THE ARESIAN

April 2025

Volume 3 No. 4

Editor: Owen Louis David **Assistant Editor:** Mary Khan **Contributors:** Victor Samuels, Dougie Smith and Peter Dale. *Published by Mars Futures Forum*

A FUSION REVOLUTION COMING TO A PLANET NEAR YOU SOON?

It might seem a bit previous to be discussing revolutionary reductions in transit times to Mars even before Starship has proved it can get there using good old-fashioned chemical combustion…but the future arrives by many routes so check in to this article.

See Page 2

THE FLIGHT 9 RABBIT HOLE

We go down the Flight 9 rabbit hole to find out where we're at. After the destruction of the Starship in Flight 8 (very similar to what happened on Flight 7) we seem to be at a critical juncture

See Page 7

IN THE NEWS

Mars is always in the news these days.

In this edition we focus on some interesting news stories

Lots to interest the Mars-focussed mind!

There's the ongoing scientific contest over Mars's past. Was it wet-and-warm or cold-and-dry?

Researchers have been using some clever computer modelling to see where Mars got its looks from.

See Page 9

TWO WEEKS TO MARS?

By Dougie Smith

The coming revolution in transit to Mars will be a game changer.

You've probably heard claims that we are on the cusp of huge changes in rocket technology that will vastly reduce transit times to the planets and even make travel to neighbouring stars possible.

What lies behind these claims? Are we really at the start of a "rocket revolution" that will change the face of space travel? We need to find out because this could affect the prospects for successful Mars colonisation tremendously.

Achieving really high spacecraft speeds has always been a dream for both sci fi and space enthusiasts. The great thing about the vacuum of space is that it allows for friction- free travel. If you can just continually accelerate your craft to (let's be modest) 10% of the speed of light then not just the world but the galaxy is your oyster.

For once the UK can pride itself on being at the forefront of the technological

Let me introduce the Sunbird which has a realistic chance of being the first rocket to demonstrate fusion technology in rocketry.

Sunbird is the brainchild of Pulsar Fusion, a UK based company which has attracted substantial financial backing from the British government. The company has significant experience of orbital satellite positioning, using to get satellites into the exact position required for them to be fully operational. Think of it as fine-tuning after a rocket has got your satellite into the right area in space.

So, these are no start-up amateurs. They are the real deal. But how will the Sunbird work? The rocket will be based on fusion energy. A note here since we are used to hearing the old joke that fusion energy is always 20 years off. The old joke is really referencing fusion energy as a means of powering the electricity grid. Here, when it comes to a rocker, we don't need to achieve significant over-unity output. It is enough if fusion energy can accelerate a craft for a period sufficient to achieve an extremely high speed.

The Sunbird is designed to carry two linear nuclear fusion engines onboard,

which will burn Deuterium and Helium-3 to produce an aneutronic fusion reaction (a much more benign form of atomic reaction that will not compromise human health in the way nuclear fission can potentially). The name given to this new propulsion system is Dual Direct Fusion Drive. Remember that name – we may be hearing a lot more about it!

The basic concept behind the engine is that a divertor is used to concentrate plasma (a hot, electrically charged gas) using superconducting magnets in a compact linear fusion reactor. The reactor is designed to operate in a steady state mode, so that input equals output.

The Sunbird engines, replace tritium (normally used in fusion energy devices) with helium-3, a rare helium isotope. The nuclear reaction between deuterium and helium-3 will expel positively charged protons which will deliver propulsion, as well as power to operate a spacecraft's systems.

The fusion reactor could generate exhaust speeds of 223 km per second with an ISP (specific impulse) reaching 10,000 to 15,000 seconds. This could result in speeds of 329,000 miles per hour. That's 91 miles per second! It would be the fastest vehicle ever created by human beings and could transit to Mars in half the time currently required.

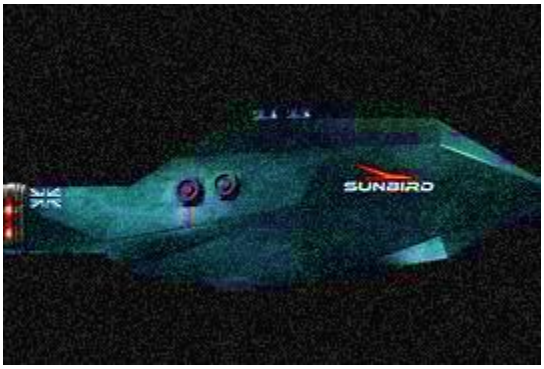
The Sunbird rocket may eventually carry human passengers on long distance space flights which will expose them to solar and cosmic radiation. As a result the rocket will make use of the latest in high-density, blended metal composite shielding. These blended metal technologies look to optimise shielding by deploying a range of metals (with different atomic numbers and characteristics) that will be integrated with polymers or other low-weight materials.

The Sunbird vehicle concept seems highly credible and could dramatically reduce mission timelines and costs. It will potentially raise scientific research to a new level as all sorts of missions become feasible.

There is no doubt that Pulsar Fusion's DDFD could potentially open up the way to faster transit of cargo and personnel to Mars. It could also facilitate asteroid mining operations, outer solar system probes, and the precise deployment of next-level space observatories beyond

Earth's orbit. For the first time as well, meaningful exploration beyond the solar system could become a possibility.

So why is fusion the way forward? The secret to fusion being a great candidate for fast rockets is that the fuel mass is so much lower than required in a chemical combustion rocket. In other words you don't need to launch so much fuel to orbit. Starship is getting round that issue by having other Starships refuel the Mars-bound Starship in orbit. But it cannot yet manage to power a lengthy period of acceleration which can get a vehicle up to truly astonishing hyperspeeds.



Credit: Pulsar Fusion

Artist's impression of the Sunbird

It is apparent that Sunbirds could potentially operate a Mars-to-Earth shuttle service taking spacecraft between the two orbits.

As well as providing a poweful means of propulsion, the fusion reactor can ensure auxillary power is supplied to onboard systems (which will be important if the spacecraft is operating on the outskirts of the solar system).

As of now, Pulsar Fusion plans for commercial use of Sunbird, including rapid delivery of cargo to Mars, outer solar system science probes, a lunar orbital supply hub, asteroid mining missions, and delivery of deep space telescopes. The cargo loads are relatively modest in the 1 to 2 tonne range. But there doesn't seem to be any physical limit to scaling up. So perhaps with the next couple of decades we might see this technology developed as a human passenger service.

CNN quote Aaron Knoll, a senior lecturer in the field of plasma propulsion for spacecraft at Imperial College London, as indicating there is huge potential for harnessing fusion power for spacecraft propulsion. "While we are still some years away from making fusion energy a viable technology for power generation on Earth", he is reported as saying, "we don't need to wait to start using this power source for spacecraft propulsion."

Pulsar Fusion are not the only game in Fusion Town. There are other companies making progress on developing nuclear fusion engines for space propulsion, including California-based Helicity Space, backed by funding from the well-known aerospace corporation Lockheed Martin in 2024.

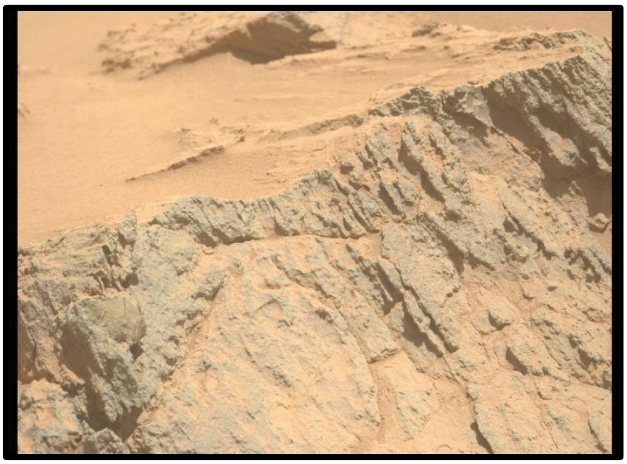
Another Californian-based company, General Atomics, is working with NASA on another type of nuclear reactor using fission rather than fusion which is also schedule for testing in 2027. This type of system is called Nuclear Thermal Propulsion, a concept that has been worked on for 7 decades now but might finally be approaching fruition. If it works, it could result in a more efficient propulsion system for a crewed mission to Mars compared to current options.

However he notes that current fusion systems involve some heavy duty items and *"Miniaturizing these systems and making them lightweight is a considerable engineering challenge."*

There seems to be every reason to think that fusion technology can be the next the next-level rocket propulsion system. At present there seems to be no challenge to the future role of the Starship as the workhorse of Mars colonisation but – in 15 or 20 years' time? - we might see a scaled up version of the fusion rocket take centre stage.

Theoretically, a fusion rocket could reach speeds of 500,000 MPH and reduce the transit time to Mars to under 30 days. That really would brings Mars so much closer to Earth in so many ways.

PICK OF THE PICS



Credit: NASA

This pic, taken by the Perseverance rover on 27 March 2025 really brings you close up to the landscape. You can imagine being able to climb up on to the ridge.

The location is Jezero Crater.

Do send in your favourite pic from Mars! We'd love to see it.

IN THE NEWS

Snow and rain in "Mars past"?

A new study from geologists at the University of Colorado in Boulder paints a picture of a Red Planet that was once relatively warm and wet, much different than the arid wasteland we are familiar with. The team's findings suggest that heavy precipitation likely fed many networks of valleys and channels that shaped the Martian surface billions of years ago. Another piece of the jigsaw perhaps.

The researchers, led by Amanda Steckel, published their findings on 21 April this year in the *Journal of Geophysical Research: Planets*.

There has been a lot of conflicting conclusions reached by researchers, with many claiming ancient Mars was always cold and dry. Of course in the planet's early history the young Sun At the time was only about 75% as powerfully radiant as it is today. One possibility is that widespread ice caps covered the highlands at and around the Martian equator, periodically melting for relatively short periods of time.

Steckel and her colleagues set out to investigate the warm-and-wet versus cold-and-dry theses regarding Mars's past climate. Using computer simulations they explored how water may have formed the surface of Mars all those billions of years ago. Their research led them to conclude that precipitation (ie snow or rain) likely created the patterns of valleys and headwaters that still exist on Mars today.

Steckel indicated it's hard to explain these topographical patterns as being created simply by ice. Around the equator, for example, huge networks of branching channels spread from Martian highlands, and appear to "empty" into dried up lakes and even, possibly, what was once an ancient ocean.

The presence of boulders in delta areas is another clue highly suggestive of powerful river currents.

The researchers used software to model the evolution of the landscape on Earth terrain that most resembles Mars close to its equator. They then modelled different types of water flow either precipitation or melting ice caps. Then, in the simulation, they let the resultant water flow for tens to hundreds of thousands of years and looked at what sort of terrain emerged.

Credit: NASA

Image shows an artist's rendition of water flowing into Jezero Crater.

The researchers found that using the model with precipitation included gave a more accurate version of Mars's present-day landscape, with headwaters being found at a

range of elevations (whereas melted ice formed headwaters only at high elevations).

Of course, this isn't the last word as these are only computer model simulations. We might say this is yet another argument for getting to Mars as soon as possible in order that we can determine on the ground who is right and who is wrong! But the consensus at *The Aresian* is that the precipitation hypothesis has a lot more going for it.

Flight 9 – Riddles, enigmas and mysteries.

By Mary Khan

So what's the story with Flight 9 of the Starship, the one that carries the burden of two previous test failures (Flights 7 and 8). Lest we forget, those two failures were when when Starship ignominiously exploded over the Caribbean sending debris into the ocean and sometimes people's backyards on some of the region's more remote islands?

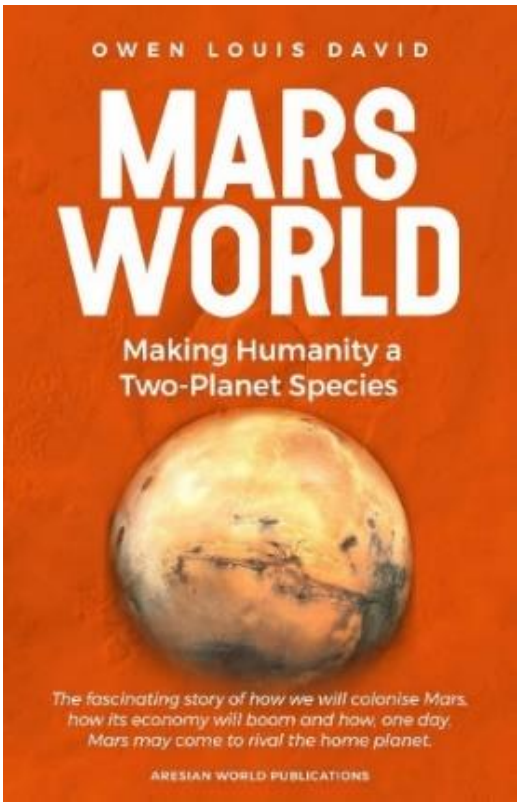
Well I suppose it's my job to find out but I have to say your guess is as good as mine. Sorry!

To date we've had nothing official from Space X. We do know the Flight 7 "mishap" report has been completed. That's something I guess. There was – and is- a rumour the Flight 9 launch will now take place in mid-May. That's still not out of the question but it's nothing more than rumour at the moment. There are some suggestions the static fire test might take place in the first week of May, so watch out for that.

It's a confused picture because at the same time we are looking backwards to the failures of Flight 7 and 8 we are looking forward to Version 3 of the Starship system with significant modifications to the Starship. And, not that you ever thought, the guys at Starbase haven't been taking a breather – activity is still frenetic with a new launchpad, Pad B, beginning to take place incorporating a new-design flame trench.

The designated Booster for Flight 9 is thought to be B17 while Starship 35 is slated to be the ship of choice. Booster 17 has already undergone cryogenic testing (back in early March) but since then progress has stalled. It appears that Ship 35 is undergoing significant modifications, which are presumably intended to make good the design defects revealed by Flights 7 and 8. Some suggest a lot of work on the engines and engine section (including the fuel pipelines to ensure there is no repeat of the "bad vibes" harmonics experienced during the two previous flights). It's reasonable to suppose that a lot of

modifications are being implemented after such dramatic disassemblies.



WEATHER REPORT!

Here's your update for the weather on Mars provided by the Curiosity Rover in Gale Crater.

For the nearest Sol to **23 April 2025** we have a *high* of **minus 28 degrees Celsius** (minus 20 degrees Fahrenheit), significantly colder than last month. The low for the same date, at **minus 83 Celsius** (or minus 117 degrees Fahrenheit) is also markedly colder than last time. We're still short of the record low recorded on Earth (minus 89.2 Celsius) which was registered at Vostok on Antarctica in 1983. But it's late autumn in this part of Mars now and there's definitely a winter chill in the air! But weather on Mars can vary as on Earth – just five sols ago, the high was much higher at minus 20 degrees Celsius.

———————————

CHINA'S TOWN

Sky News recently reported on China's Mars Base simulation in the Gobi Desert. Here's a pic of the base. We think it really looks the part. Very nice.