GENERAL DESIGN FEATURES OF THE WARSAW UNIVERSITY 200 cm ISOCHRONOUS HEAVY ION CYCLOTRON

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Design of an AVF heavy ion cyclotron was started in the Institute of Experimental Physics of the University of Warsaw in 1971. The general idea was to make a modernized copy of the 200 cm AVF cyclotron operating since 1968 in the Laboratory of Nuclear Reactions at Dubna. The project is a result of cooperation of the University of Warsaw with the Laboratory of Nuclear Reactions at Dubna and the Institute of Nuclear Research at Swierk.

The main characteristics of this cyclotron are:

a) a broad interval of accelerated ions with the mass to charge ratio $2 \leqslant A/z \leqslant 5$,

b) relatively high maximum energy given by the relation $E = 178\ (z/A)^2$ MeV/nucleon,

c) variable energy in the range to about 50 % below the maximum energy.

As a basis of this cyclotron, a commercial magnet SP-72L of conventional H-type construction is used. Its main parameters are listed in Table 1. Four straight 42 deg. sectors are used to produce the azimutal variation of the magnetic field. The isochronous average field pattern in the range from 1.6 to 2.14 T is obtained by sector shaping, circular iron shims and 8 pairs of circular trimming coils. Because of the high saturation effect, the shape of sectors and shims is determined by field measurements and semi-empirical considerations. At present the measurements are done and shaping will be finished this year.

The accelerating system consists of two 45 deg. dees excited on the 2-nd or 3-rd harmonic by two panel resonators to an amplitude of 75 kV. The RF generators supply up to 150 kW in the frequency range of 9 - 27 MHz.

The vacuum system consists of four oil diffusion pumps with liquid nitrogen traps. The total pumping speed is 2×10^4 l/s and should give a pressure of $2 - 3 \times 10^{-6}$ mm Hg in operating conditions.

Two types of internal ion source will be used:

1) arc ion source with directly heated cathode for light ion production (H_2^+, D_2^+, He_4^+),

2) indirectly heated cathode and high power arc for heavy ions (from C_{12} to Ar_{40}).

The beam extraction system will be of two types depending on ion type (Table 2): thin foil stripper (aluminium or carbon foils) or electrostatic deflector. Both systems include proper magnetic channels.

The beam handling system assures five beam lines, one of which will be equipped with a monochromising system giving an energy definition better than 10^{-3}.

Table 1: Design data of the Warsaw University cyclotron:

MAGNET	
Pole tip diameter	200 cm
Beam radius, max.	90 cm
Gap-hills	4.1 - 2.6 cm
valleys	15 cm
avf sectors	4,42 deg., straight
Main coils current	1300A max, stabil.10^{-4}
circular trimming coils	8 pairs
Weight	211 tons
Power in main coils	325 kW
rf system	
2 panel resonators	
2 dees, width 45 deg.	
Main operating modes	2-nd harmonic, 3-rd harmonic n-shift
RF range	14 - 25 MHz
RF power	150 kW
Dee voltage	75 kV

Table 2: Some particle beams of the Warsaw University cyclotron:

Particle:	Energy MeV/nuclear:	Extraction:
H_2^+	28	stripping
D_2^+	7 - 11	stripping
He_3^+	12 - 19	electrostatic
He_4^+	7 - 11	stripping
C_{12}^{+3}	7 - 11	stripping
C_{12}^{+4}	11 - 19	electrostatic
C_{14}^{+4} +5	9 - 23	electrostatic
O_{16}^{+4}	7 - 11	stripping
O_{16}^{+5}	11 - 17	electrostatic
Ne_{20}^{+5}	7 - 11	stripping
Ne_{22}^{+5}	6 - 9	stripping
P_{31}^{+6}	5 - 7	electrostatic
S_{32}^{+}	6 - 8	electrostatic
Ar_{40}^{+8}	5 - 7	electrostatic

Proc. 7th Int. Conf. on Cyclotrons and their Applications (Birkhäuser, Basel, 1975), p. 107