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M3Or1A-02: The latest progress of all-superconducting high-field magnet at the ASIPP in China

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All-superconducting high-field magnets are in high demand across various scientific disciplines, including large-scale science devices, materials science, and biology. They play a crucial role in researching material properties, the origin of life, and disease prevention and treatment. These magnets offer significant advantages, such as compact size, low power consumption, flexibility, and convenience.

With the continuous advancement in superconducting materials and magnet technology, a key focus is placed on developing the essential technology for large aperture all-superconducting high-field magnets with independent intellectual property rights. This effort, driven by the national "13th Five-Year" major science and technology infrastructure project known as "Fusion reactor Key System Comprehensive Research Facility (CRAFT)," aims to develop the homemade high-field superconducting magnet. The ultimate goal is to achieve the domestic commercialization of all-superconducting high-field magnets with apertures exceeding 15T.

After over two years of accumulating experience and conducting extensive technical research, the project team successfully realized the commercial value of a 15T&77mm aperture all-superconducting hybrid magnet. The magnet's dimensions are Ø306mm×340mm, with a central magnetic field reaching 15.12T at an operating current of 118.6A. The axial magnetic field uniformity is ≤1%@Ø60mm×42.6mm cylindrical area, and the central magnetic field reaches the target value after two excitation exercises.

Building on the key technology of designing and preparing full superconducting high-field magnets, the project team plans to develop a larger aperture (≥150mm) high-field (˜15T) all-superconducting hybrid magnet. This will be achieved by combining it with high-temperature superconducting interpolation magnets, aiming to create a central magnetic field strength of ˜35T&80mm aperture for a high and low-temperature all-superconducting hybrid magnet. The overarching goal is to provide technical reserves and core component support for high-field material scientific research in fusion reactor development and contribute to the national strategic layout for high magnetic field development.

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