

An Integrated Multi-physics Platform for the LIBRTI Facility

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The UKAEA-led Lithium Breeding Tritium Innovation programme (LIBRTI) aims to de-risk fusion fuel-cycle technologies through the delivery of a test facility for component-scale modular tritium breeding experiments. Underpinning this effort is the delivery of a flexible and scalable digital platform, which will produce high-fidelity digital replicas of LIBRTI's breeding experiments, and provide validation of its underlying multi-physics models. Not only may such a platform enhance scientific insights, but it should provide greater confidence for the application of in-silico design methodologies to breeder blankets. Such approaches can enable more rapid design-cycles, as well as identify innovative configurations, potentially reducing cost and accelerating the critical pathway to delivery of fusion power-plants.

In this contribution we present the development of the integrated multi-physics simulation framework that will provide the core modelling capability of the aforementioned LIBRTI digital platform. Building upon existing software available in the MOOSE ecosystem (including Cardinal and TMAP8) for neutronics, fluid dynamics, heat transfer and tritium transport, complementary functionality will be provided for activation and charged particle transport through wrappings of FISPACT-II and FLUKA respectively. In parallel, modelling of molten salt, solid and liquid metal experimental breeder concepts are used to demonstrate current capabilities. We report on the status of these activities, and describe our outlook for model validation, uncertainty quantification, and automation.

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