

## AbstractID: 1658 Title: Design of a directional brachytherapy source

We propose a novel design for directional brachytherapy sources for use in permanent implants. These sources could deliver the prescribed dose to the target while maintaining low doses to sensitive structures by providing a high dose gradient on opposite sides of the source. A gold shield is placed between the radionuclide carriers and the source jacket. The design is suitable for both I-125 and Pd-103 sources and the features of their dose distribution are similar. This report investigates the 3D dose distribution for an I-125 seed because I-125 is more widely used. A formalism similar to that of AAPM TG-43 is proposed to represent the directional source's 3D dose distribution. A clinical example using four directional seeds around the urethra is studied for a prostate implant and results in a reduction in the dose to the urethra of approximately a factor of twenty in the center and a factor of five to forty five at the wall depending on the urethra wall's position relative to the four implanted directional seeds. Directional sources, thus, enable a new capacity of intensity modulated brachytherapy treatment in permanent implants to avoid high dose in the sensitive structures. Since most prostate cancer treatment complications are related to urinating difficulty or rectal bleeding secondary to high dose, we conclude that by introducing directional seeds in a permanent implant, the treatment can spare the sensitive structures from overdose without compromising treatment objectives, therefore significantly reducing the complication incidence.