Abstract
The Scintillating Fibers Harp (SFH) monitors are the beam profile detectors used in the extraction lines of the CNAO (Centro Nazionale di Adroterapia Oncologica, Pavia, Italy) machine. The use of scintillating fibers coupled with a high-resolution CCD camera makes the detector of simple architecture and with high performances; on the other hand, fibers radiation damage shall be faced after some years of operation. The work presents measurements and analysis performed to understand the phenomenon. A procedure for data correction is fixed in such a way to compensate radiation damage effects and make the SFH usable, before the major intervention of fibers replacement.

Radiation effects
1. Reduction of fibers light production power involving central fibers (mainly hit by the beam)
2. Fibers transparency loss: due to the detector geometry the light produced on the positive region of the vertical plane has to cross the more damaged area (about the active area center) before being read out by the camera.

Data correction
1. Elaboration of a 2D map of correction factors per each plane, extracted from data manipulation, and depending on beam barycenter position on the horizontal/vertical plane of the detector active area. Detector response correction from radiation damage effects by means of correction factors application on raw data after a rough beam barycenter estimation. Robust and reliable procedure, but demanding and time consuming, implying the SFH dismantlement from the beam line.
2. Elaboration on 1D set of correction factors involving 4-5 central fibers for each plane. Correction factors used to modify profiles reconstruction parameters for damaged fibers response equalization. Not very rigorous procedure and usable only for a beam centered on the detector active area. At the same time quick and easy to apply to all the installed SFH detectors.

Beam parameters computation before and after data correction

Differences (Δ[mm]) on the horizontal plane between reference barycenter values (from Dose Delivery measurement) and barycenter values from one SFH measurement before (solid line) and after (dashed line) data correction (with the 2D correction factors map application) for the two outer positions on the vertical plane (Y = -20 mm and Y = 20 mm)

Conclusion
A robust procedure has been implemented to manage the radiation damage effects on the scintillating fibers based on the determination of a 2D map of correction factors per each plane of one detector. Tests on profiles reconstruction have demonstrated that the correction allows the beam barycenter reconstruction with a major accuracy. Although reliable and efficient, this procedure presents a few operational difficulties. Consequently a less robust, but quicker and easier method to compute correction factors, has been implemented. It can be applied on all the SFH detectors. The goal of radiation damage handling and managing has been reached in both cases.

Acknowledgements to M.Haguenauer and to J.Bosser for their valuable technical support and for their suggestions in facing up to the radiation damage phenomenon.

References