Nondestructive High-Accuracy Charge Measurement of the Pulses of a 27 MeV Electron Beam from a Linear Accelerator

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Abstract

• non-intercepting absolute measurement of the charge of single beam pulses from a 0.5 to 50 MeV electron LINAC with high accuracy (relative uncertainty < 0.1%)
• calibration of a Bergoz integrating current transformer (ICT) against a temporarily installed Faraday cup (FC)

Purpose

• pulsed electron beam shot on a metal target for generation of bremsstrahlung
• crucial quantity: charge per beam pulse → dose of photon radiation

Problem:
pulse charge fluctuations (3 %)
Aim:
pulse resolved nondestructive absolute charge measurement

PTB’s LINAC for research in dosimetry for radiation therapy

Collection Efficiency

• from cancellation measurement as proposed by Pruitt, Nucl. Instr. Meth. 92 (1971) 285
• FC current returned through ICT via “Q-loop”

\[ \eta = 1 - \frac{S_{\text{returns}}}{S_T} \]

\( \eta(27 \text{ MeV}) = 0.9921 \)

Conclusion

• charge of each single beam pulse can be measured nondestructively with a relative uncertainty < 0.1%
• measurement traceable to PTB’s primary standards