

^{228}Th $Z = 90$ $N = 138$ adopted link ENSDF link

Based on ENSDF from Oct 2022, and mass evaluation from 2020

BE = 1743.078 (0.002) MeV

| | Energy T | J+ | J- | J-other | T1/2 |
|----------|----------|----------|-------|-------------|---------------|
| ----- | | | | | |
| S-alpha= | -5.520 | (0.003) | ----- | | |
| 228TH 1 | 0.000 | 0+ | | | 1 1.9116 Y 16 |
| 228TH 2 | 0.058 | 2+ | | | 2 0.406 NS 7 |
| 228TH 3 | 0.187 | 4+ | | | 3 0.164 NS 4 |
| 228TH 4 | | | 0.328 | 1- | 4 |
| 228TH 5 | 0.378 | 6+ | | | 5 |
| 228TH 6 | | | 0.396 | 3- | 6 |
| 228TH 7 | | | 0.519 | 5- | 7 |
| 228TH 8 | 0.623 | 8+ | | | 8 |
| 228TH 9 | | | 0.695 | 7- | 9 |
| 228TH 10 | 0.832 | 0+ | | | 10 |
| ----- | | | | | |
| 228TH 11 | 0.875 | 2+ | | | 11 |
| 228TH 12 | | | | 0.912 (10+) | 12 |
| 228TH 13 | | | 0.921 | 9- | 13 |
| 228TH 14 | 0.939 | 0+ | | | 14 |
| 228TH 15 | | | 0.944 | 1- | 15 |
| 228TH 16 | | | 0.968 | 2- | 16 |
| 228TH 17 | 0.968 | 4+ | | | 17 |
| 228TH 18 | 0.969 | 2+ | | | 18 |
| 228TH 19 | 0.980 | 2+ | | | 19 |
| 228TH 20 | | | 1.016 | 3- | 20 |
| ----- | | | | | |
| 228TH 21 | | | | 1.023 (3)+ | 21 |
| 228TH 22 | | | 1.060 | 4- | 22 |
| 228TH 23 | 1.075 | 4+ | | | 23 |
| 228TH 24 | 1.091 | 4+ | | | 24 |
| 228TH 25 | 1.105 | 6+ | | | 25 |
| 228TH 26 | 1.120 | 0+ | | | 26 |
| 228TH 27 | | | 1.123 | 2- | 27 |
| 228TH 28 | | | 1.143 | 5- | 28 |
| 228TH 29 | 1.153 | 2+ | | | 29 0.29 NS 2 |
| 228TH 30 | | | | 1.160 | 30 |
| ----- | | | | | |
| 228TH 31 | | | 1.168 | 3- | 31 |
| 228TH 32 | | | | 1.175 (5+) | 32 |
| 228TH 33 | 1.175 | 2+ | | | 33 |
| 228TH 34 | | | 1.190 | 11- | 34 |
| 228TH 35 | | | | 1.201 3(+) | 35 |
| 228TH 36 | | | 1.227 | 4- | 36 |
| 228TH 37 | | | | 1.239 (12+) | 37 |

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|-------|----|-------|-----|-------|----|-------|------------|----|
| 228TH | 38 | 1.262 | 4+ | | | | | 38 |
| 228TH | 39 | 1.270 | 6+ | | | | | 39 |
| 228TH | 40 | 1.280 | 8+ | | | | | 40 |
| ----- | | | | | | | | |
| 228TH | 41 | 1.290 | 4+ | | | | | 41 |
| 228TH | 42 | | | | | 1.297 | (5-) | 42 |
| 228TH | 43 | | | | | 1.319 | (2+) | 43 |
| 228TH | 44 | | | 1.344 | 3- | | | 44 |
| 228TH | 45 | 1.380 | 7+ | | | | | 45 |
| 228TH | 46 | | | | | 1.393 | (1+,2,3-) | 46 |
| 228TH | 47 | | | | | 1.416 | (3-) | 47 |
| 228TH | 48 | | | | | 1.420 | | 48 |
| 228TH | 49 | | | | | 1.424 | (2+) | 49 |
| 228TH | 50 | 1.432 | 4+ | | | | | 50 |
| ----- | | | | | | | | |
| 228TH | 51 | | | | | 1.449 | 3,4- | 51 |
| 228TH | 52 | | | 1.450 | 4- | | | 52 |
| 228TH | 53 | | | | | 1.454 | (3-) | 53 |
| 228TH | 54 | | | | | 1.467 | | 54 |
| 228TH | 55 | | | | | 1.470 | (6+) | 55 |
| 228TH | 56 | 1.490 | 10+ | | | | | 56 |
| 228TH | 57 | | | | | 1.497 | (13-) | 57 |
| 228TH | 58 | 1.497 | 8+ | | | | | 58 |
| 228TH | 59 | | | | | 1.498 | (5-) | 59 |
| 228TH | 60 | 1.511 | 0+ | | | | | 60 |
| ----- | | | | | | | | |
| 228TH | 61 | | | | | 1.531 | 0+&3+ | 61 |
| 228TH | 62 | 1.539 | 2+ | | | | | 62 |
| 228TH | 63 | | | | | 1.581 | (2-) | 63 |
| 228TH | 64 | 1.587 | 2+ | | | | | 64 |
| 228TH | 65 | | | | | 1.588 | (4-) | 65 |
| 228TH | 66 | | | | | 1.599 | (14+) | 66 |
| 228TH | 67 | 1.618 | 4+ | | | | | 67 |
| 228TH | 68 | 1.618 | 4+ | | | | | 68 |
| 228TH | 69 | | | | | 1.628 | (9+) | 69 |
| 228TH | 70 | 1.628 | 0+ | | | | | 70 |
| ----- | | | | | | | | |
| 228TH | 71 | 1.638 | 2+ | | | | | 71 |
| 228TH | 72 | | | | | 1.643 | (2-,3-) | 72 |
| 228TH | 73 | 1.644 | 4+ | | | | | 73 |
| 228TH | 74 | 1.646 | 3+ | | | | | 74 |
| 228TH | 75 | | | | | 1.651 | (3-) | 75 |
| 228TH | 76 | 1.667 | 2+ | | | | | 76 |
| 228TH | 77 | 1.672 | 2+ | | | | | 77 |
| 228TH | 78 | 1.678 | 2+ | | | | | 78 |
| 228TH | 79 | | | | | 1.683 | (2+,3+,4+) | 79 |
| 228TH | 80 | | | | | 1.684 | (4-) | 80 |
| ----- | | | | | | | | |
| 228TH | 81 | | | | | 1.688 | 2+,3+ | 81 |
| 228TH | 82 | 1.691 | 0+ | | | | | 82 |

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|-----------|-------|-----|-------|----|-------|-----------|-----|
| 228TH 83 | | | | | 1.707 | (2,3-) | 83 |
| 228TH 84 | 1.711 | 0+ | | | | | 84 |
| 228TH 85 | 1.724 | 2+ | | | | | 85 |
| 228TH 86 | 1.733 | 12+ | | | | | 86 |
| 228TH 87 | 1.735 | 4+ | | | | | 87 |
| 228TH 88 | 1.744 | 4+ | | | | | 88 |
| 228TH 89 | 1.751 | 0+ | | | | | 89 |
| 228TH 90 | 1.758 | 2+ | | | | | 90 |
| ----- | | | | | | | |
| 228TH 91 | | | | | 1.758 | 2+,3,4+ | 91 |
| 228TH 92 | | | | | 1.760 | 2(+),3(+) | 92 |
| 228TH 93 | 1.763 | 10+ | | | | | 93 |
| 228TH 94 | 1.796 | 4+ | | | | | 94 |
| 228TH 95 | 1.796 | 4+ | | | | | 95 |
| 228TH 96 | 1.798 | 2+ | | | | | 96 |
| 228TH 97 | 1.803 | 2+ | | | | | 97 |
| 228TH 98 | 1.805 | 4+ | | | | | 98 |
| 228TH 99 | | | | | 1.812 | (1-,2,3-) | 99 |
| 228TH 100 | | | | | 1.813 | (6+) | 100 |
| ----- | | | | | | | |
| 228TH 101 | | | 1.817 | 4- | | | 101 |
| 228TH 102 | | | | | 1.823 | (4+) | 102 |
| 228TH 103 | | | | | 1.838 | (15-) | 103 |
| 228TH 104 | | | | | 1.842 | (2,3) | 104 |
| 228TH 105 | | | | | 1.859 | (6+) | 105 |
| 228TH 106 | | | | | 1.865 | (2+) | 106 |
| 228TH 107 | | | | | 1.876 | (3-,4,5-) | 107 |
| 228TH 108 | | | | | 1.879 | (3-) | 108 |
| 228TH 109 | 1.893 | 3+ | | | | | 109 |
| 228TH 110 | | | | | 1.900 | (2+) | 110 |
| ----- | | | | | | | |
| 228TH 111 | | | | | 1.902 | (6+) | 111 |
| 228TH 112 | | | | | 1.907 | (2+) | 112 |
| 228TH 113 | 1.908 | 0+ | | | | | 113 |
| 228TH 114 | | | | | 1.924 | (2-,3,4) | 114 |
| 228TH 115 | | | | | 1.925 | 4+,5- | 115 |
| 228TH 116 | | | | | 1.925 | 3+,4+ | 116 |
| 228TH 117 | 1.928 | 3+ | | | | | 117 |
| 228TH 118 | | | | | 1.937 | 2+,3,4+ | 118 |
| 228TH 119 | | | | | 1.939 | (4+) | 119 |
| 228TH 120 | 1.945 | 3+ | | | | | 120 |
| ----- | | | | | | | |
| 228TH 121 | | | | | 1.946 | 4+,5- | 121 |
| 228TH 122 | | | | | 1.950 | (2+) | 122 |
| 228TH 123 | | | | | 1.958 | (2+) | 123 |
| 228TH 124 | | | | | 1.965 | (2+) | 124 |
| 228TH 125 | | | | | 1.974 | (2+,3-) | 125 |
| 228TH 126 | | | | | 1.982 | (3-) | 126 |
| 228TH 127 | 1.987 | 4+ | | | | | 127 |
| 228TH 128 | | | | | 1.988 | (16+) | 128 |

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|-----------|-------|----|--|-------|---------|-----|
| 228TH 129 | | | | 1.994 | (3-) | 129 |
| 228TH 130 | | | | 2.010 | (2+) | 130 |
| ----- | | | | | | |
| 228TH 131 | | | | 2.014 | 2+,3,4+ | 131 |
| 228TH 132 | | | | 2.017 | (4+,5-) | 132 |
| 228TH 133 | | | | 2.023 | (2+) | 133 |
| 228TH 134 | 2.030 | 2+ | | | | 134 |
| 228TH 135 | | | | 2.037 | 2+,3,4+ | 135 |
| 228TH 136 | 2.045 | 0+ | | | | 136 |
| 228TH 137 | | | | 2.052 | (6+) | 137 |
| 228TH 138 | 2.070 | 2+ | | | | 138 |
| 228TH 139 | 2.080 | 0+ | | | | 139 |
| 228TH 140 | | | | 2.091 | (6+) | 140 |
| ----- | | | | | | |
| 228TH 141 | | | | 2.112 | (2+) | 141 |
| 228TH 142 | | | | 2.123 | (2+) | 142 |
| 228TH 143 | 2.131 | 0+ | | | | 143 |
| 228TH 144 | | | | 2.153 | (4+) | 144 |
| 228TH 145 | 2.159 | 0+ | | | | 145 |
| 228TH 146 | | | | 2.170 | (2+) | 146 |
| 228TH 147 | 2.198 | 2+ | | | | 147 |
| 228TH 148 | | | | 2.210 | (17-) | 148 |
| 228TH 149 | | | | 2.216 | (4+) | 149 |
| 228TH 150 | | | | 2.235 | (4+) | 150 |
| ----- | | | | | | |
| 228TH 151 | 2.290 | 0+ | | | | 151 |
| 228TH 152 | | | | 2.303 | (4+) | 152 |
| 228TH 153 | 2.323 | 2+ | | | | 153 |
| 228TH 154 | | | | 2.336 | (4+,0+) | 154 |
| 228TH 155 | | | | 2.344 | (3-) | 155 |
| 228TH 156 | | | | 2.356 | (2+) | 156 |
| 228TH 157 | | | | 2.375 | (2+) | 157 |
| 228TH 158 | | | | 2.398 | (3-) | 158 |
| 228TH 159 | | | | 2.401 | (18+) | 159 |
| 228TH 160 | | | | 2.409 | (4+) | 160 |
| ----- | | | | | | |
| 228TH 161 | | | | 2.442 | (2+) | 161 |
| 228TH 162 | 2.457 | 0+ | | | | 162 |
| 228TH 163 | | | | 2.477 | (2+) | 163 |
| 228TH 164 | | | | 2.494 | (2+) | 164 |
| 228TH 165 | | | | 2.513 | | 165 |
| 228TH 166 | | | | 2.532 | | 166 |
| 228TH 167 | | | | 2.537 | | 167 |
| 228TH 168 | | | | 2.542 | | 168 |
| 228TH 169 | | | | 2.555 | | 169 |
| 228TH 170 | | | | 2.566 | | 170 |
| ----- | | | | | | |
| 228TH 171 | | | | 2.595 | | 171 |
| 228TH 172 | | | | 2.606 | | 172 |
| 228TH 173 | | | | 2.608 | (19-) | 173 |

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|-----------|--|--|-------|-------|-----|
| 228TH 174 | | | 2.615 | | 174 |
| 228TH 175 | | | 2.635 | | 175 |
| 228TH 176 | | | 2.644 | | 176 |
| 228TH 177 | | | 2.657 | | 177 |
| 228TH 178 | | | 2.660 | | 178 |
| 228TH 179 | | | 2.667 | | 179 |
| 228TH 180 | | | 2.676 | | 180 |
| ----- | | | | | |
| 228TH 181 | | | 2.688 | | 181 |
| 228TH 182 | | | 2.696 | | 182 |
| 228TH 183 | | | 2.705 | | 183 |
| 228TH 184 | | | 2.718 | | 184 |
| 228TH 185 | | | 2.742 | | 185 |
| 228TH 186 | | | 2.764 | | 186 |
| 228TH 187 | | | 2.781 | | 187 |
| 228TH 188 | | | 2.799 | | 188 |
| 228TH 189 | | | 2.806 | | 189 |
| 228TH 190 | | | 2.821 | | 190 |
| ----- | | | | | |
| 228TH 191 | | | 2.834 | (20+) | 191 |
| 228TH 192 | | | 2.839 | | 192 |
| 228TH 193 | | | 2.854 | | 193 |
| 228TH 194 | | | 2.868 | | 194 |
| 228TH 195 | | | 2.878 | | 195 |
| 228TH 196 | | | 2.884 | | 196 |
| 228TH 197 | | | 2.919 | | 197 |
| 228TH 198 | | | 2.927 | | 198 |
| 228TH 199 | | | 2.937 | | 199 |
| 228TH 200 | | | 2.945 | | 200 |
| ----- | | | | | |
| 228TH 201 | | | 2.955 | | 201 |
| 228TH 202 | | | 2.993 | | 202 |
| 228TH 203 | | | 3.000 | | 203 |
| 228TH 204 | | | 3.014 | | 204 |
| 228TH 205 | | | 3.036 | | 205 |
| 228TH 206 | | | 3.046 | | 206 |
| 228TH 207 | | | 3.059 | | 207 |
| 228TH 208 | | | 3.075 | | 208 |
| 228TH 209 | | | 3.085 | | 209 |
| 228TH 210 | | | 3.097 | | 210 |
| ----- | | | | | |
| 228TH 211 | | | 3.105 | | 211 |
| 228TH 212 | | | 3.113 | | 212 |
| 228TH 213 | | | 3.120 | | 213 |
| 228TH 214 | | | 3.128 | | 214 |
| 228TH 215 | | | 3.159 | | 215 |
| 228TH 216 | | | 3.166 | | 216 |
| 228TH 217 | | | 3.186 | | 217 |
| 228TH 218 | | | 3.195 | | 218 |
| 228TH 219 | | | 3.210 | | 219 |

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|-----------|--|--|-------------|-------|
| 228TH 220 | | | 3.215 | 220 |
| ----- | | | | ----- |
| 228TH 221 | | | 3.225 | 221 |
| 228TH 222 | | | 3.233 | 222 |
| 228TH 223 | | | 3.240 | 223 |
| 228TH 224 | | | 3.283 (22+) | 224 |

S-p = 6.368 (0.003)-----
 S-n = 7.105 (0.003)-----
 S-2p = 11.475 (0.003)-----
 S-2n = 12.569 (0.005)-----
 S-alpha= -5.520 (0.003)-----

S+p = -4.163 (0.004)
 S+n = -5.257 (0.003)
 S+2p = -9.734 (0.005)
 S+2n = -12.051 (0.002)
 S+alpha = 5.414 (0.003)

gap p = 2.205 (0.005)
 gap n = 1.849 (0.004)
 gap 2p = 1.741 (0.006)
 gap 2n = 0.518 (0.005)
 gap alpha = -0.107 (0.004)