Adopted Levels, Gammas

Q(β^-)=17970 *80*; S(n)=2160 *80*; S(p)=1.794×10^4 *13*; Q(α)=−17770 *80* 2017Wa10

The nucleus ^{20}N is particle stable. Its atomic mass excess is 21.770 MeV *80* (2017Wa10).

A review of the production of nuclei far from stability is presented in (1989VoZM). Bulk properties of ^{20}N have been calculated or analyzed with general theoretical models in (1988PoZS, 1992Wa22, 1993Pa14, 1993Po11, 1997Ba54, 2000Zh42, 2002Ka73, 2004La24, 2004Ne16, 2006Ko02, 2012Yu07, 2015Sh21, 2016Ma06, 2016Zh05, 2018Fo04).

^{20}N Levels

Cross Reference (XREF) Flags

A	^{1}H(^{21}N,^{20}N)	H	^{20}C β^- decay	O	^{208}Pb(^{20}N,^{20}Nγ):coulex
B	^{9}Be(^{36}S,^{20}N),^{12}C(x,^{20}Nγ)	I	^{21}N(p,pn)	P	^{208}Pb(^{21}N,^{20}Nγ)
C	^{9}Be(^{40}Ar,^{20}N)	J	Ni(^{40}Ar,^{20}N)	Q	^{232}Th(p,^{20}N)
D	^{9}Be(^{48}Ca,^{20}N)	K	^{48}Ca(^{18}O,^{20}N)	R	^{232}Th(^{18}O,^{20}N)
E	C(^{20}N,X)	L	^{181}Ta(^{40}Ar,^{20}N)	S	^{232}Th(^{22}Ne,^{20}N)
F	C(^{21}N,^{20}N)	M	^{181}Ta(^{48}Ca,^{20}N)	T	U(p,^{20}N)
G	Si(^{20}N,X)	N	^{181}Ta(^{86}Kr,^{20}N)		

E(level)	J$^{\pi}$†	T$_{1/2}$	XREF	Comments
0	(2$^-$)	134.4 ms *37*	ABCDEFGH JKLMNOPQRST	%β^-=100; %β^-n=42.9 *14* %β^-n: From (2006Su12). J$^{\pi}$: From (2008So09). See also (2012Yu07). T$_{1/2}$: Weighted average of 136 ms *3* (2006Su12), 129 ms *8* (P.L. Reeder et al., Int. Conf. on Nucl. Data for Science and Technology, May 9-13, 1994, Gatlinburg, Tennessee), 70 ms *40* (1988DuZT), 100 ms *+30−20* (1988Mu08,1990Mu06); see also (1989MuZT,1990St08). Others: 142 ms *19* (1991Re02) and 130.0 ms *66* (unpublished private communications of (2008ReZZ)/(1995ReZZ)). The delayed neutron probability, P$_n$, has been reported as 57% *+11−7* (1988Mu08,1990Mu06), 66.1% *50* (1991Re02), 46% *11* (2006Su12). A reanalysis of (1991Re02) to include data published in the International conference on nuclear data for science and technology: nuclear data for the twenty-first century, Gatlinburg, TN, U.S.A.,9-13 May 1994) estimated P$_n$=52.0% *33*. The measurements of (2006Su12) provide the only quantitative measure of ^{20}O and ^{19}O spectroscopy for levels and transitions involved in the decay. The %β^-1n=42.9 *14* is deduced; furthermore, only ^{19}O*(96,1472) levels are fed in the 1n decay. Beta-decay to neutron bound levels in ^{20}O is found to comprise 53.8% *13* of decays with an additional upper limit of 3.3% feeding ^{20}O$_{g.s.}$ directly. The P$_n$=P$_{1n}$+2P$_{2n}$=52.0% *33* value from the revised zero-threshold measurement of (1991Re02) can be combined with P$_{1n}$=42.9% *14* from (2006Su12) to estimate the value of P$_{2n}$≈4.5%. The P$_{2n}$ contribution in the decay was not considered when the limit on direct feeding of ^{20}Og.s. was deduced. See also (1987BaZI,1987DuZU,1988BaYZ,1993ReZX,1994KiZU).
843 *4*	(3$^-$)		AB	%IT=100
944 *24*			AB	%IT=100
1336 *23*	(1$^-$,2$^-$)		B	%IT=100
1559 *30*			AB	%IT=100
1895 *34*	(3$^-$)		B	%IT>0
2943 *32*	(4$^-$)		B	%IT>0
3500?			O	%IT>0; %n≈100

Continued on next page (footnotes at end of table)

Adopted Levels, Gammas (continued)

^{20}N Levels (continued)

E(level)	XREF	Comments
4600?	O	%IT>0; %n≈100
5500	O	%IT>0; %n≈100
7000	O	%IT>0; %n≈100
9000	O	%IT>0; %n≈100
10200	O	%IT>0; %n≈100
11500	O	%IT>0; %n≈100

† From comparison with shell-model calculations.

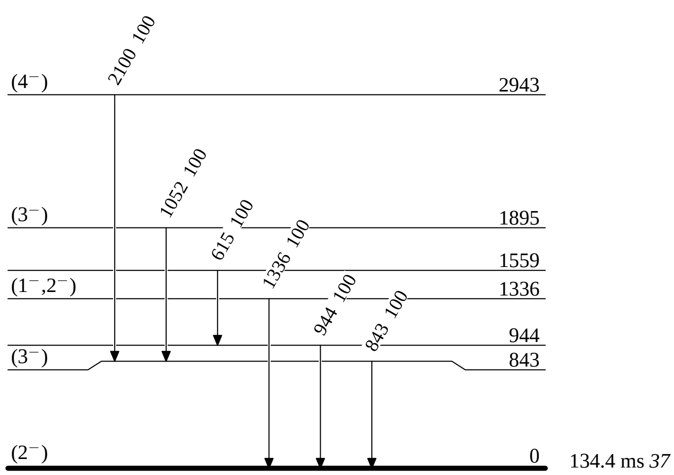
$\gamma(^{20}N)$

E_i(level)	J^π_i	E_γ	I_γ	E_f	J^π_f
843	(3^-)	843 *4*	100 *14*	0	(2^-)
944		944 *24*	100	0	(2^-)
1336	$(1^-,2^-)$	1336 *23*	100	0	(2^-)
1559		615 *18*	100	944	
1895	(3^-)	1052 *29*	100	843	(3^-)
2943	(4^-)	2100 *26*	100	843	(3^-)

Adopted Levels, Gammas

Level Scheme

Intensities: Relative photon branching from each level



$^{20}_{7}N_{13}$

$^{1}H(^{21}N,^{20}N)$ 2006OkZZ

2006OkZZ: A secondary beam of $E(^{21}N)$=72 MeV/nucleon, produced at the RIKEN Projectile fragment Separator (RIPS), impinged on a liquid hydrogen ($LiqH_2$) target with a thickness of 120 mg/cm^2. The target was surrounded by 48 blocks of NaI(Tl) scintillators to detect de-excitation γ-rays. The outgoing ^{20}N particle was identified using ΔE, time-of-flight (TOF) and magnetic rigidity (MDC and FDC3) information.

Two Doppler-shift-corrected γ-rays were observed at 612 keV *21* and 850 keV *17*.

See related work in (2010El05), and see quasifree (p,2p) cross section studies in (2018At01).

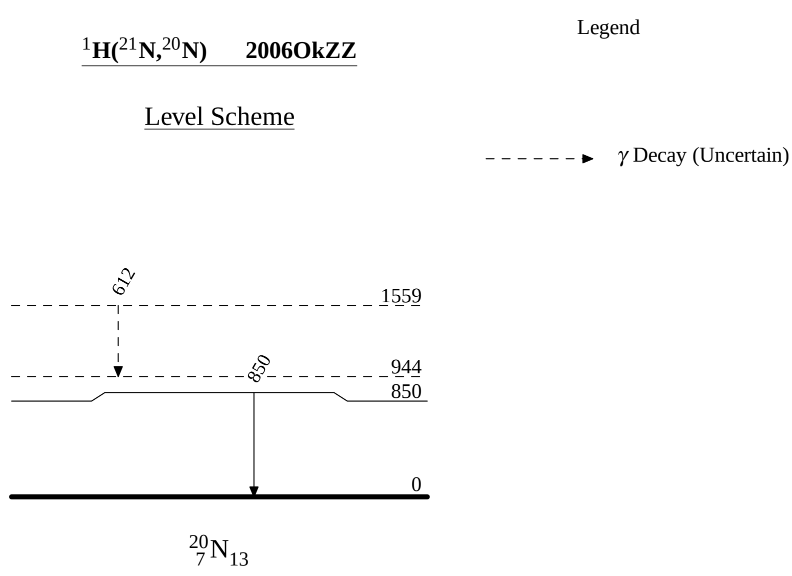
^{20}N Levels

E(level)
0
850
944?
1559?

$\gamma(^{20}N)$

E_γ	E_i(level)	E_f
612† *21*	1559?	944?
850 *17*	850	0

† Placement of transition in the level scheme is uncertain.



$^{9}Be(^{36}S,^{20}N),^{12}C(x,^{20}N\gamma)$ 2008So09

2008So09: XUNDL dataset compiled by McMaster University, 2008.

An $E(^{36}S)$=77.5 MeV/nucleon beam was delivered to the GANIL/SPEG spectrometer. In the first part of the experiment, the beam bombarded a 2.77 mg/cm^2 ^{9}Be target and the SPEG magnetic spectrometer was used to momentum analyze the reaction products and identify $^{20}N_{g.s.}$.

In the second part, a ^{12}C target, at the entrance of the SISSI device, produced a cocktail beam of ^{24}F, $^{25,26}Ne$, $^{27,28}Na$, and $^{29,30}Mg$ that was purified in the α spectrometer and then delivered to a carbon target at the dispersive image of the SPEG spectrometer. The target was surrounded by the 74 element BaF_2 *Chateau de crystal* array and four HPGe detectors. The γ rays observed in coincidence with ^{20}N ions detected at the SPEG focal plane were analyzed to obtain information on the ^{20}N level structure. Eγ, Iγ, $\gamma\gamma$-coin were measured using 74 BaF_2 crystals and four HPGe detectors.

Energy levels and J^π values were proposed from comparison with shell-model calculations.

See also (2008SoZT).

^{20}N Levels

E(level)	J^{π} †
0	(2⁻)
843 *4*	(3⁻)
944 *24*	
1336 *23*	(1⁻,2⁻)
1559 *30*	
1895 *34*	(3⁻)
2943 *32*	(4⁻)

† From comparison with shell-model calculations.

$\gamma(^{20}N)$

E_γ	I_γ	E_i(level)	J^π_i	E_f	J^π_f
615 *18*	37 *5*	1559		944	
843 *4*	100 *14*	843	(3⁻)	0	(2⁻)
944 *24*	36 *8*	944		0	(2⁻)
1052 *29*	25 *5*	1895	(3⁻)	843	(3⁻)
1336 *23*	16 *4*	1336	(1⁻,2⁻)	0	(2⁻)
2100 *26*	18 *5*	2943	(4⁻)	843	(3⁻)

$^{9}Be(^{36}S,^{20}N),^{12}C(x,^{20}N\gamma)$ 2008So09

Level Scheme

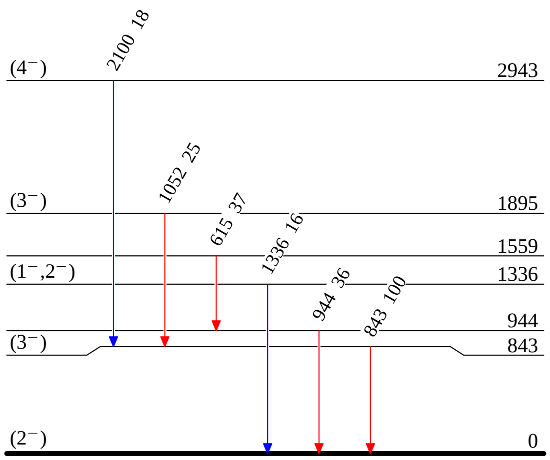
Intensities: Relative I_γ

Legend

$I_\gamma <\ \ 2\% \times I_\gamma^{max}$

$I_\gamma < 10\% \times I_\gamma^{max}$

$I_\gamma > 10\% \times I_\gamma^{max}$



$^{20}_{7}N_{13}$

^{9}Be(^{40}Ar,^{20}N) 2000Oz01,2007No13

2000Oz01: A beam of ^{40}Ar at E≈1 GeV/nucleon impinged on a Be target (4007 mg/cm^2) at the GSI SIS/FRS facility. The ^{20}N fragments of interest were identified using the Bρ settings along with scintillators to measured ΔE and time-of-flight (TOF). Fragmentation production cross sections were measured as σ_F=3.38×10^{-6} b *77*.

2007No13: Production of ^{20}N via projectile fragmentation was studied at the RIKEN Accelerator Research Facility using ^{40}Ar beams at E=90, 94 MeV/nucleon that impinged on either a 95 mg/cm^2 thick ^{9}Be target or a 17 mg/cm^2 thick ^{nat}Ta target. The beams were momentum analyzed using the RIPS doubly achromatic spectrometer before being identified using two surface-barrier silicon counters and a plastic scintillator to identify products via ΔE and time-of-flight (TOF) at the focal plane. The fragment momentum distribution and production cross sections were deduced. See also (2015Mo17) for transverse momentum (P_T) distribution and width (σ_T) analysis.

2012Kw02: Several light neutron-rich nuclides, produced by projectile fragmentation of an ^{40}Ar beam at E=140 MeV/nucleon, bombarded one of three targets, 668 mg/cm^2 ^{9}Be, 775 mg/cm^2 ^{nat}Ni, and 1086 mg/cm^2 ^{181}Ta at the National Superconducting Cyclotron Laboratory (NSCL). Fragments were momentum analyzed using the A1900 separator and identified at the final focus using time-of-flight and a telescope consisting of five Si ΔE detectors. The fragmentation cross sections, parallel momentum transfers, and parallel momentum distribution widths were measured and compared to the theoretical predictions.

^{20}N Levels

E(level)
0

^{9}Be(^{48}Ca,^{20}N) 1981St23

1981St23: Production yields for fragmentation of 213 GeV/nucleon ^{48}Ca projectiles on a berylium target were measured at the Bevalac using a 0° magnetic spectrometer. The neutron-rich fragments were focused on a stack of Lexan plastic track detectors; analysis of the tracks provided the range, charge and magnetic deflection of the produced isotopes. A charge resolution of 0.2 was obtained along with a mass resolution of approximately ≤0.2 u.

The analysis showed clear indications of ^{20}N. The cross section of roughly 19 μb was deduced.

^{20}N Levels

E(level)
0

C(^{20}N,X) 1998Bo02,1996Ch24

1998Bo02: A secondary beam of E(^{20}N)=950 MeV/nucleon ions, produced at the GSI/FRS, impinged on a carbon target. Interaction cross sections, σ_i, and charge-changing cross section, σ_{cc} were measured; r.m.s. matter radii, r_m and upper limits for r.m.s. proton radii, r_p^{max} were deduced. Evidence for the existence of a neutron skin in ^{20}N is presented.

σ_i=1121 mb *17*, σ_{cc}=774 mb *65*, r_m=2.77 fm *4*, r_p^{max}=2.39 fm *20*.

1996Ch24: A secondary ^{20}N beam, produced at the GSI Fragment Separator FRS, impinged on carbon targets with thickness 7.5 g/cm^2 and 3.7 g/cm^2. Interaction cross sections, σ_i were measured with accuracies of ≈1% and r.m.s. matter radii, r_m were deduced.

σ_i=1121 mb *17*; the values of r_m≈2.80 fm *4* were obtained with various model assumptions.

2001Oz03: A secondary beam of E(^{20}N)≈950 MeV/nucleon ions, produced at the GSI/FRS, impinged on a carbon target. Interaction cross sections, σ_i were measured and r.m.s. matter radii, r_m were deduced using Glauber-model, few-body system calculations (GMFB).

r_m=2.82 fm *5*.

See also (1995ChZV, 1997Ki22, 1999Kn04, 2000Ch20, 2001La06, 2001Oz04, 2002Me12, 2003Bh06, 2011Al11, 2017Ah08, 2018Fo17).

^{20}N Levels

E(level)
0

C(^{21}N,^{20}N) 2000Sa47,2004Sa14

2000Sa47,2004Sa14: Secondary E(^{21}N)=43 MeV/nucleon beams , produced from ^{40}Ar fragmentation at GANIL, impinged on a 170 mg/cm^2 C target. The beam energy spread was ΔE/E=1% (2% in 2000Sa47). The one-neutron removal cross sections and core fragment longitudinal and transverse momentum distributions were measured using the SPEG spectrometer.

σ_{-1n}=98 mb *13* was measured; this compares the value $\sigma_{-1n}^{Glauber}$=101 mb calculated using a Glauber model. The longitudinal momentum distribution width FWHM$_{pz}^{cm}$=162 MeV/c *4*, transverse momentum width FWHM$_{px}^{cm}$=217 MeV/c *16* (2004Sa14), and J$^\pi$=2$^-$ for the ground state were also deduced.

^{20}N Levels

E(level)	J$^\pi$
0	2$^-$

Si(^{20}N,X) 2006Kh08

2006Kh08: A ^{20}N secondary beam was produced by fragmentation of a 60.3 MeV/nucleon ^{48}Ca beam using the GANIL/SISSI beam facility. The beams were analyzed using the α spectrometer and delivered to the SPEG focal plane, where they impinged on a telescope stack of 4 cooled (−10°C) silicon detectors that were surrounded by a 4π array of 14 NaI γ-detectors. The energy dependent cross sections and the mean radius were measured.

σ(37.71 MeV/nucleon)=2.02 b *10*.

σ(43.15 MeV/nucleon)=2.142 b *19*.

r_0^2(mean radius)=1.247 fm^2 *11*.

See earlier work in (1991Vi04).

^{20}N Levels

E(level)
0

^{20}C β^- decay 2003Yo02

Parent: ^{20}C: E=0; $J^\pi=0^+$; $T_{1/2}$=16.3 ms *+40−35*; $Q(\beta^-)=1574\times10^1$ *24*; %β^- decay=100.0

^{20}C-$T_{1/2}$: weighted average of (1989Le16,1990Mu06,2003Yo02 and P.L. Reeder et al., Int. Conf. on Nucl. Data for Science and Technology, May 9-13, 1994, Gatlinburg, Tennessee).

^{20}C-Q(β^-) from (2017Wa10).

2003Yo02: ^{20}C ions were produced at the RIKEN/RIPS facility and implanted in a plastic scintillator detector. An array of 13 liquid scintillator detectors surrounded the implantation target. Following implantation, β and β+n coincidence counting were carried out for 100 MS (to permit decay of daughter & grandaughter activity). Standard pulse shape analysis was used to identify high-energy neutrons, while for 50 keV≤E_{eq}≤200 keV the time of flight information was used to separate neutrons and γ rays. Analysis of the 1n- and 2n- coincidence events yielded values of P_{1n}= 65 *+19−18* and P_{2n}<18.6 which implies %β-0n≈35 *20*. No details on the neutron emission energies was determined. $T_{1/2}$(^{20}C)=21.8 ms *+150−74* was also measured.

See also (1989LeZM,1989MuZU,1990LeZR).

^{20}N Levels

E(level)	J^π	$T_{1/2}$	Comments
0	(2$^-$)	134.4 ms *37*	
0+x			x>2157.32 keV.

β^- radiations

E(decay)	E(level)	Iβ^-†	Log *ft*
(8×10^3‡ *8*)	0+x	65 *20*	
(1.574×10^4 *24*)	0	35 *20*	4.8 *4*

† Absolute intensity per 100 decays.
‡ Estimated for a range of levels.

^{21}N(p,pn) 2018Di01

2018Di01: An E(^{21}N)=417 MeV/nucleon secondary beam, from the FRS (FRagment Separator) at GSI facility, impinged on either a 922 mg/cm^2 CH_2 or a 935 mg/cm^2 C target located at the R^{3}B-LAND setup. The 4π Crystal Ball array surrounded the targets and was used to measure γ-rays, while the ALADIN dipole magnet was used to deflect different mass and charge reaction products. Neutrons were momentum analyzed using the LAND, a Large Area Neutron Detector array, whilst the heavy fragments were tracked by two scintillators and a position sensitive time-of-flight wall; recoil protons were analyzed using two position sensitive drift chambers and a time-of-flight wall.

The ^{21}N 1n-removal cross section σ_{raw}=7.55 mb *61* was measured along with the transverse momentum distribution P_T(r.m.s.)=102 MeV/c *8*. Level energies, J$^\pi$ and spectroscopic factors C^{2}S were also deduced based on shell-model calculations.

See also (2018Go21).

^{20}N Levels

E(level)†	J$^\pi$†	C^{2}S†
0	2$^-$	1.97
600	0$^-$	0.16
900	3$^-$	2.98
1100	1$^-$	0.49

† From shell model calculations and comparison with the momentum distributions.

Ni(^{40}Ar,^{20}N) 2012Kw02

2012Kw02: Several light neutron-rich nuclides, produced by projectile fragmentation of an ^{40}Ar beam at E=140 MeV/nucleon, bombarded one of three targets, 668 mg/cm^2 ^{9}Be, 775 mg/cm^2 ^{nat}Ni, and 1086 mg/cm^2 ^{181}Ta at the National Superconducting Cyclotron Laboratory (NSCL). Fragments were momentum analyzed using the A1900 separator and identified at the final focus using time-of-flight and a telescope consisting of five Si ΔE detectors. The fragmentation cross sections, parallel momentum transfers, and parallel momentum distribution widths were measured and compared to the theoretical predictions.

^{20}N Levels

E(level)
0

^{48}Ca(^{18}O,^{20}N) 1989Or03

1989Or03: Beams of E(^{18}O)≈115 MeV, provided by the ANU tandem accelerator, bombarded 97% enriched ^{48}Ca targets (85 μg/cm^2 or 60 μg/cm^2) deposited on carbon backings. The reaction products were momentum analyzed by an Enge split-pole spectrometer and detected by a gas-filled multi-element focal plane detector. The spectrometer data was analyzed using a variety of different techniques, including tme-of-flight through the spectrometer.

The mass excess ΔM=22.63 MeV *6*, deduced from the measured Q-value Q=−25.87 MeV *2*, is in disagreement with other reported values.

^{20}N Levels

E(level)
0

^{181}Ta(^{40}Ar,^{20}N) 1986Gi10,1987Gi05

1986Gi10: The authors measured the masses of several nuclides, produced in the fragmentation of 44 MeV/nucleon ^{40}Ar ions on a 160 mg/cm^2 ^{nat}Ta target at GANIL, by measuring their time-of-flight over a 116 meter flight path that allowed them to achieve an accuracy down to a few 10^{-5}. The nuclides were detected and identified in the SPEG spectrometer focal plane.

The ^{20}N mass excess ΔM=22.20 MeV *36* was deduced.

1987Gi05: The authors measured the masses of several nuclides, produced in the fragmentation of 60 MeV/nucleon ^{40}Ar ions on a 350 mg/cm^2 ^{nat}Ta target at GANIL, by measuring their time-of-flight over a roughly 80 meter flight path. The nuclides were detected and identified in the SPEG spectrometer focal plane. A mass resolution near 5×10^{-4} was achieved.

The ^{20}N mass excess ΔM=21.62 MeV *14* was deduced.

2012Kw02: Several light neutron-rich nuclides, produced by projectile fragmentation of an ^{40}Ar beam at E=140 MeV/nucleon, bombarded one of three targets, 668 mg/cm^2 ^{9}Be, 775 mg/cm^2 ^{nat}Ni, and 1086 mg/cm^2 ^{181}Ta at the National Superconducting Cyclotron Laboratory (NSCL). Fragments were momentum analyzed using the A1900 separator and identified at the final focus using time-of-flight and a telescope consisting of five Si ΔE detectors. The fragmentation cross sections, parallel momentum transfers, and parallel momentum distribution widths were measured and compared to the theoretical predictions.

^{20}N Levels

E(level)
0

^{181}Ta(^{48}Ca,^{20}N) 1991Or01

1991Or01: The masses of 39 nuclides were measured using driect time-of-flight and ΔE-E techniques by bombarding a 330 mg/cm^2 thick tantalum target with a beam of E(^{48}Ca)=55 MeV/nucleon ions produced by the GANIL cyclotrons. The nuclides were detected and identified in the SPEG spectrometer with a mass resolution of 3×10^{-4}.

The ^{20}N mass excess ΔM=21.79 MeV *7* was deduced.

^{20}N Levels

E(level)
0

^{181}Ta(^{86}Kr,^{20}N) 1988Mu08

1988Mu08: ^{20}N ions from the fragmentation of a 45 MeV/nucleon ^{48}Ca beam on a ^{181}Ta target at GANIL were filtered by the LISE spectrometer and implanted in a Si telescope. The telescope was surrounded by a thin scintillator to detect β-rays and a segmented NE102A 4π neutron array with an energy threshold of 350 keV. Following implantation of ^{20}N in the telescope the cyclotron frequecy was scrambled and the decay event was measured.

A β-delayed neutron emission probability of P_n=53% *+11−7* was deduced. $T_{1/2}$=100 ms *+30−20* was also measured. See also (1987BaZI,1988BaYZ,1988MuZY).

^{20}N Levels

E(level)
0

^{208}Pb(^{20}N,^{20}Nγ):coulex 2016Ro13

2016Ro13: The Coulomb dissociation cross section of ^{20}N was studied at the GSI LAND/R3B facility using a secondary beam produced by fragmenting an 490 MeV/nucleon ^{40}Ar beam. The ^{20}N beam impinged on a 0.176 mm *4* thick natural lead target for the Coulomb Excitation measurements, while measurements on a 5.08 mm thick carbon target were used to estimate the nuclear breakup contributions. Reaction γ-rays were detected using the 162 NaI Crystal Ball array; neutrons from Coulomb breakup reactions were detected in the LAND neutron wall array, and the core ejectiles were deflected in the ALADIN magnet and detected and identified in a two-dimension position sensitive plastic scintillator ΔE wall.

The ^{20}N excitation energies were determined via the invariant mass method by analyzing the momenta of the neutron and ^{19}N residual and then adding the γ-ray energy. The excitation spectrum, based on the dissociation reactions, begins around the neutron breakup threshold (≈1.8 MeV) and then shows several structures between E_x=5 to 14 MeV, that are associated with excited states. Additional structures are observed above E_x≈14 MeV, but they may be consistent with background. Coincidences with the decay γ rays from the ^{19}N*(1141 keV) first excited state were also analyzed. The experimental resolution is not discussed.

^{20}N Levels

E(level)†
0
3500?‡
4600?
5500‡
7000‡
9000‡
10200
11500

† From Coulomb dissociation to $^{19}N_{g.s.}$

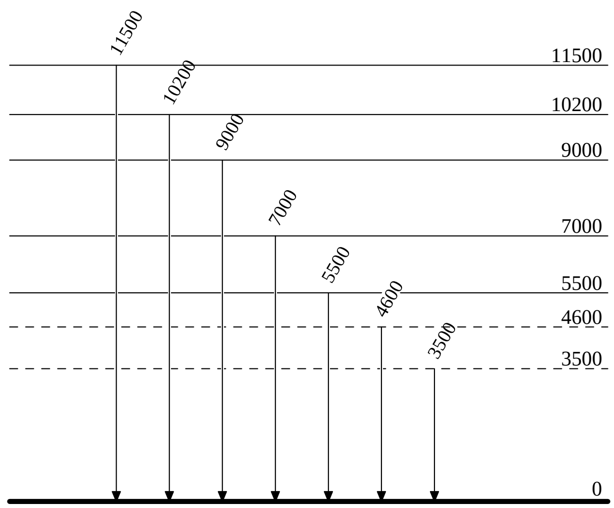
‡ Also observed in decays to ^{19}N*(1141 keV).

γ(^{20}N)

E_γ	E_i(level)	E_f
3500	3500?	0
4600	4600?	0
5500	5500	0
7000	7000	0
9000	9000	0
10200	10200	0
11500	11500	0

$^{208}Pb(^{20}N,^{20}N\gamma)$:coulex 2016Ro13

Level Scheme



$^{20}_{7}N_{13}$

^{208}Pb(^{21}N,^{20}Nγ) 2016Ro13

2016Ro13: The Coulomb dissociation of ^{21}N was studied at the GSI LAND/R3B facility using a secondary beam produced by fragmenting an 490 MeV/nucleon ^{40}Ar beam. The ^{21}N beam impinged on a 0.176 mm *4* thick natural lead target for the Coulomb Excitation measurements, while measurements on a 5.08 mm thick carbon target were used to estimate the nuclear breakup contributions. Reaction γ-rays were detected using the 162 NaI Crystal Ball array; neutrons from Coulomb breakup reactions were detected in the LAND neutron wall array, and the core ejectiles were deflected in the ALADIN magnet and detected and identified in a two-dimension position sensitive plastic scintillator ΔE wall.

Analysis of the γ-ray data from the Crystal Ball indicated the ^{21}N levels populated in the Coulomb excitation reactions neutron decay to ^{20}N*(0,850,1300) states. The γ-ray spectrum measured in coincidence with n+^{20}N shows a dominant peak with $E_\gamma \approx 850$ keV and a much smaller peak around $E_\gamma \approx 1300$ keV. The authors attribute most of the cross section to the 850 keV level, and they did not attempt to deconvolute the two observed peaks.

The Coulomb dissociation cross section of ^{21}N integrated over 0-20 MeV excitation energy for the total reaction was measured as σ(^{21}N,total)=75 mb *4*; σ(^{21}N,^{20}N$_{g.s.}$)= 31 mb *16*; σ(^{21}N,^{20}N*(850+1300 keV))=47 mb *8*; this requires a new math. The quoted uncertainties are statistical only since the systematic uncertainties from the identification of the incoming particles, from the single neutron detection efficiency of LAND, from the Crystal Ball efficiency and from the measurement of the areal density of the target were negligible compared to the statistical uncertainty.

^{20}N Levels

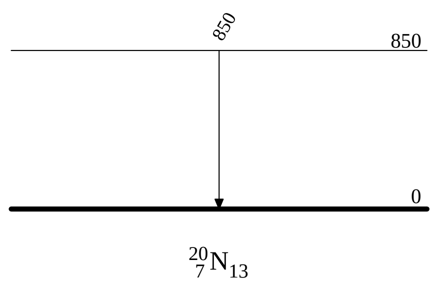
E(level)	Comments
0	
850	E(level): The authors stated that due to the limited resolution of the gamma calorimeter, the first and the second excited states could not be separated.
1300	E(level): The authors attribute most of the cross section to the 850-level, and they did not attempt to deconvolute the two observed peaks.

γ(^{20}N)

E_γ	E_i(level)	E_f
850	850	0

^{208}Pb(^{21}N,^{20}Nγ) 2016Ro13

Level Scheme



^{232}Th(p,^{20}N) 1988Wo09

1986Vi09,1988Wo09: Mass measurements of several neutron-rich light nuclei were carried out using an improved fitting technique for deducing nuclear mass values from measurements of time-of-flight (ToF) through the LANL/TOFI spectrometer; the ToF through the spectrometer depends on the mass-to-charge ratio and is independent of ion velocity.

The rare isotope species were produced by proton spallation reactions on a Th target. Typical flight times of 500 ns, with timing uncertainties near 180 ps yielded typical mass-to-charge resolutions of 3.6×10^{-4} from analysis of multiple runs that involved multiple charge states.

A ^{20}N mass excess of 21.78 MeV *12* was deduced in (1988Wo09), which compares with 21.64 MeV *26* which was previously deduced in (1986Vi09).

See also (1988ViZP,1993WoZZ).

^{20}N Levels

E(level)
0

^{232}Th(^{18}O,^{20}N) 1969Ar13

1969Ar13: The ^{20}N nucleus was first identified in the transfer reaction products resulting from E(^{18}O)=122 MeV bombardment of a 5 mg/cm^2 metalic ^{232}Th foil at Dubna. The reaction products were momentum analyzed in a magnetic spectrometer and then focused on a ΔE-E Si detector telescope, which provided particle identification.

See also (1970ArZY,2012Th01).

^{20}N Levels

E(level)
0

^{232}Th(^{22}Ne,^{20}N) 1977Ar06

1977Ar06: The transfer reaction products resulting from E(^{22}Ne)=172 MeV bombardment of a 2.5 mg/cm^2 metalic ^{232}Th foil were measured at Dubna. The reaction products were momentum analyzed in a magnetic spectrometer positioned at θ=12° and 40° and then focused on a ΔE-E Si detector telescope, which provided particle identification.

^{20}N Levels

E(level)
0

U(p,^{20}N) **1970Bu22,1986Pi09**

1970Bu22: The particle stability of ^{20}N was confirmed at the Bevatron by analysis of the spallation products emitted in the 5.5 GeV proton bombardment of a $^{nat.}$U target. The reaction products were detected using a set of Si detectors that were placed at θ=90° with respect to the incident beam. Two detectors, which provided ΔE and E signals were located at distances of 14.5 cm and 25.7 cm from the target. Particle identification was unambiguously determined by evaluating ΔE, E and the time-of-flight between the detectors.

1986Pi09: Spallation products from 800 MeV proton bombardment of a uranium target at LAMPF were detected using a series of detectors that provided ΔE, E and time-of-flight information. The products were analyzed to obtain A and Z identification, and mass excesses were deduced for a few carbon, nitrogen, oxygen, florine and neon isotopes.

The ^{20}N mass excess ΔM=21.9 MeV *57* was obtained.

^{20}N Levels

E(level)
0

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