Multigroup Discrete Ordinates Modeling of I^{125} 6702 Seed Dose Distributions Using a Broad Energy-Group, Cross-Section Representation. The Discrete Ordinates Method (DOM) is a deterministic numerical solution of the Boltzmann transport equation. Our previous studies clearly demonstrated that 2D DOM dose calculations, as implemented by the code DANTSYS, accurately (±2-3%) reproduce Monte Carlo photon transport (MCPT) simulations for encapsulated sources throughout the brachytherapy energy range. However, those simulations used very fine discretizations of the energy variable, i.e., 85 energy bins or "groups" below 35 keV, which limited the efficiency gains achieved for I-125. We now seek to optimize DOM computational efficiency by minimizing the number of energy groups. A key step is the development of geometry independent, source oriented weighting functions, i.e., approximations to the I-125 photon spectra encountered. The weighting functions developed in this study were used to derive a broad 3-group (G-3) cross-section library. Dose distributions in 2D cylindrical geometry around the model 6702 I-125 seed were calculated by DANTSYS using the G-3 library and were compared to corresponding MCPT simulations. The G-3 DANTSYS simulations retain 5% accuracy while increasing computational speed by a factor of 9 relative to the 85-group DANTSYS results. The G-3 DANTSYS calculations are a factor of 80 faster then the MCPT ones. These results indicate that the development of accurate source-specific broad group libraries is an important and feasible step opening the opportunity of direct applications of transport calculations to brachytherapy treatment planning.
This work was supported by NIH Grant R01 CA 46640.