Design and Fabrication of Low Temperature Plasma Diagnostics

San Diego State University College of Engineering

PLASMA FRONTIERS

GENERAL ATOMICS

DIII-D NATIONAL FUSION FACILITY

ME & ECE Team

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Project Overview

DIII-D is testing an RF-coupled plasma source called SupRISE for Neutral Beam Injection (NBI), while developing diagnostics to measure plasma parameters and a Faraday shield to support higher-power operation.

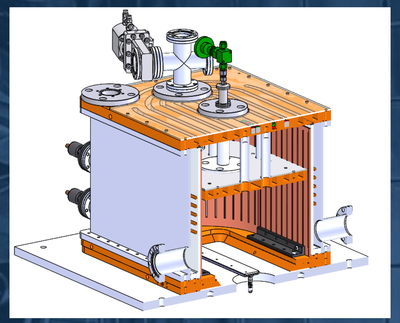
General Atomics DIII-D

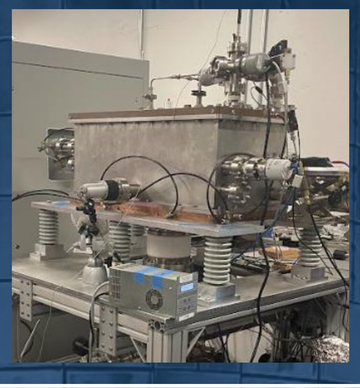
At the DIII-D Fusion Energy Research Facility, advanced fusion technologies are being developed using a tokamak that magnetically confines high-temperature plasma. Neutral Beam Injection is one of the primary heating mechanisms for the confined plasma.

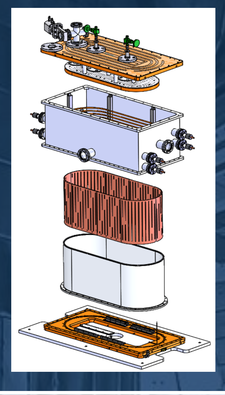
Acknowledgements

The team would like to thank Dr. Brendan Crowley and Evan Kallenberg from General Atomics as well as Dr. Scott Shaffar, Dr. Christopher Paolini, and Dr. Sam Kassegne from SDSU for arranging and supporting the team with the project.

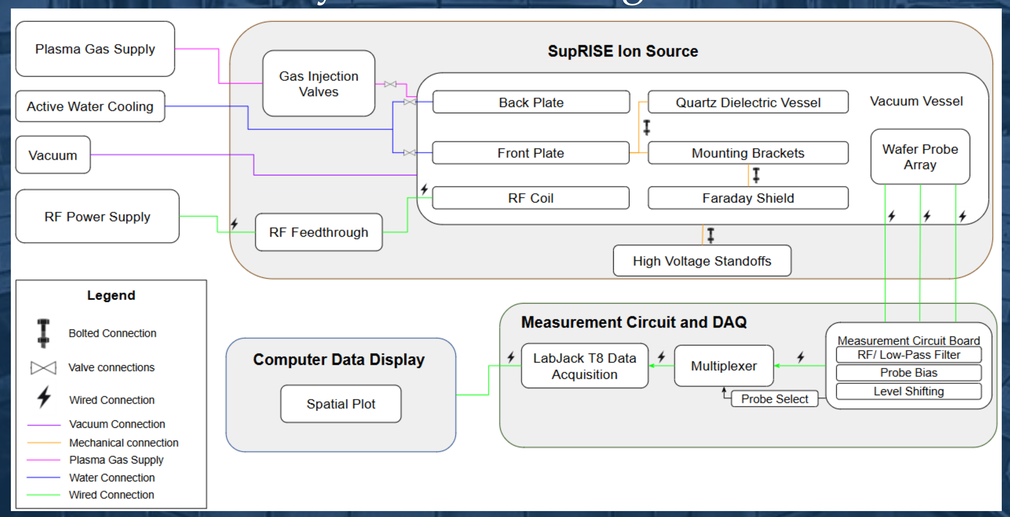
Final Assembly of System



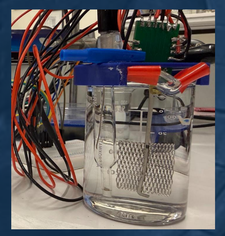


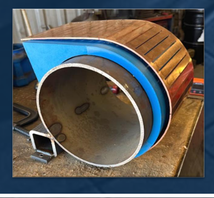


System Level Diagram

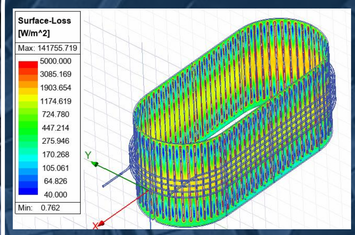


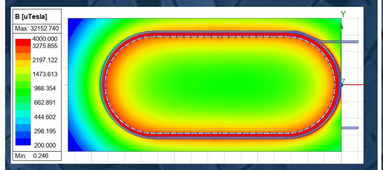
Assembly and Manufacturing





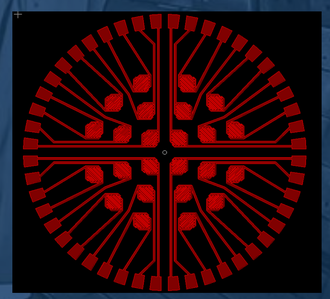
Faraday Shield

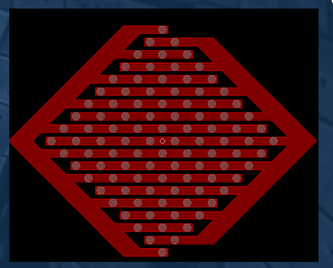




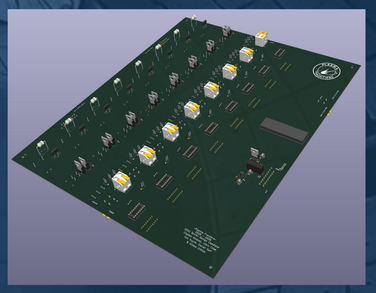
The Faraday Shield underwent electromagnetic and thermal simulations in ANSYS to investigate the ohmic heating distribution within the shield prior to integration. The surface loss distribution is then taken from the EM simulation (W/m^2) and imported into a transient thermal analysis to map temperature change due to these loadings.

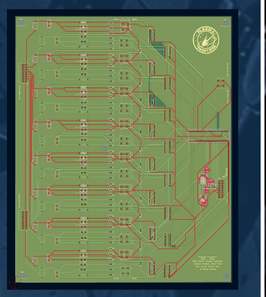
Plasma Eater (Probe Array)





Measurement Circuit





These systems work in tandem to measure current draw into each pixel on the probe array, which is then interpolated into plasma characteristics such as ion density, electron density, and electron temperature.

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