The Radiation Environment surrounding the Collider Detector at Fermilab

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Most experiments studying the properties of fundamental elementary particles, do so by measuring the remnants of collisions between beams of high energy particles. In modern collider experiments, the supporting infrastructure lies external to the detectors, but inside the radiation environment surrounding the detectors. The apparatus and its infrastructure may be sensitive to both chronic and acute radiation doses, through additional detector occupancy, single-event effects in the supporting electronics, or even irreversible failure. This sensitivity can lead to reduced reliability of the detector, additional contamination of physics signals, reduced detector lifetime, or corruption of the data. Knowledge of the spatial distribution, dose rate and sources of radiation are, therefore, critical components in the design and operation of an experiment at a hadron collider. Most designs have relied on a combination of radiation damage measurements and computer simulations of the radiation environment, e.g., see [1–3]. However, no substantial measurements of the radiation field surrounding a collider detector exist in the literature.

We present here the first detailed measurements of the radiation field surrounding the collider detector at Fermilab (CDF). We use two types of thermal luminescent dosimeters to measure both the ionizing radiation and the radiation from low energy neutrons. By comparing the results from two exposure periods, we evaluate the effectiveness of additional shielding installed between the exposures. Finally, we have used standard simulation tools to estimate the radiation field from beam losses and collisions. We compare the results of the simulations with our data.

References

