DPP20-2020-001076

Abstract for an Invited Paper
for the DPP20 Meeting of
the American Physical Society

Magneto-Inertial Fusion: A Promising Path Toward Burning Plasmas in the Laboratory[1]

PAUL SCHMIT, Sandia National Laboratories

Magnetic fields have been widely embraced since the dawn of controlled fusion research, yet their benefits in inertially confined plasmas have proven challenging to demonstrate in the laboratory. The first tests of Magnetized Liner Inertial Fusion, or MagLIF [Gomez et al., PRL 113, 155003 (2014)], represented a major step forward in fusion research, demonstrating that magnetic fields could be a positive force for tailoring inertially confined plasmas and diversifying the spectrum of approaches aimed at producing burning plasmas. In this talk, I review the key advantages of Magneto-Inertial-Fusion (MIF) approaches like MagLIF for achieving fusion conditions and the opportunities and challenges to reaching those conditions with pulsed power through magnetically driven implosions. With help from a new and comprehensive theoretical framework describing the physics of MIF implosions, I summarize our present-day understanding of several important processes affecting target performance and define a general approach to scaling MIF concepts to higher yields that minimizes deviations away from the physical regimes we can access on present-day facilities. I place the greatest focus on performance-limiting processes appreciated by the broader plasma physics community, including magnetohydrodynamic instabilities and energy transport effects, and provide examples of innovative steps we have taken to understand and control the risks associated with these processes. All paths toward burning plasmas will benefit from continued improvements to the tools used to model, diagnose, and analyze experiments, and I emphasize these opportunities throughout the talk in the context of recent achievements and outstanding questions where greater community engagement could lead to new breakthroughs.

[1]SNL is managed and operated by NTESS under DOE NNSA contract DE-NA0003525.