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Propulsion System in Space and Flight Launch

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Abstract: In the past few years scientist have published a series of new methods which promises the revolution in the space propulsion systems, Space launches and flights these includes the VASIMR, NERVA, OPOC, MMEEV, NEXT and PHOTON PROPULSION. Some of these have the potential to decrease the launch casts thousands of times and others allow to reduce pollution by combustible gases in the atmosphere. Moreover, other changes the speed and direction without spending the fuel. The author reviews and summaries some of the most revolutionary propulsion systems for scientist, engineers, mentors and public. A short review of the status of space propulsion system is presented to serve as an introduction to the more specialized technical papers. The principle of operation and the several types of space flights or launchers that are either operational or in advanced development are discussed.
Keywords: Rocket Propulsion, Photon Propulsion, VASIMR, NEXT, MMEEV, OPOC, Sample Return Mission (SRM).

I. INTRODUCTION

People had have long dream to reach the sky. The idea of building a tower high above the earth surface into the heavens is very old. The Greek Pyramid of Gaza constructed in 2570 BC, it has a height of 146m. the writing of mosses about 1450 by in genesis chapter refers to an early civilization that is about 2100 by tried to build a tower to heaven out of brick and tar. This construction was called the tower of Babel and was reported in Mesopotamia. In 1943 production of V-2 rockets began in Germany with a operational range of 300km and has a capacity to carry a 1000kg warhead with huge explosive charge. After second world war the missile system has achieved a great success but rocket system achieved greatest progress in late 90's. The research programmes were launched with the aim to decrease the launch cost, reduce pollution and have higher potential. Over recent years interference fit joining technology including the applications of space methods have been important in achieving of space propulsion. Parts results in the area of propulsion system and methods have been patented recently or are in patenting process. NASA made a significant contribution to the study of different types of propulsion systems in recent years. Some of such new innovation technologies are present in the given review.

A. VASIMR- Variable Specific Impulse Magneto Plasma Rocket

The first VASIMR experiment was conducted at MIT in 1983 on the 'magnetic mirror plasma' device; later on in 1995 it was brought to ASPL. Its first experiment in Houston was conducted using a microwave plasma source. First experiment made a helicon discharge of 10kw and on later stages it found with as much power as 250kw. In 2013, 200kw VX-200 engine has executed more than 10000 engine firings. While demonstrating greater than 70% thruster effect relative to RF power input with Argon propellant at full power. VASIMR is an electromagnetic thruster for space propellant. It uses the radio waves to ionize and heat a propellant and magnetic field to accelerate the resulting plasma to generate thrust. The method of heating plasma used in VASIMR was originally developed as a result of research into nuclear fusion. It is one of the most advanced systems. VASIMR is intended to build a gap between high thrust low specific impulse propulsion systems and low thrust, high specific impulse system. This system is capable in functioning in either mode.

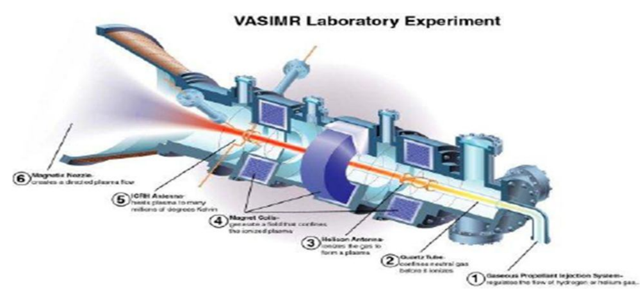

Fig 1: 'VASIMR' experiment engine at Jhonson Space Flight Center. (Image --- NASA)

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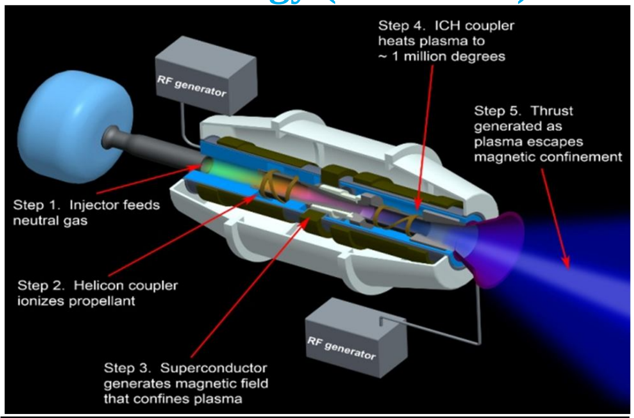

Fig 2: VASIMR schematic

B. NEXT- NASA Evolutionary Xenon Thruster

The NEXT project at Glenn Research Center aims to build an 'ion thruster' about three times as powerful as the NSTAR (NASA Solar Technology Application Readiness) used on 'Dawn' and 'Deep Space 1' spacecraft. NEXT affords larger delivered payloads, smaller launch vehicle size and other mission enhancements compared to chemical and other electric propulsion technologies for Discovery, New Frontiers, Mars Exploration, and Flagship outer-planet exploration missions. Glenn Research Center manufactured the test engine's core ionization chamber, and Aerojet Rocketdyne designed and build the ion acceleration assembly. Indeed, the NEXT engine is a type of solar electric propulsion in which thruster systems use the electricity generated by the spacecraft's solar panel to accelerate the Xenon propellant to speeds of up to 90000 mph. NEXT can produce 6.9kw thruster power. The major features of NEXT is a thruster that utilized design knowledge gained from ion thruster, that successfully propelled the 'deep space' to fly by of asteroid Braille and comet Borelli.

NEXT project is an integration of several elements which combines Next gen ion thrusts, N star technologies which are having a cutting edge design to yield a thruster with unparalleled specific impulse, throttling range, specific capability and life capacity.

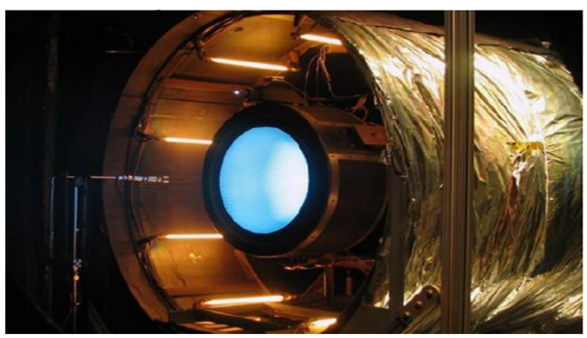

Fig 3: The next gereration of ion engines having fuel efficiency 10 to 12 times greater than traditional chemical thrusters. (Credit --- NASA)

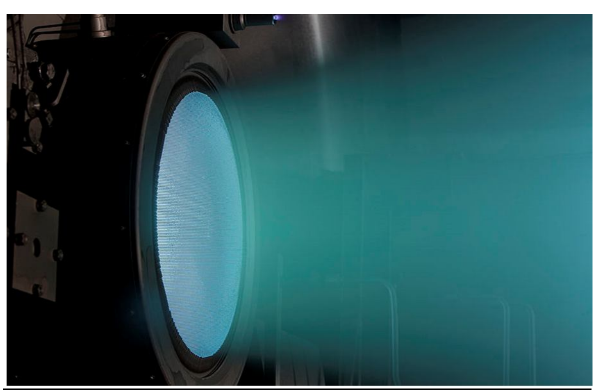

Fig 4: NEXT operation in vacuum chamber

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C. MMEEV-Multi Mission Earth Entry Vehicle

The MMEEV is a flexible design concept which can be optimized or tailored by any sample return mission, including lunar, asteroid, comet, and planetary (e.g. Mars), to meet that mission's specific requirements. Based on the Mars sample return (MSR) EEV design, which due to planetary projection requirements, is designed to be the most reliable space vehicles ever flown, the MMEEV concept provides a logical foundation by which any sample return mission can build upon in optimizing an EEV design which meets their specific needs by leveraging common design elements, this approach could significantly reduce the risk and associated cost in development across all sample return missions, while also providing significant feed-forward risk reduction in the form of technology development, testing and even flight experiment, for an eventual MSR implementation.

Fig 5: Artist's rendition of a 'sample return mission'

The current MMEEV parametric configuration and mass model is developed for a range of vehicle parameters, including vehicle diameter and payload mass/size. Since each individual sample return mission may have a unique set of performance metrics of highest interest, the goal is to provide a qualitative performance comparison across the specified trade space. From this, each sample return mission can select the most desirable design point from which to begin a more optimized design.

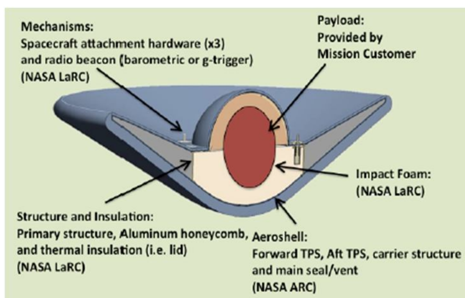

Fig 6: Cross-section of generic MMEEV

MMEEV is intended to have broad applications to any sample return mission, whether from the asteroid belt, the moon or Mars. The design trade tools and technology development within the project, particularly in the area of TPS and impact materials, have the potential to support many of the Agency's Exploration initiatives, including manned space flight.

Fig 7: Suitports on the outside of the Multi-Mission Space Exploration Vehicle (MMEEV)

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D. Photon Propulsion

Photon propulsion has been widely discussed for decades as a next generation propulsion that can make installer flight possible which requires the ability to propel spacecraft to speeds at least 10% of the light speed. It is considered as one of the best instiller technology. Compared with its theoretical progress, its actual demonstration at lab environment was very slow. It has been only very recent that a successful recycling photon thruster capable of amplifying thrust by order of magnitude was demonstrated in lab setting and that a success space deployment of solar sail was achieved with such successes along with recent impressive development of high power laser and associated optics, which forms necessary technological foundation for photon propulsion.

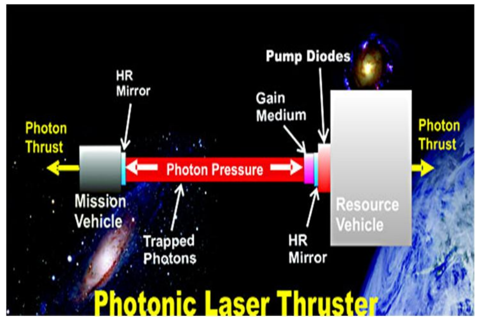

Fig 8: Photon Thruster

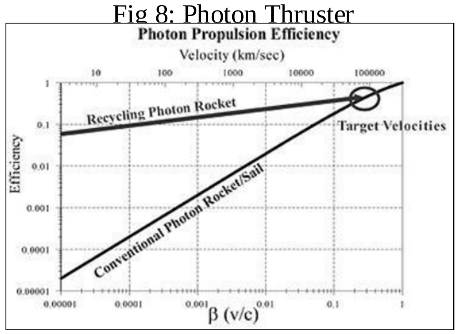

Fig 9: Energy transfer efficiency from the Photon energy to the Spacecraft kinetic energy as a function of $\beta = v/c$

E. OPOC Engine-Opposed Piston Opposed Cylinder Engine Technology

It is an internal combustion engine that can be made to run on number of fuels. It operates on two cycles principle generating one power stroke per each crank revolution per cylinder. This OPOC has following features as compared with same power conventional engines.

Smaller volumes for same power output.

Less weight for same power.

Fewer fails count.

Low emission controlled diesel efficient fuel consumption.

Low noise and vibration.

Low manufacturing cost.

Uses conventional materials and processes.

II. CONCLUSION

The main objective of this paper is to show that how new propulsion technologies can overcome the backlogs of older technologies by using these above mentioned technologies we can reduce the production cost to very large extent and also helps in reducing pollution for flight purpose. It is proposed here that such new technologies reduce size and power input to very large scale and increase the efficiency of the system. It is projected that these development phases will result in systematic evolutionary applications such as satellite formation flying, NEO mining/mitigation and space solar power which will be a sufficient sustainable economic

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interest and return investment to self sustain the development pathway, once fully developed these technologies would increase the horizon of human economic and social interests in space from space exploration to space mining colonization and permanent habitation.

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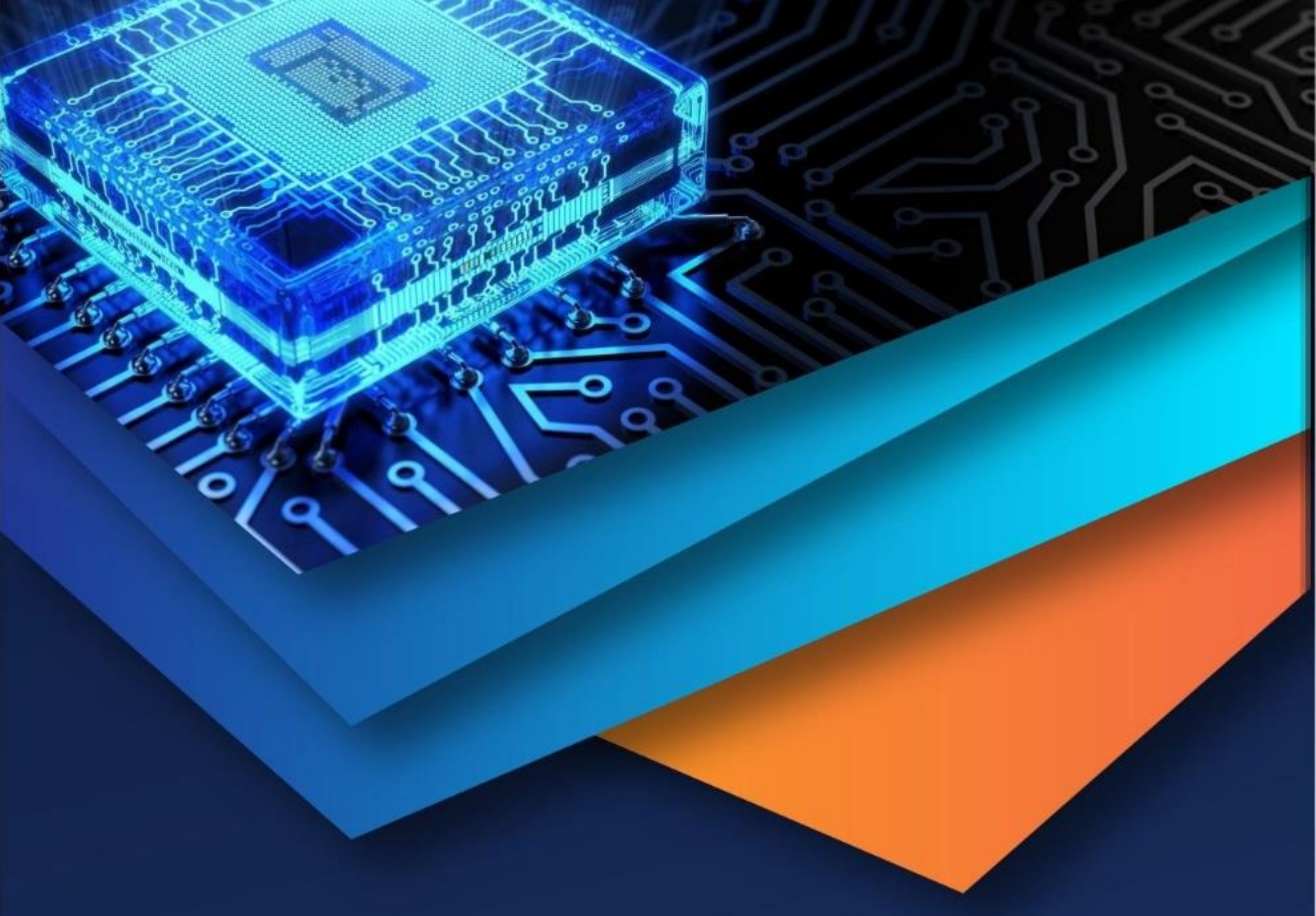

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