7.3 Isotopes requiring Coincidence Correction

isotope reference Q_ε, Q_β MeV $t_{1/2}$	β-, ε-decay, IT E_β^{max}, $(\bar{E}_\beta)$ MeV	β-, ε- *branch* intensity %	daughter-nuclide & E_γ γ-ray transitions to final level (level half-live) keV	E-list in I-order keV	γ- & X- intens. %
		β^+: 100%			
$^{88}_{39}$**Y**	$\rightarrow \beta^+$:		$\rightarrow$ $^{88}_{38}$Sr		
NDS:105,419,2005	$\rightarrow \beta^+$:	94.4	$\rightarrow$ γ : 898.04(0.7ps), 1836.03 !	1836.03$_{12}$	99.2$_3$
			γ : 2734.0^{pcd}	898.042$_3$	93.7$_3$
	$\rightarrow \beta^+$:	5.5	$\rightarrow$ γ : 1836.03 ($> 90\% \downarrow$)	2734.0$_5$	0.71$_7$
	$\rightarrow \beta^+$:0.7645$_{15}$	0.210$_{20}$	$\rightarrow$ γ : 1382.2, 1836.06(0.16ps)	511.00	0.42$_4$
	ANNIHILATION	$\longrightarrow$	$\rightarrow$ γ : 511.00 (2γ-rays)	850.6$_8$	0.065$_{13}$
	$\rightarrow \beta^+$:	0.065$_?$	$\rightarrow$ γ : 850.6(0.63ps), 898.04	1382.2$_{10}$	0.021$_6$
	SE/DE	$\longrightarrow$	γ : 1325.03/814.03	3219.7$_2$	0.0070$_{20}$
	(0.36$_5$)		$\rightarrow X : \Sigma K_\alpha$	14.142	51.8
			$\rightarrow X : K_{\alpha_1}$	14.165	34.1$_{12}$
			$\rightarrow X : K_{\alpha_2}$	14.098	17.7$_6$
	$\alpha_t^{1836} = 3.5{*}10^{-4}$		$\rightarrow X : \Sigma K_\beta$	15.870	8.3
	$\alpha_K^{1836} = 1.24{*}10^{-4}$		$\rightarrow X : K_{\beta_1}$	15.836	4.90$_{18}$
	$\alpha_t^{898} = 3.1{*}10^{-4}$		$\rightarrow X : K_{\beta_2}$	16.085	0.87$_4$
Q_{β^-}=3.6226$_{15}$	$\alpha_K^{898} = 2.8{*}10^{-4}$		$\rightarrow X : K_{\beta_3}$	15.825	2.53$_9$
106.626$_{21}$ d			$\rightarrow X : \Sigma$ L	1.81	2.79$_8$
! intensive decay cascade; pcd: peak-area of 2737.0keV is increased by $\sum$E=(898.04+1836.03)keV; For activity determination in close position use coincidence correction or the sample should be in >7cm distance to the detector end-cap					
		β^-: 100%			
$^{60}_{27}$**Co**	$\rightarrow \beta^-$:		$^{60}_{28}$Ni (stable)		
NDS:100,347,2003	$\rightarrow \beta^-$: 0.3182$_5$	99.925	$\rightarrow$ γ : 1173.23(.73ps), 1332.50 !	1332.492$_4$	99.9826$_6$
			$\rightarrow$ γ : 347.14, 826.10, 1332,49	1173.228$_3$	99.85$_3$
			$\rightarrow$ γ : 347.14, 2158.57	826.10$_3$	0.0076$_8$
	$\rightarrow \beta^-$: 1.4914$_5$	0.012$_3$	$\rightarrow$ γ : 1332.49 (3.3ps),($\downarrow >$ 99%)	347.14$_7$	0.0075$_4$
	SE/DE (1332.49)	$\longrightarrow$	γ : 821.50/310.50	2158.57$_3$	0.00120$_{20}$
	SE/DE (1173.23)	$\longrightarrow$	γ : 662.24/151.24	2505.692$_5^{pcd}$	2.0$_4$E-6
	(0.09641$_{25}$)		$\rightarrow X : \Sigma K_\alpha$	7.466	0.00967
Q_{β^-}=2.8239$_5$			$\rightarrow X : K_{\alpha_1}$	7.478$_4$	0.0064$_3$
1925.28$_{14}$ d	α_t^{1332}=1.33$*10^{-4}$		$\rightarrow X : K_{\alpha_2}$	7.461$_4$	0.00325$_{19}$
5.2714$_5$ y	α_t^{1173}=1.77$*10^{-4}$		$\rightarrow X : \Sigma K_\beta$	8.265	0.00116$_{60}$
! intensive decay cascade; $\sum$E=(1173.23 keV + 1332.49 keV)=2505.72 keV; For activity determination in close position use coincidence correction or the sample should be in >7cm distance to the detector end-cap					

$\varepsilon_t = \varepsilon_p$ /(p/t); total and absolute photopeak efficiency, peak/total-ratio; CoinCorr=N_p(exp.)/N_p(corr.), N_p=full energy peak counts

$^{60}_{27}$Co: Coincidence correction CoinCorr$_p$, P=Coincidence Probability[24]

CoinCorr = 1 - P; P(1173 keV) = 0.9999 * $\varepsilon_t^{1332keV}$

CoinCorr = 1 - P; P(1332 keV) = 0.9989 * $\varepsilon_t^{1173keV}$

$^{88}_{39}$Y: Coincidence correction CoinCorr [24]

CoinCorr = 1 - P; P(898 keV) = (0.5253 * $\varepsilon_t^{14.4keV}$ + 0.0856 * $\varepsilon_t^{15.9keV}$)*(1-$\varepsilon_t^{1836keV}$)+$\varepsilon_t^{1836keV}$

P(898 keV) $\simeq$ 0.61 * ε_t^{15keV}+ $\varepsilon_t^{1836keV}$

CoinCorr = 1 - P; P(1836 keV) = (0.6101-0.5786*ε_t^{898keV})*(0.8599 * $\varepsilon_t^{14.4keV}$ + 0.1401 * $\varepsilon_t^{15.9keV}$)+ε_t^{898keV}

P(1836 keV) $\simeq$ 0.61 * ε_t^{15keV}+ ε_t^{898keV}

Practical Example:n-type HPGe:~35%	**distance** $\downarrow$	CoinCorr w/o absorber				with absorber Perspex 1cm		
Energy in keV $\rightarrow$		**898.0**	**1836.0**	**1332.5**	**1173.2**	**898.0**	**1836.0**	**Co-60**
Detector-Source distance (flat source)	0.88 cm	0.859	0.845	0.880	0.884			
and coincidence correction factors	2.70 cm	0.925	0.919	0.939	0.941	0.943	0.937	no
CoinCorr	7.6 cm	0.976	0.974	0.980	0.981	0.981	0.980	changing