SAFETY

R&D APPLICATIONS

ATRON METROLOGY

CALIBRATION OF RADIATION SURVEY METERS USING AN ELECTRON ACCELERATOR

2 MeV X-rays

0.1 µSv/h - 100 Sv/h

BEAM STABILITY - TRACEABILITY

AN INNOVATIVE METHOD OF CALIBRATION

Calibration of radiation survey meters is usually done with radioactive sources as ^{137}Cs or ^{60}Co. ATRON Metrology has developed a new method of calibration using an electron accelerator: electrons are stopped into a Ta target to produce braking rays, which are used for the calibration of radiation survey meters.

The benefits of this method are many :

- the energy spectrum is continuous and more representative of the real condition of use of the radiation survey meters than the one obtained with a radioactive source
- the dose rate is proportionnal to the intensity which allows to reach 9 orders of magnitude of dose rate and permits to automate the process
- because there is no radioactive source, this method is safer for the workers and the environment

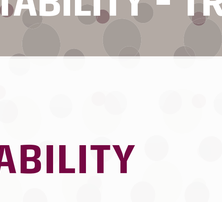
Like any metrological system, ATRON has to ensure the traceability of the measurements and the stability of the beamline over time. Also, the determination of the dose rate at the calibration point is more difficult than with a radioactive source because many factors can impact on the accuracy and the stability of the ionizing radiation source. Many detectors are set up to regulate these factors and achieve a maximum uncertainity of 5% in the final measurement.

BEAM STABILITY

In order to control the current of the accelerator at low intensities, a monitoring parallelepipedic air ionisation chamber is developed in collaboration with the CNRS/LPC Caen. This detector is placed at the end of the beamline and controls the current of the accelerator when the equivalent dose rate is under 15 mSv/h at the calibration point.

The specifications of the chamber are:

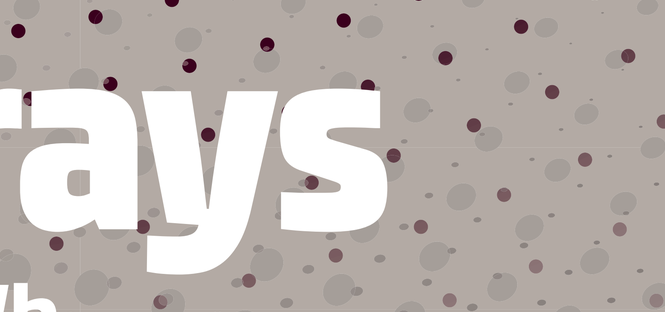
- Resilience to high dose rate, up to approximately 20 kGy/h for the electronics
- Accurate measurements (stability: 0,5 % & accuracy : 1 %) at low dose rate, from 1 µSv/h to 15mSv/h,
- Response time: maximum 2 secondes.



MCNP-X & GEANT4 simulations have been implemented to determine the most appropriate geometry of the ionisation chamber. The sensitive volume consists of 330x100x20 mm^3 of air and allows to measure approximately 3 pA at the lowest dose rate. A precision electronic unit integrates the charges with a high resolution thanks to a 22-bits ADC.

METROLOGICAL TRACEABILITY

Operational quantities used by the radiation survey meters are not directly measurable quantities.
Each protection and operational quantities have to be traceable to physical quantities: it is necessary to use these quantities, such as KERMA in air (Kinetic Energy Released per unit MAss), to compute operational quantities.



The X-rays spectrum is measured and the KERMA in air is determined with a reference ionisation chamber, calibrated with a reference ^{137}Cs radioactive source and provided by the CEA/LNHB.

Then the ambiant equivalent dose H*(10) at the calibration point is computed using the ICRP factors $h_k = H / K$.

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