

San Diego State University

## **PROJECT OVERVIEW**

The DIII-D Vessel Armor System Project aims to create an attachment mechanism for wall armor tiles inside the DIII-D tokamak. This new design will allow for easy installation and minimal maintenance while effectively transferring heat to a water-cooled wall. Due to the non-uniformity of the wall and the precision needed an adjustable mechanism is needed to maintain tile to tile alignment.

## ABOUT OUR SPONSOR

The DIII-D National Fusion Facility is a cutting-edge research program experimenting with magnetically confined plasma to further the understanding of plasma and fusion. The DIII-D Fusion Facility houses the DIII-D tokamak, the largest operating tokamak in North America.

## THE TEAM



From Left to Right: Samuel Villegas Felix (Design Lead), Sean Quirk (Manufacturing Lead), Oscar Osuna (Team Lead), Alexis Resley (Analysis Lead), Melissa Thomas (Materials and Quality Lead)

## ACKNOWLEDGEMENTS

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# **DIII-D VESSEL ARMOR SYSTEM** R.M.O.R.





### FULLY ASSEMBLED SYSTEM TILES AND THEIR MECHANISMS ANALYSIS SYSTEM LEVEL DIAGRAM Innovative new systems were developed which use rails, sheet metal, and pedestals which allow for efficient Center-Post replacement of protective armor tiles. These systems are designed to withstand the 8 MW/m2 heat flux applied from the plasma shots and 1 MW/m2 radiative heat flux in surrounding areas. These tiles must also withstand the Lorentz force caused by the particles moving through the Lower 45 electric field LOWER DIVERTOR Outer Wall Grafoil pe: Equivalent (von-Mises) Str Adjusting Shims Time: 0.83133 4/15/2025 12:23 AM 2.2043e7 Max 1.9594e7 Copper Block 1.7144e7 1.4695e7 1.2246e7 9.7968e6 7.3476e6 4.8984e6 2.4492e6 0.00017848 Min Grafoil Sheet Metal Tile **CENTER POST ASSEMBLY & MANUFACTURING** : Center Post Tile (Thermal) L: Static Structural emperature Type: Temperature quivalent Stress Unit: °C Time: 730.1 Unit: Pa 4/18/2025 4:50 PM Time: 1 s 794.25 Max 4/18/2025 4:56 PM 706.96 619.68 2.0762e7 Max 1.8455e7 1.6148e7 1.3841e 183.24 1.1534e7 95.95 9.2275e6 8.6628 Min 6.9206e6 4.6138e6 2.3069e6 0.032819 Min





45: A TZM tile is placed atop an adjustable copper pedestal, allowing for toroidal adjustment.

Floor: A solid tungsten bar is placed through the two floor tiles and locked down, using a slotted bearing pushing down on the bar

Shelf and Center Post: A system of copper dovetails function as rails, allowing for toroidal and radial adjustment.



Type: Equivalent (von-Mises) Stress

## Spring 2025