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Program and Development of Ground-based and Space-based Combustion Research in China

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1. Abstract

On June 17, 2021, the Tianhe (天和, 'Harmony in the heavens') core module has been successfully docked with the orbiting Shenzhou-12 crewed spaceship. It laid a solid foundation for the construction of Chinese Space Station (CSS; or 天宫, 'Heavenly Palace') to be fully assembled around 2022. With the completion of other space laboratories, i.e. Wentian (问天, 'Quest for the heavens') and Mengtian (梦天, 'Dreaming in the heavens') modules as the two primary national space microgravity laboratories (see Fig. 1), science programs for fluid physics, combustion, material science, biology, astrology,...etc. have been established for the first series of space station experiments and also for the operational period that projects to 2035.

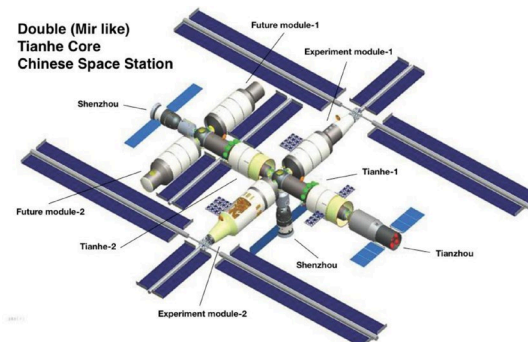


Fig. 1 Illustration of complete assembly of the CSS (picture from internet sources)

In this presentation, a review of recent development and overall program of microgravity combustion research in China will be provided. Discussion will cover the space-based combustion program (directions for both domestic and international science projects and payloads) for now and for the operational period as well as other agency initiatives that promote ground-based microgravity research in China. Targeting at the most fundamental problems, Chinese combustion community has endeavored to envision a variety of experiments that provide opportunities for combustion model validations and theory development. Areas include single and group droplet combustion, soot formation, combustion catalysis, flame speed measurements, laminar to turbulent flame transitions, flame instabilities, flame synthesis, flame spread of solid materials, burning characteristic of energetic materials,...etc. Corresponding planning for space station rack facility and other payloads will be briefly introduced. As for the ground-based microgravity facilities, in addition to the 3.6-second drop tower of the National Microgravity Laboratory in Beijing, facilities including the 2.2-second Tsinghua University Freefall Facility and a new 4-second microgravity facility with electromagnetic launch soon to be deployed for use will be introduced.

