^{9}Be(^{31}Ar,^{30}Ar) 2018Xu04,2015Mu13

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	M. S. Basunia, A. Chakraborty	NDS 197,1 (2024)	31-May-2024

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2018Xu04,2016Xu08: secondary ^{31}Ar beam at 620 MeV/nucleon produced in ^{9}Be(^{36}Ar,X),E=885 MeV/nucleon primary fragmentation reaction at SIS-GSI accelerator facility. ^{31}Ar ions separated by using the fragment separator FRS. Secondary ^{9}Be target was 4.8 g/cm^{2} thick. The ^{30}Ar ions were produced in one-neutron knockout reaction. Measured positions and angular correlations of ^{30}Ar in-flight decay products such as coincident two protons (emitted by the decay of ^{30}Ar) and heavy-ion recoil such as ^{28}S (2p-decay daughter of ^{30}Ar). Measured particle spectra, (^{28}Si)p(θ), and analyzed reaction kinematics. ^{9}Be(^{20}Mg,^{19}Mg) reaction, and subsequent 2p-decay of ^{19}Mg to ^{17}Ne was used as a reference for determination of detection efficiency, angular and half-life resolutions. Evidence for three-body (^{28}S+p+p) and sequential 1p decays in the decay of ^{30}Ar.

2015Mu13: secondary ^{31}Ar beam at 620 MeV/nucleon produced in ^{9}Be(^{36}Ar,X),E=885 MeV/nucleon primary fragmentation reaction at SIS-GSI accelerator facility. ^{31}Ar ions separated by using the fragment separator FRS. Secondary ^{9}Be target was 4.8 g/cm^{2} thick. The ^{30}Ar ions were produced in one-neutron knockout reaction. Measured positions and angular correlations of ^{30}Ar in-flight decay products such as coincident two protons (emitted by the decay of ^{30}Ar) and heavy-ion recoil such as ^{28}S (2p-decay daughter of ^{30}Ar). ^{9}Be(^{20}Mg,^{19}Mg) reaction, and subsequent 2p-decay of ^{19}Mg to ^{17}Ne was used as a reference for determination of detection efficiency, angular and half-life resolutions. Evidence for three-body (^{28}S+p+p) and sequential 1p decays in the decay of ^{30}Ar. Observed peaks "A to H" in the ^{28}S+p+p spectrum of Fig. 7 of 2018Xu04 (see also Fig. 2 in 2015Mu13) in the range of 1-15 MeV, and peaks 1-6 in spectrum of Fig. 9 (see also Fig. 3 in 2015Mu13) in the range of 2-7 MeV in the ^{28}S+p double−coin spectrum.

Observed peaks "D to H" in range of 3.5 to 15 MeV in the ^{28}S+p+p spectrum of Fig. 2c, and peaks #3, #4 and #5 in the range of 2.5-5 MeV in the ^{28}S+p spectrum of Fig. 3 in 2015Mu13 correspond to higher excitations in ^{30}Ar and ^{29}Cl, which the authors relegate to forthcoming publications.

^{30}Ar Levels

E(level)†	J$^{\pi}$‡	T$_{1/2}$	Comments
0	0^{+}	<10 ps	%2p=100 (2015Mu13) Decays by 2p decay to ^{28}S ground state. From analysis of proton distribution spectrum from 2p decays of ^{30}Ar, 2015Mu13 conclude that the process is a combination of the two decay processes: "true" or simultaneous 2p emission, and sequential 1p emissions; see Fig. 4b and Fig. 7 in 2015Mu13. E(level): the ground state is deduced at E(2p)=2.45 MeV *+5−10* from analysis of peak "B" in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04 (also analyzed as peak #2 in authors′ Fig. 9), implying S(2p)(^{30}Ar)=−2.45 MeV *+5−10* i.e. ground state is unbound towards 2p emission. E(level): the ground state is deduced at E(2p)=2.25 MeV *+15−10* from analysis of peak "B" in ^{28}S+p+p spectrum in Figs. 2c and 4b of 2015Mu13, implying S(2p)(^{30}Ar)=−2.25 MeV *+15−10* i.e. ground state is unbound towards 2p emission. Note that in 2012Wa38 S(2p)=−2840 *530* from systematic trend. T$_{1/2}$: from 2015Mu13 based on analysis of ^{28}S+p+p events. Another estimate from consideration of different decay mechanisms (sequential as well as simultaneous or "true" 2p decay) gives T$_{1/2}$=0.1-1 fs (2015Mu13).
0.53×10^{3} *22*	(2^{+})		%p=100 E(level): the excited state is 0.45 MeV *+30−14*, deduced from analysis of observed peak "C" with E(2p)=2.9 MeV *+3−1* in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04 (also analyzed as peaks #3 in authors′ Fig. 9). Other: 0.7 × 10^{3} (2015Mu13) − the excited state is deduced from analysis of observed peak "A" with E(2p)=1.4 MeV, and peak "C" with E(2p)=2.9 MeV in ^{28}S+p+p spectrum in Fig. 2c of 2015Mu13, the latter also analyzed as peaks #1 and #2 in authors′ Fig. 4c. This state decays by two branches of sequential 1p emissions via the lowest states in ^{29}Cl, finally to the ground state and first excited 2^{+} state in ^{28}S, as shown in Fig. 5 of 2015Mu13. This state decays by two branches of sequential 1p emissions via the lowest states in ^{29}Cl, finally to the ground state and first excited 2^{+} state in ^{28}S, as shown in Fig. 10 of 2018Xu04.

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$^{9}Be(^{31}Ar,^{30}Ar)$ 2018Xu04,2015Mu13 (continued)

^{30}Ar Levels (continued)

E(level)†	Jπ‡	Comments
≈1.5×10^{3}	(0^{+})	%p=100 This state decays by two branches of sequential 1p emissions via the lowest states in ^{29}Cl, finally to the ground state and first excited 2^{+} state in ^{28}S, as shown in Fig. 10 of 2018Xu04. E(level): the excited state is 1.45 MeV *+190−20*, deduced from analysis of observed peak “D1” with E(2p)=3.9 MeV *+19−2* in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04.
1.78×10^{3} *17*		%p=100 This state decays by two branches of sequential 1p emissions via the lowest states in ^{29}Cl, finally to the ground state in ^{28}S, as shown in Fig. 10 of 2018Xu04. E(level): the excited state is 1.75 MeV *+20−14*, deduced from analysis of observed peak “D2” with E(2p)=4.2 MeV *+2−1* in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04.
3.13×10^{3} *12*		%p=100 This state decays by two branches of sequential 1p emissions via the lowest states in ^{29}Cl, finally to the ground state in ^{28}S, as shown in Fig. 10 of 2018Xu04. E(level): the excited state is 3.15 MeV *+10−14*, deduced from analysis of observed peak “E” with E(2p)=5.6 MeV *1* in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04.
5.3×10^{3} *1*		%p=100 This state decays by two branches of sequential 1p emissions via the lowest states in ^{29}Cl, finally to the ground state in ^{28}S, as shown in Fig. 10 of 2018Xu04. E(level): the excited state is 5.45 MeV *+80−110*, deduced from analysis of observed peak “F1” with E(2p)=7.9 MeV *+8−11* in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04.
6.8×10^{3} *19*		%p=100 This state decays by one branch of sequential 1p emission via the lowest states in ^{29}Cl, finally to the ground state in ^{28}S, as shown in Fig. 10 of 2018Xu04. E(level): the excited state is 6.95 MeV *+170−210*, deduced from analysis of observed peak “F2” with E(2p)=9.4 MeV *+17−21* in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04.
10.1×10^{3} *11*		%p=100 This state decays by two branches of sequential 1p emissions via the lowest states in ^{29}Cl, finally to the ground state in ^{28}S, as shown in Fig. 10 of 2018Xu04. E(level): the excited state is 10.15 MeV *+100−120*, deduced from analysis of observed peak “G” with E(2p)=12.6 MeV *+10−12* in ^{28}S+p+p spectrum in Fig. 7 of 2018Xu04.

† From 2018Xu04.
‡ From analogy with the corresponding mirror states in ^{30}Mg.