Adopted Levels

$Q(\beta^-)=19.82\times10^3$ *13*; $S(n)=0.96\times10^3$ *10* 2024Mo02
$S(2n)=-840$ keV *30* from (2024Mo02).
$Q(\beta^-)$: From the mass excesses of ^{16}Be and ^{16}B given in (2024Mo02) and (2021Wa16), respectively.
S(n): From $S_n(^{16}Be)=S_{2n}(^{16}Be)-S_n(^{15}Be)$, where $S_n(^{15}Be)=-1800$ keV *100* (2013Sn02) as recommended by (2021Wa16).

See general theoretical analysis of ^{16}Be in: 1981Se06, 1985Po10, 1987Sa15, 2002Ne24, 2006Ko02, 2008Um02, 2009Yu07, 2012It04, 2015Ka02, 2017Lo03 (see also 2016LoZU), 2018Fo07, 2018Ca09, 2019Fo09, 2019Ca03, 2020It02, 2022Yu02, 2022Gu11, and 2023Mu11.

^{16}Be Levels

Cross Reference (XREF) Flags

A $^{1}H(^{17}B,2p)$
B $^{9}Be(^{17}B,^{16}Be)$
C $^{9}Be(^{40}Ar,^{16}Be)$

E(level)	$J^{\pi\dagger}$	Γ	XREF	Comments
0	0^+	0.32 MeV *8*	Ab	%2n=100 (2024Mo02,2012Sp01) XREF: b(0). E(level),Γ,J^π: From (2024Mo02). E(level): (2012Sp01) reported that the ground state is unbound to 2n decay by 1.35 MeV *10* and has a width of Γ=0.8 MeV *+1−2* (2012Sp01). However, the limited energy resolution of this experiment resulted in the observation of a broad structure comprising the unresolved ground+first excited states. The superior energy resolution of (2024Mo02) resolved these states, which are measured with much higher statistics. (2024Mo02) reports that the ground state is unbound to 2n decay by 0.84 MeV *3*. Decay is through dineutron emission (2024Mo02, 2012Sp01). A realistic 3-body modeling by (2024Mo02) showed that the ground state manifests itself with a strong dineutron-like configuration. Mass excess($^{16}Be_{g.s.}$)=56.93 MeV *13* (2024Mo02). Using the deduced mass excess from (2024Mo02), the evaluator determined the mass of ^{16}Be as 16.06112 u *14*.
1.31×10^3 *6*	2^+	0.95 MeV *15*	Ab	%2n=100 (2024Mo02) XREF: b(0). E(level),Γ,J^π: From (2024Mo02). E(level): The first excited state is unbound to 2n decay by 2.15 MeV *5*. (2024Mo02): This state decays by dineutron emission. As a result of a realistic 3-body modeling, it was found that this state exhibits a diffuse n-n spatial distribution.

† From shell model calculations by (2024Mo02).

$^{1}H(^{17}B,2p)$ 2024Mo02

2024Mo02: The authors populated the ground and first excited states of ^{16}Be by proton knockout from a ^{17}B beam and investigated their structure and decay by measuring the ^{14}Be+2n decay products using an experimental configuration which offered better energy resolution and an improved acceptance relative to the measurement of (2012Sp01).

A ^{17}B beam with E~277 MeV/nucleon was produced from fragmentation of a ^{48}Ca beam on a thick Be target at the RIBF facility in RIKEN. The ^{17}B beam was purified using the BigRIPS fragment separator and impinged on a 15-cm-thick liquid hydrogen target at the MINOS target position. The ^{16}Be nuclei were produced via the $^{1}H(^{17}Be,2p)$ reaction. The protons were measured using the MINOS TPC. The ^{16}Be nuclei decayed in flight, and the ^{14}Be and neutrons from this decay were momentum analyzed using the SAMURAI spectrometer and the NEBULA array, respectively.

The reaction vertex was reconstructed with a 5-mm position resolution using the two reaction protons′ trajectories and event-by-event beam tracking. The excitation spectrum was obtained from the reconstruction of the relative energy of ^{14}Be+n+n decay products using an invariant mass analysis. The ground and first excited states were observed with high statistics and are well resolved. The mass excess of $^{16}Be_{g.s.}$ was deduced. Some excess counts were measured above ~4 MeV, which were attributed to a non-resonant continuum or broad, weakly populated higher-lying structures.

A shell model calculation was performed using the WBP Hamiltonian, and the predictions are in good agreement with the experimental results. The decays of the observed ^{16}Be states were investigated using Dalitz plots supported by simulations. No evidence for sequential decay via ^{15}Be states was observed. Both the populated states decay via direct 2n emission. A 3-body modeling of ^{14}Be+n+n was performed to study the nature of these decays. The authors emphasized the importance of using realistic wave functions that evolve with time to describe the decay. Such a treatment was missing in (2012Sp01). Moreover, the earlier work did not consider the n-n final state interaction, which oversimplified their 2-body (^{14}Be+2n) decay study. The results of the present 3-body decay are in good agreement (except the predicted widths) with the experimental ones and support the dineutron emission from both of the observed states.

^{16}Be Levels

E(level)	J^{π} †	Γ	Comments
0	0^{+}	0.32 MeV *8*	%2n=100 E(level): The ground state is unbound to 2n decay by 0.84 MeV *3*. Decay is through dineutron emission. A realistic 3-body modeling showed that the ground state manifests itself with a strong dineutron-like configuration. Using $S_{2n}(^{16}Be)$ and mass excess(^{14}Be)=39.95 MeV *13* from (2021Wa16), the mass excess of $^{16}Be_{g.s.}$ was deduced to be 56.93 MeV *13*. The uncertainty is dominated by the mass excess of ^{14}Be. Using the deduced mass excess from (2024Mo02), the evaluator determined the mass of ^{16}Be as 16.06112 u *14*. These results supersede the earlier results of (2012Sp01), where the ground and first excited states were apparently unresolved.
1.31×10^{3} *6*	2^{+}	0.95 MeV *15*	%2n=100 E(level): The first state is unbound to 2n decay by 2.15 MeV *5*. This state decays by dineutron emission. As a result of a realistic 3-body modeling, this state exhibits a diffuse n-n spatial distribution.

† From shell model calculations by (2024Mo02).

^{9}Be(^{17}B,^{16}Be) 2012Sp01

2012Sp01: The authors populated a broad state associated with the ground state of ^{16}Be by fragmenting ^{17}B nuclei. They studied ^{16}Be decay by measuring complete ^{14}Be+2n kinematics. The aim was to determine the ^{16}Be mass and evaluate n-n correlations in search of dineutron decay.

The ^{16}Be nuclei were formed in a 2 step process: first a 120 MeV/nucleon ^{22}Ne beam was fragmented in a 2938 mg/cm^2 Be target to produce ^{17}B ions that were purified in the A1900 at the MSU/NSCL, second the ^{17}B beam at 53 MeV/nucleon impinged on a 470 mg/cm^2 ^{9}Be target where the ^{16}Be nuclei were formed by fragmentation.

The ^{16}Be nuclei decayed in flight and the residual ^{14}Be+2n were momentum analyzed using the 43° Sweeper dipole magnet and the MONA array. Kinematic energy reconstruction indicated the particle unbound ^{16}Be ground state is at E_{rel}(^{14}Be+2n)=1.35 MeV *10*. Further analysis of the ^{14}Be+n and n+n energy and angular correlations were consistent with dineutron emission from ^{16}Be, and were inconsistent with either sequential decay through ^{15}Be or simultaneous 3-body breakup into the ^{14}Be+n+n continuum. See also (2013Th04).

The most recent study by (2024Mo02) finds a similar spectrum to that of Fig. 2a in (2012Sp01). As a result of much higher statistics and a better energy resolution achieved by (2024Mo02), it is apparent that (2012Sp01) observed the unresolved ground+first excited states of ^{16}Be.

^{16}Be Levels

E(level)†	J$^\pi$	Γ	Comments
0	0$^+$	0.8 MeV *2*	%2n=100 E(level): A broad Γ=0.8 MeV *+1−2* group is reported to dineutron decay with E(^{14}Be+2n)=1.35 MeV *10*. Subsequent results by (2024Mo02) suggest this group is the unresolved ground+first excited states of ^{16}Be. Therefore, the results of (2012Sp01) were not used for the Adopted dataset.

† Unresolved ground+first excited states.

^{9}Be(^{40}Ar,^{16}Be) 2003Ba47

2003Ba47: The authors analyzed the ^{40}Ar+^{9}Be fragmentation products in search of evidence for particle bound states in ^{16}Be.

A beam of 140 MeV/nucleon ^{40}Ar ions, from the NSCL coupled cyclotron facility, impinged on a 1.5 g/cm^2 ^{nat}Be target. The resulting fragmentation products were momentum analyzed using the A1900 fragment separator. The products were detected using a position sensitive PPAC, a 500 μm thick Si ΔE detector and a stopping thickness plastic E scintillator that were located at the final focal plane of the device. The time difference between a thin plastic scintillator located at the intermediate image of the separator and the thick stopping detector were compared to determine the time-of-flight (ToF) between the two image planes. The particle identification at the focal plane was determined using both ΔE-E and ΔE-ToF techniques.

No events corresponding to ^{16}Be were observed. By comparison, ^{6,8}He, ^{9,11}Li, ^{12,14}Be, ^{17,19}B and ^{20}C nuclides were observed at the focal plane. The measured intensity of ^{19}B was expected to be an order of magnitude lower than that of ^{16}Be. As a result, the authors conclude ^{16}Be is unstable to neutron emission. See also (2004Th15).

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