

Reusable Hydrocarbon Boosters Hydrogen to the Moon and Methane to Mars Space Exploration and Development Missions for SpaceX Launch Vehicles

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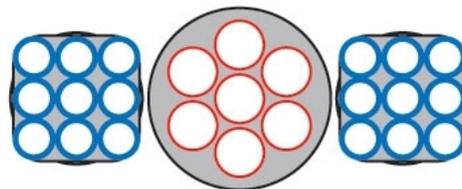
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In a series of previous papers I outlined a deep space scientific exploration, materials exploitation and infrastructure development architecture applicable to generic future reusable heavy lift launch vehicles. In this paper I will apply this design philosophy specifically to the SpaceX Falcon Heavy upper stages, which has the advantage in that its prototype the Falcon 9 already exists, and it is expected to be flying by the year 2015 when several deep space flybys of unexplored solar system planets will be occurring. SpaceX has also developed a series of hypergolic Draco thrusters for its Dragon capsule, one of which, the Super Draco, is quite powerful, and work has started on the Raptor hydrogen powered upper stage. These developments alone indicate that in the very near future, extremely efficient and fully reusable dual fuel (hydrocarbon/hydrogen) heavy lift launch vehicles will be available for architectural designs. Propulsive payload capacities available for deep space trajectories will approach or exceed 20 metric tons, including a fully space rated and reusable hydrogen powered upper stage with a cryogenic engine.

Methane fueled booster engines for new fast turnaround Earth surface to low Earth orbit spaceflight missions could also be utilized as well tested Mars orbital insertion, deorbiting and landing engines, as well as primary Mars ascent and Earth return propulsion. The hydrogen powered core stages delivering methane powered Martian spacecraft can also simultaneously deliver these fully reusable core stages to low Earth orbit, geosynchronous orbit or all the way to the lunar surface, which also allows for the use of hyperbolic, trajectory modifying lunar flyby and gravity assist trajectories for the Martian spacecraft. The combination of these fast turnaround methane fueled engines for atmospheric boost (using as many boosters as are necessary for the mission scenario) and ground started hydrogen core stage engines for high energy upper stage orbital insertions and short term lunar missions to the volatile rich lunar polar regions, enables direct trajectories and long term cryogenic fuel storage for asteroid and Mars missions.

Prepositioning of repurposed deep space storage and transport infrastructure is the single most valuable technique that will enable great savings in cost and schedule for large planetary development programs.



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