Romanian Reports in Physics, Vol. 66, No. 1, P. 39–53, 2014

ELECTRICAL ENGINEERING ASPECTS OF RADIOTHERAPY ACCELERATORS*

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Received April 23, 2013

Abstract. Linear accelerators and various kinds of cyclotrons are being used in conventional and modern radiation therapy. Acceleration of charged particles is accomplished through interaction of electromagnetic waves with the particle. The electromagnetic waves are generated in RF and microwave range. The generation and conduction of wave is managed with cavities and waveguides along with associated high power high frequency circuits. In the present work, the structure of RF circuits in medical accelerators is studied. Requirements and ratings of RF generators in various kinds of accelerators are compared and the design principles are reviewed for both LINAC and cyclotron. There are many delicate and interwoven engineering points and tips in design, construction, selection and implementation of electrical and electronic components with differences and similarities between LINACs and cyclotrons.

Key words: LINAC, cyclotron, RF circuit, loaded cavity, resonator.

1. RF FOR LINACS

In this paper, we describe the layout and the properties of the main linacs, in which the electron and positron beams are accelerated from 5 to 250 GeV at a gradient of E_{acc}= 23.4 MV/m. Some cell cavities in the linac are contained in cryomodules, which also house the focusing quadrupoles, steering magnets, and beam position monitors (BPM). The radio frequency (RF) system consists of a number of 10 MW klystronsper linac (including overhead), which are installed in connection to the pulsed power supplies (modulators) by high voltage cables. The RF system consists of 286 stations each of which provides power at 1.3GHz to a total of 36 accelerating the cavities. Peak RF power needed for one superconducting cavity at full gradient and maximum beam current (23.4 MV/m and 9.5 mA) is 231 kW. Taking into account a regulation reserve of 10% for phase

* Paper presented at the 1st Annual Conference of the Romanian Society of Hadrontherapy (ICRSH 2013), February 21–24, 2013, Predeal, Romania.