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Making a star on Earth: progress and prospects for fusion power

Dr Matthew J. Hole
Australian National University, Canberra

Monday, 30 April 2012, 8:00 PM
Physics Lecture Theatre 1, Sandy Bay Campus, University of Tasmania

ABSTRACT:

Fusion, the process that powers the sun and the stars, offers a solution to the world's long-term energy needs: providing large scale energy production with zero greenhouse gas emissions, short-lived radio-active waste compared to conventional nuclear fission cycles, and a virtually limitless supply of fuel.

Almost four decades of experiments in fusion research has produced spectacular progress. Present-day experiments have a power gain ratio of approximately unity (ratio of power out to power in), with a power output in the 10's of megawatts.

Fusion energy research is now poised to advance rapidly due to a large international investment in next step high performance fusion experiments, including billion dollar class experiments in Asia, and the $20 billion burning plasma physics experiment ITER. The next step experiment, ITER, with a power gain of over five, will explore the uncharted physics of burning plasmas, in which the energy liberated from the confined products of reaction exceeds the energy invested in heating the plasma. The ITER project, supported by a consortium of nations and alliances spanning half the planet, is the world's largest science experiment.

ITER heralds a new era in fusion research. Over 70MW of auxilliary heating will be used to initiate fusion events producing 500MW of fusion power. Temperatures will range from near absolute zero in the superconducting cryostat to 10 times hotter than the core of the Sun. The plasma volume approaches that of an Olympic swimming pool, and it will carry 15 MA of current, more than the current in 500 lightning bolts. The machine itself will weigh 23,000 tons, or about half the weight of the Sydney Harbour Bridge.

In this talk Dr Hole will outline the technical challenges posed by ITER and fusion research, the time-frame and associated R&D costs. He will summarize his own research in the physics of burning plasmas, as well as highlight fusion-relevant research across Australia. Finally, he will comment on the possibilities of an Australian engagement in ITER.

SPEAKER PROFILE:

Dr Matthew J. Hole holds degrees in Physics, Mathematics and Electrical Engineering and a PhD from the University of Sydney. After completion of his PhD he was working on fusion power on the innovative spherical tokamak concept at the U.K. Atomic Energy Authority. In 2003 Dr Hole returned to the School of Physics at the University of Sydney to do research on space plasma physics. In 2005 he joined the Plasma Theory Modelling Group at ANU.

Dr Matthew Hole is an ARC Future Fellow with Plasma Research Laboratory of the ANU. His principal field of research is magnetohydrodynamics, fluid modelling, and wave analysis of industrial plasmas, fusion plasmas, and space plasmas. He is the founding Chair of the Australian ITER Forum, the Australian member of the IAEA International Fusion Research Council, a member of the Board of Editors of Plasma Physics and Controlled Fusion and the 2010 Young Scientist of the Year of the Plasma Physics Commission of the International Union of Pure and Applied Physics.

Matthew also regularly teaches Advanced Electrodynamics to Physics Honours, which has been broadcast for the last three years to other Universities, including the University of Western Australia, Monash University and James Cook University.

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