

Fusion Energy Development Applications Utilizing the Spherical Tokamak and Associated Research Needs and Tools

Monday, October 22, 2018 2:00 PM (4h 45m)

The spectrum of scientific and technological gaps that must be closed to achieve practical fusion energy using magnetically confined plasmas has been extensively documented. A common barrier to narrowing or closing these gaps is the scale and cost of fusion facilities needed to address the gaps. The low-aspect-ratio “spherical torus/tokamak”(ST) is being explored world-wide as a potentially attractive configuration for closing scientific gaps and demonstrating technical achievements on a path toward a demonstration power plant and as a more compact and/or modular fusion power source in its own right. The international fusion community is presently assessing the suitability of the ST for applications to advance fusion energy development including: developing solutions for the plasma-material-interface (PMI) challenge, fusion-fission hybrid systems, developing fusion components capable of withstanding high fusion neutron flux and fluence including breeding blankets, demonstrating electricity break-even from a pure fusion system, and electricity production at industrial levels in modular and/or larger-scale fusion power plants. This range of fusion energy development applications utilizing the ST will be described, common application-driven research needs discussed, upcoming and recently achieved ST facility capabilities and relevant highlights described, and near-term prioritized ST research directions supporting longer-term fusion energy development applications presented.

Country or International Organization

United States of America

Paper Number

OV/P-6

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Session Classification: OV/P P1-P8 Overview Posters

Track Classification: OV - Overviews