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Office of Fusion Energy Sciences

The Scientific Challenge of Burning Plasmas

Plasma, the so-called fourth state of matter, is pervasive throughout the universe, with many diverse scientific manifestations. The U.S. Department of Energy supports plasma science research ranging from low-temperature plasmas, high energy density plasmas, and warm dense matter, to solar, space, and astrophysical plasmas. A large research effort is also devoted to studying how high-temperature plasmas can be confined by magnetic fields in the laboratory – ultimately for the production of fusion energy. The ITER experimental facility, to be operated as an international project by a consortium of international member countries representing more than 50% of the world's population, will push research into the frontier regime of "burning plasmas," which are self-heated and self-sustaining. This talk will describe the unique physics characteristics of burning plasmas, illustrate some of the outstanding research opportunities in this field, and review how the U.S. and world fusion science programs have laid the foundation for taking the present step to ITER.

About the Speaker: James Van Dam is Research Division Director at the Office of Fusion Energy Sciences, U.S. Department of Energy. He received his Ph.D. in plasma physics from UCLA in 1979. Dr. Van Dam was a visiting member of the Institute for Advanced Studies (Princeton) and then moved to The University of Texas at Austin when the Institute for Fusion Studies was established in 1980. He became Associate Director of the IFS in 1986 and served as Director 2003-2011. He was Director of the U.S. Burning Plasma Organization and Chief Scientist for the U.S. ITER Project Office 2007-2011. Dr. Van Dam's research areas include kinetic theory, MHD, plasma waves, ignition physics, equilibrium and stability in toroidal confinement fusion devices, energetic particles, and magnetospheric physics. He participated in developing the now-standard ballooning mode representation for tokamak stability theory, and predicted a new fundamental stability limit for the bumpy torus device. Dr. Van Dam applied energetic particle stabilization of ballooning modes in tokamaks and analyzed the effects of alpha particles on the stability of ideal MHD modes in ignited plasmas. Dr. Van Dam has published over 100 papers, plus two books. He is a Fellow of the American Physical Society since 1992.