Physics Colloquium

Instabilities, Turbulence and Energy Coupling into Z-Pinch Plasmas

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Abstract:

Z-pincher plasmas produced by passing multi-MA, ~100-nanosecond current pulses through cylindrical wire arrays or gas jets are the most powerful laboratory sources of soft [1] and hard [2] x-rays. Z-pincher discharges generated the highest thermonuclear neutron yields ever produced on the inertial confinement fusion facilities [3], and with the development of repetition-rate current driver technology they show promise for inertial fusion energy production. One of the key issues for most Z-pincher applications is understanding (and mitigation, when necessary) of the Rayleigh-Taylor instabilities of the implosions. Although considerable progress has been made in this direction, many issues related to the instability development and the resulting turbulence generation remain unresolved. There is evidence showing that the turbulence can enhance magnetic energy coupling to the pinch plasma, thereby increasing the peak emitted x-ray power and radiation yield [4, 5]. Much better understanding of energy coupling and dissipation issues related to turbulence is needed to confidently predict the radiative performance of, and the prospects of achieving controlled inertial fusion on the next-generation 40-60 MA high-current facilities.

I will review the basic physics of the implosion instabilities of fast Z-pinches, their mitigation techniques, with the emphasis on the issues relating instability development and turbulence to the enhanced magnetic energy coupling to Z-pincher plasmas. The goal of this lecture is to attract the attention of the broader community to the interesting and important research area, which can greatly benefit from innovative approaches to analysis and modeling.

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4:00-5:00 pm
Leifson Physics Conference Room -LP208

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