Developing shielding materials for fusion

PhD position in atomic scale simulations – AtomCraft research group

Recent development in *spherical tokamaks*, have shown that smaller magnetically-confined fusion reactors are a promising avenue for rapid development and commercialization of fusion energy. However, a significant barrier to the success of spherical tokamaks, is the limited space available for shielding of sensitive components, such as superconducting magnets, from the high energy radiation produced inside the plasma (Figure 1). Conventional shielding material (lead, steel, concrete) provide inadequate shielding, leading to excessive heating and radiation damage of the superconducting coils, which in turns reduces component lifetime, plasma efficiency, and increases maintenance costs.

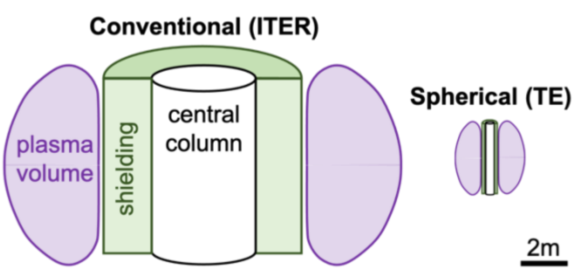

Figure 1 – Size comparison of conventional tokamak reactors (e.g. ITER) and spherical tokamak reactors (e.g. Tokamak Energy). The central column (in white) houses superconducting magnets stored at –250 °C, while the fusion plasma (purple) operates at over 100 million °C. The shielding (green) must provide protection from both extreme heat and high-energy radiation.

Recently, new candidate tungsten boride ceramics and ceramic-metal composites have been identified as potential advanced shielding materials. While these materials have exceptional thermo-mechanical properties, their response to the extreme environment of a fusion reactor is yet unknown. The aim of this project is to develop an understanding of the radiation damage in these advanced shielding materials when exposed to fusion radiation, and the effect that these will have on the materials properties.

The project is part of a new partnership between the University of New South Wales (UNSW Sydney, Australia) and the company Tokamak Energy (Culham, UK). The candidate will be based at UNSW Sydney, in the AtomCraft research group led by Dr. Patrick Burr. The candidate will perform atomic scale simulations, both classical and quantum-mechanical, to study the production and evolution of defects, and to help develop mitigation strategies to inform alloy design of radiation-tolerant shielding materials. A background in materials science or materials engineering is beneficial, as is a grasp of physics and competence in computer languages and programs.

This position comes with a high remuneration package, which includes full bursary at the Australian federal rate ($28,597/yr) plus a tax-free stipend supplement of $5,000-$15,000/yr (depending on the candidate's level of expertise), and travel and equipment support of $5,000/yr. The student will work in a tight-knit, inclusive, and enthusiastic group of diverse background. We value diversity and encourage applications from all backgrounds to apply. The project will allow ample opportunity for domestic and international collaboration, especially with (but not limited to) Imperial College London (UK), Tokamak Energy (UK), and the Australian Nuclear Science and Technology Organization (ANSTO).

For further queries and applications email p.burr@unsw.edu.au. When applying, please include your CV and transcript of most recent degree (or interim transcript if degree is not yet completed).