

$^{184}\text{W}(^{30}\text{Si},5n\gamma)$  **2004Re04**

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|-----------------|---------------------------------------|---------|---------------------|------------------------|
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**2004Re04:** E=148 MeV  $^{30}\text{Si}$  beams were produced from the ESTU tandem accelerator at the Wright Nuclear Structure Laboratory. Target is two stacked 200  $\mu\text{g}/\text{cm}^2$   $^{184}\text{W}$ . Reaction recoils were separated in the Small Angle Separator System at Yale for Evaporation Residues (SASSYER) and  $\gamma$ -rays were detected with the YRAST Ball array comprising of 8 clover HPGe detectors (at 90° and 140° rings). Delayed  $\gamma$ -rays, depopulating isomeric states, were detected within 6  $\mu\text{s}$  following a recoil implantation were detected with 5 additional HPGe detectors that were placed around the focal plane chamber. Measured  $E\gamma$ ,  $I\gamma$ ,  $\gamma\gamma$ -coin. Deduced level scheme. See also **2005Re02**.

 $^{209}\text{Ra}$  Levels

| E(level) <sup>†</sup> | J <sup>π</sup> #     | T <sub>1/2</sub>    | Comments   |
|-----------------------|----------------------|---------------------|--|
| 0.0                   | 5/2 <sup>-</sup>     | 4.8 s 2             | J <sup>π</sup> , T <sub>1/2</sub> : from Adopted Levels.   |
| 643.6 <sup>‡</sup> 5  | (9/2 <sup>-</sup> )  |                     |  |
| 882.4 7               | 13/2 <sup>+</sup>    | 117 $\mu\text{s}$ 5 | E(level), J <sup>π</sup> : from Adopted Levels. <b>2004Re04</b> suggest an isomer with J <sup>π</sup> =13/2 <sup>+</sup> at 900 keV, $\approx$ 250 keV above the 643.6 level, based on systematics of such states in $^{205}\text{Po}$ and $^{207}\text{Rn}$ isotones.<br>T <sub>1/2</sub> : from Adopted Levels. $\approx$ 50 $\mu\text{s}$ is suggested by <b>2004Re04</b> , based on the systematics of such isomers in $^{205}\text{Po}$ and $^{207}\text{Rn}$ . |
| 1014.4 <sup>‡</sup> 7 | (11/2 <sup>-</sup> ) |                     |  |
| 1408.9 <sup>‡</sup> 7 | (13/2 <sup>-</sup> ) |                     |  |
| 1450.9 9              | (17/2 <sup>+</sup> ) |                     |  |
| 1888.1 10             | (21/2 <sup>+</sup> ) |                     |  |
| 2223.7 12             | (25/2 <sup>+</sup> ) |                     |  |
| 2452.8? 13            | (27/2 <sup>+</sup> ) |                     |  |
| 2760? 15              | (29/2 <sup>+</sup> ) |                     |  |

<sup>†</sup> From a least-squares fit to  $E\gamma$ , unless otherwise stated.

<sup>‡</sup> Fed from a long-lived (a few  $\mu\text{s}$  or longer) isomeric state, since 378.8 $\gamma$ , 643.6 $\gamma$  and 765.3 $\gamma$  were observed at the focal plane.

<sup>#</sup> From **2004Re04**, based on systematics and the deduced  $\gamma$ -ray transition multipolarities, unless otherwise stated.

 $\gamma(^{209}\text{Ra})$ 

| $E\gamma$ <sup>†</sup> | $I\gamma$ <sup>†</sup> | $E_i$ (level) | J <sub>i</sub> <sup>π</sup> | $E_f$   | J <sub>f</sub> <sup>π</sup> | Mult. <sup>#</sup> | Comments  |
|------------------------|------------------------|---------------|-----------------------------|---------|-----------------------------|--------------------|---|
| 229.1 5                | 8 2                    | 2452.8?       | (27/2 <sup>+</sup> )        | 2223.7  | (25/2 <sup>+</sup> )        | (M1)               |   |
| 238.4 5                |                        | 882.4         | 13/2 <sup>+</sup>           | 643.6   | (9/2 <sup>-</sup> )         | M2                 | $E\gamma$ , Mult.: from Adopted Gammas.   |
| 306 <sup>@</sup>       |                        | 2760?         | (29/2 <sup>+</sup> )        | 2452.8? | (27/2 <sup>+</sup> )        | (M1)               |   |
| 335.6 5                | 10 1                   | 2223.7        | (25/2 <sup>+</sup> )        | 1888.1  | (21/2 <sup>+</sup> )        | (E2)               |   |
| 370.8 <sup>‡</sup> 5   | 18 1                   | 1014.4        | (11/2 <sup>-</sup> )        | 643.6   | (9/2 <sup>-</sup> )         | (M1)               | $I\gamma$ : delayed intensity=3.1 7 ( <b>2004Re04</b> ).  |
| 437.2 5                | 66 2                   | 1888.1        | (21/2 <sup>+</sup> )        | 1450.9  | (17/2 <sup>+</sup> )        | (E2)               |   |
| 568.5 5                | 192 6                  | 1450.9        | (17/2 <sup>+</sup> )        | 882.4   | 13/2 <sup>+</sup>           | (E2)               |   |
| 643.6 <sup>‡</sup> 5   | 76 3                   | 643.6         | (9/2 <sup>-</sup> )         | 0.0     | 5/2 <sup>-</sup>            | (E2)               | $I\gamma$ : delayed intensity=26 2 ( <b>2004Re04</b> ).   |
| 765.3 <sup>‡</sup> 5   | 31 2                   | 1408.9        | (13/2 <sup>-</sup> )        | 643.6   | (9/2 <sup>-</sup> )         | (E2)               | $E\gamma$ : 764.9 5 from <b>2005Re02</b> .<br>$I\gamma$ : delayed intensity=16 2 ( <b>2004Re04</b> ). |
| <sup>x</sup> 835.3 5   | 64 3                   |               |                             |         |                             |                    |   |

<sup>†</sup> From **2004Re04**, unless otherwise stated. Intensities are relative to  $I\gamma(518\gamma, ^{210}\text{Ra})=100$ . Additional  $\gamma$ -rays that were not assigned to  $^{209}\text{Ra}$  are tabulated in **2004Re04**.

<sup>‡</sup> Observed in the focal plane and, therefore, fed from an isomeric state with a half-life of a few  $\mu\text{s}$  or longer (**2004Re04**).

Continued on next page (footnotes at end of table)

$^{184}\text{W}(^{30}\text{Si},5n\gamma)$  **2004Re04** (continued) $\gamma(^{209}\text{Ra})$  (continued)

# From **2004Re04** based on measured  $\gamma$ -ray anisotropies, unless otherwise stated. Quadrupole (assumed E2) for  $R=I_\gamma(140^\circ)/I_\gamma(90^\circ)>1$  and dipole (assumed M1) for  $R<1$ .

@ Placement of transition in the level scheme is uncertain.

<sup>x</sup>  $\gamma$  ray not placed in level scheme.

