Purpose: To determine the relative dose deposition in a diamond detector and an ion chamber from a clinical photon beam in an environment having varying magnetic fields, in an effort to evaluate dosimetry techniques in an integrated MR-linac system.

Methods: Using the Monte Carlo code PENELLOPE, the PTW 60003 diamond detector was modeled and irradiated with a 6MV photon beam spectrum (Varian 600C) in the presence of a homogeneous magnetic field. The distance from the source to the centre of the diamond detector active volume was 100 cm and the detector was oriented perpendicular to the homogeneous magnetic field. An ion chamber (PR06) was also simulated with its long axis both parallel and perpendicular to the impinging photon beam, but perpendicular to the magnetic field in both cases. The homogeneous magnetic field was varied from 0 to 2500 gauss. The above system was also replicated experimentally with the aid of an electromagnet, and the measured relative ion chamber response as a function of magnetic field was compared with the simulations.

Results: There is a significant variation (1.8% at 2170 Gauss) in the relative response of ion chamber as a function of magnetic field. Simulated ion chamber response follows the measured response closely. In contrast, both simulated and measured results indicate that the diamond detector is relatively insensitive to the magnetic field compared to the farmer type ion chambers.

Conclusions: This work has significant impact on dosimetry protocols for integrated MR-linac systems, where the response of ion chambers is significantly affected by the presence of magnetic field. Thus, the use of ion chamber for reference dosimetry will require magnetic field dependent correction while a diamond detector can safely be used as a beam scanning device.