## $^{64}$Ni(p,$\gamma$) E=res 1979Er10

| Type | Author | History Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Jun Chen | NDS 202,59 (2025) | 25-Feb-2025 |

1979Er10: E=2.05-2.55 MeV proton beams were produced from the 3-MV Pelletron Tandem Accelerator at the University of Lund. Target was 100 $\mu$g/cm$^2$ $^{64}$Ni on a Ta backing. $\gamma$ rays were detected with a Ge(Li) detector, with high-energy $\gamma$ rays analyzed with a three-crystal pair spectrometer consisting of the Ge(Li) detector and two NaI side detectors. Measured E$\gamma$, I$\gamma$, average resonance $\gamma$-ray spectra. Deduced levels, J, $\pi$ from analysis with calculations using Hauser-Feshbach model for average $\gamma$-ray strength function.

1978Kr09: E(p)=3.1-3.3 keV (E(res)=3219). Measured E$\gamma$, I$\gamma$, $\Gamma_\gamma$. Ge(Li) detector.

1973Ho42: E(p)=1.00-1.85 MeV. Measured E$\gamma$, I$\gamma$, $\gamma(\theta)$.

Others: 2013Si11, 2001Fe06, 2000Ra35, 1988PaZN, 1988PaZM, 1980Ne10, 1983Ne03.

### $^{65}$Cu Levels

| E(level)[†] | J$^\pi$[‡] | Comments |
|---|---|---|
| 0 | 3/2$^-$ | |
| 770.6 *2* | 1/2$^-$ | |
| 1115.5 *2* | 5/2$^-$ | |
| 1481.8 *2* | 7/2$^-$ | |
| 1623.3 *2* | 5/2$^-$ | |
| 1725.0 *2* | 3/2$^-$ | |
| 2094.3 *2* | 7/2$^-$ | J$^\pi$: (7/2$^-$) from Hauser-Feshbach (H-F) analysis of $\gamma$-ray strength (1979Er10). |
| 2107.4 *2* | (5/2)$^-$ | J$^\pi$: (5/2$^-$) from H-F analysis (1979Er10). |
| 2212.8 *2* | (1/2)$^-$ | J$^\pi$: (1/2$^-$) from H-F analysis (1979Er10). |
| 2282.6 *4* | 7/2$^-$ | J$^\pi$: (7/2$^-$) from H-F analysis (1979Er10). |
| 2329.0 *2* | 3/2$^-$ | J$^\pi$: (3/2,5/2) from $\gamma(\theta)$ (1973Ho42). |
| 2533.0 *2* | (1/2,3/2,5/2$^-$) | |
| 2533.8 *3* | 9/2$^+$ | |
| 2594 *2* | (5/2$^-$) | J$^\pi$: (1/2$^-$,5/2$^-$) from H-F analysis (1979Er10). |
| 2649.6 *2* | (5/2$^-$) | E(level): possible doublet (1979Er10). |
| 2656[#] *3* | 5/2$^-$ | |
| 2753 *3* | (5/2$^-$,7/2$^-$) | J$^\pi$: (7/2$^+$,9/2$^+$) from H-F analysis (1979Er10). |
| 2839 *3* | (7/2$^+$) | J$^\pi$: (7/2$^+$,9/2$^+$) from H-F analysis (1979Er10). |
| 2862.7? *2* | (1/2$^-$) | |
| 2866.8 *2* | (5/2$^-$,7/2$^-$) | |
| 2874.4 *2* | (3/2$^-$) | |
| 2894.4 *2* | (3/2$^-$) | |
| 2902.4 *2* | (5/2$^-$) | |
| 2977 | (3/2$^-$) | |
| 2990[#] *2* | | |
| 2996[#] *4* | (11/2$^-$) | |
| 3079.6 *2* | (3/2)$^+$ | J$^\pi$: (1/2$^+$,3/2,5/2$^+$) from H-F analysis (1979Er10). |
| 3154[#] *3* | | |
| 3243 | (3/2,5/2$^+$) | J$^\pi$: (1/2$^+$,3/2,5/2$^+$) from H-F analysis (1979Er10). |
| 3261 *2* | (1/2$^-$,5/2$^-$,7/2$^-$) | J$^\pi$: (1/2$^-$,5/2$^-$,7/2$^-$) from H-F analysis (1979Er10). |
| 3325.4 *15* | (3/2,5/2) | E(level): from 1973Ho42. Level not populated in 1979Er10 data. |
| 3449[#] *3* | | |
| 3506[#] *3* | | |
| 3632 *2* | (1/2$^+$,3/2$^+$) | J$^\pi$: (1/2$^+$,3/2$^+$) from H-F analysis (1979Er10). |
| 3740[#] *3* | | |
| 3895[#] *3* | 1/2$^+$ | |
| 3923[#] *3* | | |
| 3964 *3* | 1/2$^-$,3/2$^-$ | |

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## $^{64}$Ni(p,γ) E=res 1979Er10 (continued)

### $^{65}$Cu Levels (continued)

| E(level)[†] | J$^{\pi}$[‡] | Comments |
|---|---|---|
| 4054 *3* | (1/2$^+$,3/2,5/2$^+$) | J$^{\pi}$: (1/2$^+$,3/2,5/2$^+$) from H-F analysis (1979Er10). |
| 4089 *3* | (1/2$^+$,3/2,5/2$^+$) | J$^{\pi}$: (1/2$^+$,3/2,5/2$^+$) from H-F analysis (1979Er10). |
| 4117[#] *4* | | |
| 4183[#] *4* | | |
| 4245[#] *4* | | E(level): a possible doublet at E=4251 is reported in 1979Er10. |

[†] From 1979Er10, unless otherwise noted.
[‡] From Adopted Levels. Supporting arguments from this dataset are given in comments where available.
[#] From 1978Kr09.

### γ($^{65}$Cu)

Branching ratios under comments are from 1973Ho42.
Uncertainties on Γ(γ) are reported (1978Kr09) to be ≈ 30% for strong lines and up to 100% for weak lines.

| E$_{\gamma}$[†] | I$_{\gamma}$[‡] | E$_i$(level) | J$^{\pi}_i$ | E$_f$ | J$^{\pi}_f$ | Mult. | δ | Comments |
|---|---|---|---|---|---|---|---|---|
| 366.3 *3* | 5.3 | 1481.8 | 7/2$^-$ | 1115.5 | 5/2$^-$ | | | Branching=0.15. |
| 382.4 *3* | 0.5 | 2107.4 | (5/2)$^-$ | 1725.0 | 3/2$^-$ | | | |
| 471.0 *3* | 1.2 | 2094.3 | 7/2$^-$ | 1623.3 | 5/2$^-$ | | | |
| 487.8 *3* | 1.3 | 2212.8 | (1/2)$^-$ | 1725.0 | 3/2$^-$ | | | |
| 499.7[#] *21* | 4.8 | 2594 | (5/2$^-$) | 2094.3 | 7/2$^-$ | | | |
| 507.8 *3* | 7.3 | 1623.3 | 5/2$^-$ | 1115.5 | 5/2$^-$ | | | I$_{\gamma}$: estimated from Iγ(852.7), Iγ(1623.3) and branchings (1973Ho42).<br>Branching=0.32. |
| 609.5 *3* | 10.1 | 1725.0 | 3/2$^-$ | 1115.5 | 5/2$^-$ | | | Branching=0.50. |
| 625.6 *3* | 4.9 | 2107.4 | (5/2)$^-$ | 1481.8 | 7/2$^-$ | | | |
| 770.6 *2* | 72.1 | 770.6 | 1/2$^-$ | 0 | 3/2$^-$ | | | Branching=1.0. |
| 808.0 *3* | 1.2 | 2533.0 | (1/2,3/2,5/2$^-$) | 1725.0 | 3/2$^-$ | | | |
| 852.7 *3* | 2.2 | 1623.3 | 5/2$^-$ | 770.6 | 1/2$^-$ | | | Branching=0.14. |
| 924.6 *3* | 1.5 | 2649.6 | (5/2$^-$) | 1725.0 | 3/2$^-$ | | | |
| 978.8 *3* | 9.8 | 2094.3 | 7/2$^-$ | 1115.5 | 5/2$^-$ | | | |
| 991.9 *3* | 6.2 | 2107.4 | (5/2)$^-$ | 1115.5 | 5/2$^-$ | | | |
| 1026.3 *3* | 0.7 | 2649.6 | (5/2$^-$) | 1623.3 | 5/2$^-$ | | | |
| 1052.0 *4* | 2.0 | 2533.8 | 9/2$^+$ | 1481.8 | 7/2$^-$ | | | |
| 1115.5 *2* | 100 | 1115.5 | 5/2$^-$ | 0 | 3/2$^-$ | D+Q | −0.09 *8* | Branching=1.0.<br>Mult.,δ: from γ(θ) data (1973Ho42). |
| 1213.5 *3* | 4.3 | 2329.0 | 3/2$^-$ | 1115.5 | 5/2$^-$ | | | Branching=0.23 *5*. |
| 1243.5 *3* | 1.1 | 2866.8 | (5/2$^-$,7/2$^-$) | 1623.3 | 5/2$^-$ | | | |
| 1271[#] *3* | 1.1 | 2753 | (5/2$^-$,7/2$^-$) | 1481.8 | 7/2$^-$ | | | |
| 1271.1 *3* | 1.1 | 2894.4 | (3/2$^-$) | 1623.3 | 5/2$^-$ | | | |
| 1336.8 *3* | 1.0 | 2107.4 | (5/2)$^-$ | 770.6 | 1/2$^-$ | | | |
| 1442.2 *3* | 8.8 | 2212.8 | (1/2)$^-$ | 770.6 | 1/2$^-$ | | | Branching=0.67 *7*. |
| 1481.8 *2* | 25.7 | 1481.8 | 7/2$^-$ | 0 | 3/2$^-$ | | | Branching=0.85. |
| 1534.1 *3* | 1.5 | 2649.6 | (5/2$^-$) | 1115.5 | 5/2$^-$ | | | |
| 1558.4 *3* | 5.4 | 2329.0 | 3/2$^-$ | 770.6 | 1/2$^-$ | | | Branching=0.32 *5*. |
| 1623.3 *2* | 13.4 | 1623.3 | 5/2$^-$ | 0 | 3/2$^-$ | | | Branching=0.54. |
| 1725.0 *2* | 26.5 | 1725.0 | 3/2$^-$ | 0 | 3/2$^-$ | | | Branching=0.50. |
| 1762.4 *3* | 6.3 | 2533.0 | (1/2,3/2,5/2$^-$) | 770.6 | 1/2$^-$ | | | Branching=0.60. |
| 1879.0 *3* | 7.6 | 2649.6 | (5/2$^-$) | 770.6 | 1/2$^-$ | | | |
| 1964.1 *3* | 1.3 | 3079.6 | (3/2)$^+$ | 1115.5 | 5/2$^-$ | | | |

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## $^{64}$Ni(p,$\gamma$) E=res 1979Er10 (continued)

### $\gamma$($^{65}$Cu) (continued)

| $E_\gamma$ † | $I_\gamma$ ‡ | $E_i$(level) | $J^\pi_i$ | $E_f$ | $J^\pi_f$ | Comments |
|---|---|---|---|---|---|---|
| 2094.3 *2* | 4.6 | 2094.3 | 7/2$^-$ | 0 | 3/2$^-$ | |
| 2107.4 *2* | 3.2 | 2107.4 | (5/2)$^-$ | 0 | 3/2$^-$ | |
| 2127.5# | 3.9 | 3243 | (3/2,5/2$^+$) | 1115.5 | 5/2$^-$ | |
| 2212.8 *2* | 5.1 | 2212.8 | (1/2)$^-$ | 0 | 3/2$^-$ | Branching=0.33 *7*. |
| 2282.6 *4* | 0.9 | 2282.6 | 7/2$^-$ | 0 | 3/2$^-$ | |
| 2309.0 *3* | 5.9 | 3079.6 | (3/2)$^+$ | 770.6 | 1/2$^-$ | |
| 2329.0 *2* | 8.9 | 2329.0 | 3/2$^-$ | 0 | 3/2$^-$ | Branching=0.45 *7*. |
| 2533.0 *2* | 5.3 | 2533.0 | (1/2,3/2,5/2$^-$) | 0 | 3/2$^-$ | Branching=0.40. |
| 2649.6 *2* | 2.1 | 2649.6 | (5/2$^-$) | 0 | 3/2$^-$ | |
| 2861# *2* | 5.9 | 3632 | (1/2$^+$,3/2$^+$) | 770.6 | 1/2$^-$ | |
| 2862.7# *2* | 2.9 | 2862.7? | (1/2$^-$) | 0 | 3/2$^-$ | |
| 2866.8 *2* | 4.3 | 2866.8 | (5/2$^-$,7/2$^-$) | 0 | 3/2$^-$ | |
| 2874.4 *2* | 7.0 | 2874.4 | (3/2$^-$) | 0 | 3/2$^-$ | |
| 2894.4 *2* | 2.7 | 2894.4 | (3/2$^-$) | 0 | 3/2$^-$ | |
| 2902.4 *2* | 4.5 | 2902.4 | (5/2$^-$) | 0 | 3/2$^-$ | |
| 3261 *2* | 3.0 | 3261 | (1/2$^-$,5/2$^-$,7/2$^-$) | 0 | 3/2$^-$ | |
| 3325.4 *15* | | 3325.4 | (3/2,5/2) | 0 | 3/2$^-$ | |
| 3632 *2* | 1.7 | 3632 | (1/2$^+$,3/2$^+$) | 0 | 3/2$^-$ | |
| 3964 *3* | 2.7 | 3964 | 1/2$^-$,3/2$^-$ | 0 | 3/2$^-$ | |
| 4054 *3* | 3.2 | 4054 | (1/2$^+$,3/2,5/2$^+$) | 0 | 3/2$^-$ | |
| 4089 *3* | 2.0 | 4089 | (1/2$^+$,3/2,5/2$^+$) | 0 | 3/2$^-$ | |

† From level-energy difference using E(level) values and uncertainties reported in 1979Er10, with $\Delta E\gamma$ deduced by the evaluator from uncertainties in E(level). Note that the reported E(level) values in 1979Er10 are deduced by the authors from their measured E$\gamma$ data, which however are not listed in 1979Er10.

‡ Relative intensity from 1979Er10. Branching ratios from 1973Ho42 are given under comments where available. 1979Er10 also report averaged intensities of primary $\gamma$ transitions from the average resonance $\gamma$-ray spectra of E(p)=2.05 to 2.55 MeV in steps of 19 keV. Those values are not included in this dataset, see 1979Er10 for those values. Uncertainties of 1979Er10 range from 1% for the strong, well-resolved lines, to 40% for some of the weakest lines.

# Placement of transition in the level scheme is uncertain.

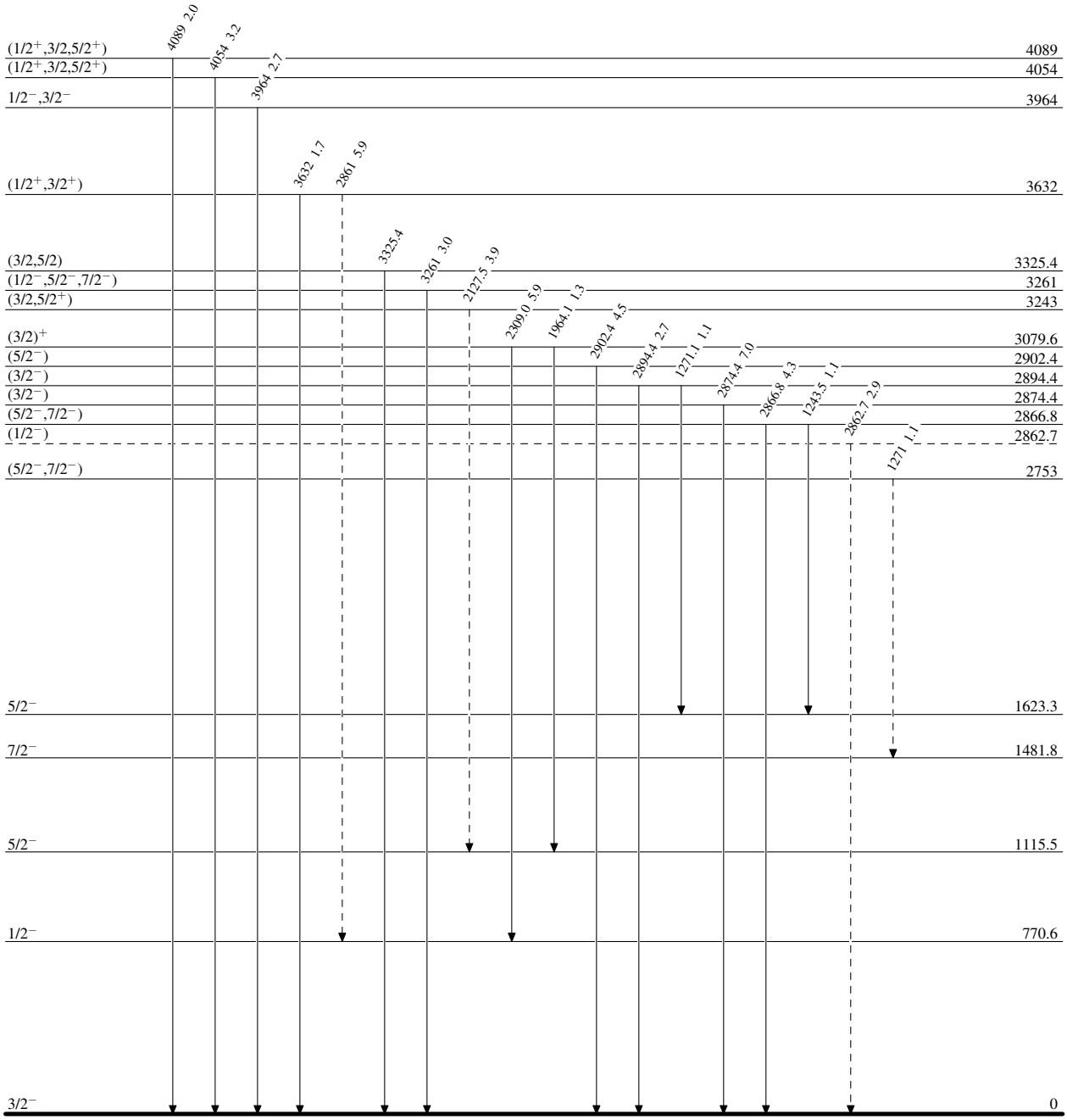
**$^{64}$Ni(p,γ) E=res 1979Er10**

Level Scheme

Intensities: Relative $I_\gamma$

Legend

- $I_\gamma < 2\% \times I_\gamma^{max}$
- $I_\gamma < 10\% \times I_\gamma^{max}$
- $I_\gamma > 10\% \times I_\gamma^{max}$
- γ Decay (Uncertain)

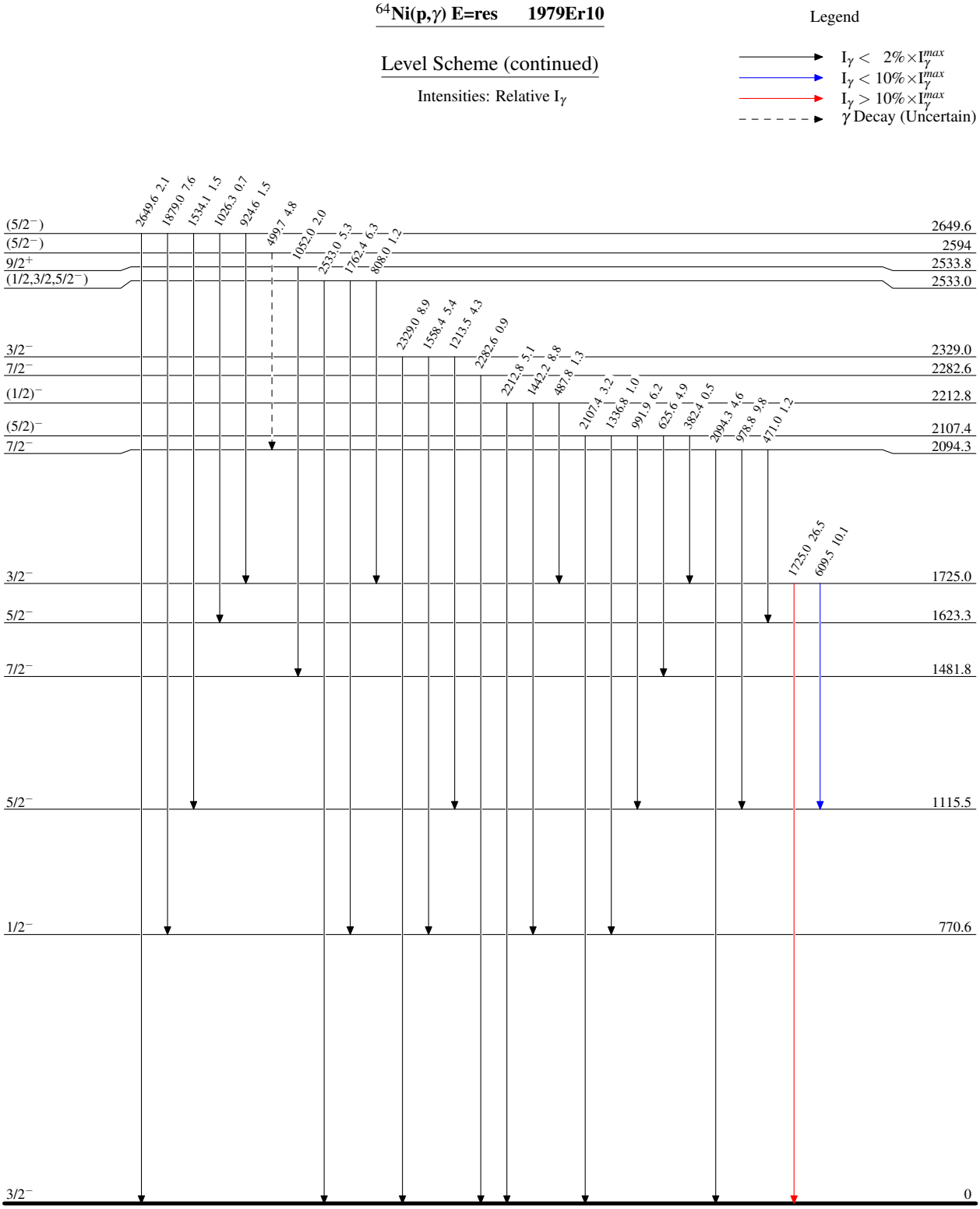



$^{65}_{29}Cu_{36}$

**$^{64}$Ni(p,γ) E=res 1979Er10**

Level Scheme (continued)

Intensities: Relative $I_\gamma$

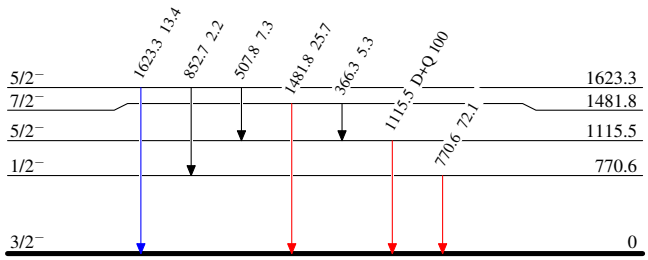



$^{65}_{29}Cu_{36}$

**$^{64}$Ni(p,$\gamma$) E=res 1979Er10**

Level Scheme (continued)

Intensities: Relative $I_\gamma$




$^{65}_{29}Cu_{36}$