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M3Or4A-02 [Invited]: Hydrogen Applications for Space Transportation

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Hydrogen has long been recognized as highly desirable for space transportation. The primary advantage of hydrogen for space applications is that in chemical or thermal propulsion systems, the exhaust products are of low molecular weight and accelerate readily. This results in very high specific impulse (propulsive efficiency). The key challenges with hydrogen applied to space propulsion are its low storage density, even as a liquid, and loss of propellant due to environmental heat induced boil-off. This presentation will briefly discuss the historic development of chemical hydrogen (and oxygen) space propulsion systems, ranging from the Saturn V upper stage and Centaur upper stage in the 1960s, the Space Shuttle and Space Launch System (SLS). Several international hydrogen based launch vehicle applications will be discussed as well. The presentation will then discuss the current goals for sustainable crewed exploration of the moon, and ultimately Mars, and how hydrogen propulsion can support those goals. Potential applications discussed include in-space transfer and refueling vehicles, landers and surface transportation. These missions bring particular challenges for long duration, minimal or zero-loss storage and in-space transfer of the hydrogen in microgravity. While past space transportation vehicles have used hydrogen for chemical or cold gas propulsion, thermal or electric propulsion technologies are being considered for missions in the more distant future for increased efficiency.

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