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The implosion and stagnation of wire array z-pinches

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Experiments at all levels of current drive have demonstrated that the first 60-80 percent of the evolution of a wire array z- pinch is dominated by the gradual ablation of cold, dense wire cores into low density coronal plasma that is projected towards the axis of the array. Implosion of the array only begins when the wire cores start to break up, at which time a piston of current snowploughs up coronal plasma as it accelerates towards the axis. Here we present the detailed measurements of the snowplough process and the dynamics of the array during its stagnation on axis. The stability and width of the snowplough and the compression of the plasma at stagnation are related to X-ray emission, providing data on the mechanisms responsible for X-ray production.
Several methods to alter the implosion of an array are explored. The interaction between the outer and inner of a nested array configuration is directly observed for the first time, highlighting how X-ray emission can be shaped. In a new type of array a "coiled" array the magnetic field topology is altered, resulting in large changes to the ablation dynamics and an implosion that snowploughs less mass to a higher velocity. With a relatively low number of wires, the use of coiled arrays can increase X-ray emission by $\sim$5x over that usually observed at stagnation. Using a radial array configuration, meanwhile, the scale of the stagnating plasma can be reduced without adversely affecting X-ray power. This may enable arrays to couple to far smaller hohlraums, significantly raising the available temperatures for HEDP experiments.

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