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HIDRA - A Stellarator for Materials Research

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In tokamaks the intimate relationship between plasma performance and materials used at the first wall and divertor are recognized but not well understood. More so, in stellarators, the role of plasma material interactions has not been as rigorously pursued since the optimization of the confinement properties has been the mian focus. However with the next generation of stellarators and tokamaks coming on line or being designed the PMI issue needs to come more into focus. The tokamaks and stellarators offer different sets of PMI challenges that need to be addressed. However one of the main ones being long exposure of materials to the plasma. Thus it is important that a device exists where it is dedicated to materials research. The Hybrid Illinois Device for Research and Applications (HIDRA) is a toroidal plasma device at the University of Illinois and aims to be a dedicated, long pulsed stellarator/tokamak for plasma materials research. The vacuum vessel has a circular cross section and a major radius of R = 0.72 m and a minor radius a = 0.19 m, with a steady-state magnetic field < 0.5 T. A limiter can be used to reduce the plasma minor radius between 0.10 -0.15 m. HIDRA has the ability for long pulse steady state operation via the classical stellarator configuration and has an actual toroidal magnetic field, just like a tokamak. A pulsed capability during steady operation allows simulation of transient events. Initial plasmas will use 2.45 GHz magnetron heating up to 26 kW and should achieve Te~ 20 eV and ne[~]1×1018 m-3. Though the plasma parameters are lower than that of larger devices like W7-X or EAST, the plasma and magnetic fields at the first wall are very close to those produced in HIDRA. These capabilities make HIDRA an ideal test bed for materials and PMI studies, for example liquid Li technology where the science and technology can be tested, understood and perfected first in preparation for a final design that would be installed on a larger device.

Eligible for student paper award?

No

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