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Proton Radiography for Electromagnetic Visualization

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Scientists at DEVCOM Army Research Laboratory and Los Alamos National Laboratory have collaborated to create a technique capable of visualizing dynamic electromagnetic fields within bulk materials and surrounding environments, in situ. This capability, proton radiography for electromagnetic field visualization (pRad-EMV), was achieved by combining proton deflectometry techniques with lens-based proton radiography. pRad-EMV enhances upon the general scheme of monitoring charged particle trajectories to infer electromagnetic field quantities in two ways: by utilizing protons of penetrating energy, and by including a lens system to extend the information collection systems away from the object location. In this talk, we will discuss development of the technique while highlighting ARL’s vision of potential impact and applicability towards solving Army problems. The talk will begin with an overview of legacy pRad capability. We will discuss modeling tools developed to predict how finite EM fields will influence the radiographic images and interact with pRad’s complex lens system. Finally, we will report on some results of a dynamic experiment in which a 250 mm long, 1.6 mm diameter copper wire was electrically burst using a ~14 kJ 12.5 kV capacitive drive. The experimental results will be compared with a simulation computed using ALEGRA magneto hydrodynamics code, and non-electromagnetic-responsive characterizations of flash X-radiography and optical photography.