Purpose: To describe a method for optimization and production of a dual scattering system for proton beam delivery.

Methods: Dual-foil passive scattering is currently the prevalent modality for proton therapy delivery. Large uniform proton fields are created using a 2-stage scattering system comprising an upstream uniform lead foil (stage 1) followed by a contoured lead/Lexan foil to provide beam and range uniformity (stage 2). Optimizing the parameters of these foils, including thickness, contour and placement, provides not only a flat and symmetrical radiation field with a uniform range, but also affects the overall efficiency of the beam line. An analytical method for optimizing the scattering system design was applied and validated with GEANT4 simulations. This method has been used to create passively scattered therapeutic and research proton fields at our proton therapy facility. A novel Cerrobend casting method is described that allows for cost-effective and accurate production of this important beam-line component.

Results: A number of dual scattering foil combinations for research and therapeutic purposes have been created and were evaluated with GEANT4 simulations. We demonstrated that the use of this system can generate passively scattered proton fields up to 60cm diameter with improved efficiency and beam flatness over existing dual-scattering systems. Scattering system performance was verified using physical measurements including Gafchromic film and ion chamber data.

Conclusions: This analytical method allows the user to optimize the proton dual scattering system with respect to specific input parameters, while the casting method provides a cost-effective way to create a unique scattering system for a given application.