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Blast Wave Radiation Source Measurement Experiments on Z[1]

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The Dynamic Hohlraum (DH) radiation on the Z facility at Sandia National Laboratories is a bright source of radiant energy that has proven useful for high energy density physics experiments. In this paper, we describe experiments that are designed to study the nature of this source through a unique mechanism using the high power and energy of the Z DH source. In these experiments, initially supersonic and diffusive radiation waves propagate into an unconstrained 40 mg/cm^3 SiO_2 foam cylinder. As this radiation wave propagates through the foam, it spreads out and the temperature drops, and as its temperature drops, so does the wave's speed. As long as the radiation is moving faster than the local shock speed, the foam cannot hydrodynamically respond in a significant way to the temperature and pressure gradients at the radiation front. However, once the speed of the radiation front reaches the shock speed, a shock wave begins to form. The density ridge at the shock front can be observed through x-ray radiography. Computer simulations have shown that the position of the shock front is sensitive to the time-integrated drive energy, thus acting as a radiation calorimeter. In the experiments on Z, radiation power is measured at the bottom of the pinch, and may be measured through a hole in the side of a foam-filled gold funnel that feeds the radiation into the sample foam. On a successful shot on Z in February of 2005 (Z1430), the peak radiant power measured out of the bottom of the pinch was roughly 12 to 13 TW and the power deduced to be radiating upward into the experiment was between 12.4 TW and 14.6 TW. The position of the shock in the foam is therefore a promising in-situ radiation source fluence diagnostic.

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