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Author: Ms. Jin Zhaojun
Chinese Academy of Sciences, China, zkxiao Zhao@126.com

PRELIMINARY IDEA OF FUTURE FLUID PHYSICS RESEARCH OF CHINESE SPACE STATION

Abstract

China will launch the core module of the Space Station around 2021 followed by the experimental module I and II which are expected to be in orbit for more than 10 years. The planning and cultivation of Chinese Space Station CSS scientific research project is extremely urgent. Fluid physics experiment rack and two-phase system experiment rack are planned in the CSS to support the study of microgravity fluid dynamics, two-phase flow, phase change heat transfer and its application, and complex fluid research. This paper puts forward a preliminary assumption of the fluid physics research of the CSS. From 2020 to 2025, it will mainly carry out fluid physics experiments with high maturity and based on previous unmanned detection research, including microgravity fluid dynamics and its application research plan, two-phase flow/phase change heat transfer and its application research plan. The two major plans include several projects. From 2025 to 2030, it is suggested to carry out (1) The complex flow law of the fluid interface of spatial phase change research plan. Including the study of complex fluid interface phenomena in space; Study on energy transfer mode and mechanism of gas-liquid interface; Numerical analysis of interface effects in phase transition phenomena, etc. (2) Soft aggregates and complex fluid research plan. Including the study of colloidal aggregation, phase transition, self-assembly and phase transition properties; Study on the characteristics of electric and magnetic fluids; Study on the particulate matter; Study on emulsion and foam system, etc. (3) Space phase change heat transfer and enhancement research plan. Including the research on gravity reducing multiphase flow, low temperature and heat exchange; Microstructure and phase change heat transfer enhancement; Study on condensation process and instability under microgravity, etc. (4) Microgravity fluid dynamics research plan. Including the study of thermally driven fluids; Study on the stability of thermal capillary convection in two-component solution; Water tunnel research, etc. (5) Study on key issues of space in-orbit fluid management. After 2030, it is recommended to carry out research on microgravity chemical industry: two-phase mixing, heat transfer and crystallization; Study on the influence of microgravity flow on combustion; Study on biological fluid mechanics; Application and promotion of space in-orbit fluid management, etc. Compared with previous missions, CSS will be more open, which is expected to produce a large number of major scientific achievements, break through a large number of core and key technologies, and obtain immeasurable economic and social benefits.