Adopted Levels

	History		
Type	Author	Citation	Literature Cutoff Date
Full Evaluation	Balraj Singh, Sukhjeet Singh	ENSDF	08-Mar-2022

S(n)=6700 *90*; S(p)=1300 *70*; Q(α)=9329 *30*   2021Wa16

S(2n)=15390 *50*, S(2p)=4610 *90*, Q(ε)=6290 *30*, Q(εp)=2410 *80* (2021Wa16).

2018Hu13: production and identification of ^{224}Np nuclide in ^{187}Re(^{40}Ar,3n),E=188 MeV reaction, and the observation of six correlated α-decay chains, starting from ^{224}Np: ^{224}Np → ^{220}Pa → ^{216}Ac → ^{212}Fr. The ^{40}Ar beam from the Sector-Focusing Cyclotron (SFC) of the Heavy Ion Research Facility in Lanzhou (HIRFL). Target=enriched ^{187}Re, 460−μg/cm^2 thick. Evaporation residues (Er) were identified and separated using SHANS separator, and implanted into a 300−μm double-sided silicon strip detector (DSSD). Measured ERs, Eα, Iα, Er-α correlated events, and half-life of the decay of ^{224}Np g.s. FWHM=22 keV for non-pileup α events, and 55 or 70 keV for overlapping α signals.

Theoretical calculations: two references extracted from the NSR database are listed in document records.
Additional information 1.

History of decay chains observed by 2018Hu13:
ER=Evaporation residues. Part=partial α energy deposit.

Event #1: E(ER)=12566 keV.
$E_{\alpha1}$=9144 keV *23*, Δt_1=0.66 μs, assigned to ^{224}Np.
$E_{\alpha2}$=9522 keV *45*, Δt_2=580 ns, assigned to ^{220}Pa.
$E_{\alpha3}$=9058 keV *9*, Δt_3=310.78 μs, assigned to ^{216}Ac.

Event #2: E(ER)=14138 keV.
$E_{\alpha1}$=9154 keV *23*, Δt_1=160.71 μs, assigned to ^{224}Np.
$E_{\alpha2}$=9587 keV *23*, Δt_2=680 ns, assigned to ^{220}Pa.
$E_{\alpha3}$=1912 keV *9* (part), Δt_3=600.43 μs, assigned to ^{216}Ac.

Event #3: E(ER)=13704 keV.
$E_{\alpha1}$=9144 keV *60*, Δt_1=24.07 μs, assigned to ^{224}Np.
$E_{\alpha2}$=9531 keV *60*, Δt_2=220 ns, assigned to ^{220}Pa.
$E_{\alpha3}$: escaped α.

Event #4: E(ER)=13233 keV.
$E_{\alpha1}$=9104 keV *60*, Δt_1=68.93 μs, assigned to ^{224}Np.
$E_{\alpha2}$=644 keV *60* (part), Δt_2=240 ns, assigned to ^{220}Pa.
$E_{\alpha3}$=9082 keV *9*, Δt_3=166.08 μs, assigned to ^{216}Ac.

Event #5: E(ER)=12579 keV.
$E_{\alpha1}$=479 keV *30* (part), Δt_1=70.81 μs, assigned to ^{224}Np.
$E_{\alpha2}$=9572 keV *30*, Δt_2=500 ns, assigned to ^{220}Pa.
$E_{\alpha3}$=8976 keV *9*, Δt_3=527.34 μs, assigned to ^{216}Ac.

Event #6: E(ER)=13144 keV.
$E_{\alpha1}$=8868 keV *60*, Δt_1=4.89 μs, assigned to ^{224}Np.
$E_{\alpha2}$=9811 keV *60*, Δt_2=100 ns, assigned to ^{220}Pa.
$E_{\alpha3}$=9067 keV *9*, Δt_3=431.74 μs, assigned to ^{216}Ac.

Adopted Levels (continued)

$\underline{^{224}\text{Np Levels}}$

E(level)	T$_{1/2}$	Comments
0	38 μs +26−11	%α≈100

Only α decay has been detected. From theoretical T$_{1/2}$(β)=5.4 s and T$_{1/2}$(α)=2 ms in 2019Mo01, only α decay is expected.

Production σ=0.38 nb +26−11 (2018Hu13), uncertainty is statistical only.

E(level): assumed that the observed α activity is emanated from the decay of the ground state of ^{224}Np, and feeds two isomeric states in ^{220}Pa.

J$^{\pi}$: 2$^-$ from systematic trend (2021Ko07). From Ω(p)=7/2 and Ω(n)=5/2 in theoretical calculations by 2019Mo01, J=(1,6).

T$_{1/2}$: measured by 2018Hu13, from (evaporation residues)α-correlated decays.

Emitted Eα=9137 keV *20* with Iα=83 *51*, and Eα=8868 keV *62* with Iα=17 *18* (2018Hu13), feeding excited states at 34 keV *26* and 297 keV *65* in ^{220}Pa, respectively. Note that no decay branch to the g.s. of ^{220}Pa is indicated by 2018Hu13.