

# Gases in Experimental and Future Rocket Propulsion Systems

Within the next 10 years, modern rockets, such as those launching the space shuttle and the Saturn 5 will be obsolete. Chemical rockets have finally reached the pinnacle of their evolution and researchers have finally turned their attention elsewhere.

Future Rockets will be separated into three categories, launch vehicles, inner-solar system, and interstellar rockets. By separating the functions of a rocket, each type will perform their given task better.

Launch vehicles will continue to be driven by chemical rockets because they require high amounts of thrust over the small distance required to escape the earth's gravity.

The space shuttle, designed and built in the late sixties-early seventies is finally going to be replaced as the premier launch vehicle in the world. The X-33 prototype has finally begun testing. The X-33 is totally reusable; it doesn't require expensive booster rockets and extra fuel tanks to achieve orbit. Its chemical rockets are all it needs. Fueled by liquid hydrogen and liquid oxygen, the X-33 will be able to blast more mass for less cash out of the earth's gravitational field. The Venture Star will quickly replace the X-33. The *Venture Star* will be three times as large and carry many times the payload.

Inner-solar system rockets will probably use a solar driven ion drive (see diagram). The ion drive uses electricity generated by solar panels to ionize xenon. The xenon ions are then electrostatically accelerated by a series of solenoids and released through a 30-cm nozzle. This engine is very fuel-efficient, it produces 10 times the specific impulse (ratio of thrust to propellant used), and it is also much faster. Unfortunately the amount of thrust provided is very small only 92mN at peak efficiency. This means that while the ion drive can go faster and farther, its acceleration is much slower. The Deep Space 1 experimental spacecraft is currently testing this drive system, as one of its many new experimental technologies.

Interstellar drives are not quite so well developed. One possibility is a nuclear rocket. This drive uses a fission reactor to superheat hydrogen gas and transform it into high-energy plasma, which then leaves the reaction chamber at high speeds. These rockets would be about 5 times as fast and strong as a current chemical rocket. The only downside to this drive is that it would require much more radiation shielding than any other type of rocket to protect its human cargo. This rocket would also release massive amounts of radiation into the

surrounding space, fine for deep space where such radiation would be like a drop of water in the pacific, but absolutely fatal for the Earth.

The ultimate source of power and propulsion in space would be the Matter/Anti-Matter Drive. Deuterium and anti-deuterium (deuterium that has been magnetically reversed) would annihilate each other producing massive amounts of energy. This energy would be used to create plasma to drive the rocket near the speed of light. Small amounts of anti-matter have been created for a few seconds in laboratories in Boston using particle accelerators, but no method of containment has been successful.

The future of space travel is by no means decided. The drive systems I have explained are only possibilities. Who knows what advances science will make? Tomorrow everything we know to be true could be turned upside down and a new concept will emerge and bring humanity to the stars.