

INTRODUCTION

The Mevion S250-FIT is the world's first ultra-compact proton therapy system designed with a form factor compatible with existing LINAC vaults. This raises questions regarding electromagnetic compatibility with adjacent radiotherapy modalities. This work evaluates magnetic field interference from the 10T superconducting synchrocyclotron on adjacent therapy systems.

METHODS

Measurements were performed throughout and around the S250-FIT vault. Magnetic field mapping was conducted at 23 locations using a calibrated gaussmeter. Pre- and post-magnet ramp-up assessments evaluated impacts on adjacent ViewRay MR-Linac and CyberKnife systems. ViewRay evaluations included MR-conditional 2D ion chamber arrays for dosimetry and MagPhan RT phantoms for image quality. CyberKnife performance was verified using high-resolution CMOS detectors and orthogonal kV imaging for targeting accuracy.

RESULTS

Magnetic field strengths ranged from 1.3–12.5 gauss at clinically relevant locations; the 5-gauss line extended approximately 8m laterally and 4m anterior-posterior. For adjacent systems, all parameters remained within institutional tolerances: ViewRay CAX dose differences $\leq 0.2\%$, field variations < 0.1 mm, and no image degradation. CyberKnife dose variations were ≤ 0.01 cGy/MU with field variations and targeting accuracy within 0.2 mm.

SUMMARY AND CONCLUSIONS

We demonstrated that a compact superconducting synchrocyclotron could be safely installed in multi-vault facilities without adversely affecting adjacent systems. The 5-gauss line is confined to the vault maze, requiring precautions for cardiac devices but not affecting other treatment areas. The self-shielded design provides adequate containment for typical clinical scenarios.

KEY FIGURES

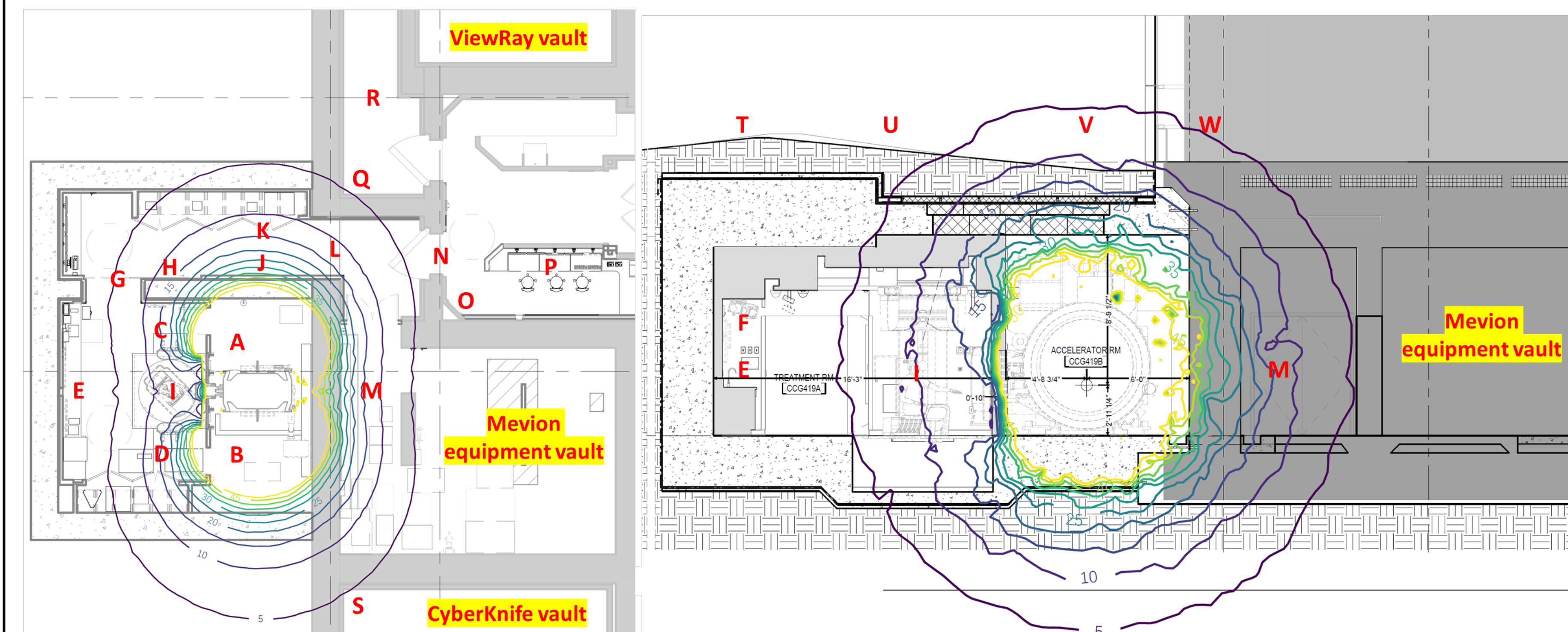


Figure 1. Predicted isomagnetic field lines, (i): plan view, (ii): section view, from simulation showing spatial distribution around the Mevion S250-FIT synchrocyclotron. The contour lines demonstrate the magnetic field strength, 5-50 gauss in 5 gauss increments, throughout the facility. Letters represent locations where radiation and magnetic field measurements were performed.

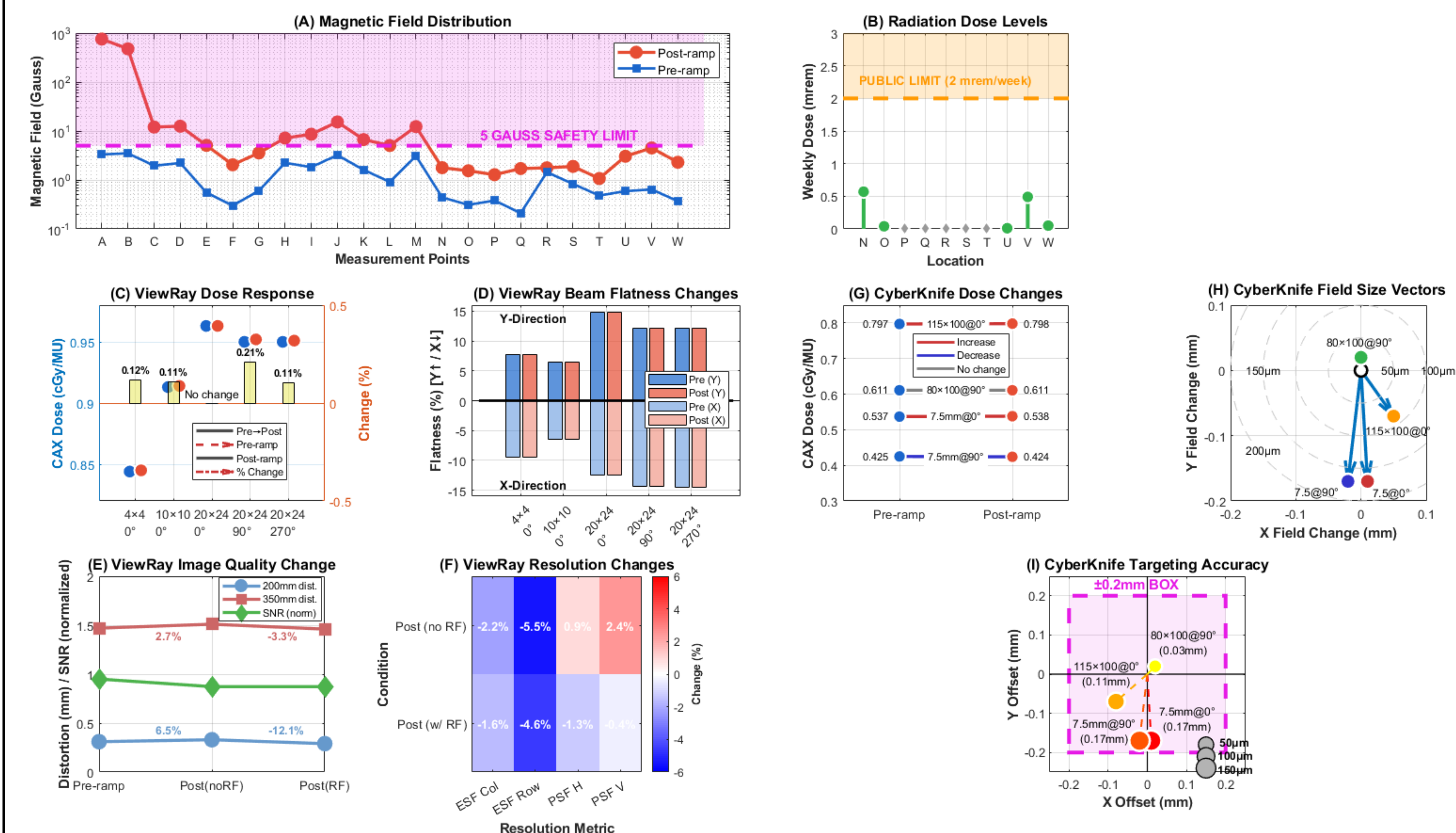


Figure 2. (A) Magnetic field distribution pre- and post-magnet ramp. (B) Weekly radiation dose levels at designated locations, confirming all areas remain significantly below the 2 mrem/week public occupancy limit. (C–F) ViewRay system stability assessment in terms of CAX dose, beam flatness, image distortion, SNR, and resolution. (G–I) CyberKnife performance verification in terms of CAX dose stability, field size changes and targeting accuracy.