

METROCOSM

How to get to Mars in 39 days

The recent anniversary of the lunar landings has reignited the question: when will we go to Mars? Nasa hopes to reach the Red Planet by the middle of this century but not before the agency has been back to the Moon and set up camp for a while.

One of the biggest obstacles facing any manned Mars mission, aside from the financial one, is the sheer length of time it takes to get there. Using conventional rockets, the best journey time we can hope to achieve is six to seven months,



Nasa sees Vasimr helping to keep the ISS in orbit, eliminating the need to bring fuel supplies from Earth

during which time your Martian pioneers would lose a bit of their edge. Without gravity, the cardiovascular system weakens and the vertebrae will pull apart. Unused muscles will atrophy and bones

will lose so much calcium they become fragile and prone to fracture. That's not to mention the psychological effects of months of incarceration and isolation. In short, by the time your hero touches down, he will be more Supergran than Superman.

What is needed is a radical new, superfast propulsion method that



Vasimr utilised as a Mars transit vehicle. The craft could reach speeds of 193,000kph and get to Mars in 39 days

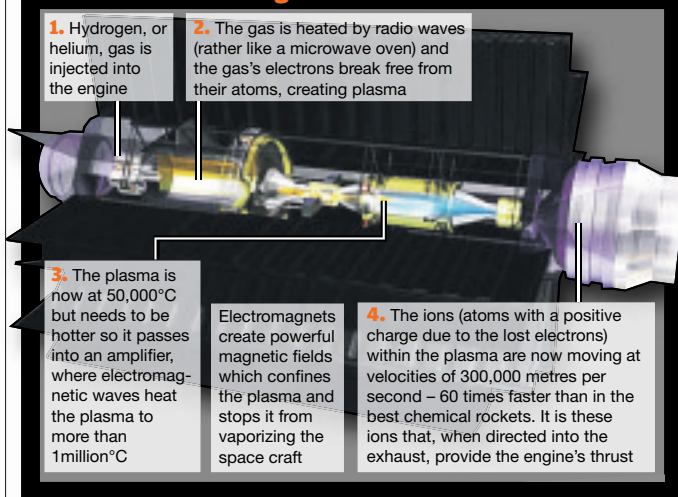
will give your astronaut a chance to step down from his capsule and not fall down from it. Enter former seven-time astronaut and plasma physicist Franklin Chang-Diaz. He and his colleagues at the Ad Astra Rocket Company are busy putting the finishing touches to an engine that will transform a seven-month Martian odyssey into a 39-day Martian jaunt. The wonderfully named Variable Specific Impulse Magnetoplasma Rocket, or Vasimr, uses super-

heated plasma to reach speeds of more than 193,000kph (the best conventional rockets top out at 64,000kph) while consuming only a fraction of the fuel.

Aside from the long journey times, the trouble with conventional rockets is they are terribly inefficient, meaning that the bulk of any Mars craft would, by necessity, have to be given over to fuel – leaving very little room for cargo or astronauts. The efficiency of a rocket engine is measured in terms of specific impulse (a kind of miles per gallon), which is a measure of how many seconds of thrust a rocket can get from a unit of fuel. A good chemical rocket has a specific impulse of about 450 seconds – it gets one pound of thrust from one

How the Vasimr engine works

1. Hydrogen, or helium, gas is injected into the engine
2. The gas is heated by radio waves (rather like a microwave oven) and the gas's electrons break free from their atoms, creating plasma
3. The plasma is now at 50,000°C but needs to be hotter so it passes into an amplifier, where electromagnetic waves heat the plasma to more than 1million°C
4. The ions (atoms with a positive charge due to the lost electrons) within the plasma are now moving at velocities of 300,000 metres per second – 60 times faster than in the best chemical rockets. It is these ions that, when directed into the exhaust, provide the engine's thrust



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MINICOSM

SCIENCE & DISCOVERY IN BRIEF

● **STUPID DIET:** Eating too many curries, kebabs and burgers can not only make you fat – it can also damage your brain. Food which is high in fat can cause memory loss and even make people less intelligent, according to Cambridge University research. After nine days on a high-fat diet, rats were not able to complete a maze and made more mistakes in the process than their low-fat diet counterparts.

● **HIGH HOPES:** Cannabis could protect bones from weakening in later life, it has been claimed. While properties of the plant caused young mice to develop brittle bones, it guarded against osteoporosis in older rodents, a study showed. A molecule in the body, which can be activated by cannabis, is key to the development of the bone disease, researchers at Edinburgh University said. They hailed the discovery 'an exciting step forward'.

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pound of fuel for 450 seconds. Vasimr, however, can achieve a specific impulse of 30,000 seconds. This means it can go a long, long way on a relatively small amount of fuel.

Vasimr works by using radio waves and something called a magnetic mirror to heat hydrogen gas so that it forms a plasma that is similar, in property and temperature, to the material that makes up the Sun.

The superheated plasma is then expelled from the rocket's exhaust to provide thrust. In rocketry, the higher the temperature of its exhaust, then the better it is.

A space shuttle exhaust gets to a few thousands degrees celsius but

Vasimr reaches temperatures in excess of 1million°C.

Another advantage to Vasimr is, since hydrogen is the most abundant element in the Universe, a Vasimr-powered craft will need to carry only enough fuel to reach its destination, such as Mars, and then refuel on arrival for the return journey. Also, hydrogen is the best radiation shield known, so the fuel could be used to protect astronauts from potentially harmful radiation exposure. Vasimr is more than just a sci-fi fantasy, though. The engine has been tested at full power in the lab and in 2012 it will be tested on the International Space Station.

Chang-Diaz hopes Vasimr-powered craft will act like a courier service, ferrying supplies to lunar colonies

Why man+Mars = Nuclear power

In space, without power, you die. The International Space Station consumes 75kW of power, most of which is used to keep astronauts alive, which it derives from its 2,500sq m solar array.

Power estimates for a Mars colony range from 20kW to 60kW, which sounds do-able until you realise that, thanks to the weakness of the Sun's rays at Mars, a solar array supplying just ten kilowatts would need to be about 68,000sq m. Solar panels of that magnitude are simply impractical. That's not taking into account the 200mW of power your Vasimr-powered craft will need to get you to Mars in 39 days.

The only practical solution to that sort of power requirement is a nuclear reactor (current Mars rovers use a sort of nuclear battery already to supplement their solar arrays) both onboard your Martian craft and on the planet's surface.

Miles (and miles and miles) to the gallon

	Specific impulse (secs)*	Energy per kg of fuel (MJ/kg)
Solid rocket	250	3
Liquid rocket	450	9.7
Ion thruster	3,000	430
Vasimr	30,000	43,000

*number of seconds it gets 1lb of thrust from 1lb of fuel

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