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ヘリカル核融合炉の先進機能実証のためのテーブルトップ装置 FFHR-01

A Tabletop Device FFHR-01 for Demonstration of Advanced Functions of the Helical Fusion Reactor

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A tabletop device, FFHR-01, with the helical coil major radius, R_c, of 0.273 m and the magnetic field strength at the helical coil center, B_c, of 1.0 T, has been designed (Fig. 1). The purpose of the FFHR-01 is to increase the technology readiness levels (TRL) of new technologies needed for the helical fusion reactor. A 1/10 section of the FFHR-01 has been made by the 3D printing technology using nylon. In the recent design of the FFHR-01, the cartridge-type liquid metal blanket, CARDISTRY-B2, is implemented with an Archimedes pump system (Fig. 2).

A step-by-step approach has been proposed toward the realization of the helical reactor FFHR-c1 (R_c = 10.92 m, B_c = 7.3 T) [1]. In this scenario, the FFHR-a1 (R_c = 2.73 m, B_c, = 4.0 T), and the FFHR-b3 (R_c = 7.8 m, B_c = 6.6 T, updated from [1]) is planned before the FFHR-c1. In the latest design of the FFHR-c1, four new technologies of (1) the high-temperature superconducting (HTS) magnet, (2) the ceramic pebble divertor, REVOLVER-D3, (3) the CARDISTRY-B2, and (4) the functional liquid metal (FLM) for the liquid metal blanket [2], are being considered. Although these new technologies are attractive to solve the issues extracted for the fusion reactor development [1], it is necessary to increase the technology readiness levels (TRL) [3] of these technologies to 6, where a system/subsystem model or prototype demonstration in a relevant environment is required. The FFHR-a1 has a role to achieve TRL = 5, where a component validation in a relevant environment is required, and then TRL = 6. Before this, TRL = 4 should be achieved, where a component validation in a laboratory environment is required. The FFHR-01 has been designed to achieve TRL = 4 on the four new technologies.

The recent statuses of the FFHR-01 design and the R&D on the four new technologies will be given in the presentation.

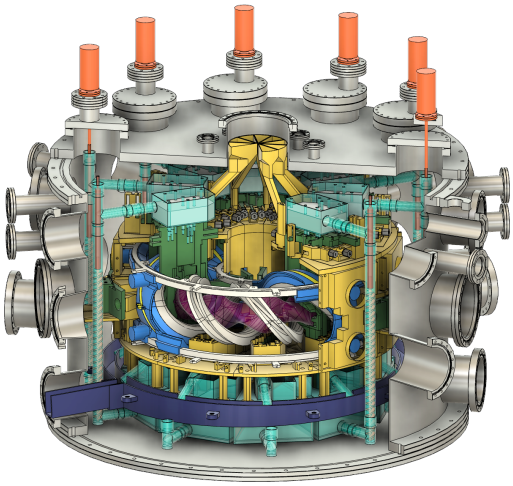

Fig. 1: Schematic view of the FFHR-01.

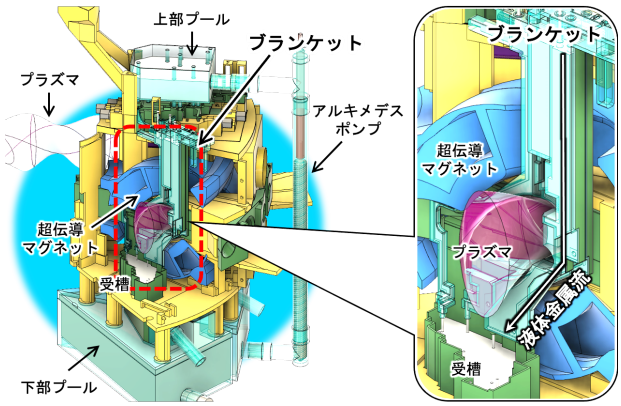

Fig. 2: Schematic view of the CARDISTRY-B2.

References

[1] J. Miyazawa, et al., Fusion Eng. Des. **146** (2019) 2233.
[2] J. Miyazawa, et al., The 29th International Toki Conference (ITC29, 2020) Poster-1-F4-13.
[3] J. C. Mankins, Technology Readiness Levels: A White Paper (NASA, 1995)