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TDYNO: Laser-driven laboratory plasma astrophysics experiments of magnetized turbulence and fluctuation dynamo

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I present an overview of the exciting fundamental science in magnetized astrophysical plasmas that the TDYNO (turbulent dynamo) team is accomplishing through concerted application of the FLASH code [1,2] and laser-driven laboratory plasma astrophysics experiments. We have conducted recent breakthrough experiments [3,4,5,6] in the study of fluctuation dynamo, a ubiquitous astrophysical mechanism thought to be responsible for present-day magnetization of numerous celestial objects that had eluded laboratory plasma physicists for decades. The experiments have enabled us to explore dynamo in various regimes, providing us with novel insights and a new tool to validate or falsify our theoretical understanding.

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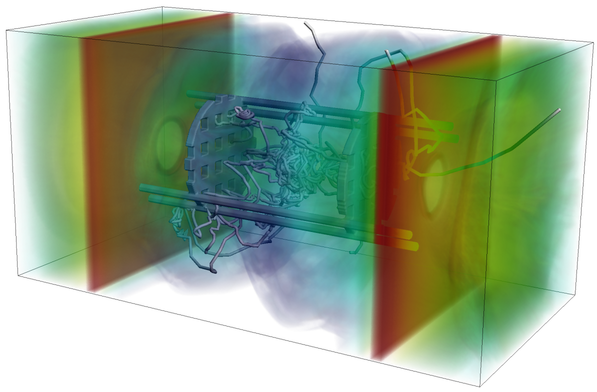

Figure 1. Three-dimensional volume rendering of the plasma density from a high-fidelity FLASH simulation of the TDYNO platform [3,4] used to demonstrate fluctuation dynamo in the laboratory for the first time. The composite targets are shown in red, whereas the gray contours denote the grids and rods of the assembly. Sample magnetic field lines in the turbulent interaction region are also shown.