The experimental dosimetry of photon-brachytherapy (BT) is challenging due to the complex energy-dependent changes of interactions in the dosimeter and rapid, medium-dependent changes of the photon spectra with depth in the phantom. The clinical medical physicist, however, must have possibilities to measure the absorbed dose to water, $D_W$, in the vicinity of a BT-source, e.g. to verify $D_W$-distributions of a new BT-source, of a new BT-irradiation technique, of a new BT-treatment planning software or of a new BT-afterloading software. This need for verification by measurements can not be replaced by dose calculations.

The detectors response, $R = M / D_{med}$, the ratio of the reading, $M$, and the absorbed dose to medium, $D_{med}$, in absence of the detector, can be separated into a product of a detector material dependent “absorbed dose response”, $R_{en}$, and the “intrinsic response”, $R_{in}$, the efficiency of the detector for measuring photons of energy E regarding intrinsic mechanisms.

regarding intrinsic mechanisms: $R = M / D_{med} = (D_{Det} / D_{med}) \cdot (M / D_{Det}) = R_{en} \cdot R_{in}$, as introduced at the AAPM Summer School 2009. (Note: there, “response” has been named “sensitivity”; but, sensitivity is already defined differently as $S = dM / dD_{med}$, see VIM200:2008).

To incorporate the energy dependences, we proposed (2010) to introduce a medium-energy radiation-quality (ME, $35 \text{ keV} < E_{\text{mean}} < 140 \text{ keV}$), between high-energy photons (HE, $E_{\text{mean}} \geq 140 \text{ keV}$) and low-energy photons (LE, $E_{\text{mean}} \leq 35 \text{ keV}$), different to the AAPM boarder energy of 50 keV between HE and LE, just in the region with rapid, large changes of $R_{in}$.

In external photon beam dosimetry, the dose-ratio $TPR_{20/10}$ is used to characterize the radiation-quality as a robust pointer (independent variable) for other dosimetric quantities.

For photon-brachytherapy, a radiation-quality index is missing. Our proposal for an individual “radiation-quality index” for photon brachytherapy is $Q^{BT} = D_{prim,2\text{ cm}} / D_{prim,1\text{ cm}}$, the ratio of the primary radiation absorbed doses to water at $r = 2 \text{ cm}$ in water to that at the reference distance at $r = 1 \text{ cm}$.

Using the primary and scatter separated dose-data from the Carlton AAPM TG-43 database, we receive the $Q^{BT}$ values in the Table.

In analogy to external photon beam dosimetry and using the IAEA TRS 398 terminology, the new BT-correction factor $k_{Q,Q_b}$ for a dosimeter-detector used is related to $M$ and $D_W$, e.g., for measurements with an $^{125}$I-source as: $k_{Q,Q_b} = (D_W^{^{125}I} / D_W^{^{192}Ir}) \cdot (M^{^{192}Ir} / M^{^{125}I})$, where $D_W^{^{125}I}$ is obtained from the calibration factor $N_D^{^{192}Ir}$ for $^{192}$Ir reference radiation: $D_W^{^{125}I} = N_D^{^{192}Ir} \cdot k_{Q,Q_b} \cdot M^{^{125}I}$.

The proposed definition of $Q^{BT}$ has to be discussed internationally to find broad consensus.