Ad Astra Rocket Company
http://www.adastrarocket.com/home
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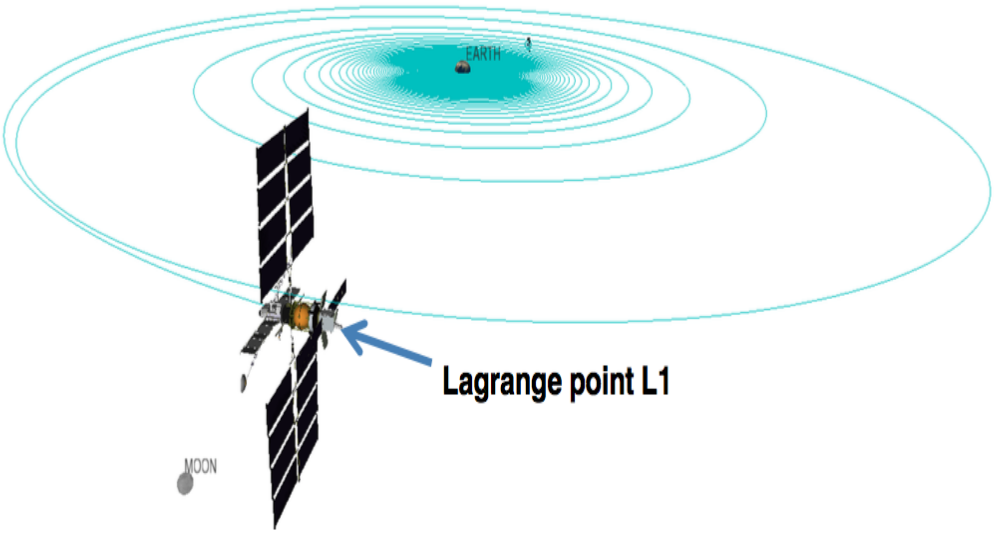
Ad Astra's VASIMR® L1 Cargo Tug
Solar Electric Space Tug for Cargo Delivery from LEO to L1

Ad Astra Rocket Co (Ad Astra), presents the advantages of using the VASIMR® electric propulsion engine as a method of transportation for space missions beyond low Earth orbit (LEO). No human has traveled beyond low Earth orbit since 1972. At that time, deep manned spaceflight was no longer financially achievable. Chemical rockets perform sufficiently to escape Earth's atmosphere however due to fuel limitations, manned spacecraft cannot travel much further than the moon in a reasonable time. Instead, humans have habituated low Earth orbit via space stations, or laboratories in space, to perform hundreds of unique science experiments. Research abroad the International Space Station has allowed for incredible growth in the field of human health, Earth observation, private space companies, and to inspire youth to pursue a field in STEM. The VASIMR® engine provides an option that did not exist in 1972, the ability of an in-space propulsion system to feasibly deliver supplies for sustained human habitation beyond LEO.

As interest grows to revisit the moon, obstacles arise of which form of transportation to use to deliver supplies for the construction of a lunar base laboratory or a lunar space station, electrical. This presentation will enter into a scenario where a lunar space station exists at the first Lagrange point (L1) between the earth and moon. L1 is a location between the earth and moon where the gravitational pull of each mass counteract each other, causing anything of small enough mass to sit stagnant in space not gravitating towards neither of the masses. The fictional spaceship is assigned a total of fifty tons, including a mixture of the supplies payload, the spacecraft itself, and fuel. Five trials were done, three were utilizing the 400kW VASIMR® engine and the remaining two utilize chemical rocket engines. The objective of the scenario was to learn which engine is more practical for a payload delivery system to a lunar space station at L1.

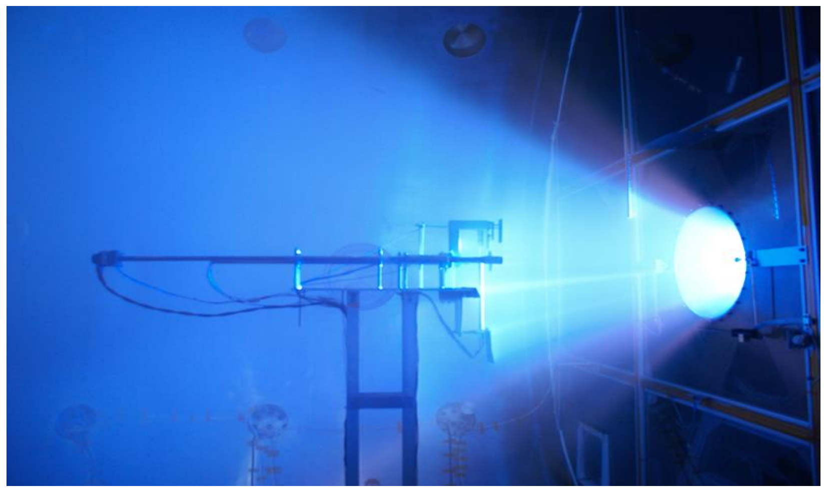


Below is the data:

Isp		Mass Budget [t]					Time [days]		mdot	DelV[m/sec]
[sec]	IMLEO	Prop(LEO-L1)	PayLoad	IML1	Prop(L1-LEO)	FMLEO	LEO-L1	L1-LEO	[kg/sec]	LEO-L1
5000	50	6.3	37.5	5.6	0.7	4.8	363	41	0.00020	6,556
2500	50	12.0	30.3	6.5	1.6	4.8	173	22	0.00080	6,652
1500	50	18.8	21.1	8.2	3.1	4.8	98	16	0.00222	6,811
450	50	29	15	6	chem one way only		4	N/A	N/A	3800
350	50	33	10	7	chem one way only		4	N/A	N/A	3800

***Definitions for table found at bottom of page**

The results show the drastic differences of using electric versus chemical propulsion. The most critical information to gather from the chart is the amount of payload that can be transported with a constrained mass of fifty metric tons, the time it took to arrive at L1 and return to LEO, and whether or not the spacecraft can return to LEO. In this test, the VASIMR® demonstrates the ability to transport three times the amount of payload than a chemical rocket. The VASIMR® does do the task in longer duration, so it depends on the urgency of the payload. Chemical rockets generate high thrust with low specific impulse (commonly used to measure rocket efficiency) and therefore must carry massive tanks of fuel to operate. The VASIMR® operates at a lower thrust than chemical but achieves a specific impulse 5 to 10 times higher, resulting in a more efficient engine. If the payload needs to be there immediately, then chemical should be utilized. In contrast, if the size of the payload is too immense for chemical and no urgency exists, the VASIMR® is the superior choice. In addition to this experiment, using the moon's gravitational pull, the VASIMR® would be able to slingshot back to earth in a month or less depending on which gear of specific impulse is selected. Coupled with the previous statement, the VASIMR® engine does not carry electrodes unlike most other electric propulsion systems which erode over time. The VASIMR® engine demonstrates as a durable, reusable, and efficient in-space propulsion system and provides an innovative alternative method of space transportation.



Conducted in Ad Astra's Houston vacuum chamber 150m^3 facility, the VASIMR® engine has successfully fired over 10,000 and has reached a thruster efficiency of 70 percent with a specific impulse value of 4500-5000 seconds. The VASIMR® engine utilizes argon ($5/kg) or krypton ($300/kg) as a propellant, much cheaper than conventional Hall and ion thrusters which operate with Xenon ($1000/kg).

Mass of the fuel tank is 10% the mass of the prop. || 12kg/kW used to find mass for spacecraft|| t-metric tons || Isp – specific impulse.

Initial mass in LEO (IMLEO)	Final mass after returning to LEO (FMLEO)
Mass of propellant used from LEO to L1 (Prop(LEO-L1))	Days it took to get from LEO to L1 (LEO-L1)
Mass of payload for space station delivery (Payload)	Days it took to return from L1 to LEO (L1-LEO)
Initial mass after delivery at L1 (IML1)	The amount of mass expelled per sec. as thrust (mdot)
Mass of propellant used from L1 back to LEO (Prop(L1-LEO))	The change in velocity from LEO to L1 (DelV)

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