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Design and calibration of a solenoid used on magnetized plasma experiments and of B-dot probes for measuring the strong magnetic fields using commercial electronic components

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Magnetic fields play an important role in many HEDP regimes, however, scaling of astrophysical relevant phenomena to a laboratory setting requires the generation of strong magnetic fields (>5T) that can match the high energies achieved by the laser plasmas commonly used in these experiments. Besides the engineering challenges of fabricating a powerful electromagnet design, suitable for laboratory-astrophysics experiments, measurement and calibration of such powerful magnetic fields and field geometries requires the use of precise and often disposable measuring devices that can be easily adapted to any experiment. Here, we present our approach to both sides of this problem. First, we show the construction of a solenoid designed to produce an axial magnetic field with strength in the central gap in the order of 10T, this design is the current iteration of a model introduced in 2014 for use in the Titan target chamber and makes several improvements in both field strength and reliability. Second, we show a method for fabricating B-dot probes using commercially available inductor elements commonly used in circuit board construction with a study of the performance in strong (10T) pulsed magnetic fields. We show that these probes, in addition to being easy and cheap to manufacture, provide accurate and responsive measurements after being properly calibrated, providing a robust and reliable method for creating magnetic probes.

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