Adopted Levels

Type	Author	History Citation	Literature Cutoff Date
Full Evaluation	B. Singh	NDS 114, 2023 (2013)	23-Sep-2013

Q(β^-)=2770 *SY*; S(n)=3470 *SY*; S(p)=9340 *SY*; Q(α)=2620 *SY* 2012Wa38
Estimated uncertainties: $\Delta Q(\beta^-)=\Delta S(n)=100$, $\Delta S(p)=\Delta Q(\alpha)=220$ (2012Wa38).
S(2n)=8530 *100*, S(2p)=17830 *320* (syst,2012Wa38).

^{215}Pb evaluated by B. Singh.

2010Al24 claim to identify ^{215}Pb for the first time, however as explained below, there have been several previous reports from GSI and ISOLDE, CERN groups where this isotope was identified, produced, and its half-life measured, for example in 1998Pf02 and in the thesis by 2004DeZV.

1998Pf02: GSI group: ^{9}Be(^{238}U,X), E=1 GeV/nucleon. Identification of ^{215}Pb by time-of-flight, energy loss, and Bρ measurements; FRS separator. Measured cross section.

1998RyZY, 1998Va13, 2003Ku26: ISOLDE, CERN group: 1998RyZY: reported tentative identification of ^{215}Pb with $T_{1/2}$=36.5 s formed in ^{232}Th(p,X) at 1 GeV from the observation of a γ cascade in ^{215}Bi. This was also mentioned briefly in 1998Va13. But later, in 2003Ku26, using RILIS source, this activity was reassigned to a high-spin isomer in ^{215}Bi. However, 2003Ku26 stated that ^{215}Pb isotope had been identified and that its study would be published elsewhere (reference 11 in 2003Ku26). In 2003Ko26, yield in Th(p,X) E=1 GeV reaction and using RILIS source, was reported (in figure 4 of 2003Ko26) as 0.3 μCi. In Fall 2002 Newsletter of ISOLDE, CERN, a short article by S. Franchoo quoted the half-life of ^{215}Pb as 147 s *12*. In 2012Au07 (NUBASE), $T_{1/2}$ is listed as 36 s *1*, a value based on a report by 1998RyZY, which was refuted in 2003Ku26. Confirmatory details of the ISOLDE, CERN group are reported in the thesis by 2004DeZV, where half-life of ^{215}Pb from γ-decay and the decay scheme of ^{215}Pb to ^{215}Bi are presented. This thesis was brought to the evaluator's attention by Professor P. van Duppen in e-mail communications of June 2011.

2004DeZV, 2013De20: ^{215}Pb produced via reaction ^{238}U(p,X) with E(p)=1.4 GeV, ionized by the Resonance ionization laser ion source (RILIS) and separated using the ISOLDE on-line mass separator. Detector system included an Si-detector for α-particles, one low-energy Ge and two HPGe detectors for x rays and γ rays, as well as a plastic scintillator ΔE detector for β-particles. Measured Eγ, Iγ, Iβ, $\beta\gamma$ and $\gamma\gamma$ coincidence. Deduced levels in ^{215}Bi, $T_{1/2}$.

2010Al24: ^{215}Pb nuclide identified in ^{9}Be(^{238}U,X) reaction with a beam energy of 1 GeV/nucleon produced by the SIS synchrotron at GSI facility. Target=2500 mg/cm^2. The fragment residues were analyzed with the high resolving power magnetic spectrometer Fragment separator (FRS). The identification of nuclei was made on the basis of magnetic rigidity, velocity, time-of-flight, energy loss and atomic number of the fragments using two plastic scintillators and two multisampling ionization chambers. The FRS magnet was tuned to center on ^{210}Au, ^{216}Pb, ^{219}Pb, ^{227}At and ^{229}At nuclei along the central trajectory of FRS. See also an earlier report 2009Al32 from the same group as 2010Al24. Unambiguous identification of nuclides required the separation of different charge states of the nuclei passing through the FRS. At 1 GeV/nucleon incident energy of ^{238}U, fraction of fully stripped ^{226}Po nuclei was about 89%. Through the measurement of difference in magnetic rigidity in the two sections of the FRS and the difference in energy loss in the two ionization chambers, the charge state of the transmitted nuclei was determined, especially, that of the singly charged (hydrogen-like) nuclei which preserved their charge in the current experimental setup. Measured production cross sections with 10% statistical and 20% systematic uncertainties. Criterion established in 2010Al24 for acceptance of identification of a new nuclide: 1. number of events should be compatible with the corresponding mass and atomic number located in the expected range of positions at both image planes of the FRS spectrometer; 2. number of events should be compatible with >95% probability that at least one of the counts does not correspond to a charge-state contaminant. Comparisons of measured σ with model predictions using the computer codes COFRA and EPAX.

Nuclear structure calculations:

2012Ko09: calculated rms radii, rms radius of neutron and proton distributions, isovector shift of nuclear rms radii, bulk density, neutron skin.

2008Ma17: HFB calculations of binding energy, two-neutron separation energy, odd-even mass staggering and pairing gaps.

2003Bo06: calculated $T_{1/2}$ using Shell model and quasiparticle RPA.

1987Sa51: calculated isotope shifts, B(E2).

Adopted Levels (continued)

^{215}Pb Levels

E(level)	J^π	$T_{1/2}$	Comments
0	$(9/2^+)$	147 s *12*	%β^-=100 RMS charge radius $<r^2>^{1/2}$=5.567 fm *7*; deduced from extrapolation of evaluated rms charge radii of ^{208}Pb to ^{214}Pb (2013An02), with slope k_z=0.36 in formula 9 of 2004An14. E(level): the observed fragments are assumed to be in the ground state of ^{215}Pb nuclei. $T_{1/2}$: from decay curves of γ rays (2013De20,2004DeZV). Other: 36 s *1* reported in 1998RyZY was refuted by 2003Ku26. J^π: $9/2^+$ from systematics (2012Au07), and also proposed in 2013De20. 7/2 predicted in 1997Mo25 calculations. From A/Z plot (figure 1 in 2010Al24), a large number (certainly more than few hundreds) of events are assigned to ^{215}Pb. In 1998Pf02, number of events in figure 1 seems about 60. The β^- decay is the only decay mode expected, and observed in 2013De20. Production σ=51.7 nb (from e-mail reply of Oct 29, 2010 from H. Alvarez-Pol, which also stated that further analysis was in progress); 90 nb *20* (1998Pf02). Production cross sections measured in 2010Al24 are given in authors′ figure 2, plot of σ versus mass number for Pb isotopes. Statistical uncertainty=10%, systematic uncertainty=20%.