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Design and Installation of Small Angle Slot (SAS) Divertor in DIII-D

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Divertor solutions to efficiently disperse heat from fusion reactors are critical because the maximum steady-state power load is limited to qt ≤ 5-10 MW/m² to the divertor target. This may pose a special challenge for next-step Advanced Tokamaks (AT), which will have lower plasma density than ITER for high performance long pulse or high duty cycle operations. A new Small Angle Slot (SAS) divertor concept has been developed to address this critical issue. The SOLPS-EIRENE edge code analysis shows that a SAS divertor can achieve strongly dissipative/detached divertor plasmas at a significantly lower upstream plasma density, thus potentially providing a power handling solution for long pulse ATs.
During the vent of the DIII-D vessel in late 2016, a graphite tile SAS divertor was installed. The design of the SAS divertor enables us to test the new slot divertor without affecting the geometry of the existing pumped divertor that is used for high performance advanced tokamak research. The new divertor tiles are mounted to an existing water cooled baffle structure that presently serves as the support structure for the graphite armor tiles for the pumped divertor region. The profile of the new tiles includes a narrow slot that is located outboard of the existing divertor target and divertor pump entrance and does not have any pumping.
Material for the SAS tiles was chosen to be Graftech XTJ-15. XTJ-15 graphite is an isotropic graphite material which is Graftech's replacement for ATJ. ATJ is the material that is primarily used in DIII-D for the graphite armor tiles, but is no longer produced.
This new SAS divertor has been operationally tested during the 2017 DIII-D physics campaign. Special design considerations were required to include Langmuir probes and thermocouples in the slot region of the new divertor.
Details of the tile design, modelling and installation will be presented. Work supported by the U.S. DOE under DE-FC02-04ER54698.

Eligible for student paper award?

No

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