HIDRA as a Platform to Test PMI and PFC Concepts

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A strong collaboration between the USA and PRC exists with the development of liquid lithium PFC technologies (LLT) and understanding the plasma material interactions associated with LLT. PFC designs such LiMIT and FLiLi show that the concept of a flowing liquid metal first wall is possible. However, there still remains much that needs to be studies e.g. can liquid lithium, with trapped deuterium and tritium be distilled to separate out the dissolved gas and lithium and be cycled back into a reactor? The design and manufacture of such liquid lithium systems needs to be followed by experiments. To date, such components have been tested directly in larger tokamaks such as EAST because facilities to evaluate such designs prior to deployment have been unavailable. The Hybrid Illinois Device for Research and Applications (HIDRA) is a toroidal plasma device at UI-UC that can change this. 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 $\leq$ 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. In time, 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 T_e ~ 20 eV and n_e ~ 1×10^{18} m^{-3}. Though the plasma parameters are lower than that of larger devices like EAST, the plasma and magnetic fields at the first wall are very close to those produced in HIDRA. This makes HIDRA an ideal test bed for liquid lithium science and technology in preparation for final designs of LLT's to be tested in machines like EAST.