^{9}Be(^{48}Ca,^{47}Caγ) 2009Ma16,2017Cr03

History

Type	Author	Citation	Literature Cutoff Date
Full Evaluation	S. Ota and E. A. Mccutchan	NDS 203,1 (2025)	1-Apr-2025

2009Ma16: A 450 MeV/nucleon ^{48}Ca beam impinged on a ^{9}Be secondary reaction target of 1720 mg/cm^2 thickness. The ^{47}Ca reaction products were identified event-by-event in the second dipole stage of the FRS and transported to the final FRS focus. Six time-projection chambers, two before and two after the secondary target at S2 and two at S4, provided position and incident as well as emergent angles of primary fragments and reaction residues, respectively, allowing to reconstruct the flight path through the experimental setup. This enabled a precise measurement of the longitudinal momentum distributions of the heavy residues coming from the knockout reaction with a relative momentum resolution of 2×10^{-3} (FWHM). Prompt gamma-rays emitted by the reaction products were detected with the eight triple-cluster detectors of the Miniball gamma-ray spectrometer. Using the 6-fold segmentation of the Miniball HPGe crystals for the Doppler correction of the gamma-rays, a resolution of ≈ 40 keV (FWHM) at a c.m. gamma-ray energy of about 580 keV was achieved. Measured: Eγ, Iγ, (fragment)γ coin, momentum distribution.

2017Cr03: ^{48}Ca beam produced in the fragmentation of 140 MeV/nucleon ^{82}Se primary beam on a 423 mg/cm^2 thick ^{9}Be target, followed by separation of reaction products using the A1900 fragment separator at NSCL-MSU facility. The ^{48}Ca beam was incident on a 370 mg/cm^2 thick ^{9}Be reaction target located at the target position of the S800 magnetic spectrograph, by which knockout products were analyzed event by event using time of flight (tof) and energy loss (ΔE) technique. The prompt γ rays were detected using seven GRETINA modules surrounding the target position of the S800 spectrograph. Measured Eγ, Iγ, $\gamma\gamma$-coin, (^{47}Ca)γ-coin, and parallel momentum distributions. Deduced levels, L-transfers, spectroscopic factors, and γ-ray yields by fitting the data by GEANT4 simulation of the GRETINA response, including $\gamma(\theta)$ distributions of the emitted γ rays.

^{47}Ca Levels

Exclusive cross section for 2578 and 2599 levels=30 mb *4*, a quenching factor of 0.65 (reduction of the spectroscopic factors) was observed (2009Ma16).

Measured direct inclusive σ=111 mb *10* (2017Cr03).

Measured total inclusive σ=123 mb *10*. The total includes indirect population of levels like the population of higher-energy states (2017Cr03).

E(level)[†]	J$^\pi$	L[‡]	Comments
0	7/2$^-$	3	Level populated by removal of $f_{7/2}$ neutron from ^{48}Ca g.s. Measured cross section=70.6 mb *+84−96* (2017Cr03). C^{2}S=6.4 *+8−9* (2017Cr03). C^{2}S(normalized)=9.3 *+11−13*(stat) *19*(syst) (2017Cr03), using a quenching factor of 0.69.
2014	3/2$^-$		Measured cross section ≤ 1.4 mb (2017Cr03). C^{2}S ≤ 0.1 (2017Cr03). C^{2}S(normalized) ≤0.2 (2017Cr03), using a quenching factor of 0.66.
2578	3/2$^+$	2	Level populated by removal of $d_{3/2}$ neutron from ^{48}Ca g.s. Measured cross section=9.4 mb *+31−19* (2017Cr03). C^{2}S=1.3 *+4−3* (2017Cr03). C^{2}S(normalized)=1.9 *+6−4*(stat) *4*(syst) (2017Cr03), using a quenching factor of 0.65. J$^\pi$: other: L=2 momentum distribution in knock-out from $d_{3/2}$ orbital (2009Ma16). Measured cross section=21 mb *4* (2009Ma16).
2600	1/2$^+$	0	Level populated by removal of $s_{1/2}$ neutron from ^{48}Ca g.s. Measured cross section=10.5 mb *+14−13* (2017Cr03). C^{2}S=0.8 *1* (2017Cr03). C^{2}S(normalized)=1.3 *2*(stat) *2*(syst) (2017Cr03), using a quenching factor of 0.65. J$^\pi$: other: L=0 momentum distribution in knock-out from $s_{1/2}$ orbital (2009Ma16). Measured cross section=15 mb *3* (2009Ma16).
2875			
3267			
3425			
3562			

Continued on next page (footnotes at end of table)

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^{47}Ca Levels (continued)

E(level)†
3934
3999
4402

† From Eγ data.
‡ From exclusive parallel momentum distribution (2017Cr03).

γ(^{47}Ca)

E_γ†	E_i(level)	J_i^π	E_f	J_f^π	E_γ†	E_i(level)	E_f	J_f^π
403	4402		3999		2875	2875	0	$7/2^-$
437	3999		3562		3267	3267	0	$7/2^-$
565‡	2578	$3/2^+$	2014	$3/2^-$	3425	3425	0	$7/2^-$
586‡	2600	$1/2^+$	2014	$3/2^-$	3562	3562	0	$7/2^-$
862	2875		2014	$3/2^-$	3934	3934	0	$7/2^-$
2014	2014	$3/2^-$	0	$7/2^-$	3999	3999	0	$7/2^-$
2578	2578	$3/2^+$	0	$7/2^-$				

† From 2017Cr03.
‡ A single doublet peak at 575 keV was observed (2009Ma16).

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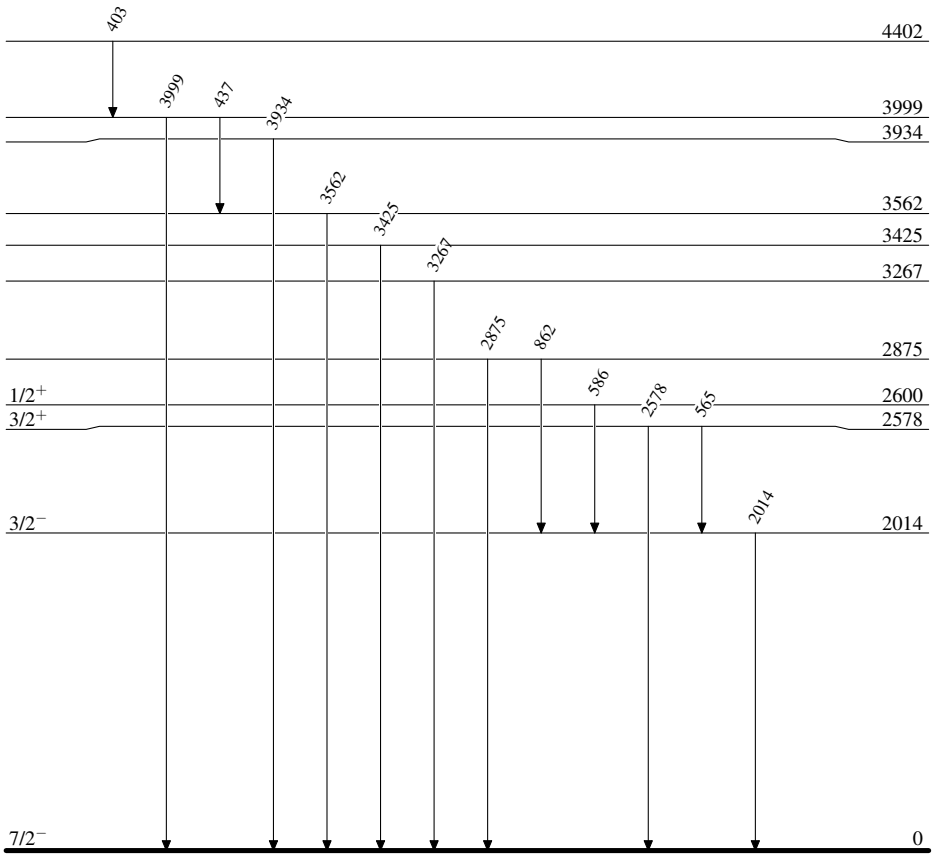
Level Scheme



$^{47}_{20}Ca_{27}$