Characterization of the performances of the ENEA Racetrack Microtron

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In the last years a variable energy (15-100 MeV) racetrack microtron has been built at the ENEA Frascati Center, in view of FEL and neutron spectroscopy applications. The operation of the machine has needed the introduction of vertical and horizontal correction coils in each return path. In this paper the last measures of the performances of the accelerator are presented.

1. INTRODUCTION

The ENEA racetrack microtron (fig.1) was built in the Accelerator Laboratories at Frascati for FEL experiments in the infrared region, but it is a machine of considerable interest for many other important applications such as neutron spectroscopy and production of short life radioisotopes [1].

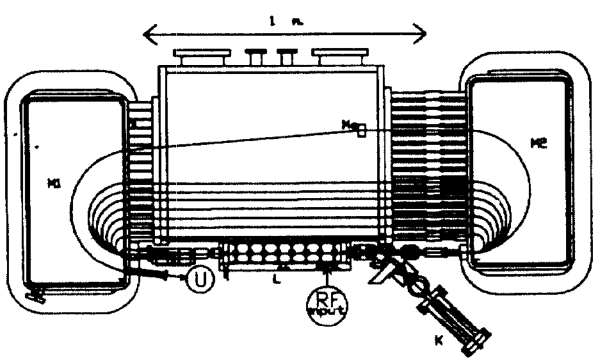

fig.1. ENEA RTM layout

A detailed description of the various parts of the machine was given in a previous paper[2], but in addition we introduced iron screens, correcting coils and an extraction magnet in a fixed position. In table 1 the main parameters of the ENEA RTM are shown.

TABLE 1
ENEA RTM parameters

RF Frequency	2.998 GHz
Injection Energy	40 KeV
Energy gain per turn	4-5.5 MeV
Magnetic field	1.07 T
Distance between magnets	124.4 cm
Max number of orbits	18

In the following sections we describe the actual state of the machine and the results of beam measurements.

2. MAGNETIC CORRECTIONS

The main magnet system of the racetrack microtron is composed of two 180° main magnets with reverse field magnets for vertical stability.
We screened the fringe region which extends in the injection region, where beam energy is low, placing two 5 mm thick ARMCO iron screen in front of the two magnets.
The thickness of the screen was choosen measuring the current after the first passage through the linac with the main magnets excited: we used different test iron slabs of increasing thickness until we reached the same current we got without the influence of the main magnetic field. On account of the small available space we placed the radial correcting coils in same cuts made for this purpose in the auxiliary poles in order to obtain an horizontal focusing and compensate the effect of alignment errors (fig.2). Each coil is supplied by an indipendent power supply which furnishes a maximum current of 1 A for a total of about 40 power supplies.

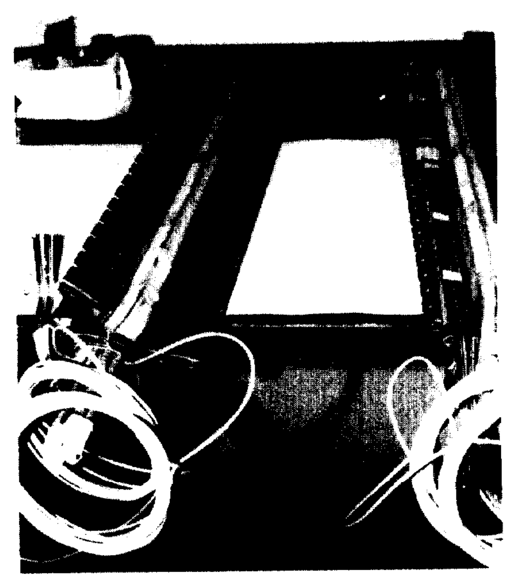

fig.2 Auxiliary poles with correcting coils mounted on

In order to improve the vertical focusing of the auxiliary poles that decreases quadratically with energy we placed some magnets outside of the vacuum chamber on the tubes on the side of the movable magnet.

3. EXTRACTION

The extraction at present is performed deflecting the beam by a magnet placed outside of the vacuum chamber in a 10 cm straight tube in corrispondence of the eighth orbit.
A 6° deflection lets the beam pass over the common axis and exit throughout a tube on the side opposite to the injection system (fig.1). In this position a current monitor is placed.

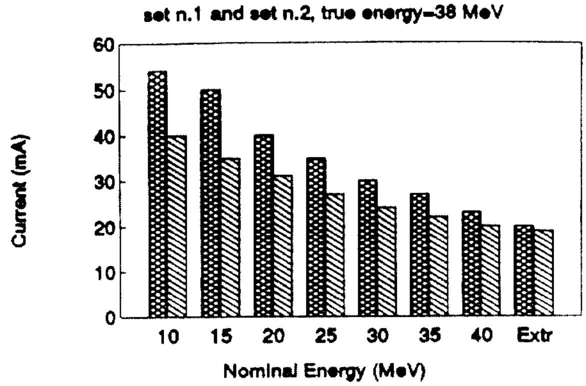

fig.3 measured beam current

4. OPERATION OF ENEA RTM

The ENEA RTM is still in a preliminary operativity stage.
The maximum number of orbits is 18, but operation has up to now been limited to 8 orbits. This is due to delay in costructing electronic controls and to radiation safety reasons. We have operated the machine between 4.6 and 5.3 energy gain per turn corresponding to an energy between 36 and 43 MeV extracting usually 80%-90% of the beam current at the maximum energy. Different configurations of the parameters and corrections leads to different distributions of the current in the orbits (fig.3).
The maximum current at the last orbit is dependent of the energy gain and varies from 12 mA at 43 MeV to 24 mA at 36 MeV. The maximum current at 10 MeV, in the first complete orbit is 120 mA but it is reached with a tune of the parameters which does not allow to recirculate the beam throughout the other orbits.

Longitudinal instabilities have been observed at the last orbit (7-8) that can easily overcome simply moving linear accelerator. Pulse repetition rate is always kept low (below 10 Hz).

5. CONCLUSIONS

The ENEA racetrack microtron has operated up to a maximum energy of 43 MeV with an extacted current of 12 mA. In the next months improvements of the controls and bunker will allow a full energy check of the accelerator. A new injection line equipped with a prebunching cavity is under design in order to improve the capture efficiency.

6. REFERENCES

[1] A.G.Belov et al., "Production of Iodine-132 by means of the microtron", Proceedings of Indo-Soviet meeting on microtrons (January 22-24,1992).
[2] L. Picardi et al., "The ENEA Racetrack microtron", Proceedings of EPAC 90 (Nice, June 12-16, 1990), Vol I, p.443.