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Guest Editor's Preface: *Z*-Pinch Special Issue

Z pinches have long been interesting to plasma physicists because of the simplicity of their geometry. They were studied first in the 1950s as potential fusion configurations and, later, as intense X-ray sources both for military and civilian applications. The development of pulsed power technologies, some reaching energy and power levels of 3 MJ and 50 TW, respectively, by many organizations around the world has accelerated the interest in *z* pinches for fusion applications.

This special issue was intended to review and document the status of *z*-pinch physics understanding as of the year 2000. We have made a special attempt to solicit input from a wide range of researchers and to include as much historical background as possible. This inclusion of a historical perspective together with a very thorough list of references should enable the interested reader to learn about *z* pinches and the physics concerns that are being studied around the world today.

The special issue on *z* pinches followed a series of conferences and workshops in the technical field of *z* pinches and, more specifically, wire-array *z* pinches. For the interested reader many of the presentations made at these workshops are available via the Internet from the Imperial College in the United Kingdom.

The progress in *z* pinches is most easily seen in their performance as X-ray sources. The fact that *z* pinches have generated pulses of X rays with power levels exceeding 200 TW and pulse widths of ~6 ns is a triumph both in *z*-pinch physics and pulsed power and vacuum power flow engineering. These spectacular experimental (and diagnostic) achievements should not obscure the fact that huge strides have been made in computational and theoretical understanding of *z* pinches.

Early computational studies of *z* pinches focussed on the evolution of the magneto-Rayleigh-Taylor (MRT) instability from thin plasma shells. These calculations were carried out in two dimensions (typically *r*-*Z*). These calculations demonstrated that the MRT instability was devastating for thin-shell and long implosion-time *z* pinches. These predictions were verified numerous times at many facilities.

Today, modern computing platforms coupled with three-dimensional computer codes with excellent radiation, resistivity, and equation-of-state physics packages are beginning to revolutionize *z*-pinch physics understanding.

Detailed studies are being made on smaller MA-class generators using state-of-the-art X-ray and optical diagnostics in an attempt to understand the basic physics of *z* pinches. The high shot rate and excellent diagnostic access allowed scientists to make new measurements that lead to exciting and, even, revolutionary understanding of wire-array *z* pinches. These experiments were aided by the close collaboration of scientists around the world.

The articles in this special issue cover the range of research from the very largest facilities, smaller facilities, and computational methods to the theoretical foundations of *z*-pinch physics. It is our hope that interested readers will contact the authors directly for additional, more detailed information.

Z-pinch research over the last decade has surely proven the maxim that scientific progress can be made more rapidly and with better quality if the entire community works together. In this environment, the free exchange of data and ideas is leading to continual new improvements in our understanding of the physics of *z* pinches.

The use of *z* pinches for fusion applications and for radiation production is still the dark horse when compared with other more mature technologies such as lasers. But, the continuing rapid advances in the field coupled with new, larger more cost effective drivers suggest more progress can be expected for *z* pinches and their applications in the near future.

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