AbstractID: 6569 Title: Tracing the sources of absolute dose errors in IMRT plan verifications

Purpose: Several years since the advent of IMRT, most institutions still perform experimental plan verifications with film and ion-chamber. In the past year of measurements of Pinnacle^3 IMRT plans in our clinic, most isocenter dose measurements were verified to be within 3%, but the 10% that were off by 4-7% were repeated or required MU adjustments. In this work, we trace the main sources of discrepancies by measurement and simulation.

Methods: We used an independent dose calculation engine (MCKS) that performs kernel-based superposition using Monte Carlo sampling of photons, interaction points, and corresponding monoenergetic kernels. The photon source for the simulations is a single phasespace plane scored just above the collimator and generated by an EGS/BEAMnrc code. Even though MCKS models the detailed MLC design (curved ends, tongue-and-groove, inter-leaf gap, and leaf offsets) the MLC material density is fine-tuned with the measurement of "uniform" intensity map delivered as sequence of narrow strips, which amplifies the leakage dose several fold.

Results & Conclusion: Using the code and measurement, we found that a major source of error in IMRT plans from Pinnacle^3 is the handling of MLC leakage. For example, if a 1.8% MLC transmission is used, then delivering a 10×10 field with ten 10×1 strips produces a dose overestimation by 12% on the central axis. This reduces to 8% if a 1.5% value is used. In typical IMRT plans, the leakage error is less dramatic, but can frequently exceed the 3% acceptance criterion. Also, no single transmission value is suitable for all possible IMRT fields because MLC scatter varies with field size and shape. Some errors also result from the use of lumped empirical square field output factors to complex IMRT segments without regard to the energy or direction of head scatter photons.