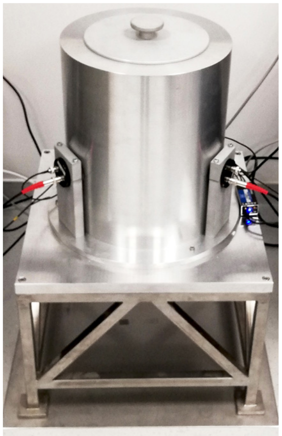
Ionizing Radiation

Launch of the ESIR

A new comparator (the 'ESIR') was launched in 2019 for standards of pure beta-emitting radionuclides; such radionuclides have applications in nuclear medicine for cancer therapy or pain palliation, and are also common in the nuclear industry. The instrument is based on liquid scintillation counting using the Triple-to-Double Coincidence Ratio (TDCR) method[16]. A problem encountered has been that measurements can be sensitive to small changes in electronic components such as the phototubes. After detailed validation studies, a method that reduces the impact of the changes to an acceptable level has been found. The first comparison based on the technique will take place early in 2020. The work was supported by experts from the POLATOM (Poland), LNHB-LNE (France), NPL (UK), PTB (Germany) and NIM (China).



The ESIR

Ongoing work with the SIR

The high-precision comparator for long-lived gamma-emitting radionuclides (the 'SIR') has continued to be well used, with seven institutes submitting standards of seven different radionuclides for measurement on the instrument. A project to replace the reference sources of ^{226}Ra, on which the measurements depend, is ongoing (this project is necessary as ^{226}Ra sources are no longer available). An alternative radionuclide has been identified (^{166m}Ho), however the raw material available on the market has been found to contain impurities. The IRA (Switzerland) is arranging purification at a specialist facility and replacement sources are expected to be available mid-2020. In 2019 comparisons were completed for: ^{139}Ce and ^{133}Ba NMISA (South Africa); ^{152}Eu NMIJ (Japan); ^{133}Ba NIST (USA); ^{88}Y BEV (Austria); ^{225}Ac PTB (Germany); and ^{60}Co VNIIM (Russian Federation).

Extension of the SIRTI

The transportable version of the SIR (the 'SIRTI') was launched in 2009 for comparing standards of short-lived radionuclides, particularly those used in medical imaging such as ^{18}F for positron emission tomography. The focus in 2019 has been on characterizing the SIRTI for two radionuclides that have not previously been measured (^{153}Sm and ^{123}I); the measurements were completed successfully with the support of a secondee from the LNMRI/IRD (Brazil). The studies have increased the number of radionuclides covered by the SIRTI, so that a metrology institute can compare a wide range of standards during a single on-site measurement campaign. In addition, the results of the first comparison of ^{11}C standards were presented at the 22nd International Conference on Radionuclide Metrology, held in Salamanca (Spain) in May 2019[17]. In 2019, studies were completed for ^{123}I and ^{153}Sm with the help of a secondee from LNMRI (Brazil) and missions will restart in 2020.

High demand for radiation dosimetry services

BIPM services for radiation dosimetry continue to be in high demand. National metrology institutes participated in five comparisons and twenty calibration exercises; each exercise can be time-consuming, involving measurements of one to three instruments in up to five radiation beams.

Traceability of LINACs

A detailed study was carried out to investigate a possible issue in the traceability of measurements of radiation dose for cancer therapy using linear accelerators (LINACs). Unlike the old technology based on ^{60}Co sources, the radiation field from a LINAC could have different characteristics depending on the make and model even if set to the same nominal energy; a calibration using one model of LINAC might therefore not be applicable at the stated uncertainty to measurements on another model. The hypothesis was tested out using measurements on LINACs at DOSEO (France), the LNE-LNHB (France) and the DTU (Denmark), supplemented by Monte Carlo simulations. The results indicate that the differences are within the measurement uncertainties, confirming that the existing traceability scheme is valid, and a report is in preparation. This work was carried out with the support of the NRC (Canada).

X-ray studies

Other studies completed during 2019 included back-scatter correction factors for x-ray dosimetry (these data are needed for an update of the IAEA publication TRS-398 and were carried out in collaboration with experts from the IAEA). Improvements were also made to characterization of measurements in low-energy x-ray and mammography beams, reducing the uncertainties and expanding the options for comparison services. This work was carried out by an expert from the VNIIM (Russian Federation).