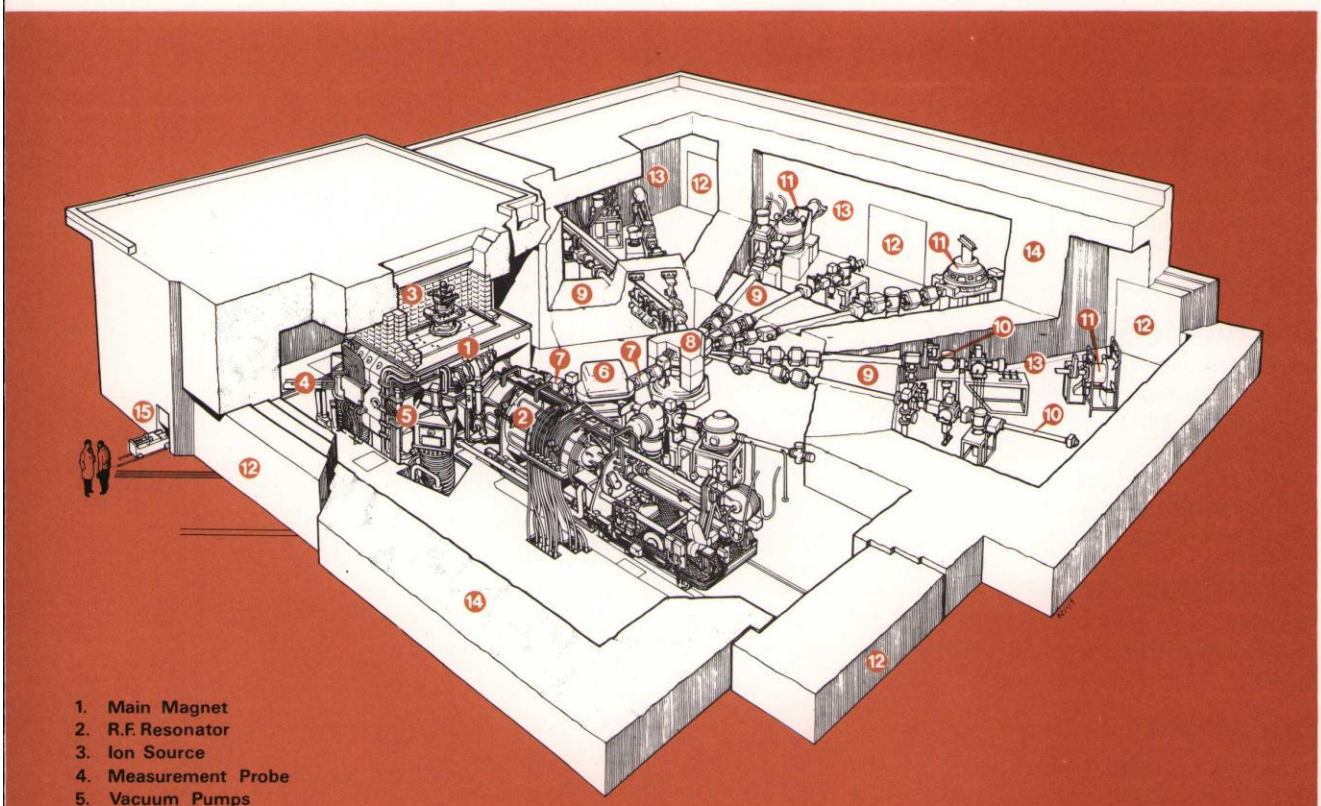
HARWELL Accelerator Services

Harwell Variable Energy Cyclotron

The V.E.C. allows ready acceleration of positive ions obtainable from gaseous elements and compounds, and from some solids, up to at least mass 90. A selection is shown overleaf.



1. Main Magnet
2. R.F. Resonator
3. Ion Source
4. Measurement Probe
5. Vacuum Pumps
6. Bending Magnet
7. Quadrupoles
8. Switching Magnet
9. Shield Plug
10. Flight Tubes
11. Users Experiments
12. Shielding Doors
13. Target Rooms
14. Concrete Shielding
15. Target Transporter

Cut-away view of vault showing Cyclotron and Beam Transport System

Energy

is continuously variable over a range of ten for lighter ions with a maximum $\frac{84\ \text{charge}^2}{\text{mass}}$ MeV (53 MeV for protons).

Currents

available depend upon the ion accelerated and range from several tens of microamperes for protons, deuterons and alpha particles to nanoamperes for highly stripped ions e.g. 175 meV C^{5+}.

Three areas of special interest are:

(i) Protons ~ 50 MeV
Alphas ~ 84 MeV

(ii) B. C. N. O. Ne ~ 5–13 MeV per nucleon at μA levels.

(iii) Ni, Cr, etc. ~ 1–2 MeV per nucleon at μA levels.

Energy Resolution

from the machine is about 0.5% but better resolution can be obtained at reduced current levels e.g. 0.1% for 50 MeV protons at 0.5 μA.

The Beam Spot

is normally about 1 cm diameter. Two dimensional programmed scanning is available to give uniform current deposition over the target area, and scattered beams can be used for extreme uniformity at very low current levels.

Eight Beam Lines

are available for alternate use and customers' target systems can usually be left in position between runs.

Equipment

is available for irradiation of thick and thin foils and some powders, and there are three scattering chambers.

Computing

A PDP8 is available in the building and there are teletype links to the IBM 370.

Enquiries to:
R. W. McIlroy
Building 540.2
AERE, Harwell
Oxfordshire
Telephone: Abingdon (0235) 24141
Ext. 2694

Table of extracted beams available: June 1974

Particle.	Approximate Energy (MeV) at extraction radius.						
H^+	7	10	13	17	20	24	27
	30	35	40	43	46	48	53
H^+ }	10.0	12.5	13.7	15	17.5	20	22.5
$_2D^+$ }	27	30	32.5	36	40	42	
$^3He^+$		12					
$^3He^{2+}$	28	33	39	53	73	83	
$^4He^+$	4	5	6	7.2	7.5	8	9.3
	11	12.1	17.5				
$^4He^{2+}$	20	25	27.5	30	35	40	45
	52	53	60	65	72	80	84
$^{10}B^{3+}$		76					
B^{4+}		134					
$^{11}B^{3+}$		67					
B^{4+}		120					
$^{12}C^{2+}$		22					
C^{3+}		24					
C^{4+}	40	44	48	52	56	65	70
	72	88	118				
C^{5+}		175					
$^{14}N^+$		3					
N^{2+}		7					
N^{4+}	45	53	84	98			
N^{5+}	125	150					
$^{16}O^{3+}$		49					
O^{4+}	32	70	81				
O^{5+}		128					
$^{18}O^{5+}$		116					
$^{19}F^{4+}$		60					
$^{20}Ne^{3+}$	20	38					
Ne^{4+}		65					
Ne^{5+}	60	85	110				
Ne^{6+}		146					
$^{27}Al^{3+}$		30					
Al^{4+}		53					
$^{40}Ar^{6+}$		64					
Ar^{8+}		130					

Table of extracted beams available: June 1974 (Continued)

Particle	Approximate Energy (MeV) at extraction radius
$^{52}Cr^{6+}$	52
$^{56}Fe^{6+}$	50
$^{58}Ni^{4+}$ Ni^{6+} Ni^{8+} Ni^{9+}	24 48 100 120
$^{59}Co^{6+}$	47
$^{63}Cu^{7+}$	60
$^{90}Zr^{6+}$ $^{92}Mo^{6+}$	32 32

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