AbstractID: 14566 Title: Clinical Implementation and Application of Monte Carlo in Photon and Electron Dose Calculations

After many years of research and development, Monte Carlo based treatment planning algorithms for photons and electrons are being implemented as part of commercial treatment planning systems. It is therefore reasonable to expect that over the next few years, the use of Monte Carlo in routine clinical planning will become substantially more widespread and could someday replace kernel-based algorithms as the default dose calculation algorithm for radiotherapy dose calculations. This continuing education session will focus on Monte Carlo treatment planning for photons and electrons. The main goal will be to familiarize clinical medical physicists with the application of Monte Carlo in treatment planning, and to discuss specific implementation issues associated with Monte Carlo based treatment planning. In addition, we will demonstrate the utility of Monte Carlo with respect to improved dose calculation accuracy (versus conventional algorithms) in heterogeneous patient tissues.

The continuing education session will be divided into two sections in order to specifically address implementation issues related to Monte Carlo-based photon and electron treatment planning techniques. Each section will address the following broad general topics:

(1) **Introduction to the MC method**: A broad review of Monte Carlo based particle transport and implementation in the radiotherapy setting, types of algorithms and commercial implementation.

(2) **Commissioning and commercial implementation of Monte Carlo based planning systems:** Differences in beam data acquisition and source modeling relative to commercial planning systems.

(3) **Implementation issues associated with dose calculation accuracy and material conversion:** How does the user control statistical uncertainty inherent in Monte Carlo based algorithms, the importance of material conversion and monitor unit calculations relative to a kernel based algorithm.

(4) **Implementing the method for specific clinical treatment sites:** Absorbed dose-to-medium versus absorbed dose-to-water calculations. What differences will the clinician expect to see in planning for Head and Neck, Thorax, and Pelvis/Abdomen treatment plans relative to kernel-based algorithms.

Educational Objectives:

1. A broad review of the Monte Carlo method as applied to radiotherapy dose calculations for electrons and photons.
2. To understand the clinical implementation of a Monte Carlo based treatment planning algorithm with respect to material conversion and absorbed dose to medium (D_m) versus absorbed dose to water (D_w).
3. To understand the clinical implementation of a Monte Carlo based treatment planning algorithm with respect to the statistical uncertainty in the calculated dose distribution as a function of spatial resolution, calculation time, and variance reduction.
4. To understand the dosimetric influence of MC in different anatomical sites and the implementation of an algorithm relative to a convolution/pencil-beam algorithm.