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P1.2023 Electromagnetic pulses generated from ultra-thin targets irradiated by the Vulcan Petawatt laser

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One of the effects accompanying laser-target interactions at high laser intensities is the generation of strong electromagnetic pulses (EMP) with frequencies in the range of tens of MHz to few GHz. Such pulses may interfere with the electronics of the data acquisition systems and pose a threat to the safe and reliable operation of high-intensity laser facilities. Recently, EMP measurements were performed at several laser facilities, including the Vulcan PW laser [1,2]. In this contribution, we report on a ride-along measurement of EMP generated at the Vulcan PW laser facility from ultra-thin (tens to hundreds of nanometers thick) metal and plastic targets. Such targets undergo substantial deformation during the interaction, with the possibility of forming particle jets, resulting in conditions for which EMP generation had been rarely studied so far.. Proper conditions were created to capture the multi-GHz component of the resulting electromagnetic pulses. Measurements were performed using conductive B-dot and D-dot probes placed inside and outside the experimental chamber. High-bandwidth double-shielded coaxial cables were used to connect the probes to an oscilloscope with a 13 GHz bandwidth and 4x40 GSa/s sampling rate. The oscilloscope was enclosed in a Faraday cage to protect it from any electromagnetic disturbances propagating directly through the air. It was found that the spectrum of the generated pulses is quite wide and the multi-GHz component constitutes the bulk of the signal. It was also observed that despite having a random and chaotic appearance such pulses are reproducible from shot to shot to a surprising degree. Electric fields on the order of 250 kV/m were measured inside the experimental chamber.

References

1. T.S. Robinson et al., Sci. Rep. 7, 983 (2017).
2. P. Bradford et al., High Power Laser Science and Engineering 6, e21 (2018).

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