



Doppler-Free Saturation Spectroscopy (DFSS) for Magnetic and Electric Field Measurements in an FRC plasma

Topic Area:
Diagnostics

Partner		Company	
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Project Summary:

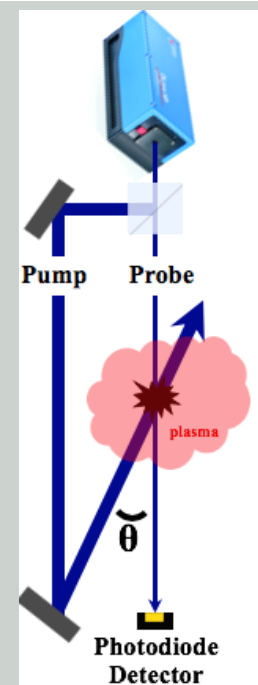
This INFUSE-supported study assessed the feasibility of utilizing DFSS diagnostic to measure low magnetic and electric fields in fusion-grade high-performance Field-Reversed-Configuration (FRC) plasmas. The study involved an extensive error analysis to determine the minimum detectable fields and their respective directions that can be accurately measured using the DFSS diagnostic. The optimum capabilities and limitations of the DFSS diagnostic are investigated for TAE's C-2W (Norman) FRC plasma. The study shows that the DFSS diagnostic can measure the magnetic field as low as a few tens of gauss along with its direction to a few degrees.

Fusion Impact:

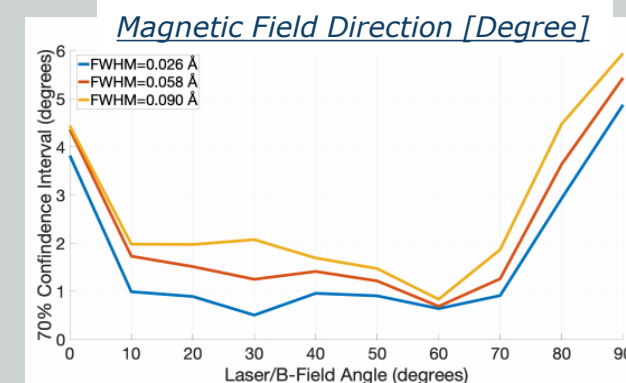
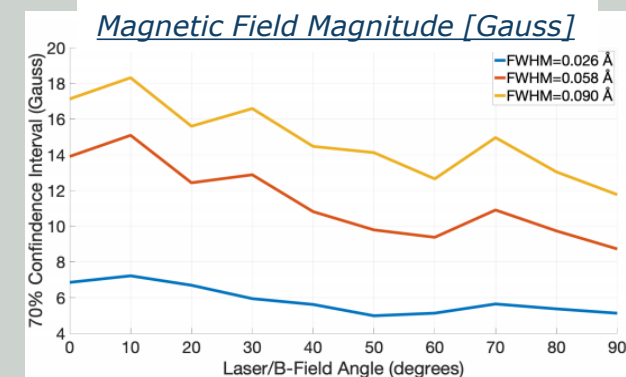
This study advances fusion energy by enabling non-perturbative and direct measurements of equilibrium magnetic field vectors in fusion-grade high-performance FRCs, improving our understanding of plasma behavior, optimizing fusion concepts, and mitigating risks associated with DFSS diagnostic implementation on such high-beta plasmas.

Business/Market Impact:

TAE, motivated by the study's positive outcomes, has decided to install the DFSS system on its existing C-2W device. In collaboration with ORNL, TAE applied for another INFUSE grant for proof-of-principle measurements on C-2W FRC plasma using DFSS diagnostic newly developed under the ARPA-E BETHE program. The DFSS measurements are currently underway. TAE may also consider developing DFSS system for future fusion devices.



DFSS Schematic and plots with sensitivity of B-field intensity & direction measurements



Period of Performance:	Federal Share:	Cost Share:
2020-2021 (INFUSE 2019)	\$96,000	\$24,000