Foreword

Special section on Advanced Fusion Concepts

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Editor

This special section of *Fusion Science and Technology* features discussion of technologies and reactor design concepts that may enable the advancement of the current state-of-the-art or change the field of fusion technology development. We begin with a review of the long-awaited Fusion Energy Sciences Advisory Committee (FESAC) report, "Transformative Enabling Capabilities for Efficient Advance Toward Fusion Energy," and follow with the discussion of conceptual designs for a pellet injection system and two new reactor design schemes.

According to its report, the FESAC was charged "to identify the most promising transformative enabling capabilities for the U.S. to pursue that could promote efficient advance toward fusion energy, building on burning plasma science and technology." The committee undertook a significant review of grand challenges, knowledge gaps, advanced algorithms, superconductors, advanced materials, the tritium fuel cycle, liquid metal plasma-facing components, novel measurements, current drive capabilities, disruption mitigation, exascale computing, advanced divertor concepts, tritium and lithium safety, power extraction, and test beds. Maingi et al. present a summary and discussion here for the community's consideration of the "tremendous opportunity to accelerate fusion science and technology toward power production."

An example of such transformative enabling technology is featured in the next paper, "A Flexible Pellet Injection System for the Tokamak JT-60SA: The Final Conceptual Design," by Lang et al. This work features an informative and interesting discussion of the authors' analysis on the likely best performance for fueling and pellet pacing for the JT-60SA device. Of particular interest here are the design requirements driven by the vacuum vessel design and control requirements. In addition to the engineering work undertaken here, this work will be of general interest to the community as it provides insight into the operation and construction of flexible pellet injection systems for future devices such as ITER or power plants such as DEMO.

Following this application-specific work, two new reactor designs are considered. First in "About a New Fusion Reactor Scheme," Mazzucato proposes a fusion reactor setup reminiscent of racetrack plasmas and lays out for the reader the potential advantages of alternate plasma configurations: here, long cylindrical plasmas connected by short curved sections. The work includes a treatment of the proposed field layout and ignition condition as well as comparisons to other fusion systems. In addition to the reactor scheme, the author offers comments on the power and scale needs of future fusion power reactors. Next, with a discussion on alternative arrangements of D-T fusion configurations and devices, Holmlid gives us an unusual proposal for muon-catalyzed, laser-driven fusion in "Existing Source for Muon-Catalyzed Nuclear Fusion Can Give Megawatt Thermal Fusion Generator." In this work, based off of experiments and theoretical analysis, the author develops a scheme for using a muon generator coupled with a pumped laser system to produce a low-power fusion generator. Further, special attention is given to radiation shielding and safety.

This special section is aimed at the fusion technology and science community at large. It is my hope that it will stimulate interesting conversation, new ideas, and fruitful research avenues. Happy reading!