$4 mm.

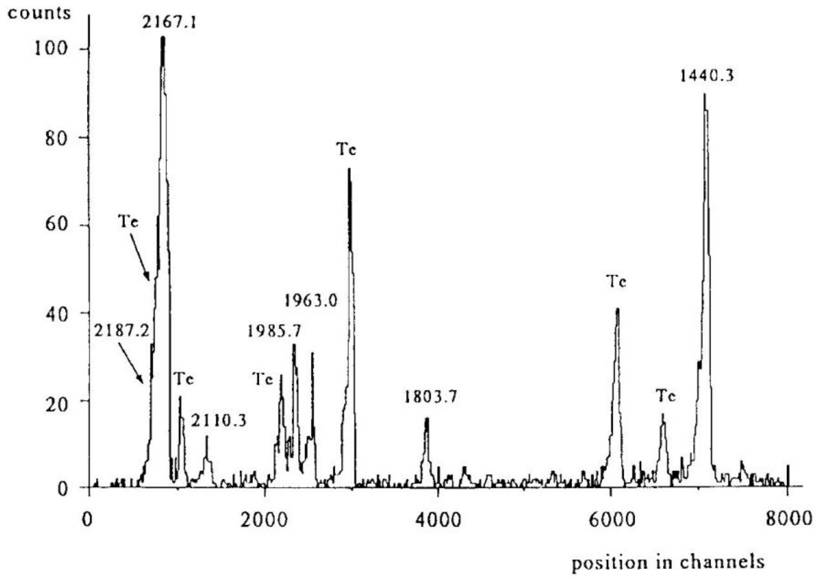

Fig. 1. Spectrum of the reaction ^{133}Cs(d, ^{3}He)^{132}Xe. *The lines of* ^{132}Xe *are labelled with their energy in* keV *(values from current NDS) while the lines of* ^{126}Te *are simply labelled with 'Te'. The energy of the incident deuterons was* 27 MeV *and the angle of observation was 30° in the laboratory system. The resolution was about* 7.5 keV *FWHM. Furthermore the remarkable low background should be mentioned.*

The measurements were performed at two different beam energies and angles of observation. The mass difference of cesium and iodine results in different reaction kinematics. Together with the focussing properties of the spectrograph this causes a small shift of the ^{132}Xe lines relative to those of ^{126}Te, when comparing spectra of different angles but of the same energy range. This systematics was used to assign lines either to xenon or to tellurium.

For the experiment the energies of the incident deuterons were chosen to be 27 MeV at 30° and 28 MeV at 50°, respectively. Several overlapping spectra were taken at each angle and calibrated using level energies from the current Nuclear Data Sheets [1]. An example of the obtained spectra is shown in Fig. 1 and all results are listed in Table 1. There the intensities are given in arbitrary units. But in spite of this the values of both angles can be directly compared, because they are normalized using a monitor detector which registered the elastically scattered deuterons from the target.

TABLE 1.
Level energies and line intensities observed in the nuclear reaction ^{133}Cs(d, ^{3}He)^{132}Xe. *Questionable lines or intensities are labelled with a '?'. The results are compared with the levels known from the current Nuclear Data Sheets [1].*

Nuclear Data Sheets **65** February 1992			30° 27 MeV				50° 28 MeV			
			energy		intensity		energy		intensity	
keV		J^{π}	keV		arb. units		keV		arb. units	
0.0		0^+	0.0	(5)	121	(9)	0.0	(5)	80	(6)
667.720	(3)	2^+	667.7	(9)	42	(6)	667.7	(11)	24	(4)
1297.919	(13)	2^+	1297.9	(8)	24	(3)	1297.9	(14)	12.9	(22)
1440.327	(11)	4^+	1440.32	(22)	101	(5)	1440.3	(4)	71	(5)
1803.719	(17)	3^+	1804.1	(8)	7.0	(14)	1803.3	(12)	10.3	(21)
1850	(80)		1854.9	(23)?	3.9	(15)?				
1963.00	(6)	4^+	1963.3	(4)	19.3	(20)	1962.9	(6)	15	(3)
1985.654	(6)	2^+	1985.3	(4)	24	(4)	1985.6	(5)	25	(4)
2040.36	(10)	(5^-)								
			2068.1	(17)?	3.1	(12)?	2062	(3)?	2.8	(20)?
2110.28	(7)	4^+	2109.6	(8)	8.5	(16)	2109.7	(10)	7	(4)
2111.85	(17)	6^+								
2167.09	(15)	5^+	2167.3	(4)	65	(11)	2167.3	(5)	70	(7)
2168.8	(4)	1, 2								
2187.22	(16)	2^+	2186.0	(5)	20	(3)	2187.4	(3)	49	(5)?^{a}
2214.06	(14)	(7^-)								
			2285.7	(17)?^{b}	3.7	(13)?^{b}				
2303.43	(15)	(6^+)	2303.98	(21)	84	(15)	2303.7	(3)	106	(7)
2350.65	(9)	5^+	2350.2	(5)	58	(21)	2350.2	(4)	50	(5)
2353.2	(4)		2356.6	(24)?	12.6	(16)?				
2394.91	(8)	4^+	2394.3	(4)	16.2	(16)	2393.7	(7)	20	(4)
2424.78	(12)	3^+	2424.0	(4)	11.0	(14)	2423.4	(9)	10	(3)
2469.11	(15)	(3^-)								
2490	(50)									
2512.1	(4)	(4^+)								
2555.40	(22)	$(2^+,3)$								
2583.75	(10)	5^+								
2588.70	(9)	(4^+)	2589.4	(4)	25	(3)	2589.3	(8)	39	(4)
2613.46	(9)	5^+	2611.7	(8)^{cd}	11.6	(22)^{cd}	2615.1	(16)?^{e}	11	(3)?^{e}
2650.4	(8)	(7^-)								
2670.01	(10)	3^+	2667.5	(5)^{cf}	30	(3)^{cf}				
2714.4	(4)	1, 2	2716.7	(12)^{cg}	14	(3)^{cg}				
2752.27	(17)	(10^+)								
2754.44	(11)	(4^+)	2753.9	(8)^{c}	10.8	(22)^{c}				
			2781.0	(7)?^{bc}	15	(3)?^{bc}				
2828.1	(9)	(7,8,9)								
2838.86	(7)	5^+	2838.4	(5)^{c}	27	(3)^{c}				
2840.10	(12)	$4^{(+)}$								
2872.6	(5)									
2890.70	(11)	(4^+)	2890.9	(12)	4.8	(9)				

TABLE 1. (continuation)

Nuclear Data Sheets **65** February 1992		30° 27 MeV				50° 28 MeV	
		energy		intensity		energy	intensity
keV		J^π	keV		arb. units		keV	arb. units
2916.85 (13)	3, 4						
		2924.7	(16)?^{b}	3.9	(10)?^{b}		
2935.4 (3)							
2958.76 (19)	3,4	2959.2	(11)	5.1	(10)		
2960.4 (12)	(7,8,9)						
		3005.2	(11)^b	4.5	(10)?^{b}		
3058.14 (11)	(3$^+$)						
3076.42 (17)	(3$^+$)						
3084.5 (3)							
3112.09 (20)	3,4						
3121.7 (3)							
3155.81 (22)	3$^+$, 4$^+$	3156.5	(14)	6.4	(13)		

Footnotes:
$^{a)}$ unresolved doublet with the 2045.2 keV line from ^{126}Te
$^{b)}$ may be from ^{126}Te
$^{c)}$ on background
$^{d)}$ may be an unresolved doublet of the 2613.5 keV line and of the 2479.8 keV line from ^{126}Te
$^{e)}$ unresolved doublet with the 2496.9 keV line from ^{126}Te
$^{f)}$ may be an unresolved doublet of the 2670.0 keV line and of the 2533.9 keV line from ^{126}Te
$^{g)}$ unresolved doublet with a 2588.9 keV line from ^{126}Te observed in the (d,p)–reaction

The results of this proton–pickup reaction shed light especially on the $\pi[1g_{7/2}1g_{7/2}]$ and $\pi[1g_{7/2}2d_{5/2}]$ two quasiparticle components of the excited states. The not observed intensity of the 6^+ level at 2112 keV is in agreement with an interpretation as the 3 phonon 6^+ state. The relatively strong intensity of the 2303 keV level supports the assignment as non-collective quasiparticle state. The 2_3^+ level at 1985.7 keV has been considered by Hamada et al. [5] to be a mixed symmetry state. When comparing the proton-pickup intensities of this level with those of the 2^+-mixed symmetry state in ^{126}Te [4] it can be stated that there is no contradiction to such an interpretation.

But serious difficulties arise from the interpretation of the 4_1^+ level as a nearly pure 2 phonon state. The large intensities shown in the table strongly support the conclusion of da Cruz and Goldman [6] that the introduction of two quasiparticle components in the theoretical models should lead to better results.

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REAKCIJA ^{133}Cs(d, ^{3}He)^{132}Xe

Pomoću Q3D magnetskog spektrografa istraživali smo reakciju ^{133}Cs(d, ^{3}He)^{132}Xe pri visokom razlučivanju. Izmjereni su spektri za energiju upadnih deuterona od 27 i 28 MeV, na kutovima raspršenja 30° odnosno 50°. Postignuto je razlučivanje između 7 i 10 keV, a energije stanja u ^{132}Xe su određene na točnost između 0.5 i 1 keV.