Physikalisch-Technische Bundesanstalt
National Metrology Institute

C. Makowski, A. Schüller

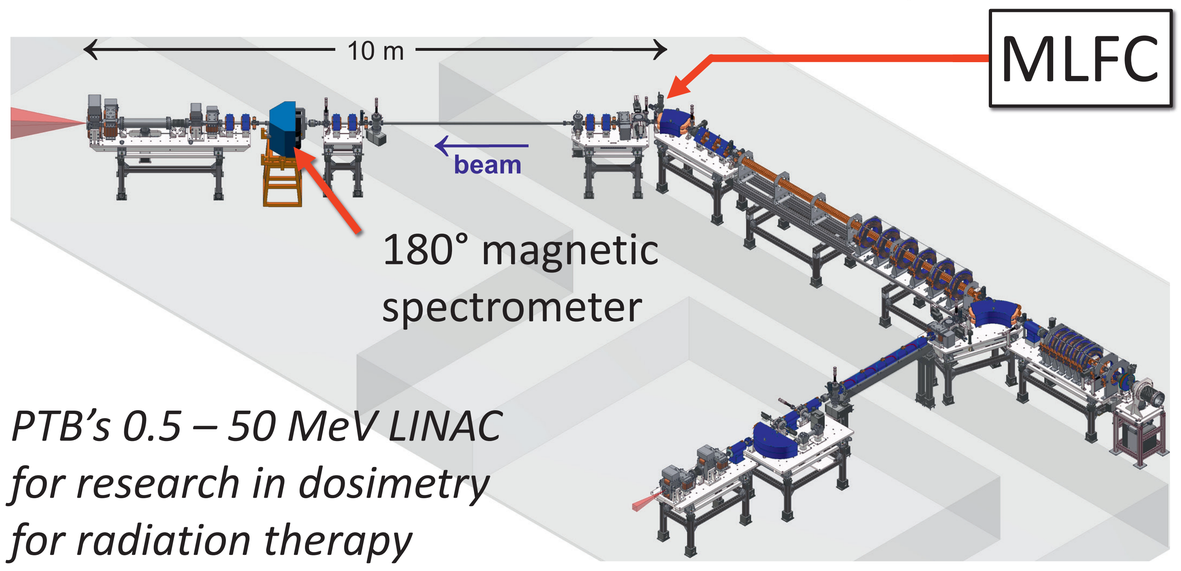
A Multi-Leaf Faraday Cup for the determination of the beam energy of a 50 MeV electron LINAC in real time

Abstract

- A Multi-Leaf Faraday Cup (MLFC) was developed to measure the beam energy and charge of a 50 MeV electron LINAC in real-time.
- The MLFC was calibrated in a monoenergetic electron beam at the exit of a magnetic spectrometer.

Purpose

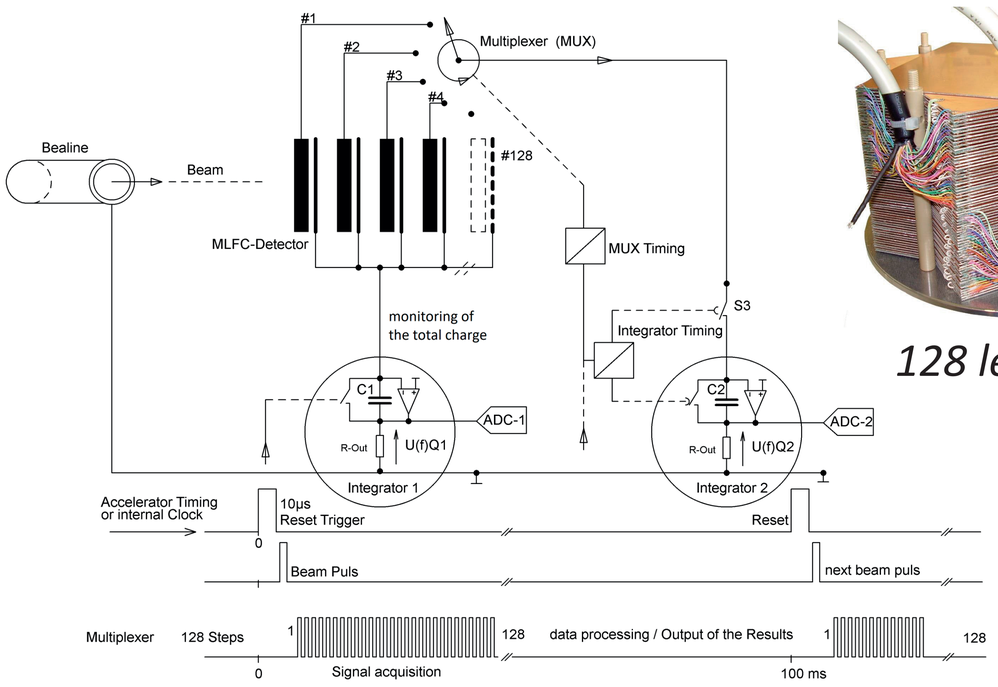
- In order to evaluate the influence of parameters such RF power or bunch charge on the current energy during the preparation or optimization of a beam, an MLFC was developed and installed at the end of the accelerator structure instead of a beam dump.



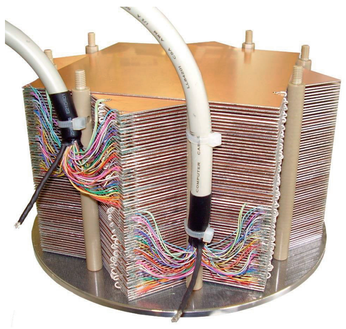
PTB's 0.5 – 50 MeV LINAC for research in dosimetry for radiation therapy

Operating principle

- 128 galvanically insulated Al plates in a stack collect the charge of each beam pulse, act as capacitors and store the charge until sequentially read out via multiplexer and current integrator before the next beam pulse.
- The range of electrons and thus the distribution of the charge on the Al plates depends on their energy.
- A further current integrator monitors the total charge without influencing the charge distribution.



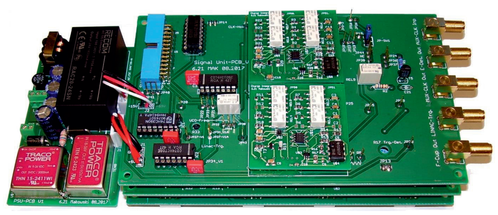
Schematic diagram for read out of the MLFC

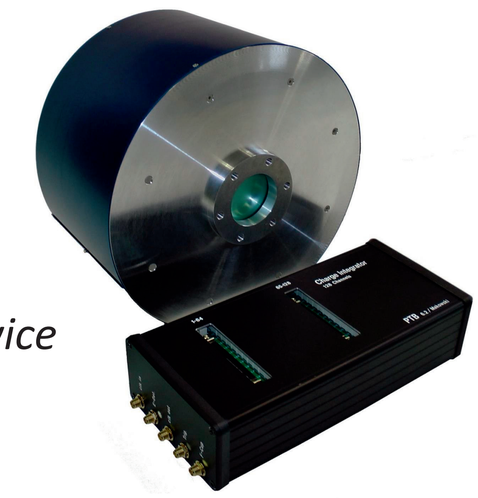


128 leafs

Specifications

- 128 leafs (15x15cm) a 35 µm Cu, 125 µm glass fiber, 0.625 mm Al, 75 µm polyamide
- Dimensions: Ø22 x 14 cm / 5 kg
- Sampling rate: 10 Hz / 100 ms
- Pulse charge range: ~ 1 nC to ~ 10 µC
- Patent Pending PCT/EP2019/065254

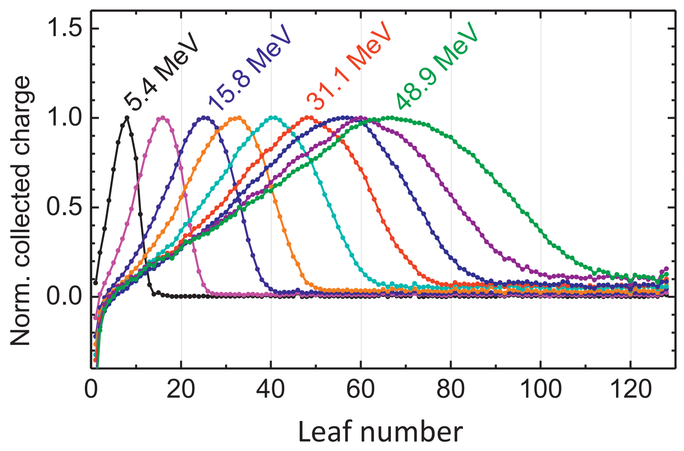




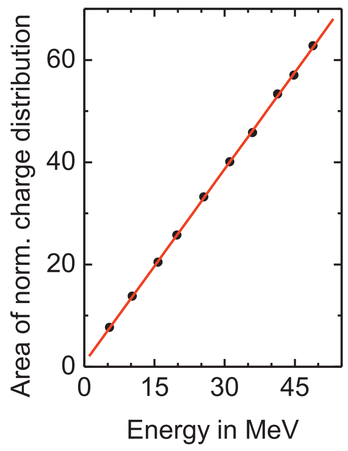
MLFC and read out device

Calibration

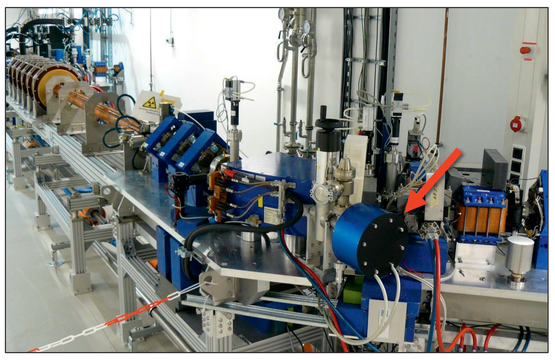
- The MLFC is calibrated with monoenergetic electrons at the exit of a magnetic spectrometer.
- The area of the maximum normalized charge distribution is recorded as function of energy.
- After mounting the MLFC at the end of the accelerator structure the energy determined from measured charge distributions is displayed in real-time.



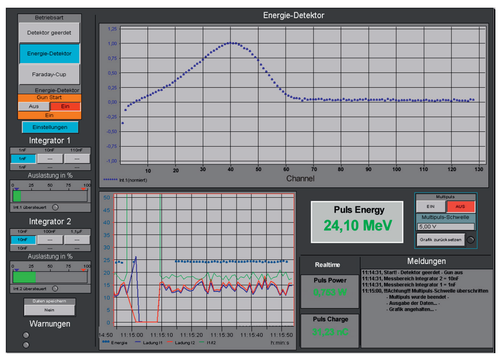
Electron distributions from MLFC



Calibration curve



MLFC mounted at LINAC



Real-time display

Conclusion

- The MLFC allows the pulse-resolved measurement of beam energy and power in real-time, so that the influence of manipulated variables can be evaluated during beam optimization.

Physikalisch-Technische Bundesanstalt
National Metrology Institute

Bundesallee 100
38116 Braunschweig, Germany
www.ptb.de

Andreas Schüller
Working Group 6.21
High-Energy Photon and Electron Radiation
phone: +49 531 592-6209
fax: +49 531 592-6205
e-mail: andreas.schueller@ptb.de