

A COMPACT CYCLOTRON C-30 FOR MEDICAL ISOTOPE PRODUCTION

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The isochronous cyclotron C-30 with pole diameter 105 cm accelerates H^+ particles up to 31 MeV or D^+ to 16 MeV with intensities about 50 μA . The protons or deuterons extracted by stripping will be used for medical isotopes production.

The magnetic structure of the C-30 cyclotron consists of four straight sectors with shaped surfaces placed on each pole of the magnet. This structure allows to get proper magnetic field for H^+ or D^+ particles without correcting coils system at field levels in the center 1.743 T or 1.765 T respectively. The accelerating system involves two 45 degrees dees coupled in the center and operating on the second or the fourth harmonic mode and resonating at frequencies 53.14 or 53.84 MHz.

The principles of the magnetic and accelerating structures are similar to the Warsaw University cyclotron U-200P /1,2/ with necessary scaling procedure described in /3/. The whole system is shown in Fig. 1.

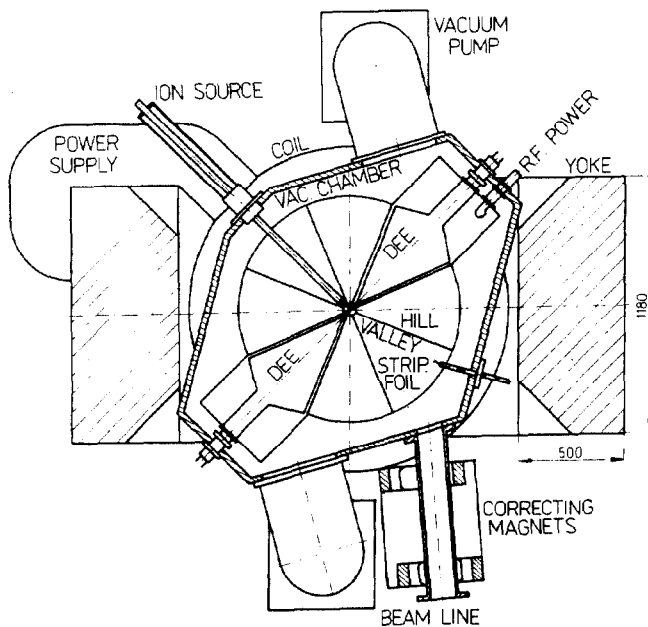


Fig. 1. The magnetic and accelerating structures of the C-30 cyclotron.

The magnet manufactured by Huta FABRYE Poland is of conventional type but constructed for easy mounting and cyclotron maintenance. On the pole faces there are placed four hills with straight boundaries and with an effective magnetic field angle of 45 degrees. The gap between hills varies from 20 mm at the extraction radius to about 33 mm near the center /Fig. 2/.

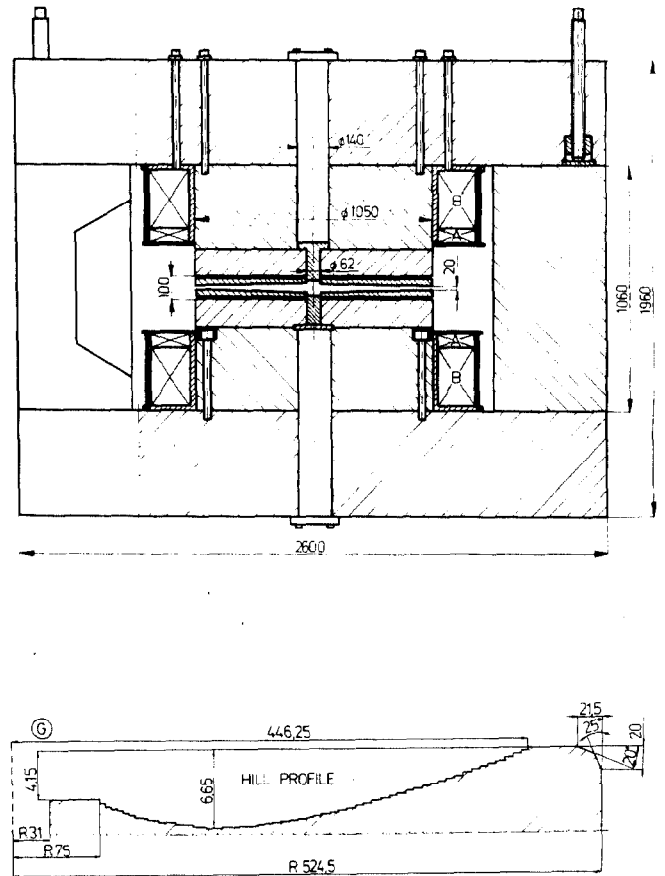


Fig. 2. Front-view of the magnet the hill profile.

Each hill is spaced from the pole face by 5 mm gap for small errors corrections in the magnetic field distribution by inclination and additional iron shims. The yoke has an ϕ 140 mm axial channel to allow an axial injection system from external ion source. The upper part of the magnet and vacuum chamber can be lifted of about 0.5 m by a screw system to allow access inside the cyclotron.

The main coils are divided into two sections A and B and separately supplied.

This system permits to tune the isochronous field for protons or deuterons using the effect of coil distance to the symmetry plane. The main isochronization is done by changing the field level. The effect of iron saturation and the differential power supply give appropriate magnetic field distribution.

The ion source used is similar to that of the CP-42 cyclotron /4,5/, and is under development for lower gas consumption. The extraction is done by stripping in a thin carbon foil of about 50 ug/cm^2 .

References

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- /2/ J. Sura, INR 1836/XXV/PL/A, Warszawa /1979/.
- /3/ J. Sura et. al., IPJ 1982/ZDAJ/PL/B, Warszawa /1983/.
- /4/ G. G. Hendry et.al., Ninth Int. Conf. on cycl. and their Appl., 125-127, Caen /1981/.
- /5/ K. W. Ehlers, IEEE Trans. NS-12, No 3 p. 811- 816.

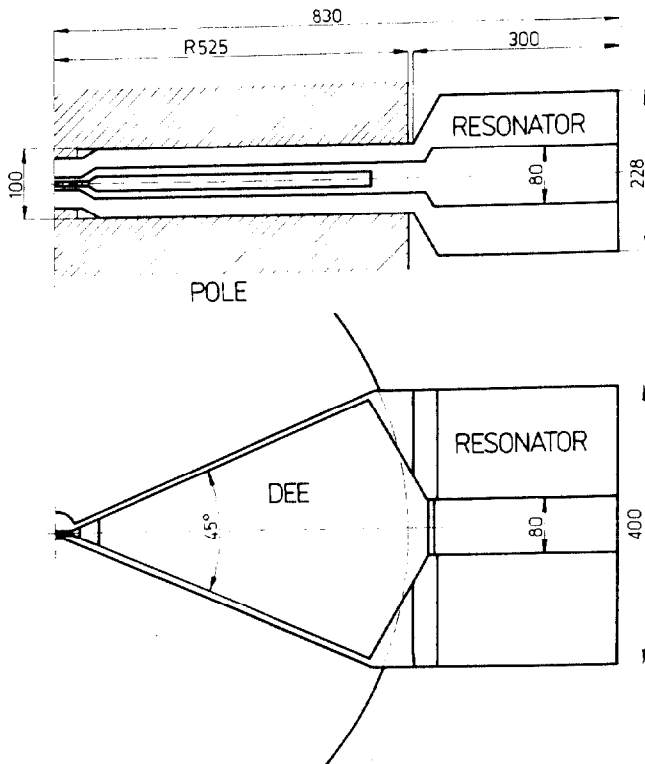


Fig. 3. One half of the accelerating system.

The accelerating system /Fig. 3/ consists of two 45 degree dees placed in two opposite valleys and rectangular resonators. The dees are bridged in the center and mounted on rectangular stems. There is no moving shorts. The necessary tuning of RF in the range of 0.6 MHz is done by inductive trimmers which are installed in each resonator and which can be rotated in 90 degrees range. This system resonates at about 53 MHz and assures 50 kV on the dees at 40 kW power. The voltage drops of about 15% from center to the extraction radius. The mode of operation for protons is the second harmonic and for deuterons the fourth harmonic. The RF power is supplied by one loop coupled to the generator. The feedback system beginning with inductive probe and acting on RF power amplification chain does assure amplitude stability about $2 \cdot 10^{-4}$. The RF power supply system is manufactured by the Radio and Television Factory ZARAT in Warsaw Poland.