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Friday, June 22, 2007

Plasma Rocket Plan Moves at Warp Speed

By Britton Jacob-Schram

Plasma propulsion.

It may soon become a household expression—that is, if Costa Rica's Ad Astra Rocket Company has anything to do with it.

The company—founded by Costa Rican-born physicist Dr Franklin Chang Díaz, a former National Aeronautics and Space Administration (NASA) astronaut, and a veteran of seven space flights and three spacewalks—is currently test-running the endurance of an innovative rocket powered by the chemical element argon.

Dr Chang, the man once referred to as “the boy NASA couldn't keep on the ground” has been challenging his Ad Astra team to put Costa Rica—a country little known for its advances in space exploration—on the so-called astronomical map.

And, after this week, such notoriety might not be far off.

Ad Astra fired up their plasma rocket, a Variable Specific-Impulse Magnetoplasma Rocket (VASIMR), for over four hours, changing the country's cosmic clout. Big time.

The rocket-science team's giant leap came Monday at Ad Astra's applied plasma physics laboratory—a facility housed at Liberia's EARTH University—when they broke their previous record of keeping the rocket's plasma (what propels the metal beast into space) stable, or at “steady stage”.

“It took us approximately five and a half months to reach this level,” said Mechanical Engineer Jorge Oguilve Araya, who explained much of that time was spent finding ways of cooling the system so components wouldn't overheat—a process called “thermal management.”

“We were very happy, and at that moment had a lot of confidence. It was a demonstration of everything we had done,” he said, discussing the group's mood after the success.

Costa Rican contractors were employed for some of the thermal tinkering, added Mr Oguilve; collaborating with local engineers and stimulating growth in the local economy was always something Dr Chang had hoped for the program.

“The thing is, once you understand the problem, solving it is a matter

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of engineering, especially if you have a good team with a lot of heart," said Ad Astra's President Ronald Chang—brother and employee of Dr Chang.

"The team of engineering is part of the dream. Franklin makes people deliver, but not because he's got a whip at us," laughs Mr Chang, who boasted the team finished about a month ahead of schedule.

"He makes us deliver because we believe in him and any engineer that has the luck to work with him understands that."

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The 12 members of the Ad Astra team bring diverse backgrounds to the space-travel table—some are mechanical or aerospace engineers, others are mechanical or information technologists.

Dr Chang, first envisioned schematics for the VASIMR system in 1979, just two years after he received a doctorate in applied plasma physics from the Massachusetts Institute of Technology (MIT).

Het recognized current chemically propelled rockets are limited by the temperature of what its components can withstand. Plasma, on the other hand, can be heated to temperatures greater than the face of the Sun. The hotter the

SILLY PUTTY: The argon plasma—a gas heated until it reaches a semi-liquefied state—the team uses can be heated to temperatures above the face of the Sun; and magnetic fields contain the purplish-colored substance. Plasma can be seen naturally when lightning strikes, or commercially in things such as flat screen TVs and plasma globes. (Photo Courtesy Carmen Valverde)

the face of the Sun. The hotter the plasma, the more active—and efficient—the rocket.

Furthermore, the substance can be highly contained by magnetic fields: the end result being that the super-heated substance never comes into contact with any of the rocket's components.

"Since plasma consists of a soup of charged particles, you have a gas—which, in our case, is argon—and we heat it by the use of radio frequency waves," explained Mr Oguilve. "Then the gas becomes heated and the electrons around the atoms' nucleus tend to separate. And instead of having a gas, you have a plasma."

"Since the electrons are somewhat disengaged from the nucleus you have a charged particle, and that reacts with the magnetic fields."

It's this charge which allows the Ad Astra team to direct the confined plasma along the magnetic fields toward the back of the rocket—this generates thrust. On a macrocosmic level, it's much like untying the knot of an inflated rubber balloon and letting it whiz through the air.

"It is just like when you have a gas and you trap it with some kind of bottle or container—that gas can't escape. When you generate plasma you do something similar, it's just that the bottle isn't physical, it's magnetic, and it can be directed at a very high speed into the exhaust area," continued Mr Oguilve.

"We make that plasma go in the direction of the back of the rocket at a very high speed, so the rocket is propelled forward."

A huge advantage to this system is the rocket may increase its speed; by comparison, conventional rockets use all of their thrust at liftoff, powering them to their destination.

Mr Oguilve says those are like a car with one gear: "It's good for climbing hills, but when you reach a plane, it's not so efficient because you can't shift."

"Our technology allows you to vary the thrust of the rocket."

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In January, NASA signed an agreement to



WEIRD SCIENCE: The Ad Astra team—(front row, from left to right) Juan Del Valle, Antonio Hasbun, Carolina Murillo, Marcela Cuendis, Ana Sofia Ruiz, Juan Valverde, (back row, left to right) Jorge Oguilve, Jorge Andres Diaz, Sergio Cortes, President of Ad Astra Ronald Chang, Diego Fonseca, Daniel Castillo—stand before their plasma generator at the Applied Plasma Physics Laboratory at the EARTH University in Liberia, Guanacaste. (Photo Courtesy Carmen Valverde)

meters) in diameter.

The technology would radically change trips to Mars, reducing them from 10 months to about 39 days, which Mr Oguilve says would also be reflected by a diminution in cost.

“Right now we are aiming to use kilowatts (one kW is equal to 1000 watts, or 1.34 horsepower), and are getting closer to using megawatts (one MW is the equivalent of 1,000,000 watts, or about 1341 horsepower),” explained Mr Chang.

“The trips to Mars will have to be in megawatts,” he said, adding the electrical engine will use solar panels to generate energy.

Toward the end of 2010—a year popularized by Arthur C Clark’s best-selling science fiction novel 2010: Odyssey Two, which describes the story of a joint Soviet-American mission to Jupiter—the Ad Astra team aims to send the VF-200, an automatic VASIMR-powered rocket into space, said Mr Chang.

He vehemently denied any kind of international Race-to-Mars competition.

He did, however, discuss the goal set for a Houston unveiling of the VX-200, a 200kW VASIMR engine prototype. “I believe we’ll have the VX-200 by the end of 2007,” Mr Chang declared, hopeful.

“If that happens, I suggest you get a ticket to Houston.”

commercialize the VASIMR concept, recognizing the system’s wide array of potential space-applications.

One possibility: taxiing broken satellites from one orbit to another (where astronauts would be able to repair them and then have them taxied back into position). This type of spacecraft is what the Ad Astra team calls a “space tug”.

Yet another: for the system to be used as a space transport vehicle by which companies could send cargo from Earth, replenishing spacecrafts already in orbit. Ad Astra would be able to charge for such “shipping” services.

The most far-reaching application would vastly improve travel to Mars.

“The idea is to make it to Mars with this technology, but we don’t want to jump without learning how to walk first. It’s climbing stairs step by step,” said Mr Chang, who said the plasma rocket is “about the size of a big person”—only 1.8 meters (about six feet) by 80 cm (0.8

