UFA Technical Policy on Burning Plasma

A burning plasma (BP) experiment would greatly strengthen the US fusion energy sciences program. The TFTR and JET experiments have produced reactor like plasmas and attained near breakeven conditions (Q ~ 1). The alpha particle beta and energetic particle heating effects in these experiments were reactor-like, allowing the first exploration of BP physics. These Q~1 results using a tokamak magnetic configuration give high confidence in the feasibility of a Q>5 experiment. Production of a strongly self-heated fusion plasma will allow the study of a number of new phenomena. The non-linear coupling between fusion alpha production, alpha-heating-sustained pressure profiles, pressure-driven current, MHD stability, turbulent transport, and boundary plasma behavior, as well as fusion ignition transient phenomena will be studied and controlled. The additional studies of Alfven wave dynamics, the effect of energetic particles on collisionless reconnection and proton and alpha particle heating will also impact space and astrophysical plasma physics.

While fusion research is ready for a BP experiment more knowledge of plasma physics is required for building a cost effective reactor. Innovations to improve the economics of the tokamak or a more cost effective configuration are needed for a practical reactor. A BP experiment will open up new scientific frontiers of study and take us a critical step closer to realizing the goal of fusion power. Further, clearly demonstrating that a BP can be achieved in a tokamak configuration will be directly applicable to a large number of related magnetic configurations. In addition, achievement of a BP will stimulate the creative engineering and technical development needed to make fusion energy practical. Finally, operating in high-Q regimes allows new discoveries, leading to significant advances towards practical fusion energy. The UFA supports the exploration of potential BP experiments and advocates that this important next step be pursued by the U S fusion energy sciences program.

The main focus of the US fusion energy sciences program is to develop the science and technical base needed for practical fusion energy by exploration across a broad spectrum of magnetic configurations. Each innovative confinement concept being investigated offers advantages that would improve the economics and/or reliability of a fusion power system. Also pursued in the present program are basic plasma science, plasma theory, computational plasma physics, system studies, and technology research that are essential to develop new understanding that leads progress toward practical fusion and towards other applications of plasmas. This base program is needed to advance essential science and technology, to develop a more cost effective concept, and to capitalize on advances made with a burning plasma experiment. Thus, a BP experiment must be funded with a significant augmentation of the fusion budget. The relatively flat funding in the US fusion energy sciences program for the past several years following a major budget cut in 1996, has left the base program badly underfunded. Therefore, the UFA supports a balanced program for a faster realization of fusion power, requiring an increased base program as well as a BP experiment.

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