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Core Technologies in Fusion–Fission Hybrids: Design and Thermal Hydraulic Studies of Divertor Systems

Fusion–fission hybrid reactors provide a promising pathway toward sustainable nuclear energy by combining fusion's high neutron flux with fission's energy multiplication and fuel breeding potential. They are particularly suited for transmuting long-lived waste and producing fissile fuel, while bridging the gap toward full fusion power [1, 2]. A key component in such systems is the divertor, responsible for impurity control and withstanding extreme heat fluxes, often above 10 MW/m² [3]. In hybrids, these demands are amplified by additional thermal and neutron loads, requiring advanced materials and cooling designs. The Pakistan Spherical Tokamak (PST), though not a hybrid device, offers a relevant testbed for divertor development under compact, high-beta conditions [4]. Its spherical geometry also imposes unique design and thermal challenges [5]. This paper outlines the design, material configuration, and thermal-hydraulic performance of the PST divertor, highlighting its relevance to future fusion–fission hybrid systems.

Technical Track

Fusion and Advanced Reactors

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