Editorial

THE present IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY issue provides a global overview of the scientific and technological development related to the superconducting magnet of the MADMAX experiment. The objective of the experiment is to detect axion in the 100 μeV mass range that would explain several mysteries of high-energy physics and cosmology (absence of CP violation, dark matter candidates, inflation and structure formation in the early universe). The MADMAX experiment will consist of multiple parallel dielectric disks, the so-called booster, hosted in a high magnetic field dipole. To host the booster, the 10 T superconducting dipole must have a large aperture of 1.3 m in diameter leading to a figure of merit of the order of 100 T^2m^2. The project is led and funded by the Max Planck Institut für Physik, who selected CEA Saclay to perform the R&D developments required to manufacture such a large-scale superconducting dipole.

This IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY issue contains seven papers. Three of them are directly focusing on the MADMAX magnet and conductor as follows: one is related to the electromechanical design of the full-scale magnet, the second one deals with the design of the conductor, and the last one focuses on the first round of R&D on the full-scale conductor. The four other papers are dedicated to the first important step of the development strategy that investigates the quench propagation in the cable in conduit conductor of MADMAX to mitigate magnet protection risks. To do so, an experiment, called MACQU, standing for MADMAX Coil for Quench Understanding, has been designed, manufactured, integrated, and successfully tested between March 2020 and August 2021 at CEA Saclay. These four papers provide a comprehensive overview of that experiment and respectively detail the conductor development and fabrication, the cryogenic system of the experiment, the integration and test of the MACQU coil, and finally the physical description of the quench propagation with a thermo-hydraulic quench back phenomenon revealed for the first time at 1.8 K.

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APPENDIX: RELATED ARTICLES

[A1] C. Lorin et al., "Development, integration, and test of the MACQU demo coil toward MADMAX quench analysis," *IEEE Trans. Appl. Supercond.*, vol. 33, no. 7, Oct. 2023, Art. no. 4500711, doi: 10.1109/TASC.2023.3273734.

[A2] W. A. Maksoud et al., "Thermohydraulic quench back in a copper CICC coil cooled by He II," *IEEE Trans. Appl. Supercond.*, vol. 33, no. 7, Oct. 2023, Art. no. 4500814, doi: 10.1109/TASC.2023.3308829.

[A3] T. Pontarollo et al., "Cryogenic design of a superconducting magnet with a copper cable-in-conduit conductor filled with static superfluid helium," *IEEE Trans. Appl. Supercond.*, vol. 33, no. 7, Oct. 2023, Art. no. 4500912, doi: 10.1109/TASC.2023.3309152.

[A4] V. Calvelli et al., "Advances in the magnetic and mechanical design of the 9 T NbTi MADMAX dipole," *IEEE Trans. Appl. Supercond.*, vol. 33, no. 7, Oct. 2023, Art. no. 4501110, doi: 10.1109/TASC.2023.3315201.

[A5] T. Pontarollo et al., "Progress on the R&D for the new cable-in-conduit conductor type of the MADMAX dipole," *IEEE Trans. Appl. Supercond.*, vol. 33, no. 7, Oct. 2023, Art. no. 4801907, doi: 10.1109/TASC.2023.3287775.

[A6] F. Stacchi et al., "Conductor qualification and fabrication for the MACQU solenoid," *IEEE Trans. Appl. Supercond.*, vol. 33, no. 7, Oct. 2023, Art. no. 4802005, doi: 10.1109/TASC.2023.3287779.

[A7] C. Berriaud et al., "Design evolution of MADMAX conductor to a Nb–Ti cable in copper conduit," *IEEE Trans. Appl. Supercond.*, vol. 33, no. 7, Oct. 2023, Art. no. 6000810, doi: 10.1109/TASC.2023.3286286.

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