The aim of this work is the study of some 2D and 3D treatment planning systems (ROCS 400, Theraplan TP11, ADAC Pinnacle) compared to the BEAM Monte Carlo code. A 6 MV photon beam was employed. The experimental results obtained with a new type of radiochromic film (MD-55) are also presented.

Situations of electronic non-equilibrium that could lead to significant errors have been investigated, using three types of phantom: 1) air gap “sandwiched” between slabs of solid water perpendicular to the beam axis; 2) a “step wedge” made of solid water slabs, to simulate non-perpendicular entrance surfaces; 3) an anthropomorphic Alderson phantom.

Since published works with BEAM still rely principally on electron beams, a benchmarking study was first performed to check the reliability of BEAM against experimental measurements in a water phantom. Good results were obtained for PDD data, while cross profiles suffer from a systematic overestimation of the peripheral dose. For this reason the study has been so far restricted to the doses on the central axis.

Very good agreement is observed between BEAM and the 3D system for non-perpendicular entrance surfaces and for inhomogeneities like lungs, bone and air cavities. The 2D systems seem to systematically overestimate the dose behind low-density regions; the observed differences vary up to 5 %.

The results obtained with radiochromic films inserted into the phantoms are in good agreement with BEAM simulations, but suffer from high noise that can be eliminated only averaging the values obtained by multiple expositions.