Nearby Micro-Galaxy of Probably Habitable, Dark Micro-Stars Potentially Containing Profitable Rocket Fuel Water and Ores

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A nearby micro-galaxy containing apparently habitable, dark micro-stars accessible to humans has been discovered during the last decade. Galileo might have labeled these objects in this way, if he could have seen them. Before this last decade, not even we could see this micro-galaxy.

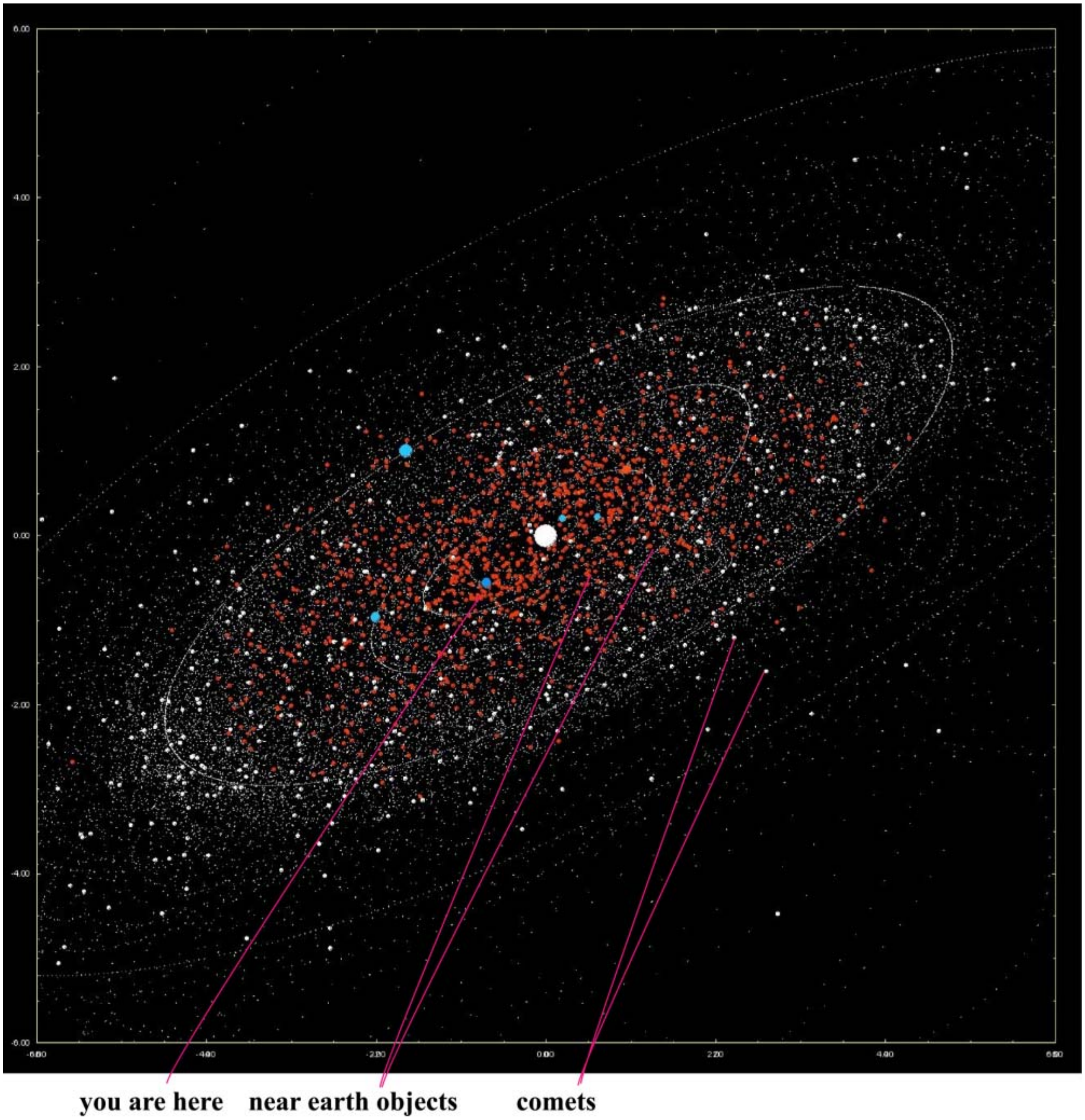
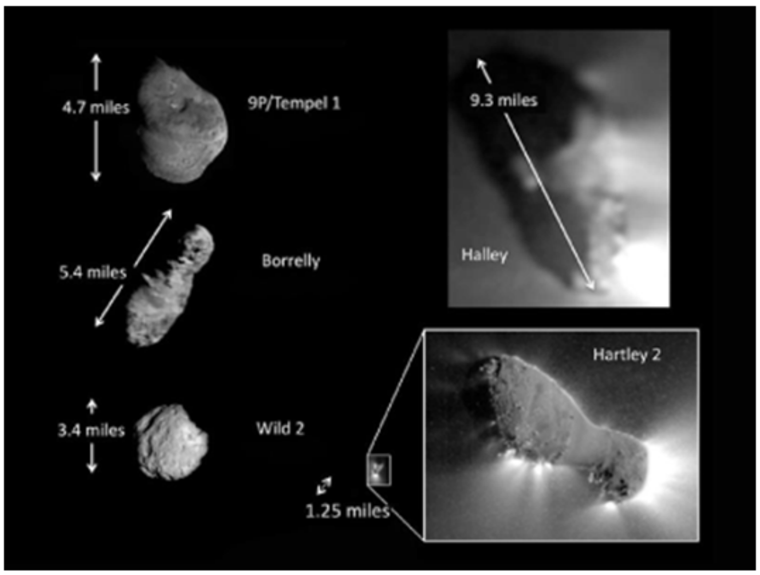
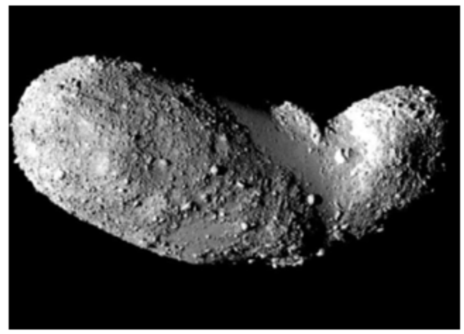


Figure 1: The micro-galaxy of nearby, probably habitable, dark micro-stars mostly within 10 years travel time from Earth was discovered sometime after year 2000. The digitally algorithmic hyperspectral image selected Jupiter-family periodic comets and near earth asteroids, as of 12 April 2011.

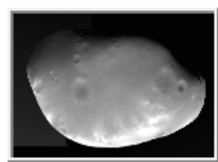
The "dark micro-stars" of Figure 1 are almost invisible, nearby objects in deep space that glow faintly and move relatively fast in the sky. The white micro-stars in Figure 1 are periodic comets, mostly within 10 years travel time from Earth. They might be best described as dirty permafrost ice and oil shale objects. Their water ice is both rocket fuel and rocket fuel ore. The red micro-stars are the approximately 1,200 near earth objects (NEOs) larger than 1 km size. Those NEOs were chosen because they could be big enough to be worth exploiting for rocket fuel. We focused only on getting the rocket fuel to move things through space. It's like finding oil. We want to own as much as we can. For reference, Jupiter is at about 1 up and -1 over (scale along edge of image, in A.U. units), Saturn at ~ 4 up and 9 over, Ceres ~ -1 up, -2 over, Sun in middle. Image is exact for 12 April 2011.



comets



asteroid Itokawa



Deimos, outer moon of Mars

Figure 2: images of: NEOs, periodic comets

Figure 2 shows the some micro-stars, including near earth objects, periodic comets, and certain asteroids of the solar system.

Because of its rocket fuel, the micro-star formation can provide thousands of new objects to inhabit, staging for interstellar travel, and enough rocket fuel to generate trillion-dollar personal wealth. If exploited, people will neither need nor want any government to tell them who gets to go or stay. They will be able to pay their own trillion-dollar ticket for (micro-) galactic transport.

Viewed from afar, our micro-galaxy looks like a distant galaxy. We live near its center. A digitally algorithmic hyper-spectral image clearly shows the galaxy from the vantage of a virtual spacecraft out beyond Pluto. We used an algorithm to show only the relatively accessible, probably habitable ones, those with more than 30 percent chance of water, low gravity and big enough to be worth it. Some 10 percent of the NEOs should also be close enough to exploit using thermal steam rockets, the simplest way to deliver 5,000 ton payloads, like 40 Space Shuttles all at once.

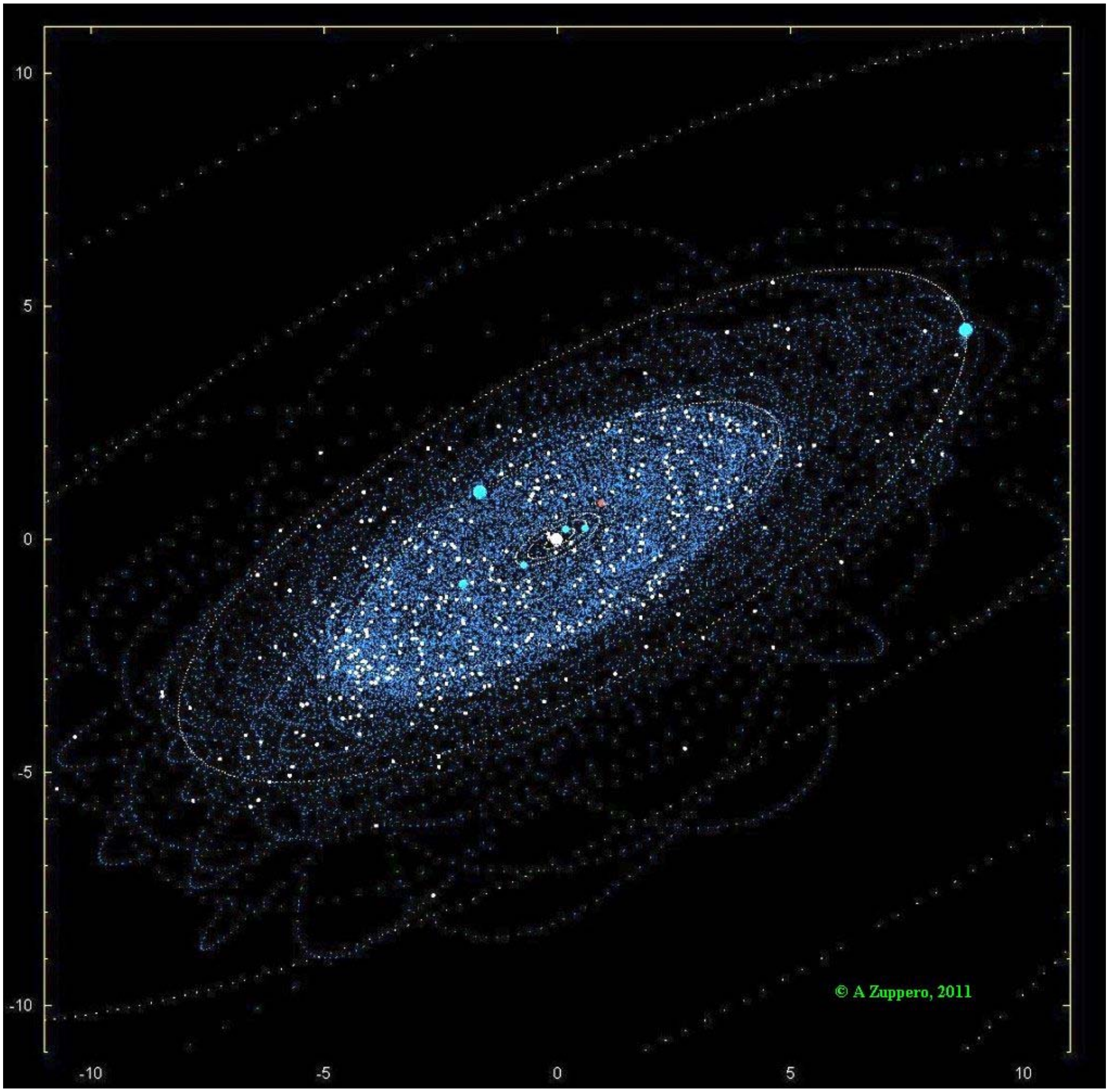


Figure 3: The Water Donut formation of periodic comets, dark micro-stars, contains permafrost and hydrocarbons, and Earth is just inside the inner edge of the donut hole. *Image accurate for 12 April 2011* © A Zuppero, **2011**

Figure 3 shows images of the comets that repeat, which Galileo might have called "dark stars" because 99% of the time they are 4 times blacker than soot ("dark"), except 1% of the time when they light up ("stars") and show their tail, their comet tail. Shown are those with trip times generally less than 12 years travel from Earth. Comet gravity is low enough to permit launch of a fully loaded, *single stage* space tanker.

We live at the inner edge of the oblate, donut-shaped formation which starts at about Jupiter and ends at about Mars or Earth. The blue fog are orbit points, plotted with equal time between orbit points to show their tubes of comet dust. Mark Sykes suggested plotting with equal times (more difficult), and Thomas K. Larson of the US Department of Energy Idaho National Laboratory first observed the donut during the early 1990's. White micro-stars are the periodic comets. What was surprising was the apparent even distribution (http://neofuel.com/donut/) of periodic comets between Jupiter and Mars/Earth, and the sudden drop in comet density past Jupiter and inside Mars' orbit.

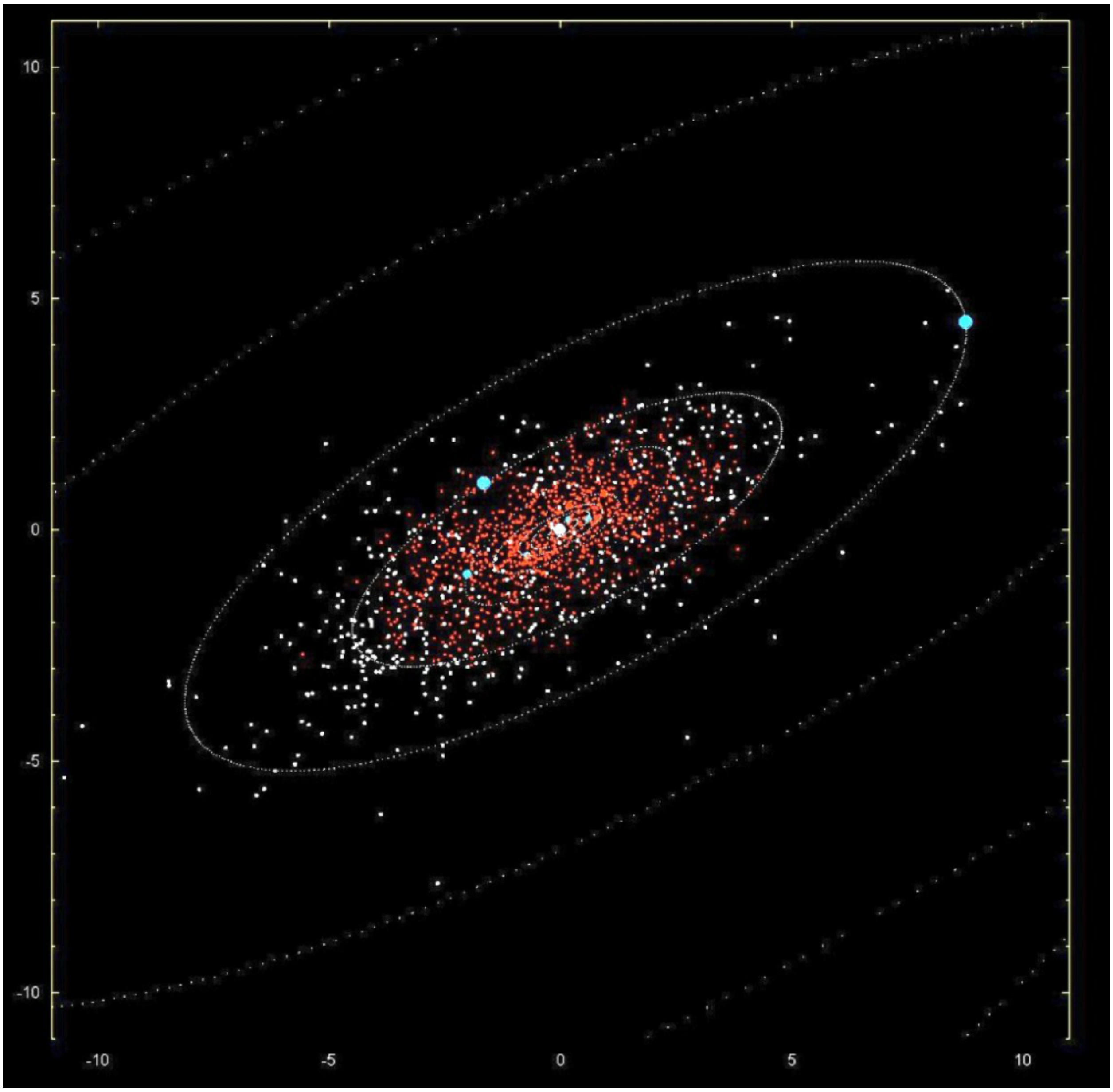


Figure 4: Perspective view of the nearly invisible, "dark micro-star galaxy" engulfing Earth on 12 April 2011. © A Zuppero, 2011

Figure 4 shows a perspective image of where we live in the dark micro-star galaxy, containing thousands of nearby, probably habitable, nearly invisible objects mostly within 10 years travel time from Earth.

Reference planets (blue) are Mercury, Venus, Earth, Mars, Ceres, Jupiter. {{{ CORRECTION: Mars should be blue, not red}}}

Water Is Everywhere

The unexpected surprise is that some percent fraction of the dark micro-star galaxy apparently should have an overabundance of extractable, directly usable water, a "rocket fuel." Current estimates imply a clear profit when bringing back and delivering that rocket fuel to a gas station in orbit around Earth. Water itself, unprocessed, is a fuel mass for Mass-Energy rockets such as ion engines and nuclear or solar thermal rockets (Energy is separate from reaction mass, completely different from the chemical rockets of the Space Shuttle and moon landings).

Statistics suggest the rocket fuel from each of many dozens of NEOs could be worth trillions ***net*** to a captured Earth orbit, such as L5, or Earth-Moon L2. The presentation emphasizes ***"net."*** *(Ref 2.)* "***Net***" means **"delivered here,"** not "in situ" or "there" as many space proponents overstate.

The massive amounts of rocket fuel and space construction material appear to enable 100,000-ton spaceships (~ 1,000 Space Shuttle masses) with 300-person capacity, synthetic gravity and total radiation shielding. In such a spacecraft, each person could have the living space of a starter home in Salt Lake City. *(Ref 3).* However, providing for humans living in deep space requires creating everything, starting with just dirt, water and energy, in a cold, dark vacuum, years from any help or parts store.

Gross Understatement: This is difficult.

Intense dismay and disappointment greet us when we attempt to detail how humans would use and occupy a micro-star, such as a moon of Mars, a water moon of the gas giant planets, a near earth permafrost object (periodic comet) or a hydrated mineral, dried-mud object (certain friable, hydrated near earth objects). Using them is nearly impossible, unless you're a life form that does'nt need air, water and civilization.

The reward is the possibility of extreme wealth to support our travels. In principle, a 25 ton water balloon space tanker, weighing as little as the *payload* of the Space Shuttle, could bring back and deliver 5,000 tons of water. The water is directly usable in a steam rocket designed for NEOspace travel. NEOspace inhabitants might be able to charge as much as $50 per pound for water in space. Returning just this rocket fuel in 10,000-ton units (~ 100 Space Shuttle masses) to rocket fuel stations around Earth could provide a billion dollars of revenue each round trip.

It's the massive amount of rocket fuel in some NEOs that makes human occupation of them appear possible. The water is for revenue to make a good living, not just to drink or extract oxygen. The discovery is like finding 1,000 Persian Gulfs worth of oil in the ground —but during the late 1800s when steam-powered railroad trains and Morse-code telegraphs were extreme high technology. Technology is advancing so fast that we could, if we wanted to, start exploiting the micro-stars within the lifetime of some of the first astronauts on the moon, perhaps at relatively low cost.

Most of the problems of such space travel are the same as going to the nearest star. The trip times are extreme, compared to an uncomfortable 14-hour trip from San Francisco to Sydney, Australia, or a one-week trip in a steam boat from Sicily to New York, like my ancestors took. A trip takes so long that the trip is practically "One Way." No reasonable trip seems to take less than many months inside a porta-potty vehicle that — like most manned spacecraft — smells like the inside of a plastic beach-ball laced with excrement.

Like Traveling at 3,000 Times the Speed of Light

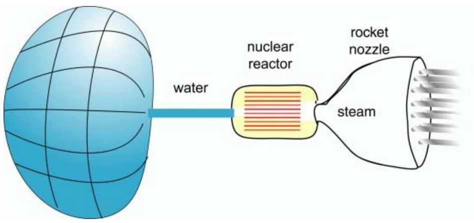
A steam rocket traveling beyond Pluto to another formation of dark micro-stars of the Solar System, the Kuiper Belt, has a travel time remarkably similar to traveling the Milky Way Galaxy at 3,000 times the speed of light. The Milky Way Galaxy is about 100,000 light years across, so travelers going 3,000 times the speed of light would take about 30 years to cross it and pass billions of stars. It would take about 30 years for a steam rocket to go from a NEO, by way of Jupiter, to the Kuiper Belt. The Kuiper Belt extends from about 30 to 55 AU and is probably populated with hundreds of thousands of icy bodies more than 100 km (62 miles) across and an estimated trillion or more comets. (ref 1) Along the way, the ship would find billions or trillions of useful, habitable Kuiper Belt Objects (KBOs). In total, the KBOs might have more accessible water mass than all the Earth's oceans.

Occupying and exploiting the Kuiper Belt has the same kinds of issues as traveling the Milky Way. To inhabit KBOs is remarkably similar as well, including the puzzling problem of how to stop at one. At least the travel time can be less than several decades.

Trips to NEOs must be timed for when Earth and NEO orbits align, which happens mostly with two-year or more wait times. There are zero hospitals, zero drug stores, zero plastic space suit factories, with zero support, zero backup, zero rescue. There are no parts stores or food stores, no air to breathe, no living off the land because nothing is alive out there, and no electricity except for a megawatt trickle one could get using massive, space nuclear electric generators. Megawatts are a trickle. We would need hundreds of megawatts continuously to supply cryo-fuel for a tiny 10,000-ton spaceship.

Trillion Dollar Space Transport

About 1 in 8 of the NEOs are closer than the moon, as measured by mission delta_V. The delta_V is a good measure of how much rocket and mass the mission will take. An orbit that makes them easier to get to than the moon can result in a return of more than 100 times the tanker mass when using a thermal steam rocket.



water reaction mass version, space tanker   liquid hydrogen version -- fast Mars missions

Figure 5: Thermal steam rockets heated by nuclear reactors

Figure 5 shows a thermal steam rocket using water as its rocket fuel. Water provides momentum in the form of reaction mass coming out of a rocket nozzle. The rocket uses an energy source like a solar or nuclear water boiler for its rocket energy. For example, a nuclear reactor heats the water pumped into it from a water tank or bladder. A rocket nozzle is bolted directly to the nuclear heater.

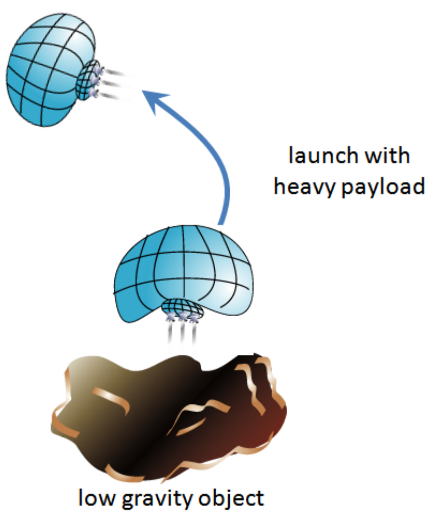


Figure 6: Low-gravity objects permit direct and simple heavy payload launch.

Each of the dark micro-stars shown in Figure 1 has low enough gravity that a space tanker propelled by a steam rocket can launch from any of them with a full payload, as suggested in Figure 6.

A stunning surprise to all but a very few, statistically speaking: Some tens of percent of about 8,000 known NEOs should have water in some form (NEOs defined by JPL Cal Tech) . These would be "habitable," though most are rather small. "Habitable" implies one can make a clear profit using its resources, such as water, a rocket fuel. This does not imply that it would be cheap or easy. In contrast, Mars and the moon are only visitable.

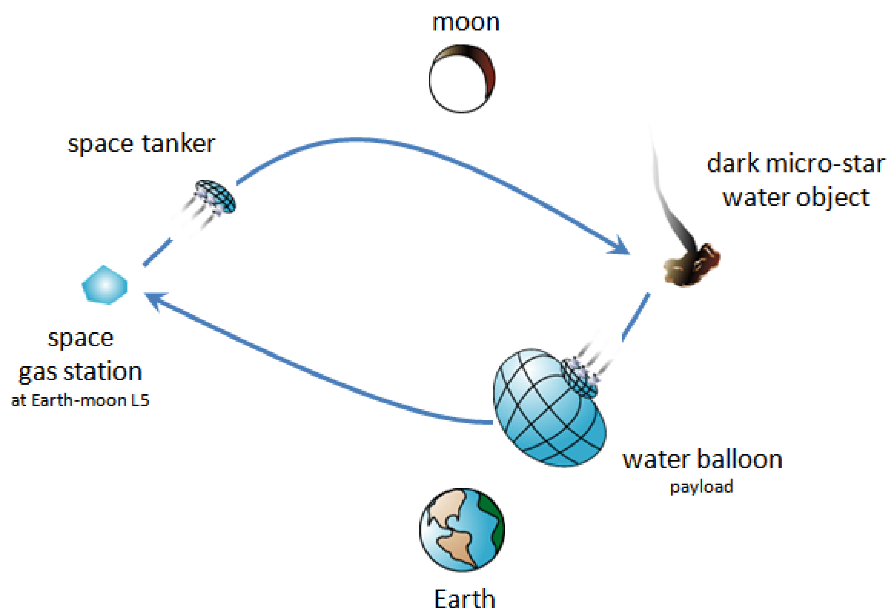


Figure 7: Space tankers can bring back up to 200 times their weight in rocket fuel, with fuel left over to repeat the cycle.

To generate trillion-dollar wealth, bring rocket fuel back to a captured orbit around Earth. Based on statistical data we know today, about 50 to 150 of those NEOs should be close enough to get to, big enough to be worth it, and easy enough to use. Those 50-150 NEOs closer than the moon are each expected to have enough excess water for us to sell for a trillion dollars. Figure 7 sketches how we would deliver it to a rocket fuel -gas station orbit around Earth and the moon (example: L5 or EML2). These NEOs must have low gravity so we can launch from them. Each must be larger than approximately 1 km in size to be worth a $1 Trillion (size depends on water content, and other factors).

From this subset of NEOs, space tankers could bring back 100-200 times as much rocket fuel to Earth orbit as the mass of the tanker sent to haul it. If we could sell the fuel for only $50 per pound, the delivered fuel from each of these 50-150 NEOs would be worth more than a $ 1 trillion dollars *net* in Earth orbit.

However, even this apparently simplest of schemes revealed unexpected difficulties. Like being hit by a fence post across the side of the head, we were jolted to find an unexpectedly difficult and nearly impossible task when trying to design simple ways to occupy and use these deep space objects.

The objects are so far from us that remote control systems become remote *suggestion* systems. Communication at the speed of light is so slow that real-time, live remote controlled robotics become impossible. Imagine a simple walking task on a narrow ledge on the side of a steep, high mountain. I could encounter 20 minutes or even hours of delay between what I see now and where my foot has moved.

Heat Alone — Not Using electricity — Lowers Costs Dramatically

The scheme shown in Figure 8 shows a concept to extract the water. It involves frying hydrated space dirt or permafrost objects, releasing steam. Some NEOs can be fried at self-cleaning-oven temperatures. Comet permafrost melts at 0 Celsius (32 F). The simplest heater is a small nuclear reactor. In principle, solar heaters could work.

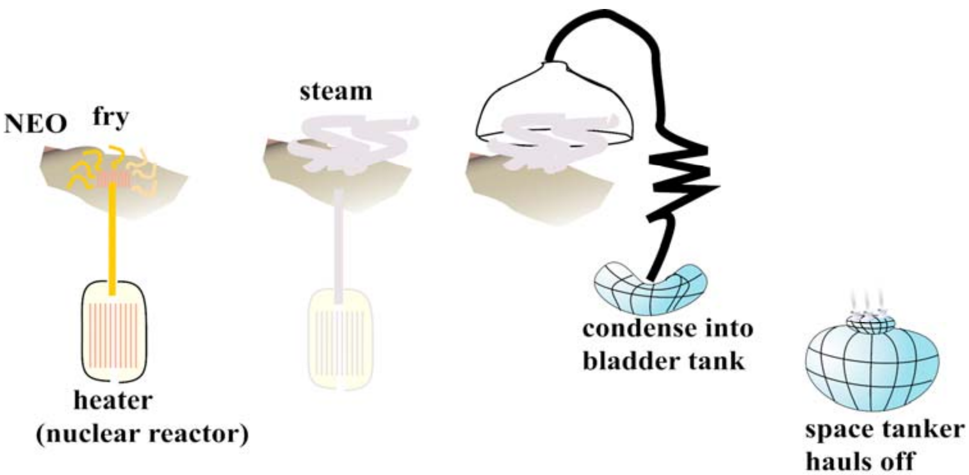


Figure 8: Fry a NEO for its steam, condense to water, fill bladder tank, space tanker delivers to elsewhere

Nuclear- or solar-heated steam rockets would nudge the giant bladders of water or ice to an orbit around Earth. The Department of Energy and Department of Defense explored this space tanker scheme, which would use only heat for all processing steps, not electricity. For objects as close as the moons of Mars (Deimos and Phobos), using only heat for energy and only water for propulsion apparently lowered the cost by a factor of 100-500.

The cost is compared to schemes that make liquid hydrogen and/or liquid oxygen chemical rocket fuel (cryo-fuel) from in situ sources. These schemes demand more electrical energy than the rocket fuel they would produce. This amount of electricity is extremely expensive to generate in space because of the Second Law of Thermodyamics: One must provide a high-power heat sink for any engine producing high-power electricity. Since space is a very hard vacuum, there is no heat sink. Space is like a thermos jar and is almost an insulator. This is a crippling handicap for generating electricity in space.

The world’s premiere space agency prefers liquid hydrogen/nuclear thermal rockets for their "race car," flag-planting spaceships. This provides the fastest rocket, but definitely not the best space tanker rocket. It’s even more expensive than cryo-fuel chemical rockets because oxygen split from in situ water must be discarded or stored.

In contrast, the relatively slow space tankers don't require massive amounts of electricity, heavy electrolysis gear, gas liquefaction equipment or insulated fuel tanks. They use every atom of extracted water and can be a cubic football field in size. They're designed to take full advantage of water from near earth objects.

The presentation showed digitally algorithmic hyperspectral images of the nearly invisible periodic comets and recently discovered near earth objects from a perspective beyond Pluto and obliquely out of the ecliptic plane. The view is strikingly similar to a galaxy. The images focus on the netTrillion-dollar objects. The reward is 100,000 new worlds to occupy, not as visitors but as victors.

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* Dr. Anthony Zuppero was the last Principal Investigator for Space Nuclear Propulsion at the Department of Energy's Idaho National Laboratory. http://neofuel.com/space
Zuppero is currently registered to practice before the United States Patent and Trademark Office. http://neofuel.com/patents

1. http://solarsystem.nasa.gov/planets/profile.cfm?Object=KBOs&Display=OverviewLong
2. *DOE publications from Idaho National Lab at rocket science meetings*
3. *NASA meeting, Zuppero's Ice Ship: http://www.lpi.usra.edu/publications/reports/TR98-01/TR98-01.html Duke, MB, "Workshop On Using In Situ Resources For Construction Of Planetary Outposts", LPI Technical Report Number 98-01, Lunar and Planetary Institute 3600 Bay Area Boulevard Houston TX 77058-1113*

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Steam rocket to edge of Kuiper Belt — calculation of dV-Oberth from Jupiter

A steam rocket would achieve a V_infinity of about 10 km/sec if it accelerated when it passed as close as possible to Jupiter. At closest approach to Jupiter, e.g., 1.1 Jupiter radii away the steam rockets would be activated. When the vehicle achieved a net delta_V of 976 meters/second during an hour near periapsis, the speed far from Jupiter would be a V_infinity of about 10 km/second. The Oberth-style maneuver provides the gain in speed. Jupiter has enough mass to make this happen. Traveling at 10 km/second the vehicle would travel to the outer edge of the Kuiper Belt, 55 AU, or 8.25 E12 meters, in 27 years.

	input			Hohman trajectory, Oberth Warp
	from High Jupiter orbit to periapsis, for high V Infinity			
Perihelion	1.10E+00		R / Ro	R/Rvcir ref periapsis
Aphelion	3.00E+02		R / Ro	R/Rvcir ref apoapsis
CircularVelocity	42160		m/s	circular orbit velocity reference

	optional input			
Vinfinity	1.00E+04		m/s	velocity far from object
	output			
UpDeltaV	16546.613		m/s	delta V to go up
DownDeltaV	-2226.0452		m/s	delta V to go down
SemiMajorAxis	150.55		R / Ro	"a"
PeriodWRTVcir	1847.2307		relative period	orbit period relative to reference period
WarpDeltaV	**976.76**		m/s	Warp Zero: delta V at periapsis needed to achieve Vinfinity
Warp Gain	10.237864		ratio	delta V gain: V-infinity / delta V

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