WP2025-18

REACTION codes of ^{89}Y(p,n)^{89}Zr and ^{89}Y(d,2n)^{89}Zr datasets

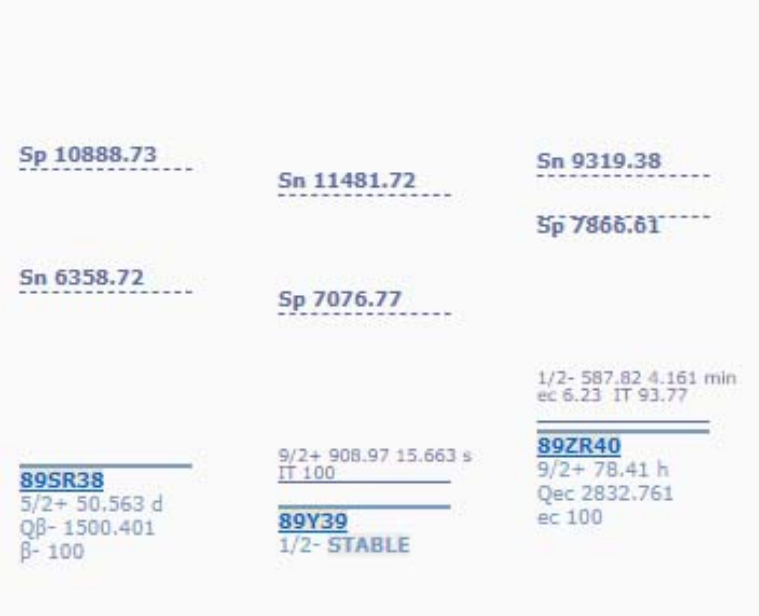
(N. Otsuka, 2024-08-30, Memo CP-D/1116)

The $^{89g+m}$Zr production cross section can be determined in an activation measurement only when the ^{89m}Zr production cross section is measured separately.

ANALYSIS=DECAY (decay curve analysis) is coded in D4059.012. But the authors do not give the half-life of the metastable state.

Motivated by a question on the metastable state contribution in the excitation function of ^{89}Y(p,n)^{89}Zr (a candidate of positron emitter production route) displayed on the NDS website, I looked into the EXFOR situation.

The half-life of the metastable state (m.s.) ^{89m}Zr (4 min) is extremely shorter than the half-life of the ground state (g.s.) ^{89g}Zr (78 h). Therefore, we expect the cross sections measured by the g.s. activity is for ^{89g}Zr (78 h) production and ~94% of ^{89m}Zr (4 min) production unless separate measurement of the m.s. activity is done. I see only a part of experiments report the real total cross sections (by measuring both g.s. and m.s. activities or by neutron detection). I reviewed the situation in EXFOR for both (p,n) and (d,2n) reactions, and summarized my suggestions in the table appended to this memo.



Cross sections in EXFOR for ^{89}Y(p,n)$^{89g+m}$Zr and ^{89}Y(d,2n)$^{89g+m}$Zr (as of 2024-08-29)

Dataset ID	REACTION (current)	Suggested corrections	Remark
A0347.039	39-Y-89(D,2N)40-ZR-89,,SIG	(no suggestion)	m.s. cross section in A0347.038
A0510.185	39-Y-89(P,N)40-ZR-89,,SIG	Add -G in SF4 and (M) in SF5	Famous report in Russian by Levkovskii.
A0931.004	39-Y-89(P,N)40-ZR-89,,SIG	Add -G in SF4 and M+ in SF5.	Absence of correct mentioned by the authors.
C0774.002	39-Y-89(P,N)40-ZR-89,,SIG	(no suggestion)	Neutron detection by BF3
C1299.002	39-Y-89(P,N)40-ZR-89,,SIG	Add -G in SF4 and (M) in SF5	No discussion about IT contribution
D0029.002	39-Y-89(P,N)40-ZR-89,,SIG	Add -G in SF4 and (M) in SF5	No discussion about IT contribution
D0584.003	39-Y-89(P,N)40-ZR-89,,SIG	Add -G in SF4 and M+ in SF5.	Declared as cumulative by the authors.
D0629.010	39-Y-89(P,N)40-ZR-89,,SIG	Add -G in SF4 and M+ in SF5.	Declared as cumulative by the authors.
D4059.012	39-Y-89(D,2N)40-ZR-89,,SIG	Add -G in SF4 and (M) in SF5	No discussion about IT contribution
D6178.004	39-Y-89(P,N)40-ZR-89,,SIG	(no suggestion)	g.s. and m.s. cross sections in D6178.002 and 003.
E2653.002	39-Y-89(D,2N)40-ZR-89,,SIG	Add -G in SF4 and M+ in SF5.	Declared as cumulative by the authors.
O2103.005	39-Y-89(P,N)40-ZR-89,,SIG	Add -G in SF4 and (M) in SF5	No discussion about IT contribution (though they report calculated isomeric ratios.)
O2453.002	39-Y-89(D,2N)40-ZR-89,,SIG	Add -G in SF4 and M+ in SF5.	Declared as cumulative by the authors.
S0040.002	39-Y-89(P,N)40-ZR-89,,SIG	Add DERIV in SF9.	Corrected with isomeric ratio measured by P0012.
T0130.013	39-Y-89(P,N)40-ZR-89,,SIG	(no suggestion)	Neutron detection by boron long counter