LINEAR MOMENTUM TRANSFER IN THE $^{3}He + ^{59}Co$ REACTION AT ENERGIES BETWEEN 110 AND 270 MeV

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We have recently submitted for publication a paper[1] in which the results of a study of linear momentum transfer in the $^{3}He + ^{59}Co$ reaction in the energy range between 10 MeV and 146 MeV were presented. These studies are now extended to the highest ^{3}He energy available at IUCF.

Information about the linear momentum transfer is obtained through the measurement, for the radioactive reaction products, of their thick target recoil ranges and formation cross sections. The average and maximum linear momentum transfer are deduced. We refer to Refs. 1,2 for details of the experimental procedure as well as for the definition of measured quantities.

Table I (see Appendix) presents the cross sections and forward recoil ranges (FW) for six ^{3}He bombarding energies investigated in the present work. For three bombarding energies we have also determined the backward recoils for some reaction products. The ratios of forward to backward catcher activities (F/B) are also listed in Table I.

The indicated errors reflect the spread of the measured quantities in successive measurements, performed during about nine months. Additional systematic error up to 15%, due to uncertainty in collected charge, cannot be excluded for the cross section values. The systematic error for recoil ranges may reach 3% due to the target thickness uncertainty.

Figure 1 shows, for the highest and lowest energy employed in this work, the deduced forward velocities (in compound nucleus velocity units) as a function of ΔA, the difference between target mass and the mass of a given reaction product.

Figure 2 summarizes the available data about the average and maximum momentum transfer in $^{3}He + ^{59}Co$ reaction.

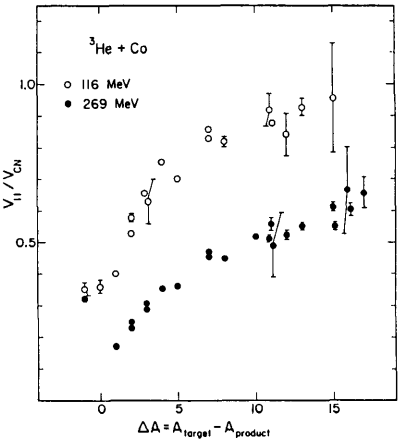

Figure 1. Forward velocities (in compound nucleus velocity units) of the radioactive recoils observed in the $^{3}He + ^{59}Co$ reaction as a function of ΔA, the difference between target mass and the mass of a given product.

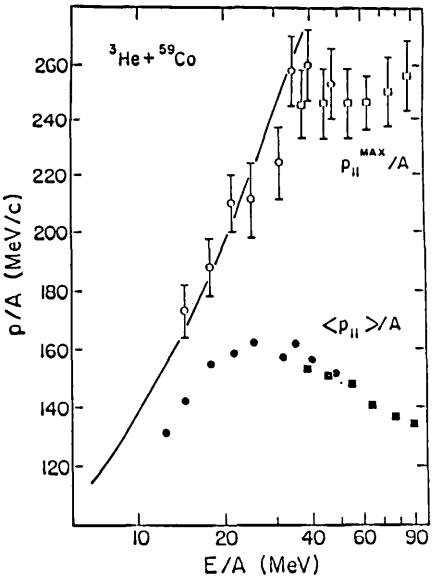

Figure 2. Average and maximum transferred linear momentum divided by A, the mass of the projectile, as a function of the bombarding energy divided by A for the $^{3}He + ^{59}Co$ reaction. The round points are from Ref. 1, the squares from the present work.

Table I. Cross sections (in mb), thick target recoil ranges FW (in mg/cm^2 in Co) and forward to backward ratios F/B for ^{3}He + ^{59}Co reaction products

	E_{lab} (MeV)							
	115.6			136.5		166.2		
Product	σ	FW	F/B	σ	FW	σ	FW	F/B
^{57}Ni	4.8 (2)	0.44 (2)	500 (100)	3.9 (1)	0.39 (2)	3.1 (2)	0.32 (1)	162 (30)
^{60}Co	11 (1)	0.18 (2)	20 (6)	8.6 (6)	0.24 (6)	6.1 (2)	0.32 (5)	21 (7)
^{58}Co^{m+g}	191 (3)	0.228 (7)	70 (10)	174 (3)	0.199 (5)	156 (2)	0.165 (4)	30 (3)
^{57}Co	166 (2)	0.377 (4)	168 (15)	148 (5)	0.331 (5)	130 (2)	0.277 (4)	85 (15)
^{56}Co	47 (1)	0.536 (9)	204 (35)	43 (1)	0.484 (9)	39 (1)	0.404 (8)	116 (20)
^{55}Co	6.7 (5)	0.67 (1)		6.2 (5)	0.64 (2)	5.9 (2)	0.53 (1)	
^{59}Fe	2.2 (1)	0.20 (1)		2.1 (1)	0.18 (3)	2.0 (1)	0.17 (1)	
^{52}Fe	0.41 (5)	0.80 (20)		0.44 (9)	0.70 (9)	0.48 (4)	0.74 (9)	
^{56}Mn	6.3 (4)	0.54 (10)		6.8 (5)	0.53 (2)	7.0 (3)	0.47 (5)	
^{54}Mn	73 (2)	0.62 (1)	172 (20)	73 (3)	0.60 (2)	72 (1)	0.56 (1)	91 (10)
^{52}Mn^{g}	26.6 (5)	0.79 (1)	408 (100)	26.0 (2)	0.75 (2)	27.4 (9)	0.72 (1)	209 (25)
^{51}Cr	49 (1)	0.78 (2)		58 (3)	0.79 (3)	65 (1)	0.75 (1)	182 (60)
^{49}Cr				3.2 (2)	0.88 (2)	4.4 (2)	0.82 (15)	
^{48}Cr	0.19 (3)	0.87 (7)		0.26 (2)	0.82 (6)	0.36 (2)	0.91 (7)	
^{48}V	6.3 (2)	0.85 (1)	165 (30)	10.1 (2)	0.88 (3)	13.3 (4)	0.846 (10)	124 (30)
^{48}Sc				0.12 (3)	0.78 (9)	0.31 (7)	0.70 (15)	
^{47}Sc	0.6 (2)	0.84 (9)		0.6 (2)		1.5 (3)	0.85 (7)	110 (30)
^{46}Sc	1.3 (2)	0.95 (4)		1.9 (2)	0.92 (4)	3.3 (1)	0.92 (2)	
^{44}Sc^{g}				0.5 (2)	0.89 (5)	1.1 (3)	0.85 (6)	
^{44}Sc^{m}	0.26 (5)	0.95 (2)		0.8 (1)	0.93 (3)	1.6 (1)	0.96 (2)	71 (20)
^{43}Sc						0.8 (4)		
^{43}K						0.14 (3)	0.84 (15)	

	E_{lab} (MeV)						
	195.7		232.4			269.3	
Product	σ	FW	σ	FW	F/B	σ	FW
^{57}Ni	2.5 (1)	0.28 (2)	0.9 (2)	0.25 (2)	97 (20)	1.6 (1)	0.20 (2)
^{60}Co	4.0 (2)	0.22 (3)	2.6 (3)	0.27 (6)		1.5 (2)	0.36 (10)
^{58}Co^{m+g}	144 (3)	0.135 (3)	126 (2)	0.115 (2)	15 (1)	106 (3)	0.098 (2)
^{57}Co	118 (3)	0.232 (4)	99 (2)	0.199 (4)	39 (2)	82 (2)	0.173 (4)
^{56}Co	36 (1)	0.354 (7)	31 (1)	0.31 (1)	71 (5)	26 (1)	0.267 (7)
^{55}Co	5.4 (3)	0.47 (2)	4.9 (3)	0.41 (2)		4.2 (2)	0.372 (15)
^{59}Fe	2.0 (2)	0.19 (5)	1.7 (2)	0.11 (5)	37 (16)	1.2 (2)	
^{52}Fe	0.51 (6)	0.68 (6)	0.44 (4)	0.61 (5)		0.48 (3)	0.60 (4)
^{56}Mn	7.3 (2)	0.39 (2)	8.0 (4)	0.310 (15)	16 (6)	7.0 (3)	0.32 (4)
^{54}Mn	69 (1)	0.50 (1)	65 (1)	0.45 (1)	52 (5)	59 (1)	0.412 (8)
^{52}Mn^{g}	26.5 (7)	0.68 (2)	25.3 (2)	0.621 (3)	105 (5)	23 (1)	0.594 (15)
^{51}Cr	68 (3)	0.70 (1)	68 (1)	0.65 (2)	119 (35)	67 (3)	0.59 (3)
^{49}Cr	5.2 (5)	0.78 (5)	6.1 (6)	0.66 (12)		6.0 (5)	0.71 (10)
^{48}Cr	0.51 (4)	0.86 (10)	0.6 (1)	0.82 (4)		0.67 (10)	0.78 (5)
^{48}V	16.3 (10)	0.815 (15)	18.6 (3)	0.79 (1)	90 (10)	21.1 (2)	0.715 (15)
^{48}Sc	0.30 (4)	0.73 (5)	0.37 (6)	0.92 (5)		0.5 (1)	0.72 (25)
^{47}Sc	2.1 (2)	0.82 (3)	2.7 (1)	0.80 (3)	68 (18)	3.0 (2)	0.78 (4)
^{46}Sc	4.6 (2)	0.90 (2)	5.9 (3)	0.86 (2)	50 (15)	6.9 (2)	0.831 (15)
^{44}Sc^{g}	1.6 (1)	0.89 (6)	2.7 (4)	0.91 (5)		3.2 (3)	0.92 (3)
^{44}Sc^{m}	2.5 (1)	0.93 (2)	3.5 (1)	0.94 (3)	77 (10)	4.6 (3)	0.79 (10)
^{43}Sc	1.0 (2)	1.20 (20)				1.8 (3)	1.00 (20)
^{43}K	0.22 (3)	0.89 (4)	0.32 (2)	0.95 (10)	28 (14)	0.44 (3)	0.96 (4)
^{42}K	0.7 (2)	0.93 (2)	1.0 (3)	0.89 (8)		1.3 (2)	1.05 (10)
^{42}K							

1) J. Jastrzebski et al., submitted to Phys. Rev. C.

2) J. Jastrzebski et al., Phys. Lett. 136B, 153 (1984).