AbstractID: 7782 Title: Should we worry about neutrons?

Advanced treatment techniques (e.g., IMRT, protons) are able to deliver more conformal dose distributions. However, they may cause potential risks for second malignancies due to increased scattered radiation.

Protons deposit secondary dose outside the treatment volume mainly via neutrons (generated either in the patient or the treatment head). In particular for passive scattered proton beams, a general statement about this dose cannot be made because the yield and energy of these neutrons depends on several factors, e.g. the characteristics of the beam entering the treatment head, the material in the double scattering system and the modulator wheel, and the field size incident to the patient specific collimator. The latter can easily cause neutron dose variations up to two orders of magnitude (the neutron dose delivered by treatment head generated neutrons decreases with increasing collimator opening). Several experimental and simulated data from passive scattered proton beams show that the biologically effective neutron dose (weighted by a quality factor) could be higher or even lower than scattered doses in photon therapy. However, depending on the beam line design and the field size used for a specific treatment it might be significantly higher in some rare cases. Because the neutron dose is dominated by the contribution from the treatment head, proton beam scanning produces a much lower neutron background than passive scattering. Presumably, it delivers the lowest scattered dose of all treatment modalities.

The likelihood of developing secondary cancer depends on both the scattered dose to the whole body and the high-dose volume. Depending upon the dose response relationship, a main concern may not be the dose far away from the field (e.g. from neutrons), but the dose delivered to, or directly adjacent to, the target. The integral dose with any type of photon beams is higher than with proton beams.

Educational objectives: 1. To understand the determinants of neutron radiation in proton beam therapy 2. To understand risks associated with neutrons doses