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BIBLIOGRAPHY OF PARTICLE ACCELERATORS

JULY 1948 TO DECEMBER 1950

Bonnie E. Cushman

March, 1951

Berkeley, California
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Introduction

This bibliography is a supplement to that compiled and edited by E. Thomas, P. Mittelman, and H. H. Goldsmith, issued July 1, 1948 as BNL-L-101. The journals searched were Chemical Abstracts; Science Abstracts, Section A (Physics) and Section B (Electrical Engineering); Nuclear Science Abstracts; and Nucleonics. The period covered was June 1948 through December 1950. News briefs are not included in the list, nor is the majority of reports published by various institutions concerning progress in the construction of their particle accelerators. Information pertaining to particle accelerators was obtained primarily from a list of questions sent to institutions throughout the world. It is hoped that both the bibliography and list of accelerators are fairly complete. Notification of omissions and inaccuracies will be greatly appreciated.
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McKibben, J. L.


Mjakishev, G. Y.

Motz, H.

Murray, Raymond

Oliphant, M. L.

Pallock, Herbert C., and Westendorp, Willem F. (to General Electric Co., Schenectady, N. Y.)

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Svartholm, Nils

Westcott, C. H.

Westendorp, W. F. (to General Electric Co., Schenectady, N. Y.)
### PARTICLE ACCELERATORS IN THE UNITED STATES

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Dimensions</th>
<th>Energy (Mev)</th>
<th>Particle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argonne National Laboratory</td>
<td>*Constant frequency cyclotron</td>
<td>60&quot; pole piece dia.</td>
<td>20</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td>Tank 7' dia. x 25'long, 15' accelerating tube</td>
<td>1.5</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bartol Research Foundation</td>
<td>Van de Graaff</td>
<td>5' accelerating tube, Tank 4' dia. x 12' long, 200 lbs. pressure</td>
<td>1.8</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td>21' accelerating tube, Tank 12' dia. x 35' long, 300 lbs. pressure</td>
<td>5-10</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Linear Accelerator</td>
<td>1.75' long</td>
<td>1.4</td>
<td>e</td>
</tr>
<tr>
<td>Biochemical Research Foundation (Nswark, Delaware)</td>
<td>Cyclotron¹</td>
<td>38&quot; pole piece dia.</td>
<td>12</td>
<td>d</td>
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</tbody>
</table>

*Under construction

¹Data from Goldsmith, H. H., List of High Energy Installations, Brookhaven National Laboratory, 1948.
<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Dimensions</th>
<th>Energy (MeV)</th>
<th>Particle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brookhaven National Laboratory</td>
<td>Electrostatic accelerator</td>
<td>8' accelerating tube</td>
<td>2-3</td>
<td>d, p</td>
</tr>
<tr>
<td></td>
<td>Electrostatic accelerator</td>
<td>12' accelerating tube</td>
<td>4</td>
<td>p, d</td>
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<tr>
<td></td>
<td>*Cyclotron</td>
<td>60' pole piece dia.</td>
<td>20</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Electrostatic accelerator</td>
<td>3' accelerating tube</td>
<td>2</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>*Proton synchrotron (Cosmotron)</td>
<td>30' orbit radius</td>
<td>2000-3000</td>
<td>p</td>
</tr>
<tr>
<td>University of California</td>
<td>Cyclotron (60&quot;)</td>
<td>72' pole piece dia.</td>
<td>9</td>
<td>p</td>
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<tr>
<td></td>
<td>Synchrocyclotron</td>
<td>184' pole piece dia.</td>
<td>350</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>Linear accelerator</td>
<td>40' long</td>
<td>32</td>
<td>p</td>
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<tr>
<td></td>
<td>Synchrotron</td>
<td>1 meter orbit radius</td>
<td>335</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>*Proton synchrotron (Bevatron)</td>
<td>ca 120' pole piece dia.</td>
<td>6440</td>
<td>p</td>
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<tr>
<td>University of California</td>
<td>*Synchrotron</td>
<td>11.5' orbit radius</td>
<td>70</td>
<td>e</td>
</tr>
<tr>
<td>Medical School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of California</td>
<td>Cyclotron</td>
<td>37' pole piece dia.</td>
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<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (Mev)</td>
<td>Particle</td>
</tr>
<tr>
<td>--------------------------------</td>
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<tr>
<td>California Institute of Technology</td>
<td>Kevatron (Transformer-condenser rectified)</td>
<td>13&quot; tube</td>
<td>0.135</td>
<td>p, d</td>
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<tr>
<td></td>
<td>Electrostatic generator</td>
<td>5' x 6' tank, 27&quot; tube</td>
<td>0.6</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Electrostatic generator</td>
<td>8' x 13' tank, 8'6&quot; tube</td>
<td>1.7</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Electrostatic generator</td>
<td>8' x 22' tank, 9' tube</td>
<td>3</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>*Synchrotron</td>
<td>138&quot; radius</td>
<td>500</td>
<td>e</td>
</tr>
<tr>
<td>Carnegie Institute of Technology</td>
<td>*Synchrocyclotron</td>
<td>141.67&quot; dia.</td>
<td>ca 440</td>
<td>p</td>
</tr>
<tr>
<td>Carnegie Institution</td>
<td>Cyclotron¹</td>
<td>60&quot; pole piece dia.</td>
<td>15</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>Electrostatic generator¹</td>
<td></td>
<td>1</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Electrostatic generator¹</td>
<td></td>
<td>3.5</td>
<td>p, d</td>
</tr>
<tr>
<td>Case School of Applied Science</td>
<td>Flux-forced field-biased betatron</td>
<td>Radius 17.15 cm</td>
<td>30</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>*Direct voltage accelerator</td>
<td>Length 8'</td>
<td>0.7</td>
<td>p</td>
</tr>
<tr>
<td>Catholic University of America</td>
<td>Electrostatic generator¹</td>
<td></td>
<td>0.5</td>
<td>p, d</td>
</tr>
<tr>
<td>University of Chicago</td>
<td>Synchrocyclotron</td>
<td>170&quot; dia.</td>
<td>500</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>Cyclotron¹</td>
<td>32.5&quot; pole piece dia.</td>
<td>8</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>Cockcroft-Walton¹ (being rebuilt)</td>
<td></td>
<td>0.4</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Betatron¹</td>
<td></td>
<td>50-100</td>
<td>e</td>
</tr>
<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (MeV)</td>
<td>Particle</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------</td>
<td>--------------------------------</td>
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<td>----------</td>
</tr>
<tr>
<td>Columbia University</td>
<td>Cyclotron</td>
<td>36&quot; pole piece dia.</td>
<td>8-10</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>Cyclotron (F.M.)</td>
<td>164&quot; pole piece dia.</td>
<td>385</td>
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<tr>
<td>Cornell University</td>
<td>Synchrotron</td>
<td>1 m orbit radius</td>
<td>300</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Linear Accelerator¹</td>
<td></td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cyclotron¹</td>
<td>15&quot; pole piece dia.</td>
<td>1,5</td>
<td>d, p</td>
</tr>
<tr>
<td>Duke University</td>
<td>*Van de Graaff</td>
<td>25' tank</td>
<td>4</td>
<td>p, d, a</td>
</tr>
<tr>
<td>El Cerrito High School,</td>
<td>Cyclotron</td>
<td>6&quot; pole piece dia.</td>
<td>1</td>
<td>p</td>
</tr>
<tr>
<td>El Cerrito, California</td>
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<td></td>
</tr>
<tr>
<td>General Electric Company</td>
<td>6 betatrons</td>
<td>3 - 33&quot; orbit radii</td>
<td>100</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 - 7.5&quot; orbit radii</td>
<td>10</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 - 5.25&quot; orbit radius</td>
<td>20</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>*Cyclotron</td>
<td>60&quot; pole piece dia.</td>
<td>20</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>4 Synchrotrons</td>
<td>3 - 11.5&quot; orbit radii</td>
<td>70</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>(2 under construction)</td>
<td></td>
<td>180</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td>8'</td>
<td>2.5</td>
<td>p</td>
</tr>
<tr>
<td>Harvard University</td>
<td>Synchrocyclotron</td>
<td>95&quot; pole piece dia.</td>
<td>125</td>
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<tr>
<td>Hofstra College</td>
<td>*Cyclotron</td>
<td>24&quot; pole piece dia.</td>
<td>ca 6</td>
<td>p</td>
</tr>
<tr>
<td>University of Illinois</td>
<td>Cyclotron¹</td>
<td>47&quot; pole piece dia.</td>
<td>10</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Betatron¹</td>
<td></td>
<td>22</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Betatron¹</td>
<td></td>
<td>4</td>
<td>e</td>
</tr>
<tr>
<td>Location</td>
<td>Type</td>
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<td>Energy (Mev)</td>
<td>Particle</td>
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<td>-----------------------------------</td>
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<td>----------</td>
</tr>
<tr>
<td>University of Illinois (cont.)</td>
<td>Betatron</td>
<td>26 cm orbit radius</td>
<td>80</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Betatron</td>
<td>120 cm orbit radius</td>
<td>340</td>
<td>e</td>
</tr>
<tr>
<td>University of Illinois Medical</td>
<td>Betatron</td>
<td>19.5 cm orbit radius</td>
<td>25</td>
<td>e</td>
</tr>
<tr>
<td>School</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indiana University</td>
<td>Cyclotron</td>
<td>45&quot; pole piece dia.</td>
<td>11.4</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.7</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>22.8</td>
<td>α</td>
</tr>
<tr>
<td>Iowa State College</td>
<td>Transformer-rectifier produced</td>
<td>Tube length ca 60&quot; long</td>
<td>0.325-0.650</td>
<td>p, d</td>
</tr>
<tr>
<td>d.c. potential; linear accelerator</td>
<td>tube</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Synchrotron</td>
<td>11.5&quot; orbit radius</td>
<td>70</td>
<td>e</td>
</tr>
<tr>
<td>University of Iowa</td>
<td>Pressurized Van de Graaff</td>
<td>22' accelerator tube</td>
<td>3-4.</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Voltage multiplier accelerator</td>
<td>5' accelerator tube</td>
<td>0.5</td>
<td>p, d</td>
</tr>
<tr>
<td>Johns Hopkins University</td>
<td>Van de Graaff</td>
<td>6' dia. x 14' long tank,</td>
<td>1.5</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td></td>
<td>accelerating tube 7' long</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Kansas</td>
<td>Van de Graaff</td>
<td>Horizontal tank 6' dia. x 14'</td>
<td>2.5</td>
<td>positive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>long, 120 psi pressure</td>
<td></td>
<td>ions</td>
</tr>
<tr>
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<td>Pressurized Van de Graaff</td>
<td>Electrode dia. 48&quot;</td>
<td>1</td>
<td>p, d</td>
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<tr>
<td></td>
<td></td>
<td>Accelerating tube length 8'</td>
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<td></td>
</tr>
<tr>
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<td>42&quot; pole piece dia.</td>
<td>10</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td></td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Van de Graaff</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Betatron</td>
<td></td>
<td>20</td>
<td>e</td>
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<td></td>
<td>*Betatron</td>
<td></td>
<td>20</td>
<td>e</td>
</tr>
<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (Mev)</td>
<td>Particle</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------------------</td>
<td>--------------</td>
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<tr>
<td>Los Alamos Scientific Laboratory (cont.)</td>
<td>Betatron</td>
<td></td>
<td>14</td>
<td>e</td>
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<tr>
<td></td>
<td>Cockcroft-Walton</td>
<td></td>
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<td>Cockcroft-Walton</td>
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<td>0.125</td>
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<tr>
<td>Massachusetts Institute of Technology</td>
<td>Van de Graaff</td>
<td>2' tube, 2&quot; equipotential module</td>
<td>ca 0.800</td>
<td>p, d</td>
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<tr>
<td></td>
<td>Standing wave linear electron accelerator</td>
<td>20' long, Guide wave length 10.7 cm</td>
<td>18</td>
<td>e</td>
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<td>Standard cyclotron</td>
<td>42&quot; pole face</td>
<td>15</td>
<td>d</td>
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<td></td>
<td>7.5</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>a</td>
</tr>
<tr>
<td></td>
<td>Synchrotron</td>
<td>1 m orbit radius</td>
<td>340</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Vertical electrostatic</td>
<td>9&quot; accelerating tube</td>
<td>4</td>
<td>positive ions</td>
</tr>
<tr>
<td></td>
<td>generator, pressurized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Van de Graaff</td>
<td>Tank 1' dia. x 32' high 400 psi pressure</td>
<td>2-12</td>
<td>p, d, e</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td>Tank 4.5' dia. x 13' high 200 psi pressure</td>
<td>3.5</td>
<td>e</td>
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<tr>
<td></td>
<td>2 Van de Graaff x-ray</td>
<td>Tanks 3' dia. x 6' high 400 psi pressure</td>
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<td>e</td>
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<tr>
<td></td>
<td>generators</td>
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<tr>
<td>University of Michigan</td>
<td>*Racetrack synchrotron</td>
<td>40&quot; orbit radius</td>
<td>300</td>
<td>e</td>
</tr>
<tr>
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<td>Cyclotron</td>
<td>42&quot; pole piece dia.</td>
<td>10</td>
<td>d</td>
</tr>
<tr>
<td>University of Minnesota</td>
<td>*Proton linear accelerator</td>
<td>100' long linear acceleration path</td>
<td>66</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td>18' dia., 100 psi tank, single electrode</td>
<td>4</td>
<td>singly charged ions</td>
</tr>
<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (Mev)</td>
<td>Particle</td>
</tr>
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<td>-------------------------------------</td>
<td>-------------------------------------------</td>
<td>-----------------------------</td>
<td>--------------</td>
<td>----------</td>
</tr>
<tr>
<td>University of Missouri</td>
<td>Van de Graaff (for demonstration purposes)</td>
<td></td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>National Bureau of Standards</td>
<td>Electrostatic 1</td>
<td></td>
<td>1.4</td>
<td>e, p</td>
</tr>
<tr>
<td></td>
<td>*Synchrotron</td>
<td>33&quot; orbit radius</td>
<td>180</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Betatron</td>
<td></td>
<td>50</td>
<td>e</td>
</tr>
<tr>
<td>Naval Ordnance Laboratory</td>
<td>Betatron</td>
<td>5.5&quot; orbit radius</td>
<td>10</td>
<td>e</td>
</tr>
<tr>
<td>Naval Research Laboratory</td>
<td>Betatron 1</td>
<td></td>
<td>4</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Betatron</td>
<td>18.5 cm orbit radius</td>
<td>20-22</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>*Synchrotron</td>
<td>77 cm orbit radius</td>
<td>10 (now)</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Cockcroft-Walton - half-wave quadrupler</td>
<td>Accelerator tube 39.25&quot;</td>
<td>0.075-0.250</td>
<td>p, d, a</td>
</tr>
<tr>
<td></td>
<td>*High pressure horizontal</td>
<td>Accelerating tube 175&quot;</td>
<td>5</td>
<td>p, d, a</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td>12' accelerating path</td>
<td>4.5</td>
<td>p, d, a</td>
</tr>
<tr>
<td>Northwestern University</td>
<td>*Vertical Van de Graaff, pressurized</td>
<td>12' accelerating path</td>
<td>4.5</td>
<td>p, d, a</td>
</tr>
<tr>
<td>University of Notre Dame</td>
<td>Pressure electrostatic generator, horizontal</td>
<td>40' long x 8' dia. tank</td>
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<tr>
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<td>Pressure electrostatic generator, horizontal</td>
<td>6' long x 3' dia. tank</td>
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<tr>
<td>Oak Ridge National Laboratory</td>
<td>Van de Graaff</td>
<td>12' accelerator tube</td>
<td>5.7</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Van de Graaff</td>
<td>5' accelerator tube</td>
<td>2.7</td>
<td>p, d, and heavier particles</td>
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<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (Mev)</td>
<td>Particle</td>
</tr>
<tr>
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<tr>
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</tr>
<tr>
<td></td>
<td>Cyclotron</td>
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<td>p</td>
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<td></td>
<td>Cyclotron</td>
<td>86&quot; pole piece dia.</td>
<td>&gt;20</td>
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<tr>
<td>Ohio State University</td>
<td>Betatron¹</td>
<td>5' dia. x 20' long tank</td>
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<td>p, d</td>
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<tr>
<td></td>
<td>Horizontal Van de Graaff</td>
<td>Accelerator tube 12' long</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cyclotron</td>
<td>42&quot; pole piece dia.</td>
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<td>p</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.5</td>
<td>³H</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>³α</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td>²He³</td>
</tr>
<tr>
<td>University of Pennsylvania</td>
<td>Statitron¹ (electrostatic generator)</td>
<td></td>
<td>2-3</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>Betatron¹</td>
<td></td>
<td>22-25</td>
<td></td>
</tr>
<tr>
<td>Picatinny Arsenal</td>
<td>Betatron</td>
<td>7.5&quot; orbit radius</td>
<td>22</td>
<td>e</td>
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<tr>
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<td></td>
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<td></td>
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<td>Frequency modulated cyclotron</td>
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<tr>
<td>Purdue University</td>
<td>Microwave linear electron accelerator</td>
<td>3' long</td>
<td>1.5</td>
<td>e</td>
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<tr>
<td></td>
<td>Cyclotron</td>
<td>37.5&quot; pole piece dia.</td>
<td>20</td>
<td>³α</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10</td>
<td>d</td>
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<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (MeV)</td>
<td>Particle</td>
</tr>
<tr>
<td>---------------------------</td>
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<tr>
<td>Purdue University (cont.)</td>
<td>Synchrotron</td>
<td>40&quot; orbit radius</td>
<td>300</td>
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<tr>
<td></td>
<td>*Microwave linear electron</td>
<td>12' long</td>
<td>4-8</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>accelerator</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice Institute</td>
<td>Van de Graaff, horizontal</td>
<td>14' vacuum tube</td>
<td>2.5</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>pressure tank</td>
<td></td>
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<tr>
<td>University of Rochester</td>
<td>Cyclotron</td>
<td>26&quot; pole piece dia.</td>
<td>7</td>
<td>p</td>
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<tr>
<td></td>
<td>Synchrocyclotron</td>
<td>130&quot; pole piece dia.</td>
<td>250</td>
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<tr>
<td>Rock Island Arsenal</td>
<td>Betatron</td>
<td>ca 15&quot; orbit dia.</td>
<td>22</td>
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<tr>
<td>Stanford University</td>
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<td>2.9</td>
<td>d</td>
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<td>Linear electron accelerator</td>
<td>14'5&quot; long</td>
<td>6</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>(traveling-wave type)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Linear accelerator - Mark II</td>
<td>12' long</td>
<td>35</td>
<td>e</td>
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<tr>
<td></td>
<td>*Linear accelerator - Mark III</td>
<td>220' long (80' now</td>
<td>1,000</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>operating)</td>
<td>(200 now)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Texas</td>
<td>*Van de Graaff</td>
<td>Accelerating tube 10' long</td>
<td>4-5</td>
<td>positive</td>
</tr>
<tr>
<td></td>
<td>Cockcroft-Walton</td>
<td></td>
<td>0.100</td>
<td>ions</td>
</tr>
<tr>
<td>University of Washington</td>
<td>*Cyclotron</td>
<td>60&quot; pole piece dia.</td>
<td></td>
<td>positive</td>
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<tr>
<td>(Seattle)</td>
<td></td>
<td></td>
<td></td>
<td>ions</td>
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<tr>
<td>Washington University</td>
<td>Cyclotron</td>
<td>45&quot; pole face dia.</td>
<td>5</td>
<td>d</td>
</tr>
<tr>
<td>(St. Louis)</td>
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<tr>
<td>Westinghouse Electric Co.</td>
<td>Electrostatic generator</td>
<td>30' accelerating tube</td>
<td>3.7</td>
<td>p, d</td>
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<tr>
<td></td>
<td></td>
<td>65 psi pressure</td>
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<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (MeV)</td>
<td>Particle</td>
</tr>
<tr>
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<td>-------------------------------------------</td>
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<td>--------------</td>
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</tr>
<tr>
<td>University of Wisconsin</td>
<td>2 electrostatic generators (one under construction)</td>
<td></td>
<td>4.5</td>
<td>p, d, α</td>
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<tr>
<td>Yale University</td>
<td>Linear electron accelerator</td>
<td>4' 10.5&quot; long</td>
<td>10-15</td>
<td>e</td>
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<tr>
<td></td>
<td>Cyclotron</td>
<td>28&quot; pole piece dia.</td>
<td>8</td>
<td>α</td>
</tr>
<tr>
<td>University of Virginia</td>
<td>Van de Graaff (atomispheric)</td>
<td>5' column</td>
<td>0.4</td>
<td>positive ions</td>
</tr>
<tr>
<td></td>
<td>Resonant cavity linear accelerator</td>
<td>1' length</td>
<td>1</td>
<td>e</td>
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## Particle Accelerators Outside the United States

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Dimensions</th>
<th>Energy (MeV)</th>
<th>Particle</th>
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<tbody>
<tr>
<td><strong>Australia</strong></td>
<td></td>
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<tr>
<td>Australian National University,</td>
<td><em>Cyclo-synchrotron</em></td>
<td>Pole tip diameter 136&quot;. Synchrotron orbit 117&quot;.</td>
<td>Cyclotron section 200</td>
<td>p, d</td>
</tr>
<tr>
<td>Canberra</td>
<td></td>
<td></td>
<td>Then synchrotron action to 2000</td>
<td></td>
</tr>
<tr>
<td>University of Melbourne</td>
<td>Synchrotron</td>
<td>Orbit radius 7.5 cm</td>
<td>20</td>
<td>e</td>
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<tr>
<td></td>
<td>Electrostatic generator</td>
<td>Length of accelerating tube 9'.</td>
<td>1</td>
<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Electrostatic generator</td>
<td>Length of accelerating tube 6'6&quot;.</td>
<td>0.8</td>
<td>p, d</td>
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<tr>
<td><strong>Canada</strong></td>
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<tr>
<td>McGill University</td>
<td>Synchrocyclotron</td>
<td>82&quot; pole piece dia.</td>
<td>100</td>
<td>p</td>
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<tr>
<td>National Research Council</td>
<td>Cockcroft-Walton</td>
<td></td>
<td>0.65</td>
<td>positive ions</td>
</tr>
<tr>
<td>Laboratories, Ottawa</td>
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<td></td>
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<tr>
<td>National Research Council of</td>
<td>Vertical Van de Graaff</td>
<td>Length of accelerating tube 9', 200 psi, tank 16' high x 6' dia.</td>
<td>5</td>
<td>positive ions</td>
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<tr>
<td>Canada, Chalk River</td>
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<td></td>
<td>Positive ion accelerator</td>
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<td>0.2</td>
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<tr>
<td>Queens University, Kingston, Ont.</td>
<td>Synchrotron</td>
<td>Orbit radius ca 30 cm</td>
<td>75-80</td>
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<tr>
<td>University of Saskatchewan</td>
<td>Betatron</td>
<td>Orbit radius 20 cm</td>
<td>27.5</td>
<td>e</td>
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<tr>
<td>Location</td>
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<td>Dimensions</td>
<td>Energy (MeV)</td>
<td>Particle</td>
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<td><strong>Denmark</strong></td>
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<tr>
<td>Institute of Theoretical</td>
<td>Cyclotron(^1)</td>
<td>36&quot; pole piece dia.</td>
<td>9.5</td>
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<td>Physics, Copenhagen</td>
<td>Two electrostatic</td>
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<td>p</td>
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<tr>
<td>generators(^2)</td>
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<tr>
<td><strong>France</strong></td>
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<tr>
<td>Collège de France, Paris</td>
<td>Cyclotron(^1)</td>
<td>31&quot; pole piece dia.</td>
<td>7.5</td>
<td>d</td>
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<tr>
<td>Commissariat à l'Energie</td>
<td>*Cyclotron</td>
<td>162 cm pole piece dia.</td>
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<tr>
<td>Atomique, Laboratoires du</td>
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<td>Column length above base plate</td>
<td>3.5-4</td>
<td>p, d</td>
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<tr>
<td>Fort de Chatillon, Fortenay-</td>
<td>*Van de Graaff</td>
<td>5.85 m</td>
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<tr>
<td>aux-Roses, Seine, France</td>
<td></td>
<td>Cavity dia. 92 cm</td>
<td>0.5</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>*Resonant cavity ac-</td>
<td>Accelerating gap 3 cm</td>
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</tr>
<tr>
<td></td>
<td>celerator</td>
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<td>Electrostatic(^1)</td>
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<td>0.8</td>
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<td>Atomique, Ivry (Seine)</td>
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<td>0.6</td>
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<tr>
<td>University of Strasbourg</td>
<td>Cockcroft-Walton</td>
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<td>1.5</td>
<td>p, d</td>
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<td><strong>Germany</strong></td>
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<td>Physikalisches Institut der</td>
<td>Van de Graaff</td>
<td>Length 1.4 m</td>
<td>0.5</td>
<td>p, d</td>
</tr>
<tr>
<td>Universität Bonn</td>
<td>Cyclotron(^1)</td>
<td>16&quot; pole piece dia.</td>
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<td>p</td>
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<tr>
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<td>Type</td>
<td>Dimensions</td>
<td>Energy (Mev)</td>
<td>Particle</td>
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<tr>
<td>Institut für Physik im Max-Planck-Institut für Med. Forschung der Universität Heidelberg</td>
<td>Cyclotron</td>
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<td>13</td>
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<td>Van de Graaff</td>
<td>Length 3.60 m (12')</td>
<td>1</td>
<td>p, d, e</td>
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<td>40&quot; pole piece dia.</td>
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<td>Megavolt Versuchsanstalt, Wrist</td>
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<td>15</td>
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<td>Siemens-Reiniger-Werke, Erlangen</td>
<td>Betatron</td>
<td>Radius of equilibrium 85 mm</td>
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<td>*Betatron</td>
<td>Radius of equilibrium 105 mm</td>
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<td>Great Britain</td>
<td>Associated Electrical Industries, Ltd., Aldermaston</td>
<td>Van de Graaff</td>
<td>Overall length 66&quot;</td>
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<td></td>
<td>Van de Graaff</td>
<td>Pressure vessel height 18'6&quot;, dia. 6'10.5&quot;</td>
<td>3.1</td>
<td>p, d, a</td>
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<tr>
<td></td>
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<td>400 psi, tube length 9'</td>
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<tr>
<td>Atomic Energy Research Establishment, Harwell</td>
<td>Synchrocyclotron</td>
<td>110&quot; pole piece dia.</td>
<td>175</td>
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<td>Van de Graaff</td>
<td>Stack length 9'</td>
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<td>p, d, a</td>
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<tr>
<td></td>
<td>Van de Graaff</td>
<td>Tank 8' x 4', accelerating tube 5&quot; dia., 350 psi</td>
<td>2.3</td>
<td>e</td>
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<tr>
<td></td>
<td>*Cockcroft-Walton</td>
<td>Accelerating tube 6' long</td>
<td>0.6</td>
<td>positive ions</td>
</tr>
<tr>
<td>Travelling-wave linear accelerator (non-feedback type)</td>
<td>Accelerating waveguide 2 m long</td>
<td>3.6</td>
<td>e</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (Mev)</td>
<td>Particle</td>
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<tr>
<td>--------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-------------------------------------------</td>
<td>--------------</td>
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<tr>
<td>Harwell, (cont.)</td>
<td>*Travelling-wave linear accelerator (2 stage feedback type)</td>
<td>Each section 3 m long, total 6 m</td>
<td>15</td>
<td>e</td>
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<td></td>
<td>*Cockcroft-Walton (Machine for Medical Research Council's Radiobiological unit at Harwell)</td>
<td>Pressure tank ca 3 m high x 2 m dia.</td>
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<td>positive ions (d)</td>
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<td>Fixed frequency cyclotron 61.5&quot; pole piece dia.</td>
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<td>9</td>
<td>p</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>36</td>
<td>α</td>
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<tr>
<td>Cambridge University</td>
<td>*Proton synchrotron</td>
<td>15&quot; pole piece dia.</td>
<td>1,300</td>
<td>p</td>
</tr>
<tr>
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<td>Van de Graaff</td>
<td></td>
<td>4-5</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>Cyclotron</td>
<td>37&quot; pole piece dia.</td>
<td>7</td>
<td>d</td>
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<tr>
<td></td>
<td>Phillips</td>
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<td>p, d</td>
</tr>
<tr>
<td></td>
<td>Phillips</td>
<td></td>
<td>2</td>
<td>p, d</td>
</tr>
<tr>
<td>University of Edinburgh</td>
<td>*Cockcroft-Walton</td>
<td></td>
<td>1</td>
<td>p, d</td>
</tr>
<tr>
<td>Glasgow University</td>
<td>*Synchrotron</td>
<td>Orbit radius 125 cm</td>
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<td>e</td>
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<td></td>
<td>Synchrotron</td>
<td>Orbit radius 10 cm</td>
<td>30</td>
<td>e</td>
</tr>
<tr>
<td>Imperial College of Science and Technology, London University</td>
<td>Pressurized electrostatic generator</td>
<td></td>
<td>ca 2</td>
<td>positive ions and e</td>
</tr>
<tr>
<td>University of Liverpool</td>
<td>*Synchrocyclotron</td>
<td>150&quot; pole piece dia.</td>
<td>400</td>
<td>p, d, α</td>
</tr>
<tr>
<td></td>
<td>Cyclotron</td>
<td>36&quot; pole piece dia.</td>
<td>9</td>
<td>d</td>
</tr>
<tr>
<td>Location</td>
<td>Type</td>
<td>Dimensions</td>
<td>Energy (Mev)</td>
<td>Particle</td>
</tr>
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<tr>
<td>Medical Research Council, Hammersmith Hospital, London</td>
<td>Van de Graaff</td>
<td>Accelerating tube 7'6&quot; long x 10&quot; dia., 10 atm. pressure</td>
<td>2</td>
<td>p, d, e, etc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Linear accelerator</td>
<td>8-10</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Corrugated wave guide 3 m long</td>
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<tr>
<td></td>
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<td>*Continuous wave cyclotron 45&quot; pole piece dia.</td>
<td>15</td>
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<td></td>
<td></td>
<td></td>
<td>30</td>
<td>a</td>
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<tr>
<td>Metropolitan-Vickers, Ltd.</td>
<td>Betatron</td>
<td></td>
<td>20</td>
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<tr>
<td>High Voltage Laboratory, Manchester</td>
<td>Betatron</td>
<td></td>
<td>30</td>
<td>e</td>
</tr>
<tr>
<td>Oxford University</td>
<td>*Synchrotron</td>
<td>Orbit radius 46.7 cm</td>
<td>140</td>
<td>e</td>
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<td>Orbit radius 20 cm</td>
<td>16</td>
<td>e</td>
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<tr>
<td>Royal Cancer Hospital, London</td>
<td>Synchrotron</td>
<td>Orbit radius 10 cm</td>
<td>30</td>
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<tr>
<td>Telecommunications Research Establishment (A.E.R.E. Section), Malvern Great</td>
<td>Dielectric loaded traveling linear accelerator without feedback</td>
<td></td>
<td>1.5</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Synchrotron</td>
<td></td>
<td>15</td>
<td>e</td>
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<td>Synchrotron</td>
<td></td>
<td>30</td>
<td>e</td>
</tr>
<tr>
<td>Italy</td>
<td>Istituto Superiore di Sanità, Rome</td>
<td>Cockcroft-Walton</td>
<td>Length of accelerator tube ca 3.5 m</td>
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<tr>
<td></td>
<td>University of Padua</td>
<td>Electrostatic</td>
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<tr>
<td>Netherlands</td>
<td>Institute for Nuclear Research, Amsterdam</td>
<td>Synchrocyclotron</td>
<td>71&quot; pole piece dia.</td>
<td>28</td>
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<tr>
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<td></td>
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<td>56</td>
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<tr>
<td>Location</td>
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<td>Energy (MeV)</td>
<td>Particle</td>
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<td>-----------------------------------------------</td>
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<td>Philips Corp., Eindhoven</td>
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<td>p, d</td>
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<tr>
<td>University of Groningen</td>
<td>Electrostatic</td>
<td></td>
<td>0.3</td>
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<td>Norway</td>
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<td>Electrostatic</td>
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<td>1.5</td>
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</tr>
<tr>
<td></td>
<td>*Electrostatic</td>
<td></td>
<td>1.5</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>*Synchrotron</td>
<td></td>
<td>70-80</td>
<td>e</td>
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<tr>
<td>Norges Tekniske Høgskole, Trondheim</td>
<td>*Van de Graaff</td>
<td>Tank 6.6 m long x 2.35 m dia.</td>
<td>4</td>
<td>p, d</td>
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<tr>
<td></td>
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<td>15 atm. pressure, accelerating tube 3.6 m</td>
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<tr>
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<td>Neutron generator</td>
<td>Length 50 cm</td>
<td>0.1</td>
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<td></td>
<td>Van de Graaff</td>
<td>Length 1.5 m</td>
<td>0.5</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>*Pressure insulated Van de Graaff</td>
<td>Length 3.6 m</td>
<td>4</td>
<td>p, d</td>
</tr>
<tr>
<td>Russia</td>
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<tr>
<td>Radium Institute, USSR</td>
<td>Cyclotron</td>
<td>14&quot; pole piece dia.</td>
<td>1.8</td>
<td>d</td>
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<tr>
<td>Academy of Sciences, Leningrad</td>
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<tr>
<td>Physico-technical Institute, USSR Academy of Sciences, Leningrad</td>
<td>Electrostatic</td>
<td></td>
<td>0.7</td>
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<tr>
<td>Physico-technical Institute, Ukrainian SSR Academy of Sciences, Kharkov</td>
<td>Electrostatic</td>
<td></td>
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<td>Location</td>
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<td>Dimensions</td>
<td>Energy (MeV)</td>
<td>Particle</td>
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<td><strong>Sweden</strong></td>
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<tr>
<td>National Defense Research Laboratory, Stockholm</td>
<td>Electrostatic generator Pressure insulated (9 atm N₂)</td>
<td>Height of accelerating tube 2.25 m</td>
<td>1.8</td>
<td>p, d</td>
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<tr>
<td>Nobel Institute for Physics, Stockholm</td>
<td>Cyclotron</td>
<td>32&quot; pole piece dia.</td>
<td>7</td>
<td>d</td>
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<tr>
<td></td>
<td>*Cyclotron</td>
<td>88.5&quot; (225 cm) pole piece dia.</td>
<td>25</td>
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<td></td>
<td>Cascade generator</td>
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</tr>
<tr>
<td>Royal Institute of Technology, Stockholm</td>
<td>Synchrotron</td>
<td>Orbit radius 20 cm</td>
<td>35</td>
<td>e</td>
</tr>
<tr>
<td></td>
<td>Betatron</td>
<td>Orbit radius 8.3 cm</td>
<td>5.3</td>
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<tr>
<td>University of Stockholm</td>
<td>Two electrostatic generators</td>
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<tr>
<td>University of Uppsala</td>
<td>*Synchrocyclotron</td>
<td>230 cm pole face dia</td>
<td>200</td>
<td>p</td>
</tr>
<tr>
<td><strong>Switzerland</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Universität Basel</td>
<td>Cascade generator</td>
<td></td>
<td>1</td>
<td>p, d</td>
</tr>
<tr>
<td>Eidgenössische Technische Hochschule, Zürich</td>
<td>Van de Graaff</td>
<td>Length 3 m</td>
<td>1</td>
<td>p</td>
</tr>
<tr>
<td></td>
<td>Tensator (Transformer-rectifier)</td>
<td>Length 6 m</td>
<td>2</td>
<td>d</td>
</tr>
<tr>
<td></td>
<td>Cyclotron</td>
<td>1 m pole piece dia.</td>
<td>8</td>
<td>p</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>14</td>
<td>d</td>
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Information Division
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