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The development of instabilities in wire array Z-pinches JEREMY CHITTENDEN, Imperial College, CHRISTOPHER JENNINGS, Sandia National Laboratories — The X-ray power produced by wire array Z-pinches is ultimately limited by the uniformity and the characteristic width of the imploding plasma structure. This uniformity is in turn determined by spatial variations in the ablation rate of the individual wires earlier in time. These variations exhibit a fixed and highly periodic structure with a characteristic natural wavelength. The reasons for this fixed structure and the origin of such perturbations have been the subject of much debate in recent years. Using three-dimensional MHD calculations of a single wire in an array, we show that such variations can arise as the result of an m=0 like instability growing in the plasma ablating from each wire. The structure of this instability is modified by the magnetic topology of the array and is shown to grow spontaneously from noise to adopt a fixed wavelength which is consistent with experimental observations. Using separate three-dimensional MHD simulations of the entire array volume, we then show how the separate modulations from each wire combine to form a perturbation to the array implosion as a whole. The effect of the non-linear development of this perturbation on the X-ray power pulse is then illustrated. This work was partially supported by the U.S. Department of Energy through cooperative agreement DE-FC03-02NA00057.

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