

Water-equivalent plastic scintillation detectors for high-energy photon and electron beams

Abdou-Samad Beddar

A minimally perturbing plastic scintillation detector has been developed for the dosimetry of high-energy beams in radiotherapy. The detector system consists of two identical parallel sets of radiation resistant optical fiber bundles, each connected to independent photomultiplier tubes (PMT). One fiber bundle is connected to a miniature water-equivalent scintillator and so scintillation as well as Cerenkov light generated in the fibers is detected at its PMT. The other "background" bundle is not connected to the scintillator and so only Cerenkov is detected by its PMT. The background signal is subtracted to yield only the signal from the scintillator.

The dose distribution in water is measured using these plastic scintillation detectors for different high-energy photon and electron beams. Excellent agreement is obtained when compared to ionization chambers and silicon diodes.

The most important properties of the system are its high spatial resolution (0.003 cc) and its nearly water-equivalence. It is shown that they have better spatial resolution than ion chambers, require no replacement correction in phantoms, have less energy dependence than Si diodes in x-ray beams, have much less energy (or depth) dependence than ion chambers in electron fields, and less perturbation of either x-ray or electron beams than either Si diodes or ion chambers. Their other strength lies in their use for field mapping in water phantoms, or in-vivo insertions.