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CALCULATED FRACTIONAL INDEPENDENT YIELDS OF PRODUCTS FORMED IN THE SPONTANEOUS FISSION OF 252Cf

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R. L. Watson and J. B. Wilhelmy

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CALCULATED FRACTIONAL INDEPENDENT YIELDS OF PRODUCTS
FORMED IN THE SPONTANEOUS FISSION OF $^{252}$Cf

R. L. Watson and J. B. Wilhelmy

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CALCULATED FRACTIONAL INDEPENDENT YIELDS OF PRODUCTS
FORMED IN THE SPONTANEOUS FISSION OF $^{252}$Cf

R. L. Watson$^\dagger$ and J. B. Wilhelmy

Lawrence Radiation Laboratory
University of California
Berkeley, California  94720

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I. DEFINITIONS

a) The absolute fission yield of a product of mass $M$ is given by

\[ Y_M(i) = \frac{R_M(i)}{R_F}, \tag{1} \]

where $R_M(i)$ is the rate of formation of the product and $R_F$ is the fission rate.

b) The independent yield of a product, $Y_M^I(i)$, is its yield by direct formation from the fissioning nucleus.

c) The cumulative yield of a product is its yield by direct formation plus its yield of formation from precursors;

\[ Y_M^C(i) = \sum_{n=1}^{i} Y_M^I(i). \tag{2} \]

\*Work performed under the auspices of the U. S. Atomic Energy Commission.

$^\dagger$Present address: Cyclotron Institute, Texas A. and M. University,
College Station, Texas  77843.
Hence the cumulative yield of a product is equal to the sum of
the independent yields of all precursors plus the independent
yield of the product itself. The secondary yield of a product
is its yield of formation from precursors alone and thus is
given by

$$y_{M}^{S(i)} = \sum_{n=1}^{i-1} y_{M}^{I(n)} .$$  (3)

d) The chain yield is given by the sum of the independent yields of
all members of the same mass chain. For a mass chain containing
K members, the chain yield is

$$y_{M} = \sum_{n=1}^{K} y_{M}^{I(n)} .$$  (4)

e) The element yield is given by the sum of the independent yields
of all products having the same atomic number;

$$y_{Z} = \sum_{M=1}^{n} y_{M}^{I(Z)} .$$  (5)

f) The fractional independent yield of a product is its absolute
fission yield divided by the chain yield of the mass chain to
which it belongs;

$$\frac{y_{M}^{I}(i)}{y_{M}^{I}} = \frac{y_{M}^{I(i)}}{y_{M}} .$$  (6)

the fractional cumulative yield is
The present calculations have incorporated the prescription given by Wahl et al.\(^1\) in which the charge distribution of direct formation products is assumed to be Gaussian. Based upon the experimental information currently available, it was assumed that a single charge dispersion curve may be used to represent all charge dispersion data (i.e., that the width of the Gaussian is approximately a constant).

In the formulation of a Gaussian distribution in the cumulative form (i.e., with the Gaussian normalized such that the area under the curve is unity), the fractional cumulative yield of a fission product with charge \(Z\) is given by:

\[
Y^C_{M_f}(Z) = \sum_{n=0}^{Z_f} Y^I_{M_f}(n) = \frac{1}{\sqrt{2\pi} \sigma} \int_{-\infty}^{Z_1^{1/2}} e^{-\frac{(Z_1-Z_p)^2}{2\sigma^2}} dZ .
\]

The fractional independent yield of a fission product with charge \(Z\), then, is given by:

\[
Y^I_{M_f}(Z) = \frac{1}{\sqrt{2\pi} \sigma} \int_{Z_1^{-1/2}}^{Z_1^{1/2}} e^{-\frac{(Z_1-Z_p)^2}{2\sigma^2}} dZ .
\]

Changing variables such that

\[
t = \frac{(Z_1 - Z_p)}{\sigma}
\]

\[
dZ = \sigma dt
\]
Eq. (9) may be re-expressed by:

$$Y_{M_p}^{I}(Z_i) = \frac{1}{\sqrt{2\pi}} \int_{t_2}^{t_1} e^{-t^2/2} dt .$$  \hspace{1cm} (10)

The limits are found to be:

$$Z_i + \frac{1}{2} = \sigma t_2 + Z_p$$

$$t_2 = \frac{Z_i - Z_p + \frac{1}{2}}{\sigma} .$$

$$Z_i - \frac{1}{2} = \sigma t_1 + Z_p$$

$$t_1 = \frac{Z_i - Z_p - \frac{1}{2}}{\sigma} .$$

Hence, the fractional independent yields are calculable from the difference between two normal probability integrals;

$$Y_{M_p}^{I}(Z_i) = \frac{1}{2} \left[ \frac{1}{\sqrt{2\pi}} \int_{-t_2}^{t_2} e^{-t^2/2} dt - \frac{1}{\sqrt{2\pi}} \int_{-t_1}^{t_1} e^{-t^2/2} dt \right] .$$  \hspace{1cm} (11)

Values of these integrals are given in Ref. 5.
III. RESULTS

The value of the standard deviation of the Gaussian charge distribution used in the calculations is \( \sigma = 0.59 \) as given by Norris and Wahl.² Most probable charge values were taken from the curve in Fig. 1 (see Table I). This curve was constructed on the basis of empirical \( Z_p \) values given by Wahl et al.¹ and \( Z_p \) values determined from X-ray measurements given by Kapoor et al.³ Fission chain yields for \(^{252}\)Cf were obtained from the radiochemical measurements of Nervik⁴ and are given in Table II.

The element yields were calculated for \( Z = 36 \) to \( Z = 62 \) and are listed in Table III and plotted in Fig. 2. Table IV lists the calculated values of the fractional independent yields and the absolute fission yields for the elements comprising each mass chain.
REFERENCES

Table I. Average $Z_p$ values from Fig. 1.

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<th>$Z_p$</th>
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Table II. Fission yields for $^{252}$Cf (Nervik$^1$).

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<th>Fission Yield (%)</th>
<th>Average (%)</th>
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### Table IV. (Continued)

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<td>0.031</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>0.129</td>
<td>0.010</td>
<td></td>
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<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>33</th>
<th>34</th>
<th>35</th>
<th>36</th>
<th>37</th>
<th>38</th>
</tr>
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<tbody>
<tr>
<td>Mass Chain = 90</td>
<td>Mass Yield = $0.44 \times 10^{-2}$</td>
<td></td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
<td></td>
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</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>0.254</td>
<td>0.051</td>
<td>0.001</td>
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<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>34</th>
<th>35</th>
<th>36</th>
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<tbody>
<tr>
<td>Mass Chain = 91</td>
<td>Mass Yield = $0.59 \times 10^{-2}$</td>
<td></td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.545</td>
<td>0.346</td>
<td>0.021</td>
<td>0.000</td>
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</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>0.322</td>
<td>0.204</td>
<td>0.012</td>
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Table IV. (Continued)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Mass Chain</td>
<td>92</td>
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<td></td>
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<tr>
<td>Mass Yield</td>
<td>$0.75 \times 10^{-2}$</td>
<td></td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.292</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
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</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.219</td>
<td>0.433</td>
<td>0.087</td>
<td>0.002</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>35</th>
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<tbody>
<tr>
<td>Mass Chain</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mass Yield</td>
<td>$0.83 \times 10^{-2}$</td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.116</td>
<td>0.577</td>
<td>0.292</td>
<td>0.014</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.096</td>
<td>0.479</td>
<td>0.242</td>
<td>0.012</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>35</th>
<th>36</th>
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<tbody>
<tr>
<td>Mass Chain</td>
<td>94</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass Yield</td>
<td>$1.13 \times 10^{-2}$</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.031</td>
<td>0.402</td>
<td>0.504</td>
<td>0.063</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.035</td>
<td>0.459</td>
<td>0.570</td>
<td>0.071</td>
<td>0.001</td>
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</tr>
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</table>

(Continued)
Table IV. (Continued)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>35</th>
<th>36</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.003</td>
<td>0.151</td>
<td>0.596</td>
<td>0.240</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>0.004</td>
<td>0.207</td>
<td>0.817</td>
<td>0.329</td>
<td>0.012</td>
<td></td>
</tr>
</tbody>
</table>

MASS CHAIN = 96
MASS YIELD = 1.47 x 10^{-2}

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>36</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>40</th>
<th>41</th>
</tr>
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<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.045</td>
<td>0.455</td>
<td>0.455</td>
<td>0.045</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>0.066</td>
<td>0.669</td>
<td>0.669</td>
<td>0.066</td>
<td>--</td>
<td></td>
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</table>

MASS CHAIN = 97
MASS YIELD = 1.59 x 10^{-2}

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>36</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>40</th>
<th>41</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.009</td>
<td>0.240</td>
<td>0.596</td>
<td>0.151</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>0.014</td>
<td>0.370</td>
<td>0.918</td>
<td>0.233</td>
<td>0.005</td>
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</tbody>
</table>

(Continued)
<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>40</th>
<th>41</th>
<th>42</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.086</td>
<td>0.545</td>
<td>0.346</td>
<td>0.021</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>0.002</td>
<td>0.180</td>
<td>1.139</td>
<td>0.723</td>
<td>0.044</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>40</th>
<th>41</th>
<th>42</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.021</td>
<td>0.346</td>
<td>0.545</td>
<td>0.086</td>
<td>0.001</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>--</td>
<td>0.059</td>
<td>0.889</td>
<td>1.401</td>
<td>0.221</td>
<td>0.003</td>
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</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>38</th>
<th>39</th>
<th>40</th>
<th>41</th>
<th>42</th>
<th>43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.002</td>
<td>0.116</td>
<td>0.577</td>
<td>0.292</td>
<td>0.014</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>0.006</td>
<td>0.365</td>
<td>1.818</td>
<td>0.920</td>
<td>0.044</td>
<td>--</td>
</tr>
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</table>
Table IV. (Continued)

<table>
<thead>
<tr>
<th>Atomic No.</th>
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<th>39</th>
<th>40</th>
<th>41</th>
<th>42</th>
<th>43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.031</td>
<td>0.402</td>
<td>0.509</td>
<td>0.063</td>
<td>0.001</td>
</tr>
<tr>
<td>Absolute Yield (x 10²)</td>
<td>--</td>
<td>0.115</td>
<td>1.487</td>
<td>1.865</td>
<td>0.233</td>
<td>0.004</td>
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MASS CHAIN = 102
MASS YIELD = 4.25 x 10⁻²

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>38</th>
<th>39</th>
<th>40</th>
<th>41</th>
<th>42</th>
<th>43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.006</td>
<td>0.193</td>
<td>0.603</td>
<td>0.193</td>
<td>0.006</td>
</tr>
<tr>
<td>Absolute Yield (x 10²)</td>
<td>0.026</td>
<td>0.820</td>
<td>2.563</td>
<td>0.820</td>
<td>0.026</td>
<td></td>
</tr>
</tbody>
</table>

MASS CHAIN = 103
MASS YIELD = 4.80 x 10⁻²

<table>
<thead>
<tr>
<th>Atomic No.</th>
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<th>41</th>
<th>42</th>
<th>43</th>
<th>44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.063</td>
<td>0.504</td>
<td>0.402</td>
<td>0.031</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield (x 10²)</td>
<td>0.005</td>
<td>0.302</td>
<td>2.419</td>
<td>1.930</td>
<td>0.149</td>
<td>--</td>
</tr>
</tbody>
</table>

(Continued)
Table IV. (Continued)

<table>
<thead>
<tr>
<th>Atom No.</th>
<th>39</th>
<th>40</th>
<th>41</th>
<th>42</th>
<th>43</th>
<th>44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.014</td>
<td>0.292</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.076</td>
<td>1.577</td>
<td>3.116</td>
<td>0.626</td>
<td>0.011</td>
</tr>
</tbody>
</table>

MASS CHAIN = 105
MASS YIELD = $5.99 \times 10^{-2}$

<table>
<thead>
<tr>
<th>Atom No.</th>
<th>40</th>
<th>41</th>
<th>42</th>
<th>43</th>
<th>44</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.002</td>
<td>0.116</td>
<td>0.577</td>
<td>0.292</td>
<td>0.019</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.012</td>
<td>0.695</td>
<td>3.456</td>
<td>1.749</td>
<td>0.084</td>
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</tr>
</tbody>
</table>

MASS CHAIN = 106
MASS YIELD = $6.20 \times 10^{-2}$

<table>
<thead>
<tr>
<th>Atom No.</th>
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<th>41</th>
<th>42</th>
<th>43</th>
<th>44</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.031</td>
<td>0.402</td>
<td>0.504</td>
<td>0.063</td>
<td>0.001</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.192</td>
<td>2.492</td>
<td>3.125</td>
<td>0.391</td>
<td>0.006</td>
</tr>
</tbody>
</table>
Table IV. (Continued)

MASS CHAIN = 107
MASS YIELD = \( 6.20 \times 10^{-2} \)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>41</th>
<th>42</th>
<th>43</th>
<th>44</th>
<th>45</th>
<th>46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.003</td>
<td>0.151</td>
<td>0.596</td>
<td>0.240</td>
<td>0.009</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ( (x 10^2) )</td>
<td>0.019</td>
<td>0.936</td>
<td>3.695</td>
<td>1.488</td>
<td>0.056</td>
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</table>

MASS CHAIN = 108
MASS YIELD = \( 6.00 \times 10^{-2} \)

<table>
<thead>
<tr>
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<th>43</th>
<th>44</th>
<th>45</th>
<th>46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.045</td>
<td>0.455</td>
<td>0.455</td>
<td>0.045</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ( (x 10^2) )</td>
<td>--</td>
<td>0.270</td>
<td>2.730</td>
<td>2.730</td>
<td>0.270</td>
<td>--</td>
</tr>
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</table>

MASS CHAIN = 109
MASS YIELD = \( 5.69 \times 10^{-2} \)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>41</th>
<th>42</th>
<th>43</th>
<th>44</th>
<th>45</th>
<th>46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.009</td>
<td>0.240</td>
<td>0.596</td>
<td>0.151</td>
<td>0.003</td>
</tr>
<tr>
<td>Absolute Yield ( (x 10^2) )</td>
<td>--</td>
<td>0.051</td>
<td>1.366</td>
<td>3.391</td>
<td>0.859</td>
<td>0.017</td>
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</tbody>
</table>

(Continued)
### Table IV. (Continued)

**MASS CHAIN = 110**

**MASS YIELD = \( 5.45 \times 10^{-2} \)**

<table>
<thead>
<tr>
<th>Atomic No.</th>
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<th>42</th>
<th>43</th>
<th>44</th>
<th>45</th>
<th>46</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>(0.016)</td>
<td>(0.823)</td>
<td>(3.248)</td>
<td>(1.308)</td>
<td>(0.049)</td>
<td></td>
</tr>
</tbody>
</table>

**MASS CHAIN = 111**

**MASS YIELD = \( 5.19 \times 10^{-2} \)**

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>43</th>
<th>44</th>
<th>45</th>
<th>46</th>
<th>47</th>
<th>48</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>(0.031)</td>
<td>(0.402)</td>
<td>(0.504)</td>
<td>(0.063)</td>
<td>(0.001)</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield (\times 10^2)</td>
<td>(0.161)</td>
<td>(2.086)</td>
<td>(2.616)</td>
<td>(0.327)</td>
<td>(0.005)</td>
<td>--</td>
</tr>
</tbody>
</table>

**MASS CHAIN = 112**

**MASS YIELD = \( 3.65 \times 10^{-2} \)**

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>42</th>
<th>43</th>
<th>44</th>
<th>45</th>
<th>46</th>
<th>47</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>(0.006)</td>
<td>(0.193)</td>
<td>(0.603)</td>
<td>(0.193)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Absolute Yield (\times 10^2)</td>
<td>--</td>
<td>(0.022)</td>
<td>(0.704)</td>
<td>(2.201)</td>
<td>(0.709)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>MASS CHAIN</td>
<td>113</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MASS YIELD</td>
<td>$4.23 \times 10^{-2}$</td>
<td></td>
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</tr>
<tr>
<td>Atomic No.</td>
<td>43</td>
<td>44</td>
<td>45</td>
<td>46</td>
<td>47</td>
<td>48</td>
</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.063</td>
<td>0.504</td>
<td>0.402</td>
<td>0.031</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.004</td>
<td>0.266</td>
<td>2.132</td>
<td>1.700</td>
<td>0.131</td>
<td>--</td>
</tr>
</tbody>
</table>

| MASS CHAIN | 114       |
| MASS YIELD | $3.07 \times 10^{-2}$ |
| Atomic No. | 44  | 45  | 46  | 47  | 48  |
| Frac. Ind. Chain Yield        | 0.014 | 0.292 | 0.577 | 0.116 | 0.002 |
| Absolute Yield ($\times 10^2$) | 0.043 | 0.896 | 1.771 | 0.356 | 0.006 |

| MASS CHAIN | 115       |
| MASS YIELD | $2.28 \times 10^{-2}$ |
| Atomic No. | 44  | 45  | 46  | 47  | 48  | 49  |
| Frac. Ind. Chain Yield        | 0.002 | 0.116 | 0.577 | 0.292 | 0.014 | --  |
| Absolute Yield ($\times 10^2$) | 0.005 | 0.264 | 1.316 | 0.666 | 0.032 | --  |
Table IV. (Continued)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>44</th>
<th>45</th>
<th>46</th>
<th>47</th>
<th>48</th>
<th>49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.045</td>
<td>0.455</td>
<td>0.455</td>
<td>0.045</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>--</td>
<td>0.072</td>
<td>0.728</td>
<td>0.728</td>
<td>0.072</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>44</th>
<th>45</th>
<th>46</th>
<th>47</th>
<th>48</th>
<th>49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.014</td>
<td>0.292</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>--</td>
<td>0.015</td>
<td>0.321</td>
<td>0.635</td>
<td>0.128</td>
<td>0.002</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>45</th>
<th>46</th>
<th>47</th>
<th>48</th>
<th>49</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.002</td>
<td>0.116</td>
<td>0.577</td>
<td>0.292</td>
<td>0.014</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^{-2}$)</td>
<td>0.001</td>
<td>0.081</td>
<td>0.404</td>
<td>0.204</td>
<td>0.010</td>
<td>--</td>
</tr>
</tbody>
</table>
Table IV. (Continued)

MASS CHAIN = 119
MASS YIELD = \(0.42 \times 10^{-2}\)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>45</th>
<th>46</th>
<th>47</th>
<th>48</th>
<th>49</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>(0.045)</td>
<td>(0.455)</td>
<td>(0.455)</td>
<td>(0.045)</td>
<td>(\text{--})</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield ((x \times 10^2))</td>
<td>(0.019)</td>
<td>(0.191)</td>
<td>(0.191)</td>
<td>(0.019)</td>
<td>(\text{--})</td>
<td></td>
</tr>
</tbody>
</table>

MASS CHAIN = 120
MASS YIELD = \(0.24 \times 10^{-2}\)

<table>
<thead>
<tr>
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<th>47</th>
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<th>49</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>(0.014)</td>
<td>(0.292)</td>
<td>(0.577)</td>
<td>(0.116)</td>
<td>(0.002)</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield ((x \times 10^2))</td>
<td>(0.003)</td>
<td>(0.070)</td>
<td>(0.138)</td>
<td>(0.028)</td>
<td>(\text{--})</td>
<td></td>
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</tbody>
</table>

MASS CHAIN = 121
MASS YIELD = \(0.14 \times 10^{-2}\)

<table>
<thead>
<tr>
<th>Atomic No.</th>
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<th>47</th>
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<th>50</th>
<th>51</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.002</td>
<td>0.116</td>
<td>0.577</td>
<td>0.292</td>
<td>0.014</td>
<td>(\text{--})</td>
</tr>
<tr>
<td>Absolute Yield ((x \times 10^2))</td>
<td>0.016</td>
<td>0.081</td>
<td>0.041</td>
<td>0.002</td>
<td>(\text{--})</td>
<td>(\text{--})</td>
</tr>
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</table>

(Continued)
Table IV. (Continued)

<table>
<thead>
<tr>
<th>MASS CHAIN = 122</th>
<th>MASS YIELD = $0.073 \times 10^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic No.</td>
<td>46</td>
</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MASS CHAIN = 123</th>
<th>MASS YIELD = $0.035 \times 10^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic No.</td>
<td>46</td>
</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MASS CHAIN = 124</th>
<th>MASS YIELD = $0.015 \times 10^{-2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atomic No.</td>
<td>46</td>
</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
</tr>
</tbody>
</table>

(Continued)
Table IV. (Continued)

<table>
<thead>
<tr>
<th>MASS CHAIN = 125</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASS YIELD = 0.009 x 10^{-2}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>47</th>
<th>48</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.086</td>
<td>0.545</td>
<td>0.346</td>
<td>0.021</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>--</td>
<td>0.001</td>
<td>0.005</td>
<td>0.003</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MASS CHAIN = 126</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASS YIELD = 0.052 x 10^{-2}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>47</th>
<th>48</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.031</td>
<td>0.402</td>
<td>0.504</td>
<td>0.063</td>
<td>0.001</td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>--</td>
<td>0.002</td>
<td>0.021</td>
<td>0.026</td>
<td>0.003</td>
<td>--</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MASS CHAIN = 127</th>
</tr>
</thead>
<tbody>
<tr>
<td>MASS YIELD = 0.13 x 10^{-2}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>47</th>
<th>48</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.009</td>
<td>0.240</td>
<td>0.596</td>
<td>0.151</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>0.001</td>
<td>0.031</td>
<td>0.077</td>
<td>0.020</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>
Table IV. (Continued)

| MASS CHAIN | 128 |
| MASS YIELD | $0.32 \times 10^{-2}$ |

| Atomic No. | 47 | 48 | 49 | 50 | 51 | 52 |
| Frac. Ind. Chain Yield | -- | 0.003 | 0.151 | 0.596 | 0.240 | 0.009 |
| Absolute Yield ($\times 10^2$) | -- | 0.001 | 0.048 | 0.191 | 0.077 | 0.003 |

| MASS CHAIN | 129 |
| MASS YIELD | $0.62 \times 10^{-2}$ |

| Atomic No. | 48 | 49 | 50 | 51 | 52 | 53 |
| Frac. Ind. Chain Yield | 0.001 | 0.086 | 0.545 | 0.346 | 0.021 | -- |
| Absolute Yield ($\times 10^2$) | 0.001 | 0.053 | 0.338 | 0.215 | 0.013 | -- |

| MASS CHAIN | 130 |
| MASS YIELD | $0.92 \times 10^{-2}$ |

| Atomic No. | 48 | 49 | 50 | 51 | 52 | 53 |
| Frac. Ind. Chain Yield | -- | 0.045 | 0.455 | 0.455 | 0.045 | -- |
| Absolute Yield ($\times 10^2$) | -- | 0.041 | 0.419 | 0.419 | 0.041 | -- |

(Continued)
<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>48</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.014</td>
<td>0.292</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>--</td>
<td>0.018</td>
<td>0.371</td>
<td>0.733</td>
<td>0.147</td>
<td>0.003</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>48</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.003</td>
<td>0.151</td>
<td>0.596</td>
<td>0.240</td>
<td>0.009</td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>--</td>
<td>0.005</td>
<td>0.264</td>
<td>1.043</td>
<td>0.420</td>
<td>0.016</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.063</td>
<td>0.504</td>
<td>0.402</td>
<td>0.031</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield (x 10^2)</td>
<td>0.003</td>
<td>0.175</td>
<td>1.396</td>
<td>1.114</td>
<td>0.086</td>
<td>--</td>
</tr>
</tbody>
</table>
### Table IV. (Continued)

**MASS CHAIN = 134**

MASS YIELD = \(3.50 \times 10^{-2}\)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.014</td>
<td>0.242</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
</tr>
<tr>
<td>Absolute Yield (\times 10^2)</td>
<td>--</td>
<td>0.049</td>
<td>1.022</td>
<td>2.020</td>
<td>0.406</td>
<td>0.007</td>
</tr>
</tbody>
</table>

**MASS CHAIN = 135**

MASS YIELD = \(4.33 \times 10^{-2}\)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>49</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.003</td>
<td>0.151</td>
<td>0.596</td>
<td>0.240</td>
<td>0.009</td>
<td></td>
</tr>
<tr>
<td>Absolute Yield (\times 10^2)</td>
<td>--</td>
<td>0.013</td>
<td>0.654</td>
<td>2.501</td>
<td>1.039</td>
<td>0.039</td>
<td></td>
</tr>
</tbody>
</table>

**MASS CHAIN = 136**

MASS YIELD = \(4.40 \times 10^{-2}\)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.045</td>
<td>0.455</td>
<td>0.455</td>
<td>0.045</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield (\times 10^2)</td>
<td>--</td>
<td>0.198</td>
<td>2.002</td>
<td>2.002</td>
<td>0.198</td>
<td>--</td>
</tr>
</tbody>
</table>

(Continued)
Table IV. (Continued)

MASS CHAIN = 137
MASS YIELD = $4.40 \times 10^{-2}$

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.006</td>
<td>0.193</td>
<td>0.603</td>
<td>0.193</td>
<td>0.006</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.026</td>
<td>0.849</td>
<td>2.653</td>
<td>0.849</td>
<td>0.026</td>
</tr>
</tbody>
</table>

MASS CHAIN = 138
MASS YIELD = $4.94 \times 10^{-2}$

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.045</td>
<td>0.455</td>
<td>0.455</td>
<td>0.045</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.222</td>
<td>2.248</td>
<td>2.248</td>
<td>0.222</td>
<td>--</td>
</tr>
</tbody>
</table>

MASS CHAIN = 139
MASS YIELD = $5.73 \times 10^{-2}$

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.009</td>
<td>0.240</td>
<td>0.596</td>
<td>0.151</td>
<td>0.003</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.052</td>
<td>1.375</td>
<td>3.415</td>
<td>0.865</td>
<td>0.017</td>
</tr>
</tbody>
</table>

(Continued)
Table IV. (Continued)

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.063</td>
<td>0.504</td>
<td>0.402</td>
<td>0.031</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.006</td>
<td>0.398</td>
<td>3.185</td>
<td>2.541</td>
<td>0.196</td>
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</tr>
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</table>

MASS CHAIN = 140  
MASS YIELD = $6.32 \times 10^{-2}$

<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.014</td>
<td>0.292</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.083</td>
<td>1.723</td>
<td>3.404</td>
<td>0.689</td>
<td>0.012</td>
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</table>

MASS CHAIN = 141  
MASS YIELD = $5.90 \times 10^{-2}$

<table>
<thead>
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<th>Atomic No.</th>
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<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>58</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.086</td>
<td>0.545</td>
<td>0.346</td>
<td>0.021</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.006</td>
<td>0.516</td>
<td>3.270</td>
<td>2.076</td>
<td>0.126</td>
<td>--</td>
</tr>
</tbody>
</table>

(Continued)
<table>
<thead>
<tr>
<th>Atomic No.</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>58</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mass Chain = 143</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mass Yield = 5.94 × 10^{-2}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.021</td>
<td>0.346</td>
<td>0.545</td>
<td>0.086</td>
<td>0.001</td>
</tr>
<tr>
<td>Absolute Yield (× 10^2)</td>
<td>--</td>
<td>0.125</td>
<td>2.055</td>
<td>3.237</td>
<td>0.511</td>
<td>0.006</td>
</tr>
<tr>
<td>Atomic No.</td>
<td>54</td>
<td>55</td>
<td>56</td>
<td>57</td>
<td>58</td>
<td>59</td>
</tr>
<tr>
<td>Mass Chain = 144</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mass Yield = 5.77 × 10^{-2}</td>
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</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.002</td>
<td>0.116</td>
<td>0.577</td>
<td>0.292</td>
<td>0.014</td>
<td>--</td>
</tr>
<tr>
<td>Absolute Yield (× 10^2)</td>
<td>0.012</td>
<td>0.669</td>
<td>3.329</td>
<td>1.685</td>
<td>0.081</td>
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<tr>
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<td>Mass Chain = 145</td>
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<tr>
<td>Mass Yield = 5.50 × 10^{-2}</td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.031</td>
<td>0.402</td>
<td>0.504</td>
<td>0.063</td>
<td>0.001</td>
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<tr>
<td>Absolute Yield (× 10^2)</td>
<td>--</td>
<td>0.170</td>
<td>2.211</td>
<td>2.772</td>
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**Table IV. (Continued)**

MASS CHAIN = 146

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<th>56</th>
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<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.003</td>
<td>0.151</td>
<td>0.596</td>
<td>0.240</td>
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<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.015</td>
<td>0.778</td>
<td>3.069</td>
<td>1.236</td>
<td>0.046</td>
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MASS CHAIN = 147

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<td>Frac. Ind. Chain Yield</td>
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<td>0.045</td>
<td>0.455</td>
<td>0.455</td>
<td>0.045</td>
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<td>0.211</td>
<td>2.134</td>
<td>2.134</td>
<td>0.211</td>
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MASS CHAIN = 148

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<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.006</td>
<td>0.193</td>
<td>0.603</td>
<td>0.193</td>
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<tr>
<td>Absolute Yield ($\times 10^2$)</td>
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<td>0.021</td>
<td>0.676</td>
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Table IV. (Continued)

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<tr>
<td>MASS YIELD = $2.65 \times 10^{-2}$</td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.063</td>
<td>0.504</td>
<td>0.402</td>
<td>0.031</td>
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<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>0.003</td>
<td>0.167</td>
<td>1.336</td>
<td>1.065</td>
<td>0.082</td>
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<table>
<thead>
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<tr>
<td>MASS YIELD = $2.34 \times 10^{-2}$</td>
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</tr>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.009</td>
<td>0.240</td>
<td>0.596</td>
<td>0.151</td>
<td>0.003</td>
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<tr>
<td>Absolute Yield ($\times 10^2$)</td>
<td>--</td>
<td>0.021</td>
<td>0.562</td>
<td>1.395</td>
<td>0.353</td>
<td>0.007</td>
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<table>
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<td>MASS CHAIN = 151</td>
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<td>MASS YIELD = $2.18 \times 10^{-2}$</td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.001</td>
<td>0.086</td>
<td>0.545</td>
<td>0.346</td>
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<td>Absolute Yield ($\times 10^2$)</td>
<td>0.002</td>
<td>0.187</td>
<td>1.188</td>
<td>0.754</td>
<td>0.046</td>
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Table IV. (Continued)

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<th>62</th>
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<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.014</td>
<td>0.292</td>
<td>0.577</td>
<td>0.116</td>
<td>0.002</td>
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<tr>
<td>Absolute Yield ((x \times 10^2))</td>
<td>0.024</td>
<td>0.499</td>
<td>0.987</td>
<td>0.198</td>
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<th>Atomic No.</th>
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<th>63</th>
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<tbody>
<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.002</td>
<td>0.116</td>
<td>0.577</td>
<td>0.292</td>
<td>0.014</td>
<td></td>
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<tr>
<td>Absolute Yield ((x \times 10^2))</td>
<td>0.003</td>
<td>0.164</td>
<td>0.814</td>
<td>0.412</td>
<td>0.020</td>
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<table>
<thead>
<tr>
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<td>Frac. Ind. Chain Yield</td>
<td>0.021</td>
<td>0.346</td>
<td>0.545</td>
<td>0.086</td>
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<td>0.984</td>
<td>0.605</td>
<td>0.095</td>
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<tbody>
<tr>
<td>Mass Chain = 155</td>
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</tr>
<tr>
<td>Mass Yield = $0.86 \times 10^{-2}$</td>
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<td>0.151</td>
<td>0.596</td>
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<td>0.003</td>
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<td>0.513</td>
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<td>Mass Chain = 156</td>
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<td>Mass Yield = $0.70 \times 10^{-2}$</td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>--</td>
<td>0.031</td>
<td>0.402</td>
<td>0.504</td>
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<tr>
<td>Absolute Yield ($\times 10^2$)</td>
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<td>0.022</td>
<td>0.281</td>
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<td>Mass Chain = 157</td>
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</tr>
<tr>
<td>Mass Yield = $0.52 \times 10^{-2}$</td>
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<tr>
<td>Frac. Ind. Chain Yield</td>
<td>0.006</td>
<td>0.193</td>
<td>0.603</td>
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<td>0.003</td>
<td>0.100</td>
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Table IV. (Continued)

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<th>MASS CHAIN = 158</th>
<th>MASS YIELD = $0.39 \times 10^{-2}$</th>
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<td></td>
<td>Frac. Ind. Chain Yield</td>
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<td>Absolute Yield ($\times 10^2$)</td>
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<thead>
<tr>
<th>Atomic No.</th>
<th>MASS CHAIN = 159</th>
<th>MASS YIELD = $0.29 \times 10^{-2}$</th>
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<td></td>
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<td>Absolute Yield ($\times 10^2$)</td>
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<td></td>
<td>Frac. Ind. Chain Yield</td>
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<td>Absolute Yield ($\times 10^2$)</td>
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(Continued)
Table IV. (Continued)

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<th>Frac. Ind. Chain Yield</th>
<th>Absolute Yield ($\times 10^2$)</th>
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<tr>
<td>62</td>
<td>0.014</td>
<td>0.002</td>
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<td>MASS YIELD = $0.10 \times 10^{-2}$</td>
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<th>Atomic No.</th>
<th>Frac. Ind. Chain Yield</th>
<th>Absolute Yield ($\times 10^2$)</th>
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</thead>
<tbody>
<tr>
<td>62</td>
<td>0.001</td>
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FIGURE CAPTIONS

Fig. 1. Most probable charge curve.

Fig. 2. Calculated element yields.
Fig. 1.

- $^{235}\text{U}$ empirical curve - Wahl et al.
- $^{252}\text{Cf}$ x-ray det. - Kapoor et al.
Fig. 2.
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