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## "High LET photons" from integration of HIFU with radiotherapy

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By adding High Intensity Focused Ultrasound (HIFU or FUS) to Radiotherapy (RT), a totally new weapon (FUS/RT) against cancer is created. This new therapy possesses the benefits of each of the two modalities, but is more than a simple addition of the two. In fact the hyperthermia field and cavitational effects (sonoporation), generated by FUS are potent enhancers of the effects of the ionizing radiation, and enable a significant radiation dose reduction and a totally different spatial distribution. In fact HIFU ablation can be restricted to a reduced part of the tumor, in principle to just the hypoxic region, which is relatively insensitive to ionizing radiation and may be located in the most central part of the tumor. It is probable that the survival of hypoxic cells play a major role in local recurrence and treatment failure. Having destroyed the hypoxic region with HIFU, X-radiation can be delivered selectively to the well oxygenated, annular-shaped volume surrounding the central (hypoxic) region, which consists of tumor clonogens amongst healthy tissue. The lower dose level and the reduced irradiation volume will reduce the probability of side effects (sequelae) of the radiation treatment. In addition, FUS facilitates mediated drug delivery, eventually in combination with radiation. This combination of therapies that can be administered to the patient in a short time period may open a new horizon in patient-tailored, 'Medical' Oncology.

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## Determination of the reference air kerma rate for Ir-192 and Co-60 HDR sources using three different international protocols

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The long half-life and comparable dose distributions to Ir-192 make Co-60 sources economically attractive, especially in developing countries. Dosimetry protocols provide no guidance for verification of Co-60 source calibration by the medical physicist. The applicability of the procedures recommended for Ir-192 in three international dosimetry protocols were applied to both Co-60 and Ir- 192 sources. The reference air kerma rates of Co-60 and Ir-192 sources were measured with ionization chambers using the procedures applicability for Ir-192 in IAEATECDOC- 1274, DIN 6809-2, and AAPM Report 4. Wherever the protocols give no correction factors for Co- 60 sources, equivalent factors from literature were used. Measurements were performed with an ionization chamber in a solid phantom and free in air, and with a well chamber. The measurements were evaluated with all three protocols. The results are compared to reference air kerma rates given in the source certificates. The measured air kerma rates show deviations from the certificate values smaller than 1.2% for Ir-192 and 2.5% for Co-60-Sources. The measurements with the well chamber show the lowest deviations from the certificate value.

Determination of air kerma rate for Co-60 HDR sources using the existing protocols are possible withaccuracy sufficient to verify source calibration even though the protocols are not specifically designed for Co-60 measurements. New protocols are desirable, based on measurements with ionization chambers calibrated in absorbed dose to water and providing the complete measurement procedure and correction formalism also for Co-60 sources.

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