OBJECTIVE
For an effective treatment, radiotherapy patients must receive the prescribed radiation dose. To be sure of the dose, each hospital needs to be traceable to the SI via their national metrology institute.

For this reason, the CCRI endorsed the BIPM on-going comparison of dosimetry for clinical-type accelerator photon beams, BIPM.RI(1)-K6, which started in 2009. Since then, eight comparisons have been carried out and another nine are planned.

The absorbed dose to water \( D_w \) in a high-energy photon beam is determined through three different measurements in the beam (1-3), combined with Monte Carlo calculations modelling these experimental configurations (1-3) and also the ideal configuration (4).

\[ D_w = D_c \frac{Q_w}{Q_c} C_{w,c} \]

METHOD

1) Calorimetric measurement and Monte Carlo simulation in vacuum with the graphite core in the graphite jacket.

2) Ionometric measurement and MC simulation where the core is replaced by a parallel-plate ionization chamber.

3) Ionometric measurement and MC simulation with the parallel-plate ionization chamber placed in a water phantom.

4) The fourth step is a Monte Carlo calculation to determine the absorbed dose in a homogeneous water phantom.

REALIZATION
A primary calorimetric standard to measure the absorbed dose of ionizing radiation in \(^{60}\)Co and in clinical accelerator photon beams, developed in the Ionizing Radiation Department at the BIPM, enables the standards of the NMIIs to be compared.

For this purpose, small temperature increments of 1 mK or 2 mK, and small ionization currents of a few nA, are measured using the BIPM equipment.

RESULTS
Typical uncertainty components of \( D_{w,BIPM} \) obtained in accelerator beams in the range from 6 MV to 25 MV

<table>
<thead>
<tr>
<th>Uncertainty term</th>
<th>Range x 10^-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>( D_{Q(0)} )</td>
<td>[1.5-2.8]</td>
</tr>
<tr>
<td>( D_{Q(1.1)} )</td>
<td>[0.9-1.9]</td>
</tr>
<tr>
<td>( Q_{rel} )</td>
<td>[1.3-1.6]</td>
</tr>
<tr>
<td>( Q_{rel} )</td>
<td>[1.0-5.0]</td>
</tr>
</tbody>
</table>

The phantom design, a cylinder cut into left and right components, favours a homogeneous temperature distribution front to back.