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### Publication Date

1954-11-16

UCRL 2672

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UCRL-2672  
Unclassified Physics

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Radiation Laboratory  
Berkeley, California

Contract No. W-7405-eng-48

PARTICLE ACCELERATORS

I Bibliography

II List of High-Energy Installations

Frederick E. Frost and Jane M. Putnam

November 16, 1954

PARTICLE ACCELERATORS:  
Bibliography

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## PARTICLE ACCELERATORS

### I Bibliography

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November 16, 1954

### 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 Brookhaven National Laboratory BNL-L-101, and to the later extensions prepared by Bonnie E. Cushman, and issued in March, 1951, as University of California, Radiation Laboratory Report No. UCRL-1238 and to the extension prepared by Sergey Shewchuck and issued in September, 1952 as University of California, Radiation Laboratory Report No. UCRL-1951.

The journals searched in this compilation include:

Chemical Abstracts, 1952 through June 1954.  
Nuclear Science Abstracts, 1952 through June 1954.  
Science Abstracts

Section A (Physics), 1952 through June 1954.  
Section B (Electrical Engineering), 1952 through June 1954.

The list of references also includes some articles and reports that had not been indexed by the above. News briefs are not included in the list; however, some reports published by various institutions concerning progress in the construction of their particle accelerators are covered. References have been arranged alphabetically by author's surname under the type of accelerator. Each reference is numbered chronologically to facilitate searching for information by individual authors with the aid of the author index. An author index, showing all authors, is provided. Articles by companies, societies, organizations, etc. are arranged by source alphabetically in the author index.

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 the list of accelerators are fairly complete. Notification of omissions and inaccuracies will be greatly appreciated.

KEY TO ABBREVIATIONS

- CA . . . . Chemical Abstracts
- NSA . . . . Nuclear Science Abstracts
- SA . . . . Science Abstracts, Section A (Physics)
- SB . . . . Science Abstracts, Section B (Electrical Engineering)

Examples:

- CA 46:6783a indicates an abstract appearing in position 'a' in column 6783 of Chemical Abstracts for 1952. (Vol. 46-1952, Vol. 47-1953, and Vol. 48-1954)
- NSA 7:4667 indicates an abstract appearing as number 4667 in Nuclear Science Abstracts for 1953. (Vol. 6-1952, Vol. 7-1953, and Vol. 8-1954)
- SA 55:167 indicates an abstract appearing as number 167 in Science Abstracts, Section A (Physics) for 1952. (Vol. 55-1952, Vol. 56-1953, and Vol. 57-1954)
- SB 55:167 indicates an abstract appearing as number 167 in Science Abstracts, Section B (Electrical Engineering) (Vol. 55-1952, Vol. 56-1953, and Vol. 57-1954)

PARTICLE ACCELERATORS

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PARTICLE ACCELERATORS:  
List of High-Energy Installations

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## PARTICLE ACCELERATORS

### II List of High-Energy Installations

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November 16, 1954

### INTRODUCTION

The data pertaining to a particle accelerator were acquired in most cases by direct response to a questionnaire sent to the installation. Approximately eighty percent of the tabulated information in this section was obtained directly from the respective installations. The information requested was: type of machine, dimensions, status of construction, particles accelerated, and the accelerated energy of these particles. In a few cases it was necessary to acquire the needed information by indirect means, that is, the technical literature, previous bibliographies on particle accelerators, and from responses to questionnaires that were sent to foreign scientific and technical attachés.

Three months was the time interval arbitrarily decided upon for the response to approximately two hundred and fifty questionnaires. In some cases not all information required was available on the returned questionnaire.

Notification of omissions of accelerators would be greatly appreciated by this installation.

PARTICLE ACCELERATORS IN THE UNITED STATES

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Allis Chalmers Mfg. Co. (Milwaukee Wisconsin)	Betatron		24	e
<sup>1</sup> Argonne National Lab. (Illinois)	Cyclotron (constant frequency)	60" pole piece diam.	21.3	d
	Electrostatic	3' accelerating tube (horizontal)	0.25	p, d
	Electrostatic	20" accelerating tube (vertical) 6' ht.	0.25	d
	Van de Graaff	25' tank length (horizontal) 7' diam. 18' length of accelerating tube	3.6	p, d
	Van de Graaff	9' tank ht. (vertical) 3.5' diam.	1	e
<sup>1</sup> Bartol Research Foundation of the Franklin Institute (Swarthmore, Pa.)	Cockcroft-Walton		0.1	d
	Linear Accelerator	60 cm length	1.5	e

\* Under construction

<sup>1</sup> Direct information obtained in response to a questionnaire

<sup>2</sup> Indirect information (i. e. information from the technical literature, UCRL-1951, or from foreign scientific and technical attachés in response to questionnaires)

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Bartol Research Foundation of the Franklin Institute (Swarthmore, Penn.)	Van de Graaff	21' length of accelerating tube	5-10	p, d
	Van de Graaff	8' tube length	1.75	d, p
<sup>1</sup> Biochemical Research Foundation (Newark, Delaware)	Cyclotron	38" pole piece diam.	10	d
<sup>1</sup> Bradley Container Corp., (Maynard, Mass.)	Van de Graaff	12' length of accelerator	2	e
<sup>1</sup> Brookhaven National Lab. (Upton, L. I., N. Y.)	Cyclotron	18" pole piece diam.	2.8 2	p d
	Cyclotron	60" pole piece diam.	22	p, d, α
	Electrostatic accelerator	8' accelerating tube	2-3	d, p
	Electrostatic accelerator	12' accelerating tube	4	p, d, α
	Electrostatic accelerator	3' accelerating tube	2	e
	*Synchrotron (alternating gradient)	400' orbit radius	2500-3500	p
<sup>1</sup> Brown University, (Providence, R. I.)	Linear accelerator	3' length	0.2	p, d
<sup>1</sup> California, Univ. (Los Angeles, Calif.)	Cyclotron (FM)	41" pole piece diam.	21	p
<sup>1</sup> California, Univ. Medical School (San Francisco, Calif.)	Synchrotron (Electron)	29 cm orbit radius	70	e

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> California, University, Radiation Laboratory (Berkeley, California)	Bevatron	600" orbit radius	6440	p
	Cyclotron	72" pole piece diam.	10	p
			20	d
			40	a
	Linear accelerator	40' length	32	p
	Synchrocyclotron	184" pole piece diam.	350	p
			195	d
390			a	
Synchrotron	39" orbit radius	335	e	
Van de Graaff	27' tank length 8" tank diam.	4	p	
<sup>1</sup> California, University, Radiation Laboratory (Livermore, Calif.)	Cockcroft-Walton	12' accelerating tube	0.5	p, d, a
	*Cyclotron	90" pole piece diam.	4-14 5-12.5 10-25	p d a
<sup>1</sup> California Institute of Technology (Pasadena, California)	Electrostatic generator	5'x6' tank, 27" tube	0.6	p, d
	Electrostatic generator	8'x13' tank, 8'6" tube	1.8	p, d
	Electrostatic generator	8'x22' tank, 9'0" tube	2.6	p, d, a
<sup>1</sup> Carnegie Institute of Technology (Pittsburgh, Pa.)	Synchrocyclotron	142" pole piece diam.	450	p

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Carnegie Institution of Washington (Washington, D. C.)	Cyclotron (fixed frequency)	60" pole piece diam.	8 16 32	p d a
	Electrostatic		1	p, d, a
	Electrostatic		3.5	p, d, a
<sup>1</sup> Case Institute of Technology (Cleveland, Ohio)	Betatron	17.25 cm orbit radius	27	e
<sup>1</sup> Catholic University of America (Washington, D. C.)	Van de Graaff		0.5	p, d, a
<sup>1</sup> Chicago, University (Chicago, Ill.)	Betatron	33" orbit radius	100	e
	Cockroft-Walton		0.5	positive ions
	Synchrocyclotron	170" pole diam.	450	p
	Van de Graaff		2	p, d
<sup>1</sup> Chicago, University, Hospital (Chicago, Ill.)	Linear accelerator	16'	60	e
<sup>1</sup> Columbia University (New York, N. Y.)	Cyclotron	36" pole piece diam.	14 10 20	p d a
	Synchrocyclotron	164" pole piece diam.	400	p
	*Van de Graaff		10	p, d
<sup>1</sup> Connecticut University (Storrs, Conn.)	Cockroft-Walton	3' length of accelerating tube	.025-.250	positive ions

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Continental Foundry and Machine Co. (Coraopolis, Pa.)	Betatron	8.13 cm orbit radius	24	e
<sup>1</sup> Cornell University (Ithaca, N. Y.)	Synchrotron	150" orbit radius	1500	e
<sup>1</sup> Detroit Arsenal (Center Line, Mich.)	Betatron	5 1/2" orbit radius	15	e
<sup>1</sup> Dow Chemical Corp. (Midland, Mich.)	Van de Graaff	7' tank length 3' acceleration tube	2.0	H <sup>+</sup> , e
<sup>1</sup> Duke University (Durham, N. C.)	Van de Graaff	23' length of tank (horizontal)	4	p, d, α
<sup>1</sup> Ethicon Inc. (New Brunswick, N. J.)	Van de Graaff	67" ht. of machine 36" diam.	2	e
<sup>1</sup> Florida, University (Gainesville, Fla.)	Van de Graaff		1	p, d, α
<sup>1</sup> Foster Wheel Corp. (Mountaintop, Pa.)	Van de Graaff	58" linear accelerating tube	2.0	e
<sup>1</sup> General Electric Research Lab. (Schenectady, N. Y.)	Betatron	33" orbit radius	100	e
	Synchrotron	11 1/2" orbit radius	75	e
	Synchrotron	24" orbit radius	340	e
<sup>1</sup> Harvard University (Cambridge, Mass.)	Cyclotron (FM)	95" pole piece diam.	100	p
<sup>1</sup> Humble Oil and Refining Co. (Houston, Texas)	* Van de Graaff	1 million column	1-2.2	e
<sup>1</sup> Illinois, University (Urbana, Illinois)	Betatron	7.5 cm orbit radius	4.5	e
	Betatron	19.5 cm orbit radius	22	e

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Illinois, University (Urbana, Ill.)	Betatron	26 cm--orbit radius	80	e
	Betatron	120 cm--orbit radius	340	e
	Cyclotron	47" pole piece diam.	6 12 24	p d a
<sup>1</sup> Illinois, University, Medical School (Chicago, Ill.)	Betatron	19.5 cm--orbit radius	25	e
<sup>1</sup> Iowa State College (Ames, Iowa)	Synchrotron	11.5" orbit radius	70	e
<sup>1</sup> Kentucky, University (Lexington, Ky.)	Cockcroft-Walton	2' accelerating tube	0.120	d
	Van de Graaff	7'7" accelerating tube	2.7	p, d
<sup>1</sup> Los Alamos Scientific Laboratory (Los Alamos, New Mexico)	Betatron	19 cm orbit radius	24	e
	Cockcroft-Walton	40" horizontal accelerating tube	0.25	p, d
	*Cockcroft-Walton	76" vertical accelerating tube	0.6	d, p
	Cockcroft-Walton	76" vertical accelerating tube	0.25	d, p
	*Cyclotron	42" pole diameter	16 8 11 32	d p t a

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Los Alamos Scientific Laboratory (Los Alamos, New Mexico)	Van de Graaff	20' vertical accelerating tube 13 1/2' tank diam. 40' tank length	6.5	p, d
	Van de Graaff	66" horizontal accelerating tube 87" tank diam. 16' tank length	2.7	He <sup>3</sup> ions and t
	Van de Graaff	66" horizontal accelerating tube 5 1/2' tank diam. 16 1/2' tank length	2.7	p, d
<sup>1</sup> M. D. Anderson Hospital, Univ. of Texas (Houston, Texas)	Betatron	9.5" orbit radius	24	e
<sup>1</sup> Magnolia Petroleum (Dallas, Texas)	Van de Graaff	24 1/2" length of accelerating tube	0.50	H <sup>+</sup>
<sup>1</sup> Massachusetts Institute of Technology, Laboratory for Nuclear Science (Cambridge, Mass.)	Cyclotron	42" pole piece diam.	7.5 15 30	p d α
	Linear Accelerator	21' accelerator length	17	e
	Synchrotron	40" orbit radius	350	e
	Van de Graaff	9' length of accelerating tube (vertical) 5' diam. of tank 16' length of tank	4	p, d



Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Massachusetts Institute of Technology, Laboratory for Nuclear Science (Cambridge, Mass.)	Van de Graaff	18' length of accelerating tube (vertical) 12' diam. of tank 31' length of tank	8.5	p, d, α
<sup>1</sup> Memorial Center for Cancer and Allied Diseases (New York, N. Y.)	Betatron	20 cm orbit radius	24	e
<sup>2</sup> Michael Reese Hospital (Chicago, Ill.)	Linear Accelerator	10'	35	e
<sup>1</sup> Michigan, University, (Ann Arbor, Mich.)	Cyclotron	42" pole piece diam.	7.8	d
	Synchrotron (Electron)	40" orbit radius	300	e
<sup>1</sup> Minnesota, University (Minneapolis, Minn.)	Three section proton linear accelerator	100' long linear acceleration path (1st. section 20') (2nd. section 40') *(3rd. section 40')	10 40 68	p
<sup>1</sup> Missouri, University (Columbia, Mo.)	Van de Graaff		0.5	
<sup>1</sup> Montana State University (Missoula, Montana)	Travelling wave electron linear accelerator	37.8" length (2 section cavity)	7	e
<sup>1</sup> National Institute of Health (Bethesda, Maryland)	Van de Graaff	17' column	3	e
<sup>1</sup> Nebraska, University (Lincoln, Neb.)	Cockcroft-Walton		0.375	p
<sup>1</sup> Northwestern University (Evanston, Illinois)	* Van de Graaff	12' vertical accelerator tube	4.5	p, d, α
<sup>1</sup> Oak Ridge National Lab. (Oak Ridge, Tennessee)	Cockcroft-Walton	4'	0.250	positive ions

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Oak Ridge National Lab. (Oak Ridge, Tennessee)	Fixed frequency cyclotron	44" pole face	5	p
	Fixed frequency cyclotron	63" pole face	27	N <sup>+++</sup>
	Fixed frequency cyclotron	86" pole face	25	p
	Electrostatic generator	100" accelerator tube	0.625-1.25	positive ions
	Van de Graaff	12' accelerator tube	6.3	p, d
	Van de Graaff	58" accelerator tube	2.5	p, d
<sup>1</sup> Ohio State University (Columbus, Ohio)	*Cyclotron (fixed frequency)	47" pole piece diam.	7.5 15	p d a
	Van de Graaff	12' accelerating tube (horizontal)	1.8	p
<sup>1</sup> Oregon State College (Corvallis, Ore.)	Cyclotron (CW)	37" pole piece diam.	7.5 15	d p
<sup>1</sup> Pennsylvania, University (Philadelphia, Penn.)	Betatron	7 1/2" orbit radius	24	e
	Statitron (Electrostatic accelerator)	12'	2-3	positive ions
<sup>1</sup> Picattinny Arsenal (Dover, N. J.)	Betatron	8.125" orbit radius	24	e

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Pittsburgh, University (Pittsburgh, Pa.)	Cyclotron	47" pole piece diam.	10	p
			20	d
			40	a
<sup>1</sup> Princeton University (Princeton, N. J.)	* Proton Synchrotron	22' orbit radius	2000	p
	Cyclotron (FM)	35" pole piece diam.	19	p
<sup>1</sup> Purdue University (Lafayette, Indiana)	Cyclotron	37" pole piece diam.	10	d
			20	a
	Linear Accelerator	12' length	2-6	e
	Synchrotron	100 cm orbit radius	300	e
<sup>1</sup> Rice Institute (Houston, Texas)	Cockcroft-Walton		0.200	p, d
	Van de Graaff		2	p, d
	Van de Graaff		6	p, d
<sup>1</sup> Rock Island Arsenal (Rock Island, Ill.)	Betatron	19 cm orbit radius	22	e
<sup>1</sup> Shell Development Co. (Houston, Tex.)	Van de Graaff	78" length of tank	2	positive ions e
<sup>2</sup> Stanford Hospital (Palo Alto, Calif.)	* Linear Accelerator	6'	5-6	e
<sup>1</sup> Stanford Research Institute (Palo Alto, Calif.)	Van de Graaff	78" length of accelerator tank	2.0-2.5	p, e, d, t
<sup>1</sup> Stanford University (Palo Alto, Calif.)	* Linear Accelerator	20'	60-75	e
	Linear Accelerator	12'	35	e

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> Stanford University (Palo Alto, Calif.)	Linear Accelerator	220'	1000	e
	Linear Accelerator	12'	6	e
<sup>1</sup> The Swedish Hospital (Seattle, Wash.)	Van de Graaff	78" length of tank	2	positive ions e
<sup>1</sup> Texas, University (Austin, Texas)	Cockcroft-Walton		0.100	d
	Van de Graaff	10' accelerating tube length 7' tank diameter	4	p, d
<sup>1</sup> U. S. National Advisory Committee for Aeronautics, Lewis Flight Propulsion Lab. (Cleveland, Ohio)	Cyclotron	60" pole piece diam.	20	d
<sup>1</sup> U. S. National Bureau of Standards, Radiation Physics Lab. (Washington, D. C.)	Betatron	11.5" orbit radius	50	e
	Electrostatic generator	25' length (vertical axis)	1.4	e
	Electrostatic generator	5' length (vertical axis)	0.250	p, d
	Synchrotron	33" orbit radius	180	e
	*Van de Graaff	6' tank length	2	positive ions
<sup>1</sup> U. S. Naval Ordnance Lab. (White Oak Silver Spring, Maryland)	Betatron		10	e

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> U. S. Naval Ordnance Lab. (White Oak Silver Spring, Maryland)	Electrostatic		2	e
<sup>1</sup> U. S. Naval Postgraduate School (Monterey, Calif.)	Van de Graaff	4' accelerating column (horizontal)	2	p, d, e
<sup>1</sup> U. S. Naval Radiological Defense Lab. (San Francisco, Calif.)	Van de Graaff	78" tank length	2	p, d, e
<sup>1</sup> U. S. Naval Research Lab. (Washington, D. C.)	Betatron	7.3" orbit radius	21	e
	Cockcroft-Walton		0.50	positive ions
	Cockcroft-Walton		0.250	positive ions
	Four Microtrons	6"-9" pole piece diameter	1st. 3.3 2nd 3.3 3rd 6 *4th. ?	e
	*Synchrotron	77 cm orbit radius	100	e
	Van de Graaff	30" accelerating tube length	2.1	p, d, a
	Van de Graaff	174" accelerating tube length	5.0	p, d, a
	Van de Graaff	78" length of tank	1-2	e
	Van de Graaff			e, p

Location	Type	Dimensions	Energy (Mev)	Particle
<sup>1</sup> University Hospital of Cleveland (Cleveland, Ohio)	* Van de Graaff	78" length of tank	2	e
<sup>1</sup> The Upjohn Company (Kalamazoo, Mich.)	Van de Graaff		2	e
<sup>1</sup> Virginia, University (Charlottesville, Va.)	Linear Accelerator (resonant cavity)	1' length	0.75	e
	Van de Graaff	5' length of tank	0.5	positive ions
	* Van de Graaff	4' length of tank	1	positive ions
<sup>1</sup> Washington, University (Seattle, Wash.)	Cyclotron (CF)	60" pole piece diam.	21.5	d
			43	a
			10.8	p
<sup>1</sup> Washington University (St. Louis, Missouri)	Cyclotron (fixed frequency)	45" pole piece diam.	10.2	d
			5.1	p
			20.4	a
<sup>1</sup> Washington University, Institute of Radiology (St. Louis, Mo.)	Betatron		24	e
<sup>1</sup> Watertown Arsenal (Watertown, Mass.)	Van de Graaff		2.2	p, d
<sup>1</sup> Watervliet Arsenal (Watervliet, N. Y.)	Betatron	19 cm orbit radius	24	e
<sup>1</sup> Westinghouse Electric Corp. (Pittsburgh, Pa.)	Electrostatic	30' tube length 15' diam.	2.5	p, d
<sup>1</sup> Yale University (New Haven, Conn.)	* Independent-cavity linear electron accelerator	9'4" cavity assembly	15	e

PARTICLE ACCELERATORS OUTSIDE THE UNITED STATES

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Australia</u>				
<sup>1</sup> Melbourne University (Victoria, Australia)	*Cyclotron	40" pole diam.	5-10 4-5 8-10	p d a
	Electron Synchrotron	10 cm orbit radius	20	e
	Van de Graaff	6.5' vertical accelerating tube length	0.7	p, d
	Van de Graaff	10' vertical accelerating tube length	1	p, d
<u>Belgium</u>				
<sup>2</sup> Liege, Universite, Centre de Physique Nucleaire (Liege, Belgium)	Cockcroft-Walton		1	p, d
<sup>2</sup> Louvain, Universite, Centre de Physique Nucleaire (Louvain, Belgium)	Cyclotron	90 cm pole piece diam.	13	d
	Van de Graaff		0.5-2	e
<sup>2</sup> Ecole Royale Militaire, Centre de Physique Nucleaire (Bruxelles, Belgium)	Cockcroft-Walton	4 m length	1.4	p
	*Linear Accelerator	5 m	1-10	p
<sup>2</sup> Faculte Polytechnique de Mons, Centre de Physique Nucleaire (Mons, Belgium)	Cockcroft-Walton		1.2	e, p

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Belgium</u>				
<sup>2</sup> Gand, Universite, Centre de Physique Nucleaire (Gant, Belgium)	Linear Accelerator		0.8	e
<sup>2</sup> Institut Interuniversitaire des Sciences Nucléaires, Centre Annexé a la Faculté Polytechnique de Mons (Mons, Belgium)	Cockcroft-Walton	6 m length of accelerating tube	1.3	positive ions
<sup>2</sup> Libre de Bruxelles, Universite (Bruxelles, Belgium)	Cockcroft-Walton	4 m tube length	0.650	p, d
<sup>2</sup> Libre de Bruxelles, Universite (Bruxelles, Belgium)	Cockcroft-Walton		0.80	p, d
<u>Canada</u>				
<sup>1</sup> Atomic Energy of Canada Ltd. (Chalk River, Ontario)	Positive ion accelerator		0.10	p, d
	Positive ion accelerator		0.35	p, d, He <sup>3</sup> , t
	Van de Graaff	9' accelerating tube length	3.5	p, He <sup>3</sup>
<sup>2</sup> British Columbia, University (Vancouver, Canada)	Van de Graaff	16' length of tube 8' tank	2.3	p, d, He <sup>+</sup>
<sup>1</sup> McGill University (Montreal, P.Q., Canada)	Cyclotron (FM)	82" pole piece diam.	90	p
<sup>2</sup> Montreal, University (Montreal)	Cockcroft-Walton		0.50	p, d
<sup>1</sup> Queens University (Kingston, Ontario)	Synchrotron	29.3 cm orbit radius	70	e
<sup>1</sup> Saskatchewan, University (Saskatoon, Saskatchewan)	Betatron	20 cm orbit radius	27	e



Location	Type	Dimensions	Energy (Mev)	Particle
<u>Denmark</u>				
<sup>1</sup> Copenhagen, University (Copenhagen, Denmark)	Cyclotron	90 cm pole piece diam.	10	d
<u>France</u>				
<sup>1</sup> Centre National de la Recherche Scientifique, Laboratoire de Synthèse Atomique (Ivry (Seine))	Electrostatic		0.6	p
	Electrostatic		0.9	d
<sup>1</sup> College de France (Paris, France)	Cyclotron	80 cm pole piece diam.	9 18	d He <sup>+</sup>
<sup>2</sup> College de France (Paris, France)	Linear Accelerator		2	e
<sup>1</sup> Commissariat à l'Énergie Atomique, Centre d'Études Nucléaires de Saclay	Synchrocyclotron	160 cm pole piece diam.	25	d
	*Synchrotron	840 cm orbit radius	1750-2500	p
	Van de Graaff	1.25 m length	1.5	p
	Van de Graaff	3.75 m length	5	p, d
<sup>2</sup> Ecole Normale Supérieure (Paris, France)	Linear Accelerator		1-2	e
	Linear Accelerator		6	e
<sup>2</sup> Institut des Hautes Etudes (Paris, France)	Betatron	24.5 cm orbit radius	31	e

Location	Type	Dimensions	Energy (Mev)	Particle
<u>France</u>				
<sup>1</sup> Strasbourg, Universite, Institute de Recherches Nucléaires (Strasbourg, France)	Cockcroft-Walton	5 m accelerating tube length (vertical)	1.5	p, d
<u>Germany</u>				
<sup>1</sup> Hechspannungs laboratorium Hechingen Abt. des Max Planck-Instituts für Physik der Stratosphäre, Hechingen (Hohenzollern) Tübinger Str. 2	Cockcroft-Walton	5.5 m linear accelerating tube	1.5	p, d
<sup>2</sup> Institute for Nuclear Physics (Hamburg, Germany)	Van de Graaff		2.5	
<sup>1</sup> Max-Planck-Institut für Chemie (Mainz, Germany)	Electrostatic	425 cm length of accelerating tube	1.5	p, d
	* Van de Graaff	350 cm length of accelerating tube	>3	e, p, d
<sup>2</sup> Max-Planck-Institut für Physik, (Heidelberg, Germany)	* Betatron		30	e
	Betatron		15	e
<sup>1</sup> Max-Planck-Institut für Physik (Heidelberg, Germany)	Cyclotron	1010 mm	13	d, p, $\alpha$
<sup>2</sup> Max-Planck-Institut für Physik (Heidelberg, Germany)	Van de Graaff	3.6 m length	1	p, d, e
<sup>2</sup> Physikalisches Institut der Technischen Hochschule (Karlsruhe, Germany)	Betatron	24.5 cm orbit radius	31	e

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Germany</u>				
<sup>2</sup> Rheinische Friedrich-Wilhelms-Universität Bonn (Bonn, Germany)	*Synchrocyclotron		50	p
	*Synchrotron		500	e
	Van de Graaff	1.4 m length	0.5	p, d
<sup>2</sup> Siemens-Reiniger-Werke (Erlangen, Germany)	Betatron	105 mm radius of equilibrium	12-15	e
	Betatron	85 mm radius of equilibrium	6	e
<u>Great Britain</u>				
<sup>1</sup> Associated Electrical Industries Ltd. (Aldermaston, Berks., England)	*Electrostatic	3'6" length of tube	4	p
	Van de Graaff	4'6" length of tube	0.550	p, d
	Van de Graaff	9' length of tube	3.8	p, d
<sup>1</sup> Atomic Energy Research Establishment (Harwell, Berks., England)	Cockcroft-Walton		0.5	p, d, t
	Cockcroft-Walton	68" tube length	1	p, d
	*Linear Accelerator	6 m length	37	e
	Linear Accelerator	6 m length	14.5	e
	Linear Accelerator	6 m length	45	e
	*Linear Accelerator	270 m length	600	p

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Great Britain</u>				
<sup>1</sup> Atomic Energy Research Establishment (Harwell, Berks., England)	Synchrocyclotron	110" pole piece diam.	175	p
	*Van de Graaff	13' length of tube	3.1	p, He <sup>+</sup>
	Van de Graaff	4' length of accelerator 8'3"x4' tank size	2.3	e
<sup>1</sup> Birmingham, University (Birmingham, England)	Cyclotron (fixed frequency)	62 1/2" pole piece diameter	10 20 40	p d a
	Synchrotron, Proton	450 cm pole piece diameter	1000	p
<sup>1</sup> Cambridge, University (Cambridge, England)	Cockcroft-Walton	12' length of accelerating tube (vertical)	1	p, d
	Cockcroft-Walton	16' length of accelerating tube (vertical)	1.4	p, a
	Cyclotron	35.5" pole piece diam.	8(d)	p, d, a
	Van de Graaff	9' accelerating tube length (vertical) 5'10.5" tank diam. 18'10" tank length	2.8	H <sub>1</sub> <sup>+</sup> , He <sub>2</sub> <sup>+</sup>
<sup>1</sup> Christie Hospital and Holt Radium Inst. (Withington, Manchester, England)	Betatron	22 cm orbit radius	20	e
	Linear Accelerator	1 m length	4	e

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Great Britain</u>				
<sup>1</sup> Edinburgh, University (Edinburgh, Scotland)	Cockcroft-Walton	12'3" length of accelerating column	1	p, d
<sup>1</sup> Glasgow, University (Glasgow, Scotland)	Synchrotron (Electron)	125 cm orbit radius	350	e
<sup>1</sup> Hammersmith Hospital, Radiotherapeutic Research Unit (London, England)	*Cyclotron	50" pole piece diam.	15	d, α
	Linear Accelerator (Travelling Wave)	3m length	8	e
	Van de Graaff	7' accelerating tube	2	e, d
<sup>1</sup> Liverpool, University (Lancashire, England)	Synchrocyclotron	150" pole piece diam.	400	p
<sup>1</sup> Metropolitan-Vickers Elec. Co., Ltd. Research Dept. (Manchester, England)	Betatron	19 cm orbit radius	20	e
	Linear Accelerator (Travelling Wave)	1 m length	4	e
<sup>2</sup> Mount Vernon Hospital (London, Eng.)	Linear Accelerator	1 m length	4	e
<sup>2</sup> Newcastle General Hospital (Newcastle upon Tyne)	Travelling Wave Linear Electron Accelerators	1 m length of Accelerator	3.7	e
<sup>1</sup> Oxford University (Oxford, England)	Cockcroft-Walton	12' vertical column	1	p, d, He <sup>+</sup>
	Cockcroft-Walton	6' vertical column	0.500	p, d, He <sup>+</sup>
	Synchrotron	47 cm orbit radius	125	e

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Great Britain</u>				
<sup>1</sup> Royal Cancer Hospital (London, England)	Synchrotron	10 cms orbit radius	30	e
	Van de Graaff	4'5" accelerating tube	2	e
<sup>2</sup> St. Bartholomew's Hospital (London, England)	Travelling wave linear electron accelerator	6 m length of accelerator	15	e
<sup>1</sup> University College (London, England)	Microtron	17" pole piece diam.	5	e
	* Microtron	80" pole piece diam.	25	e
<sup>2</sup> Western General Hospital (Edinburgh, Scotland)	Linear Accelerator	1 m length	4	e
<sup>1</sup> Westminster Hospital (London, England)	Van de Graaff	78" length of tank	2	e
<u>India</u>				
<sup>1</sup> Institute of Nuclear Physics (Calcutta)	Cyclotron	39" pole diam.	8	d
<sup>1</sup> Tata Institute of Fundamental Research (Bombay, India)	Cascade Generator		1.2	d
	Cyclotron	12" pole piece diam.	1	p
	* Cyclotron	60" pole piece diam.	15	p
	* Linear Accelerator	4 m accelerating guide length 6 m machine length	15	e
	* Van de Graaff		1	

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Italy</u>				
<sup>1</sup> Centro Italian Studi Esperienze (Milan, Italy)	Cockcroft-Walton	1.5 m length	0.400	p, d, e
<sup>2</sup> Clinica Medica, Università-Torino, (Turin, Italy)	Betatron	24.5 cm orbit radius	31.5	e
<sup>2</sup> Istituto di Fisica, Università-Torino, (Turin, Italy)	* Synchrotron	29 cm orbit radius	104	e
<sup>2</sup> Istituto Nazionale di Fisica Nucleare-Frascati (Rome, Italy)	* Synchrotron	360 cm orbit radius	1000	e
<sup>1</sup> Pisa, University (Pisa, Italy)	* Synchrotron	360 cm orbit radius	1000	e
<sup>2</sup> Università-Catania (Catania, Italy)	* Electrostatic generator	3.5 m pressure tank ht. 2 m pressure tank diam.	2	p, d
<u>Japan</u>				
<sup>2</sup> Central Research Laboratory of Hitachi Limited (Tokyo, Japan)	Betatron	7 cm radius of electron orbit	3.5	e
	Betatron	22 cm radius of electron orbit	2.0	e
<sup>2</sup> Institute of Science (Tokyo, Japan)	Cyclotron	25" pole piece diam.	40	d
<sup>2</sup> Konan University (Kobe, Japan)	Cockcroft-Walton			p, d
<sup>2</sup> Kushu, University (Fukuoka, Japan)	Van de Graaff			heavy particles
<sup>2</sup> Kyoto University, Department of Physics (Kyoto, Japan)	* Cyclotron		15	

Location	Type	Dimensions	Energy (Mev)	Particles
<u>Japan</u>				
<sup>2</sup> Kyoto, University (Kyoto, Japan)	Cockcroft-Walton			p, d
	Cyclotron	105 cm pole piece diam.	16	d
<sup>2</sup> Osaka, University (Osaka, Japan)	Betatron	19 cm radius of electron orbit	24	e
	Betatron	8 cm radius of electron orbit	6	e
	Betatron	5 cm radius of electron orbit	4.5	e
	Cockcroft-Walton			p, d
	Cyclotron	111.8 cm pole piece diameter	12	d
	Van de Graaff			heavy particles
<sup>2</sup> Research Laboratory, Mitsubishi Electric Co., Limited (Hyogo, Japan)	Betatron	18 cm radius of electron orbit	30	e
<sup>2</sup> Scientific Research Institute (Tokyo, Japan)	Cockcroft-Walton			p, d
	Cyclotron	66 cm pole piece diam.	4	d
<sup>2</sup> Shimazuseisakusho Limited (Nakakyoku, Japan)	Betatron	8 cm radius of electron orbit	6	e
	Betatron	20 cm radius of electron orbit	24	e



Location	Type	Dimensions	Energy (Mev)	Particle
<u>Japan</u>				
<sup>2</sup> Tohoku, University (Sendai, Japan)	Synchrotron	25 cm orbit radius	40	e
	Van de Graaff			heavy particles
<sup>2</sup> Tokyo Institute of Technology (Tokyo, Japan)	*Synchrotron	15 cm orbit radius	30	e
<sup>2</sup> Tokyo, University (Tokyo, Japan)	Cyclotron	40 cm pole piece diam.	2	d
	*Synchrocyclotron	160 cm pole piece diam.	21 70	d p
	Van de Graaff			heavy particles
<sup>2</sup> Tokyo University of Education (Tokyo, Japan)	Betatron	8.2 cm radius of electron orbit	6	e
<sup>2</sup> Tokyo, University (Tokyo, Japan)	*Synchrotron	100 cm orbit radius	60	e
<u>Netherlands</u>				
<sup>2</sup> Delft Institute of Technology (Delft, Netherlands)	Betatron		8	e
	*Proton Synchrotron	3.25 m	1000	p
	Van de Graaff		2.5	p, d
<sup>1</sup> Instituut voor Kernfysisch Onderzoek (Amsterdam, Netherlands)	Synchrocyclotron	71" pole piece diam.	27 54	d a

Location	Type	Dimensions	Energy (Mev)	Particles
<u>Netherlands</u>				
<sup>2</sup> Natuurkundig Laboratorium der Rijksuniversiteit (Groningen, Netherlands)	Cockcroft-Walton	3 m accelerating tube length	0.6	d
	Cockcroft-Walton	3 m cascade generator ht. 1.60 m accelerating tube length	0.6	p, d
	* Van de Graaff	2.50 m generator ht. 1.20 m accelerating tube length	0.5-0.6	p, d
	* Van de Graaff (pressurized)	8 m pressure tank, ht. 3.20 m pressure tank diam. 4 m accelerating tube length	6	positive ions
<sup>1</sup> State University of Utrecht (Utrecht, Netherlands)	Cockcroft-Walton	8' length of accelerating tube	0.700	p, d
<u>Norway</u>				
<sup>2</sup> Det Norske Radium Hospital (Oslo, Norway)	Betatron	24.5 cm orbit radius	31	e
<sup>2</sup> Haukeland Sykehus (Bergen, Norway)	Van de Graaff	5.2 m accelerating tube	1.5	e
<sup>2</sup> Norges Tekniske Högskole (Trondheim, Norway)	Van de Graaff	3.6 m accelerating tube	4	p, d
<sup>2</sup> Oslo, University (Oslo, Norway)	Electrostatic	50 cm accelerating tube	0.1	d

Location	Type	Dimensions	Energy (Mev)	Particles
<u>Norway</u>				
<sup>2</sup> Oslo, University (Oslo, Norway)	Van de Graaff	3.6 m tube length	3-3.5	p
	Van de Graaff	1.2 m tube length	0.5	p
	Van de Graaff	3.6 m accelerating tube	4	p, d
	Van de Graaff	1.5 m accelerating tube	0.5	p
<sup>1</sup> Bergen, University (Bergen, Norway)	Betatron	40 cm orbit radius	50	e
	Van de Graaff	7 m length of tank 4.5 m diam.	1.5	p, d
<u>South Africa</u>				
<sup>1</sup> South African Council for Scientific and Industrial Research (Pretoria, South Africa)	*Cyclotron	44.5" pole piece diam.	18	d, p, a
<u>Sweden</u>				
<sup>2</sup> Chalmers University of Technology (Göteborg, Sweden)	Van de Graaff	4.5 m accelerating tube (vertical) 2.5 m tank diam. 7.3 m tank length	4-5	e positive ions
	Van de Graaff	225 cm accelerating tube length (vertical) 180 cm diam. of tank 410 cm tank length	1.8	e, p, d
Van de Graaff		225 cm accelerating tube length (vertical)	1.8	e, p, d

Location	Type	Dimensions	Energy (Mev)	Particle
<u>Sweden</u>				
<sup>2</sup> Fysiska Institutionen (Lund, Sweden)	* Van de Graaff	400 cm accelerating tube length (vertical) 700 cm length of tank 200 cm diam.	4	p, d
<sup>1</sup> The Gustaf Werner Institute, Univ. of Uppsala (Uppsala, Sweden)	Synchrocyclotron	90" pole piece diam.	200	p
<sup>2</sup> Institutionen för fysikalisk Kemi, Kungl. tekn. högskolan (Stockholm, Sweden)	Betatron	9.5 cm orbit radius	5	e
<sup>2</sup> Lund, University (Lund, Sweden)	Synchrotron	20 cm orbit radius	35	e
<sup>1</sup> Nobel Institute of Physics (Stockholm, Sweden)	Cockcroft-Walton	6.5 m accelerating tube length (vertical)	1.4	p, d
	Cyclotron (fixed-frequency)	80 cm pole piece diam.	3.5 7 14	p d a
	Cyclotron (fixed-frequency)	225 cm pole piece diam.	12.5 25 50 200	p d a heavy ions
<sup>2</sup> Radiofysiska Institutionen, Karolinska Sjukhuset (Stockholm, Sweden)	Cockcroft-Walton	3.5 m tank length	1.2	e
<sup>2</sup> Royal Institute of Technology (Stockholm, Sweden)	* Synchrotron (alternating gradient)	3.0 m orbit radius	1000	e

Location	Type	Dimensions	Energy (Mev)	Particles
<u>Switzerland</u>				
<sup>1</sup> Basel, University (Basel, Switzerland)	Electrostatic accelerator	3 m tube length	1	p, d
<sup>1</sup> Conseil Européen Pour La Recherche Nucléaire, Proton-Synchrotron Group (Geneva, Switzerland)	* Proton Synchrotron	200 m pole piece diam.	25	p
	* Synchrocyclotron		600	p
<sup>2</sup> Inselspital (Bern, Switzerland)	Betatron	24.5 cm orbit radius	31	e
<sup>2</sup> Physikalisches Institut der Eidg. Technischen Hochschule, (Zürich, Switzerland)	Cockcroft-Walton		1.2	p, d, α
	* Cockcroft-Walton		2	p
	Cyclotron	70 cm pole piece diam.	8	p
	Linear Accelerator	6 m length	1.4	p, d, α
<sup>1</sup> Zürich Cantonal Hospital (Zürich, Switzerland)	Betatron	24.5 cm orbit radius	31.5	e
<sup>1</sup> Zürich, University (Zürich, Switzerland)	Van de Graaff	4' length of tube	1.7	p, d
<u>Yugoslavia</u>				
<sup>1</sup> Institute of Nuclear Sciences "Boris Kidritsch" (Belgrade, Yugoslavia)	Cockcroft-Walton	1 m accelerating tube length	0.2	p, d

Location	Type	Dimensions	Energy (Mev)	Particles
<u>Yugoslavia</u>				
<sup>1</sup> Institute of Nuclear Sciences, "Boris Kidritch" (Belgrade, Yugoslavia)	Cockcroft-Walton	6m accelerating tube length	1.45	p, d
<sup>2</sup> Physikalisches Institut "J. Stefan" (Ljubljana, Yugoslavia)	Betatron	24.5 cm orbit radius	31	e