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## Physicists at Aldermaston

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**The UK's nuclear warheads are designed and maintained by the staff of the Atomic Weapons Establishment. Stephen White explains the vital role played by researchers there**

The Atomic Weapons Establishment (AWE) is the home of the UK's nuclear deterrent and is responsible for the entire lifecycle of the country's warheads from research and design through assembly to in-service support and, finally, decommissioning and disposal. AWE also plays a vital role in national security and international monitoring of the Comprehensive Test Ban Treaty. Its core mission is to build and maintain the warheads for the submarine-launched Trident ballistic-missile system that forms the UK's sole nuclear deterrent. It is also required to maintain the capability to design a warhead to replace Trident, should it ever be required.

In order to perform all these tasks, AWE carries out world-class science in some of the most challenging fields, including explosive detonation, hydrodynamics, high-strain-rate deformation behaviour, radiation physics and computer modelling. The AWE site at Aldermaston in Berkshire includes all the facilities needed to carry out this science – extremely fast supercomputers, areas for explosive trials and experimental facilities for high-energy-density physics. It employs researchers in not just nuclear physics, but all branches of the subject: from atomic and condensed-matter physics to astrophysics and quantum physics.



*Variety at work*

AWE is currently investing in its building and facilities in order to support Trident safely and reliably for the next 20 years. But behind all these facilities are the people. AWE currently employs 4300 staff and 1500 contractors across its sites in Aldermaston and nearby Burghfield, and it prides itself on recruiting only the best people in science, engineering and technology. Maintaining the UK's nuclear deterrent is not textbook science – everything AWE does is innovative. It carries out experiments on materials under extreme temperatures, strain rates and pressures that are over in the blink of an eye. AWE needs technical experts in a wide variety of physics fields to be able to understand and model the phenomena of interest.

### Explosive research

I applied to work at AWE after completing my undergraduate degree in physics at Lancaster University in 1993. I was looking for a career in physics research, and AWE seemed to offer everything I wanted. I was recruited into the hydrodynamics department as a research scientist and spent the first few years carrying out experiments in the explosive facilities researching the detonation of condensed high explosives. During this time AWE sponsored me to carry out a part-time MSc in numerical methods at the Royal Military College at Shrivenham. I also had the opportunity to publish my work and travel to many conferences around the world.

In 2000 my team and I moved to the theoretical- physics area on site, where I started leading a team of scientists looking into models of shear strength in condensed matter. At this time I also embarked on a company-sponsored part-time PhD in non-equilibrium thermodynamics. Within two years I was asked to lead the theoretical material-modelling group, consisting of some 25 staff – quite a leap for a mere scientist! In January this year I moved back to the hydrodynamics division to head up its science group of 50 full-time employees. I have lots of opportunities to develop in both technical and business matters, and I travel regularly to work with AWE's international counterparts. No two days are ever the same.

Most of the physicists at AWE work within the Directorate for Research and Applied Science. The directorate has about 1100 staff, of whom some 600 are scientists – a mixture of physicists, chemists, materials scientists, computational scientists and mathematicians. There is a roughly even split between theoretical and experimental staff, although we all work closely together to deliver integrated programmes.

Although the science and technology we need is self-contained at AWE, we do have active external collaborations, consultancies and contracts. We work with UK universities to employ summer students and foster graduate and postgraduate research, thus helping to develop the scientists of the future. We also contract work out to industry, thereby helping to invigorate technological advances in the UK as a whole. We have regular audits of our technical work, which allow top academics and experienced workers in industry access to our work, and we take on board their suggestions for future research directions. There is also an ongoing peer-review process with our colleagues in the US weapons laboratories that allows the exchange of data, ideas and staff under the auspices of the 1958 US/UK Mutual Defence Agreement.

### **Continuing development**

Many scientists at AWE say that working in a technical area at Aldermaston is like being back at university but with higher pay and greater job security. AWE encourages its researchers to publish externally, to attend and speak at prestigious international

conferences, to write textbooks, to assist the research councils with paper reviews and funding approvals, and to advise and direct UK technical policy. Substantial funding is also allocated to blue-sky work, where it is relevant to the core business.

AWE has a recognized graduate scheme for all recently graduated scientists and engineers that lasts about two years. The focus is on learning more about the wider company and workplace skills. An attractive remuneration package goes along with this. AWE continues to take professional development very seriously beyond the first few years, with on-the-job mentoring by experienced staff, funding for higher education and postdoctoral work, and placements at international facilities. The company vision is to be "internationally recognized for science, engineering and technology", and as such AWE constantly strives for excellence – mediocrity simply will not do.

### **About the author**

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