AbstractID: 3679 Title: Parameterizing the Phantom Scatter Components for Polyenergetic Photon Beams.

Purpose: To develop an improved analytical model of the phantom scatter-to-primary ratio *(SPR)* of megavoltage photon beams with improved accuracy for a wider range of field sizes and depths than the existing analytical model [1] by accounting for backscattered photons.

Method and Materials:
EGS4 Monte-Carlo simulations are performed to calculate the scatter and primary doses from parallel photon beams for ^{60}Co spectrum and the Mohan spectra simulating photon beams with nominal energies of 4, 6, 10, 15, and 24 MV. The depths varied from d_{max} to 30 cm. The field size varied between 3 and 40 cm. SPR has previously been modeled by the equation $SPR=(a_0\ s\ d)/(w_0\ s + d)$ [1]. We model *SPR* by $SPR=(a_0\ s\ (d+d_0))/(w_0\ s + (d+d_0))$, where s is the field size at depth, *d* is the depth in the phantom, and a_0, w_0 and d_0 are free parameters. The addition of the depth offset d_0 accounts for the dependence of *SPR* on field size at shallow depths. We fit the *SPR* data derived from Monte Carlo simulation to determine a_0, w_0 and d_0 for each of the simulated nominal energies.

Results:
The phantom scatter-to-primary ratio increases with increasing depth and field size, up to 161% and 34% for ^{60}Co and 24 MV, respectively, for s = 40 cm and d = 30 cm. The maximum (standard) error for the new and standard analytical models are 3.5% (1.1%) and 2.2 % (1.1%), respectively, for 6 MV. At shallow depths (d_{max}), the maximum (standard) error of the fitting are 6.4% (3.9%) and 4.2 % (2.4%), respectively, for ^{60}Co, and decreases with increasing nominal energy.

Conclusion:
The addition of the offset parameter d_0 improves the fitting of the data, significantly reducing the error for clinical energies.

1: Bjarngard BE, Med Phys 19:195-198 (1992).