

Engineering Science Opportunities in Fusion Research

1-page summary

Technology research contributes to both the energy and science goals of the US Fusion Energy Sciences program. Contributions to the energy goal are generally well-understood: “plasma enabling technologies” are required to support the creation and control of reactor grade plasmas, whereas “fusion energy technologies” are needed to create a useful product that meets economic, safety and environmental requirements.

In addition, the technology program makes important contributions to the science mission of the fusion program. Improved fundamental understanding of the relevant engineering sciences is needed to help create a more desirable end-product, and therefore this aspect of the technology program deserves increased attention. A broad array of engineering sciences is involved in fusion technology, including:

- Materials science
- Surface science and atomic physics (Ulrickson)
- Fluid dynamics and MHD (Morley)
- Thermomechanics, thermal hydraulics and thermal sciences (Baxi)
- Chemistry
- Aerosol Science
- Magnet science and superconductivity
- Electrodynamics: rf and microwaves
- Physics of beams, accelerators and coherent radiation generation
- Nuclear science

Several of the more important disciplines have been described with emphasis on how advances can serve not only to accelerate the development of an attractive fusion energy product, but also to push the frontiers of basic engineering sciences.

The fusion technology program also plays an important role as “enabler of science”. This has long been appreciated within the fusion program itself, as many of the most significant advances in confinement became possible as a direct consequence of improvements in heating and current drive, plasma feedback control, magnetics, plasma-interactive components and other plasma enabling technologies. In this document we summarize “plasma science” enabling technologies, with emphasis on the far-reaching benefits of enabling technologies for plasma research beyond the boundaries of the fusion energy sciences program.