

$^{60}\text{Ni}(\text{p,p}),(\text{p,p}')$:resonances [1989Ti01,1976FIZY,1970Br33](#)

Type	Author	History	Citation	Literature Cutoff Date
Full Evaluation	Kazimierz Zuber, Balraj Singh		NDS 125, 1 (2015)	25-Jan-2015

[1970Br33](#): E(p)=1.8-3.0 MeV. Measured $\sigma(E,\theta)$, $\theta=90^\circ, 120^\circ, 135^\circ, 160^\circ$, semi, enriched target, FWHM=0.3-0.45 $\Delta E(\text{p})=2$, $\Delta\Gamma(\text{p})\approx 10\%$ for $\Gamma(\text{p})>100$ and $\approx 50\%$ for $\Gamma(\text{p})=10-20$.

[1976FIZY](#): E(p)=2.95-3.45 MeV. Measured $\sigma(E,\theta)$, $\theta=90^\circ, 105^\circ, 122^\circ, 160^\circ$, semi, enriched target, FWHM=0.3, $\Delta E(\text{p})=2$.

[1976Ar01](#): E(p)=2.94-4.02 MeV. Measured $\sigma(E,\theta)$, $\theta=90^\circ, 120^\circ, 135^\circ, 160^\circ$, semi, enriched target, FWHM=0.4, $\Delta E(\text{p})=3$.

[1957Bu64](#): E=0.7-1.8 MeV; 54 proton resonances from 725 to 1793 keV. Measured yields, primary and secondary $E\gamma, I\gamma$.

For possible analogs at E(p) \approx 5.76, 5.88, and 5.96 MeV, see [1979EI06](#).

For possible analogs at E(p) \approx 4.67, 5.08, 5.33, and 5.44 MeV, see [1969Gu07](#).

 ^{61}Cu Levels

S_0 values are given as $[2J(\text{res})+1]\Gamma(\text{p})\Gamma(\gamma_0)/\Gamma$ in meV ([1989Ti01](#)).

E(level) [†]	Comments
5849.9 [‡] 9	$S_0=4.9$ 19.
5860.6 [‡] 10	E(level): evaluators assume 5860.6, but it could be 5906.6 as well. A 5960.6 10 level in table 4 of 1989Ti01 seems a misprint. In 1999-NDS (1999Bh04), Ep(lab) deduced from this value was listed at 1108.2, which also seems a misprint. $S_0=6.7$ 19.
5917.0 [‡] 10	$S_0=8$ 2.
5960.2 [‡] 7	$S_0=2.6$ 7.
5972.4 [‡] 12	$S_0=4.5$ 14.
5987.2 [‡] 6	$S_0=32$ 5.
6026.6 [‡] 7	$S_0=44$ 6.
6098.4 [‡] 10	$S_0=140$ 20.
6124.1 [‡] 6	$S_0=180$ 30.
6150.4 [‡] 10	$S_0=22$ 8.
6193.0 [‡] 11	$S_0=25$ 9.
6210 [‡] 3	$S_0=22$ 9.
6227.1 [‡] 6	$S_0=400$ 50.
6293.4 [‡] 8	$S_0=83$ 16.
6313.6 [‡] 8	$S_0=160$ 20.
6352.2 [‡] 8	$S_0=110$ 20.
6362.7 [‡] 8	$S_0=99$ 1.
6374.0 [‡] 6	$S_0=390$ 50.
6379.9 [‡] 6	$S_0=450$ 50.
6394.3 [‡] 6	$S_0=530$ 60.
6418.3 [‡] 6	$S_0=480$ 60.
6431.0 [‡] 6	$S_0=540$ 60.
6442.7 [‡] 7	$S_0=150$ 30.
6467.1 [‡] 8	$S_0=260$ 40.
6486.4 [‡] 13	$S_0=51$ 13.
6509.1 [‡] 7	$S_0=140$ 20.
6541.3 [‡] 8	$S_0=430$ 50.
6566.7 [‡] 10	$S_0=65$ 16.

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${}^{60}\text{Ni}(\text{p,p}),(\text{p,p}')\text{:resonances}$ [1989Ti01](#),[1976FIZY](#),[1970Br33](#) (continued)

				${}^{61}\text{Cu}$ Levels (continued)	
E(level) [†]	$J^{\pi a}$	E(p)(Lab) keV	$\Gamma(\text{P})$ eV ^c	Comments	
6584.6 22	1/2 ⁺	1814	25		
6590.7 [‡] 15				S ₀ =100 20.	
6606.4 [‡] 7				S ₀ =93 18.	
6620.3 [‡] 6				S ₀ =580 70.	
6625.9 22	1/2 ⁻	1856	25		
6629.8 [‡] 8				S ₀ =65 14.	
6644.5 [‡] 8	1/2 ⁻			S ₀ =170 30.	
6678.0 22	(1/2 ⁻)	1909	5		
6681.2 [‡] 6				S ₀ =280 40.	
6693.8 22	1/2 ⁺	1925	20		
6699.0 [‡] 7				S ₀ =370 50.	
6713.8 [‡] 8				S ₀ =89 15.	
6725.7 [‡] 8				S ₀ =72 13.	
6744.7 [‡] 6				S ₀ =350 40.	
6762.7 [‡] 6				S ₀ =210 30.	
6784.6 [‡] 14				S ₀ =69 14.	
6802.9? 22	1/2 ⁺	2036	15	May be the same as E(p)=2038.	
6804.0 [‡] 8				S ₀ =115 18.	
6815.0 [‡] 7				S ₀ =160 20.	
6847.8 [‡] 9				S ₀ =150 20.	
6868.4 [‡] 6				S ₀ =490 50.	
6889.5 [‡] 7				S ₀ =200 30.	
6912.5 [‡] 8				S ₀ =260 30.	
6940.3 [‡] 7				S ₀ =280 30.	
6953.4 22	1/2 ⁺	2189	90		
6972.0 [‡] 8				S ₀ =480 50.	
6991.8 22	1/2 ⁺	2228	25	Probable misprint in 1970Br33 .	
6997.3 [‡] 6				S ₀ =540 60.	
7014.1 [‡] 7				S ₀ =180 20.	
7028.5 [‡] 7				S ₀ =140 20.	
7039.0 22	1/2 ⁺	2276	60		
7043.2 [‡] 5				S ₀ =1040 10.	
7054.7 22	1/2 ⁺	2292	45		
7060.3 [‡] 6				S ₀ =650 70.	
7084.2 22	(1/2 ⁻ , 3/2 ⁻)	2322	5		
7090.5 [‡] 8				S ₀ =200 30.	
7107.8 22	(1/2 ⁺)	2346	5		
7113.7 22	(3/2 ⁻ , 1/2 ⁻)	2352	5		
7197.3 22	1/2 ⁺	2437	60		
7223.8 22	1/2 ⁺	2464	25		
7241.6 22	(1/2 ⁻ , 3/2 ⁻)	2482	5		
7263.2 22	1/2 ⁺	2504	145 15		
7274.0 22	(3/2 ⁻ , 1/2 ⁻)	2515	5		
7283.8 22	1/2 ⁺	2525	20		
7316.3 22	1/2 ⁺	2558	90		
7329.1 22	(1/2 ⁻ , 3/2 ⁻)	2571	15		
7378.3 22	5/2 ⁺	2621	25		
7414.6 22	(1/2 ⁻ , 3/2 ⁻)	2658	10		
7430.4 22	1/2 ⁺	2674	10		

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${}^{60}\text{Ni}(\text{p,p}),(\text{p,p}')$:resonances 1989Ti01,1976FIZY,1970Br33 (continued) ${}^{61}\text{Cu}$ Levels (continued)

E(level) [†]	$J^{\pi\alpha}$	$T_{1/2}$	E(p)(Lab) keV	$\Gamma(\text{P})$ eV ^c
7438.2 22	1/2 ⁺		2682	75
7474.6 22	1/2 ⁻		2719	40
7485.5 22	1/2 ⁻		2730	15
7489.4 22	1/2 ⁻		2734	30
7497.3 22	1/2 ⁻		2742	15
7510.0 22	1/2 ⁺		2755	10
7519.9 22	(3/2 ⁻ ,1/2 ⁻)		2765	5
7525.8 22	(3/2 ⁺ ,5/2 ⁺)		2771	5
7541.5 22	1/2 ⁻		2787	35
7549.4 22	1/2 ⁺		2795	55
7554.3 22	1/2 ⁻		2800	25
7556.3 22	1/2 ⁻		2802	10
7560.2 22	1/2 ⁺		2806	110 11
7569.0 22	(5/2 ⁺ ,3/2 ⁺)		2815	5
7578.9 22	1/2 ⁻		2825	165 17
7581.8 22	1/2 ⁻		2828	25
7583.8 22	1/2 ⁻		2830	115 12
7588.7 22	1/2 ⁻		2835	25
7608.4 22	(3/2 ⁻ ,1/2 ⁻)		2855	10
7631.0 22	(5/2 ⁺ ,3/2 ⁺)		2878	10
7636.9 22	1/2 ⁺		2884	160 16
7638.9 22	(5/2 ⁺)		2886	20
7647.7 22	1/2 ⁺		2895	70
7657.6 22	(3/2 ⁻ ,1/2 ⁻)		2905	15
7662.5 22	(5/2 ⁺ ,3/2 ⁺)		2910	5
7672.3 22	(5/2 ⁺ ,3/2 ⁺)		2920	5
7681.2 22	1/2 ⁺		2929	45
7702.1	3/2 ⁺		2950.3	55 8
7702.7	(5/2 ⁺)		2950.9	12 6
7705.3	(1/2 ⁻)		2953.5	45 15
7722.5	(3/2 ⁺)		2971.0	65 10
7728.7	(1/2 ⁻)		2977.3	45 15
7743.9	1/2 ⁺		2992.8	250 30
7746.0	(5/2 ⁺)		2994.9	11 5
7762.0	(5/2 ⁺)		3011.2	23 7
7767.4	1/2 ⁺		3016.7	400 35
7781.9	(3/2 ⁻)		3031.4	15 5
7785.1	(5/2 ⁺)		3034.7	28 8
7805.8	3/2 ⁺		3055.7	56 15
7806.7	1/2 ⁺		3056.7	115 10
7837.5	(3/2 ⁺)		3088.0	35 10
7842.6	1/2 ⁺		3093.2	110 10
7848.7	3/2 ⁺		3099.4	80 10
7849.5	(1/2 ⁻)	40 eV 10	3100.2	50 10
7855.0	3/2 ⁻		3105.8	55 8
7886.2	(1/2 ⁻)		3137.5	50 10
7894.1	(1/2 ⁻)		3145.5	45 8
7896.4	1/2 ⁺		3147.9	180 20
7919.2	1/2 ⁺		3171.0	20 8
7921.1	1/2 ⁻	0.25 keV 5	3173.0	340 35
7931.2	(5/2 ⁺)		3183.2	12 6
7943.6	1/2 ⁺		3195.9	270 20
7946.9	3/2 ⁺		3199.2	45 6
7950.9	1/2 ⁻	35 eV 7	3203.3	60 8
7962.4	1/2 ⁺		3215.0	350 30
7970.2	1/2 ⁺		3222.9	22 10

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$^{60}\text{Ni}(\text{p,p}),(\text{p,p}')$:resonances 1989Ti01,1976FIZY,1970Br33 (continued) ^{61}Cu Levels (continued)

E(level) [†]	$J^{\pi a}$	E(p)(Lab) keV	$\Gamma(\text{P})$ eV ^c	Comments
7971.9	3/2 ⁻	3224.6	20 8	
7987.5	1/2 ⁺	3240.5	175 20	
7996.9	1/2 ⁺	3250.1	95 10	
8006.1	3/2 ⁻	3259.4	45 8	
8015.3	3/2 ⁺	3268.8	115 10	$\Gamma(\text{p}')=16$ eV 5.
8016.3	1/2 ⁻	3269.8	50 8	
8019.8	1/2 ⁻	3273.3	50 8	
8023.3	5/2 ⁺	3276.9	60 8	$\Gamma(\text{p}')=7$ eV 3.
8028.3	(5/2 ⁺)	3282.0	15 4	
8031.6	(5/2 ⁺)	3285.3	20 8	
8043.1	(5/2 ⁺)	3297.0	17 8	
8054.8	(1/2 ⁻)	3308.9	25 20	
8057.3	1/2 ⁺	3311.5	450 40	
8067.9	(5/2 ⁺)	3322.2	25 6	
8075.4	3/2 ⁻	3329.9	50 8	
8076.3	1/2 ⁺	3330.8	40 5	
8086.6	1/2 ⁺	3341.3	280 28	
8090.2	5/2 ⁺	3344.9	6 4	
8096.8	3/2 ⁻	3351.6	50 5	
8101.8	1/2 ⁺	3356.7	25 4	
8103.1	(1/2 ⁻)	3358.0	30 10	
8108.6	1/2 ⁺	3363.6	15 5	
8113.1	5/2 ⁺	3368.2	15 4	$\Gamma(\text{p}')=5$ eV 1.
8118.5	1/2 ⁻	3373.7	70 12	
8120.7	(5/2 ⁺)	3375.9	20 6	
8121.7	1/2 ⁺	3377.0	550 50	
8122.5	3/2 ⁻	3377.8	65 8	
8127.7	(5/2 ⁺)	3383.1	30 7	
8130.9	1/2 ⁺	3386.3	65 6	
8139.5	(1/2 ⁻)	3395.0	80 30	
8139.5	(5/2 ⁺)	3395.0	17 5	
8148.9	1/2 ⁺	3404.6	145 15	
8151.5	(5/2 ⁺)	3407.2	15 5	
8156.1	5/2 ⁺	3411.9	60 6	$\Gamma(\text{p}')=2$ eV 1.
8162.0	5/2 ⁺	3417.9	75 8	$\Gamma(\text{p}')=6$ eV 2.
8164.9	(1/2 ⁻)	3420.9	35 10	
8167.8	5/2 ⁺	3423.8	100 10	$\Gamma(\text{p}')=7$ eV 2.
8168.7	(1/2 ⁻)	3424.7	35 10	
8170.0	1/2 ⁻	3426.1	110 12	
8171.2	5/2 ⁺	3427.3	25 5	$\Gamma(\text{p}')=7$ eV 2.
8173.6	1/2 ⁺	3429.7	165 15	
8175.3	1/2 ⁺	3431.4	500 45	
8177.9	3/2 ⁻	3434.1	55 6	$\Gamma(\text{p}')=6$ eV 2.
8181.2	1/2 ⁻	3437.5	90 10	
8187.5	(5/2 ⁺)	3443.9	35 6	
8194.3	(5/2 ⁺)	3450.8	10 5	
8222.4	1/2 ⁻	3479.3	40 10	
8250.3	1/2 ⁻	3507.7	40 10	
8272.4	1/2 ⁻	3530.2	40 10	
8290.1	3/2 ⁻	3548.2	20 10	
8307.6	1/2 ⁻	3566.0	40 10	
8361.0	1/2 ⁻	3620.3	60 12	
8364.6	1/2 ⁻	3623.9	40 10	
8415.3	1/2 ⁻	3675.5	109 11	
8426.8	1/2 ⁻	3687.2	56 8	
8448.3	3/2 ⁻	3709.0	80 16	

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${}^{60}\text{Ni}(\text{p,p}),(\text{p,p}')$:resonances **1989Ti01,1976FIZY,1970Br33** (continued) ${}^{61}\text{Cu}$ Levels (continued)

E(level) [†]	$J^{\pi a}$	E(p)(Lab) keV	$\Gamma(\text{P})$ eV ^c	Comments
8449.2 ^{#@}	9/2 ^{+b}	3710.0	2	$\Gamma(\text{p}')=0.8$ eV (1990Sz01).
8453.6 ^{#@}	9/2 ^{+b}	3714.4	3.9	$\Gamma(\text{p}')=3.7$ eV (1990Sz01).
8456.1	3/2 ⁻	3717.0	60 12	
8456.5 ^{#@}	9/2 ^{+b}	3717.4	2.0	$\Gamma(\text{p}')=1.1$ eV.
8460.1 ^{#@}	9/2 ^{+b}	3721.0	2.1	$\Gamma(\text{p}')=0.9$ eV (1990Sz01).
8466.6 ^{#@}	9/2 ^{+b}	3727.6	14.9	$\Gamma(\text{p}')=10.1$ eV (1990Sz01).
8467.8 ^{#@}	9/2 ^{+b}	3728.9	9.5	$\Gamma(\text{p}')=10.6$ eV (1990Sz01).
8468.7	1/2 ⁻	3729.8	155 6	
8475.5 ^{#@}	9/2 ^{+b}	3736.7	11.9	$\Gamma(\text{p}')=2.7$ eV (1990Sz01).
8477.6 ^{#@}	9/2 ^{+b}	3738.8	5.2	$\Gamma(\text{p}')=0.1$ eV (1990Sz01).
8477.9	1/2 ⁻	3739.1	1222 54	
8480.3 ^{#@}	9/2 ^{+b}	3741.6	14.0	$\Gamma(\text{p}')=2.8$ eV (1990Sz01).
8483.1 ^{#@}	9/2 ^{+b}	3744.4	2.5	$\Gamma(\text{p}')=3.4$ eV (1990Sz01).
8487.1 ^{#@}	9/2 ^{+b}	3748.5	6.1	$\Gamma(\text{p}')=4.3$ eV (1990Sz01).
8488.0	1/2 ⁻	3749.4	536 36	
8497.8	3/2 ⁻	3759.4	110 7	
8591.0	3/2 ⁻	3854.1	19 4	
8631.1	3/2 ⁻	3894.9	80 16	
8692.5	1/2 ⁻	3957.3	70 14	
8731.6	1/2 ⁻	3997.1	40 10	
8734.3	1/2 ⁻	3999.9	160 32	
8742.7	1/2 ⁻	4008.4	60 12	
10671.9 ^{&}	1/2 ^{+&}	5970	1750	

[†] From $E=S(\text{p})+E(\text{p})$, where $S(\text{p})=4800.3$ 10 (2012Wa38) and $E(\text{p})$ is proton energy in the c.m. system. values of $E(\text{p})$ are from 1970Br33 ($E(\text{p})=1814-2929$), 1976FIZY ($E(\text{p})=2950.3-3450.8$), and 1976Ar01 ($E(\text{p})=3479.3-4008.4$), respectively. Additional 56 s-wave and 76 d-wave resonances in the energy range of 2.94-4.02 MeV are observed in 1976Ar01 but not listed. Values in 1970Br33 are systematically $\approx 2-3$ keV lower than in 1976FIZY.

[‡] From 1989Ti01.

[#] From 1990Sz01.

[@] 1g_{7/2} isobaric analog resonance fragments corresponding to 9/2⁺ 2122-keV excited state in ${}^{61}\text{Ni}$.

[&] From 1985AnZV.

^a From $\sigma(E,\theta)$ and resonance analysis, except as noted.

^b From analog resonance analysis (1990Sz01).

^c Values of 1976FIZY are almost an order of magnitude higher than those of 1970Br33. Values are not given here.