ELECTRON ACCELERATOR

LINAC Model LPR–4 (TESLA)

Institute of Isotopes, Budapest

DESCRIPTION

DOSIMETRY

SELECTED PUBLICATIONS

SCHEME

PHOTO

ELECTRON ACCELERATOR

The LPR-4 (TESLA) electron accelerator produces an electron beam of **3 to 5 MeV** average energy in pulse mode with **200 mA peak current**.

Two modes of operation are available:
i) single pulses
ii) continuous train of pulses with repetition frequency selectable as 50, 25, 12.5 or 6.25 Hz (about 100 W)

The normal pulse length is **2.6 μs**. The pulses can be shortened to about **800 ns** by an electrostatic deflection system placed between the electron gun and the accelerator tube. An electromagnetic deflection system is positioning the beam entering the "scanning chamber" and allows scanning with about 1 Hz frequency. The electron beam leaves the chamber through a 0.03 mm thick titanium window of 200 x 18 mm^2 size.

Using a high-density metal target, such as platinum, strong bremsstrahlung (X-rays) can be produced with a conversion efficiency of a few percent. The high-energy part of the X-ray spectrum can be converted by the relevant (X,n) nuclear reaction to neutrons using deuterium (heavy water) or beryllium placed around or adjacent to the metal target.

It is noted that during operation a strong high frequency electromagnetic field is present around the accelerator that may interfere with electronic devices.

Dosimetry

Physical measurements of beam energy:

The **Faraday cup** with an electrometer measures the total beam charge. The cage is placed usually besides the target and the electron beam is altering between the cage and the target.

The **ferrite core toroidal coil** produces a voltage proportional to the beam charge. The coil is placed between the target and the electron source, without intercepting the beam. The method can be calibrated by the Faraday cage or by a chemical dosimeter.

Chemical dosimetry:

It is based on the measurement of chemical reaction products produced by radiation.

The **Fricke** dosimeter uses the radiation-induced oxidation of Fe^{2+} ions to Fe^{3+}. The conventional Fricke dosimeter can measure **dose-rates up to 10 Gy/pulse**.

The **thiocyanate** dosimeter uses $(SNC)_2^-$ ions produced in aqueous solution of potassium thiocyanate. The detection limit is about 0.1 Gy.

The **ethanol-chlorobenzene dosimeter** uses the hydrochloric acid formation. Dose range: **0.1 kGy – 1 MGy** (see details in chapter on Gamma Irradiation Facility)

Radiochromic films (films and pieces of polymers) exposed to radiation change their colour and the absorbance (e.g. at 656.5 nm) measured can be related to dose by calibration

Selected Publications

A. Kovács: Study and applicability of routine methods in electron beam and "Bremsstrahlung" dosimetry; progress Report No. 5135/R1/RB for IAEA (1996)

A. Kovács, A. Miller: Use of ethanol-monochlorobenzene dosimeters at electron accelerators, Radiat. Phys. Chem. 36/6 (1990) 709-713

A. Kovács, K. K. Mehta, A. Miller: Characterization of linear electron accelerators using reference and routine dosimetry methods; Proc IAEA Symp. High-Dose Dosimetry, Vienna (1990)

A. Kovács, M. Baranyai, L. Wojnárovits: Characterization of fluorometric, calorimetric, oscillometric and radiochromic dye film dosimeters under processing conditions at electron accelerators, in: Dosimetry for radiation processing, IAEA-TECDOC-1156, IAEA, Vienna June 2000, pp 71-79

See also chapter on Gamma Irradiation Facility

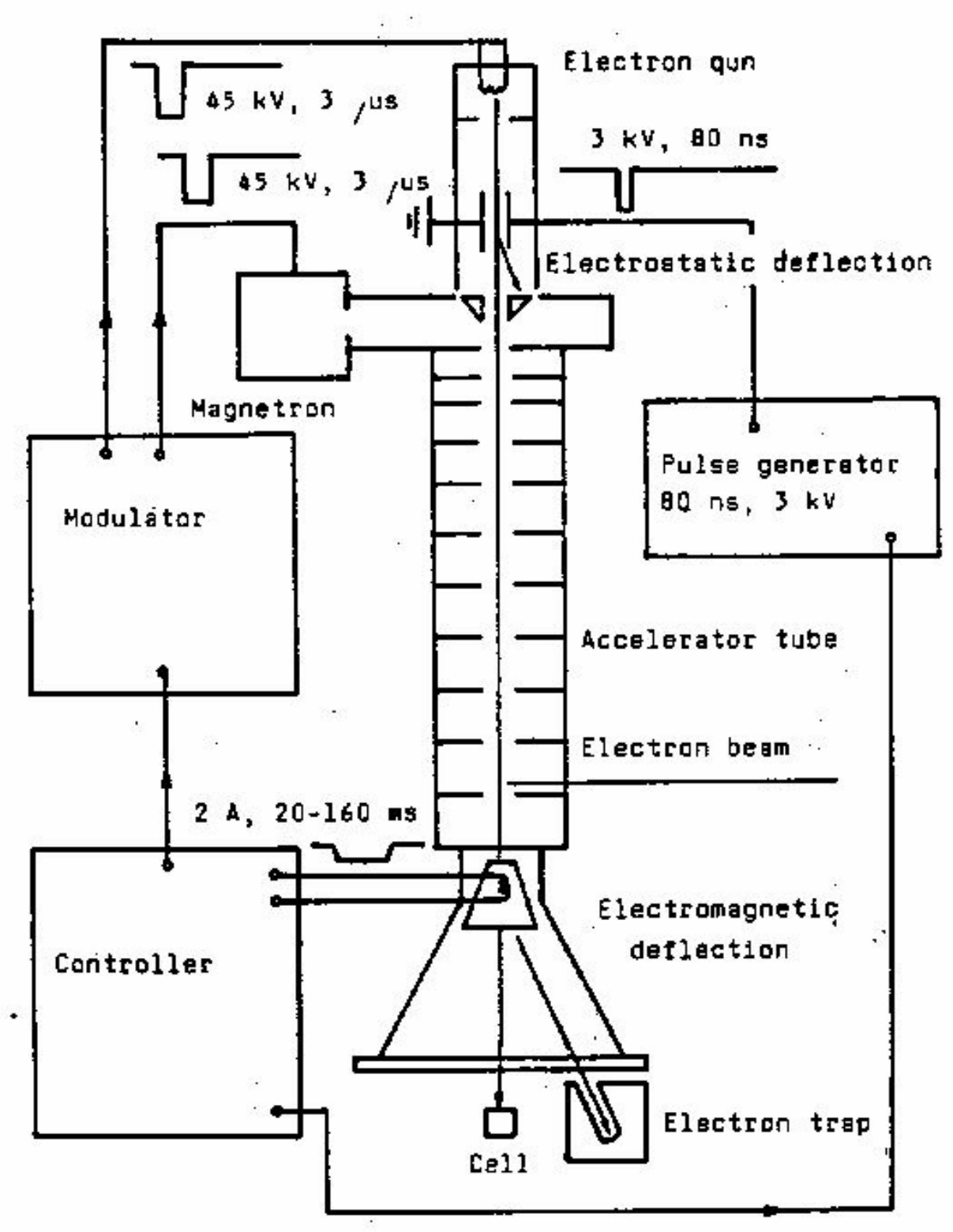

Fig. 3.

Scheme of the accelerator

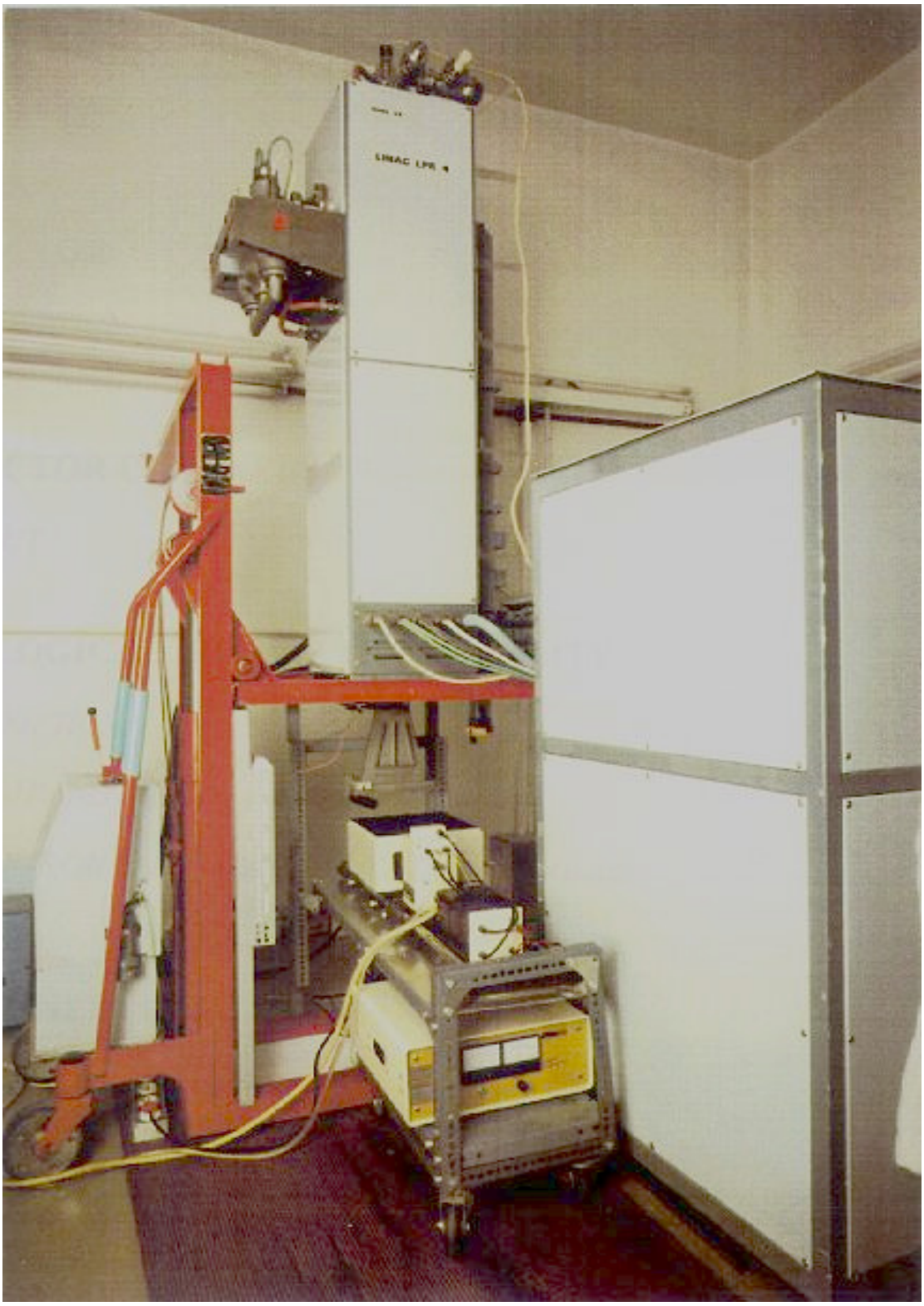

Photo 4.

LINAC Electron Accelerator