MARS PLANET CONQUEST

TOME I

FIRST RED CATS EDITION
Monday, October 23, 2023

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ABSTRACT

The Mars planet conquest, is part of the human greatest dream. Men has always been an eye pointed to the stars, and now it's possible to touch this dream. In this research work, I put together some useful information that will be required for the red planet colonization. A great conceptualization work, and years of web navigation was required, but like almost every research paper, it will be publicized without it's complete achievement.

Without entering the every details, there are the different phases for the colonization:

1. Preliminary design phase
2. Terrestrial test phases
3. Building and test of colonization vessels
4. Spacecrafts first wave departure
5. Landing of modules
6. Landing of Marsonautes
7. Building of first bases
8. Building and development of colonization infrastructures
9. Beginning of the colonization, by sending Marsonautes every 2 years

All the phases will be treated in this book, and I will add my own fantasy touch for the future of Mars. Mars is not like Earth, the life on this planet will never be the same that on our origin planet. But there is some motivation to establish our self on it:

I. Surpassing oneself
II. Security of all the nations and life
III. First step to elsewhere

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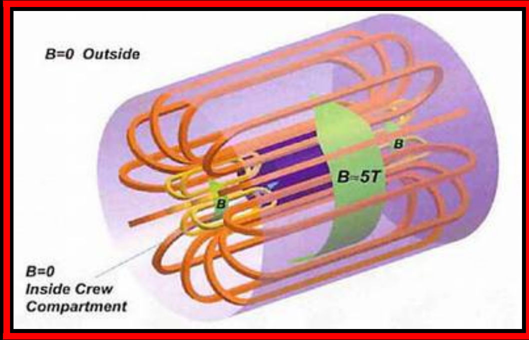
This book is dedicated to my mom…

THE CONQUEST MOTIVATIONS



Space conquest... Who never dreamed to leave to the unknown to discover new worlds. New technological discoveries, shown in an other book, let us hope for others planetary system. The first problem will certainly be the cosmic radiations that could be lethal even on short period. But, the concept of electromagnetic shield, may help us to make this trip possible. The image on the right, credit to J. Hoffman of MIT, let us visualize a zone with this kind of protections. Without any, it will be more than dangerous to leave the solar system. The cost associate with a spaceship of the required size to colonize an other planet, will be very expensive, but in the case of the Mars planet, the shielding provided by mass of matter will be enough.

The security aspect can't be put aside: What could happened to the earth planet, after a collision with an asteroid? In the case of a major impact, we know that the crust will melt with the energy. The logic teach us, that more extraterrestrials sites we are going to have, better it is. If our home world is destroyed, we will only have to continue elsewhere...

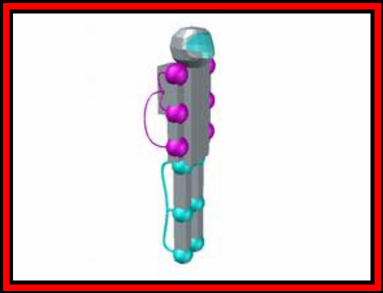
With the beginning of the colonization on the saint year 2037, we could figure that this protection will be available 25 years later. And I also add than those Marsonautes won't be back soon, because of the cost to bring them back. The return capacity won't be disembark there, at least for every one of them. The colony dependence from Earth will be short, for the mainstream shipment, but exotics objects could be sent for reasonable cost. The ultimate magic number will be 8 500 $ (US-2019) per kg of matter, under certain assumption of density :)

For the crew transportation vessels, of the first development phases, the cost will be reduce by the effect of large numbers (but more than 8 500 $ / kg of body, see later for details). For the mascot, the first family of cats, the effect of the actual economic crisis, will have to be taken into account.

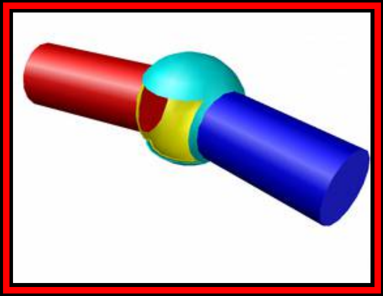
In conclusion, we have the financial capacity for this unbound project, because of the unlimited military waste, that will be studied carefully, in some chapters. So, we will do it...

	PIB	Budget défense
Chine	21,140,000,000,000 $	420,686,000,000 $
États-Unis	18,560,000,000,000 $	807,360,000,000 $

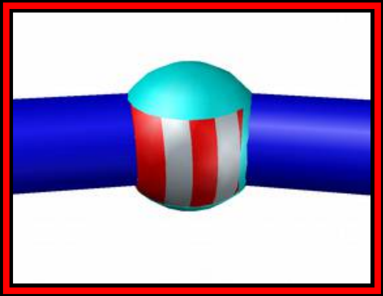
THE IMPROVED SPACESUIT



The super spacesuit with improved mobility, is one of the uncertain concept, that I put forward in this book for the step after the landing. The main reason for this uncertainty, is the longevity of the joints, relatively to the said mobility improvement. The concept is easy to understand, but it required ultimate precision parts for the bearings, if we don't want to loose more than the 250 Watts of energy available for it.

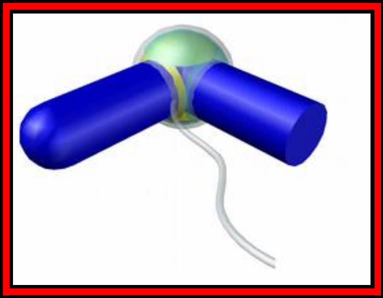


The articulations, will be covered by a layer of tissue to maintain low pressure with the help of three air pump, located in the back of the Marsonautes suits. The suit will maintain the Marsonautes, with 100 % Oxygen "Air" to lowering the differential pressure with the outside. Inside the suit, let's say 20 k Pa, and outside 500±200 Pa. To give an example, the pressure in a football is 100 K Pa (differential), so 1/5 of this softness :)



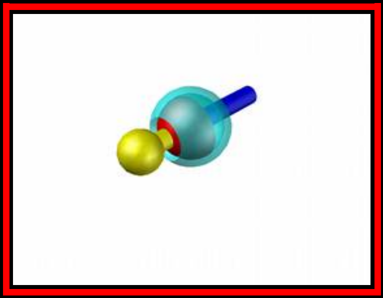
This force will be diverted by the "bearings" that could be C-60 or regular micro bearings, depending on the concept that will be retain. We can see on those images, small rectangles that will slides one on the others, to close as much than possible, the opening of air pressure.

Those rectangles, won't be 100% gas proof, so the necessity to the tissue layer that will contain the pressure while the gas is pumped to the back for reinsertion.



The martian temperature won't be prohibitive: -120°C to 20°C, but will require good insulation and active heating provided by the heat lost of the pumps and CO_2 scrubber. But, this temperature range could be reduce by the fact that the base will be almost complete for the Mars winter, and the drop will occurred during the spring or summer (seasons are twice the length on Mars).

The final complexity of the human body can't be reproduced by the suit, but every single degree of freedom is required by the task.



russian module statistics	
CO2 retreive	40-120 L/hour
Puissance	260 – 330 watts
Airflow	20 m^3/hour
Humidité	14 g/hour
lifecycle	3 years

I projected a 500 W system (very preliminary), Lithium-ion battery and an external input power. We can see the image with the system in the ISS. We also need some liquid water reserve (very few), and for security reasons, Lithium oxide cartridge with a 24 hours capacity. You should notice than the image module is for 3-6 persons, so the individual unit will be smaller.

Reference 1 :

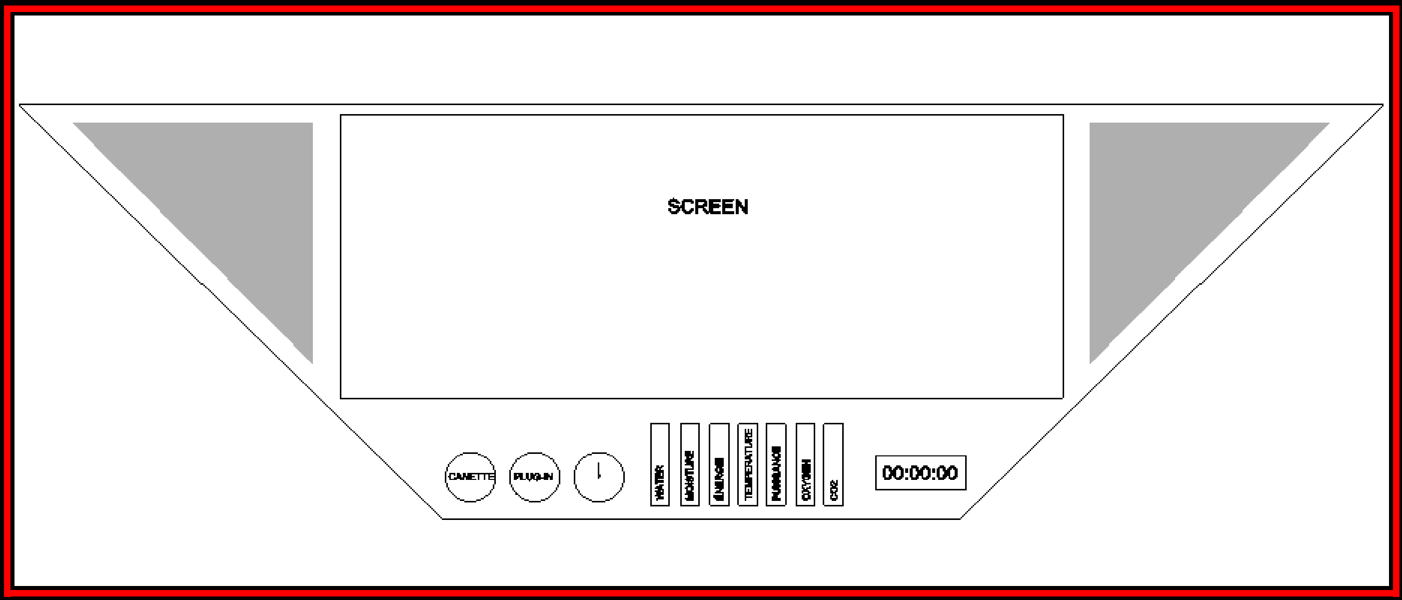
The Vozdukh system can be divided into three parts: the preliminary purification unit (БПО), a heat exchanger unit (БТ), and an atmosphere purification unit (БОА). This system consists of three molecular sieve beds, two desiccant beds, two electrical heating units, an air-to-air heat exchanger, an air-to-liquid heat exchanger, a vacuum pump, eight valves, and a fan. The desiccant material is silica gel. Carbon dioxide is removed from the atmosphere by molecular sieves, consisting of Zeolite, a solid porous adsorbent material. The operation of the molecular sieves is based on capillary action. CO2 adsorption efficiency depends on the air flow rate, absorption and dis-absorption cycle duration and CO2 concentration in the atmosphere. Once saturated, the Zeolite is regenerated by exposing the bed to vacuum.

Regeneration of the silica-gel occurs when the hot, dry air vaporizes the water stored in the desiccant bed (ОС-2). This process humidifies and cools the air which is then returned into the atmosphere of the SM.

The CO2-saturated zeolite (ПП-2) is regenerated by exposing the bed to vacuum via valve (БВК-2) while vacuum valves (АВК-2 and АВК-СОА) are open. The pressure differential causes the zeolite to release the adsorbed carbon dioxide, thereby regenerating it.

This technology, from the ISS program, tested on a long period, will be great asset for the Mars colonization process. Adding a vacuum pump will be necessary to counter the effect of CO2 partial pressure of Mars atmosphere.

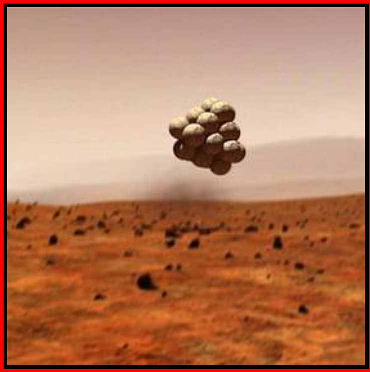
The helmet of the suit, will included an OLED screen on the bottom of the face window. With a vocal recognition system, this will allow a better coordination of Marsonautes works.



During the landing phase, the Marsonautes will have access to a large amount of Oxygen recharge, CO_2 scrubber and batteries, that will be sent before the said phase on the planet surface. We could calculate a surface of 10 km X 30 km, for a total of 300 squares kilometers. For a distribution of one shipment every 50 meters, it will take 120,000 units. But, we may calculate that every ordinary shipment will contain one safety package (see next chapter for details). The screen of the helmet, will indicate the optimal path to follow, depending on the conditions and the current phase step of the procedure.

The helmet and it's camera, will allow each marsonaute to be monitored carefully. As we had seen in recent past conflict, this system is very efficient.

MODULATED LANDING PHASE CONCEPT



For a question of cost and security, the landing of the materials in the form of build able modules will be required. Maybe that the very first step should be made of more massive structures, that will land by themselves, but for the most it will be by separate part to be assembled. We could cite two methods that has be proven to be efficient, the parachutes and balloons, or the retro rockets of the Phoenix. With a mass of 350 kg, the demonstration of this method was a great success. With the lack of atmosphere, on Mars, we will have to choose between one of them.

A successful and efficient landing, will consisting of the good choice of the amount of mass consecrated to the softness of the landing itself. No need to give the same way to personnel or aluminum plates. The cost difference between the two methods will be relatively low, then I think it will be preferable to use the balloons, for the most of the job, because it look safer :)

The past missions where launched from only one spacecraft, but the massive landing that will occur in there is going to be different. The material, will be sent by single spacecraft maybe up to six years before the D-Date, but the Marsonauts will be launched from the orbit of Mars. Let's hoping for good precision...

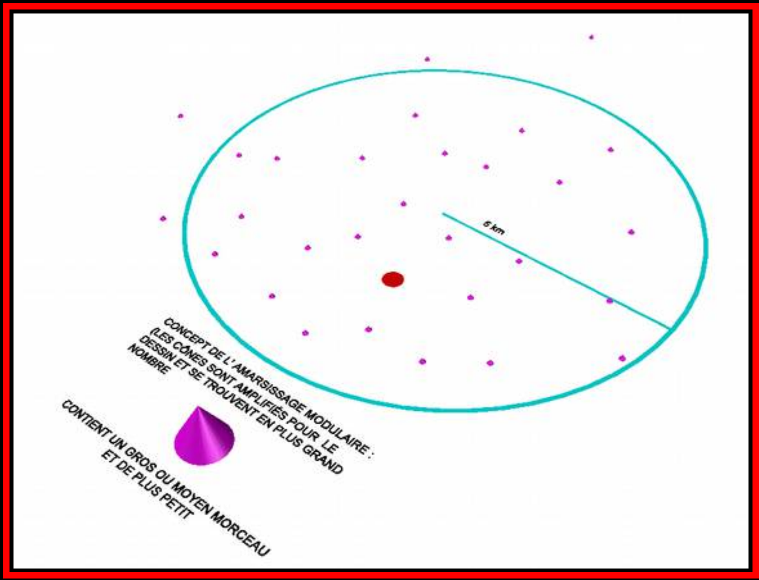
The majors advantages will be:

1. Limitations about the scale of the parachutes, will be lifted
2. Almost flexible, base position, with the possibility of moving light parts away
3. Better use of dimensional space in the spacecrafts
4. Better cost efficiency, for the overall operations
5. The lost of one part, doesn't imply the lost of an entire module
6. The numbers of shipment, will increase the strength of the operations mathematical statistic

The majors disadvantages will be:

1. Assembly required
2. Energy is required for assembly
3. Marsonautes will need life support during the assembly
4. Marsonautes could have landed far away from each other

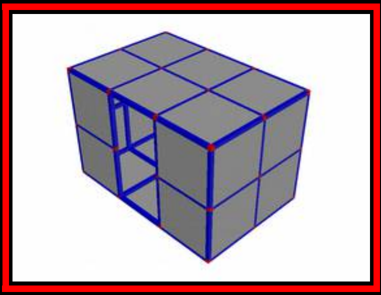
This image, describe the zone aspect. As we can see, it's look like a circular zone, but in fact it will be oval. The red circle, represent the base site, as determined before the landing process with some kind of positional algorithm.

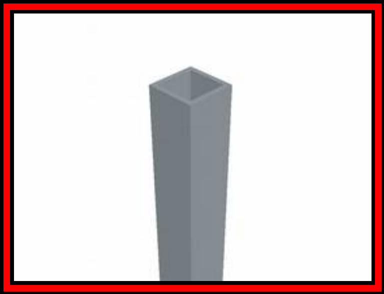


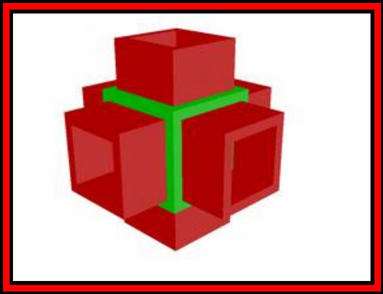
We could imagine a zone of 50 km², a large quantity of shipment will be sent, many hundreds, to build the different structures like the principal complex, greenhouses and others, that will be presented in next chapters.

There is the structure of a standard dormitory of my first designed base (there is some others versions). It is build, from plates, tubes and connections, such represented in lower images. We simply have to insert parts in others, to build different structures that are needed. We could imagine about three set of those parts:

1. Principal complex, on surface
2. Initial underground bases
3. Expansion base, build on Mars

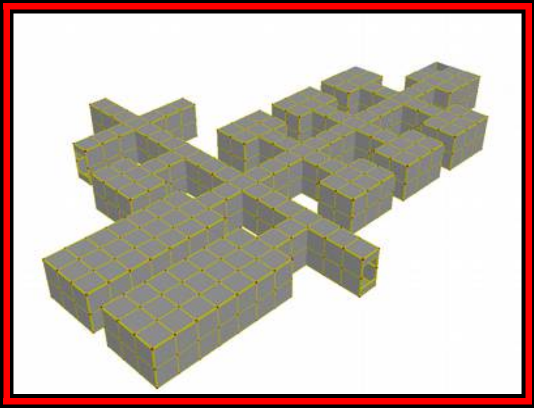






The major differences between those set assortments, will be the size of them. For interconnection purpose, it is need to have one large set for the initial landing, at least. The parts will certainly be build with aluminum, for weight and welding.

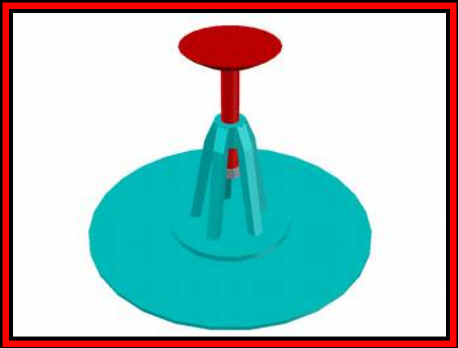
Structures complexe principal	Masse (kg)	Nombres
Tube	1.30	1655
Connexion	0.75	1655
Plaque	2.33	1592



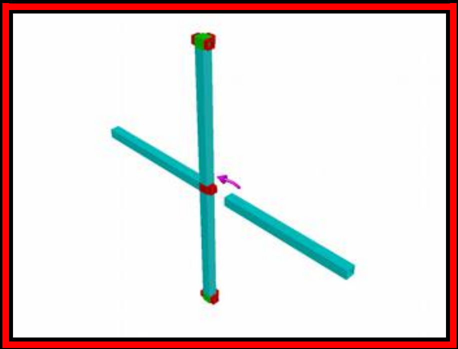
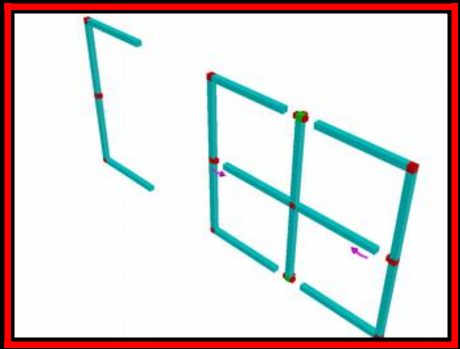
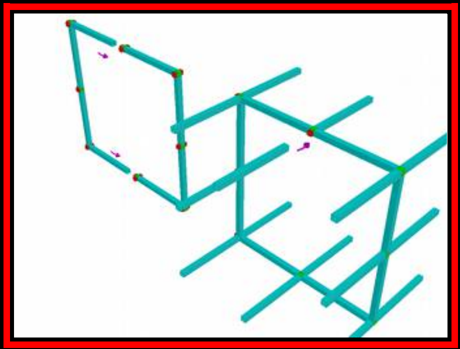
A grand total of 7 metric tons, for the complex against, but not my last version of the main complex.

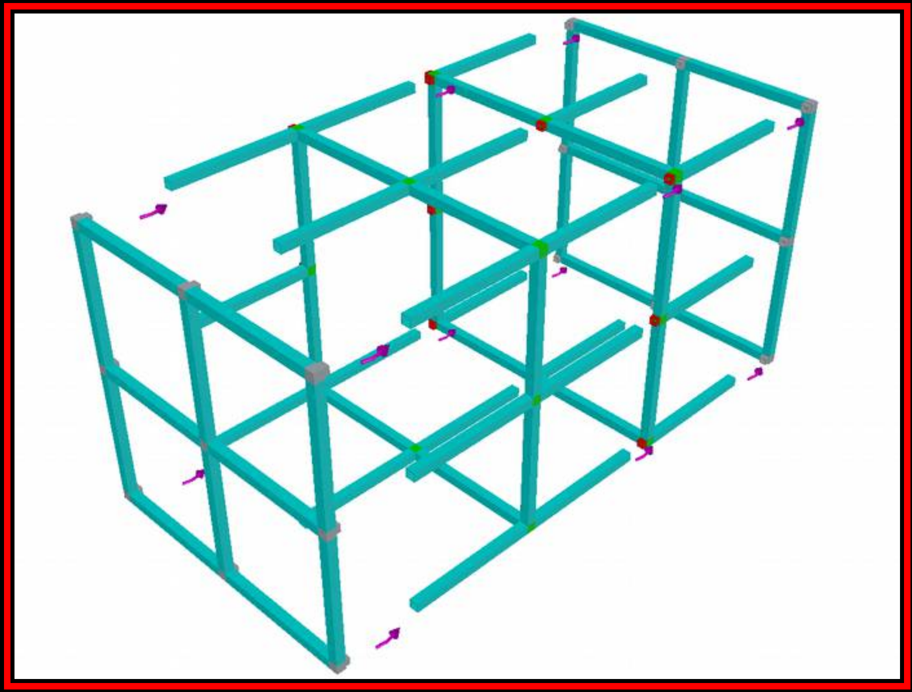
MODULES ASSEMBLY

Step-1 : The modules will need flat surface or large screw, to be well seated. So, the first priority will be to prepare the surface with crick, screw or both, those device need to be well insulated and variable height with a damping spring. We could imagine those tools to be useful assets:

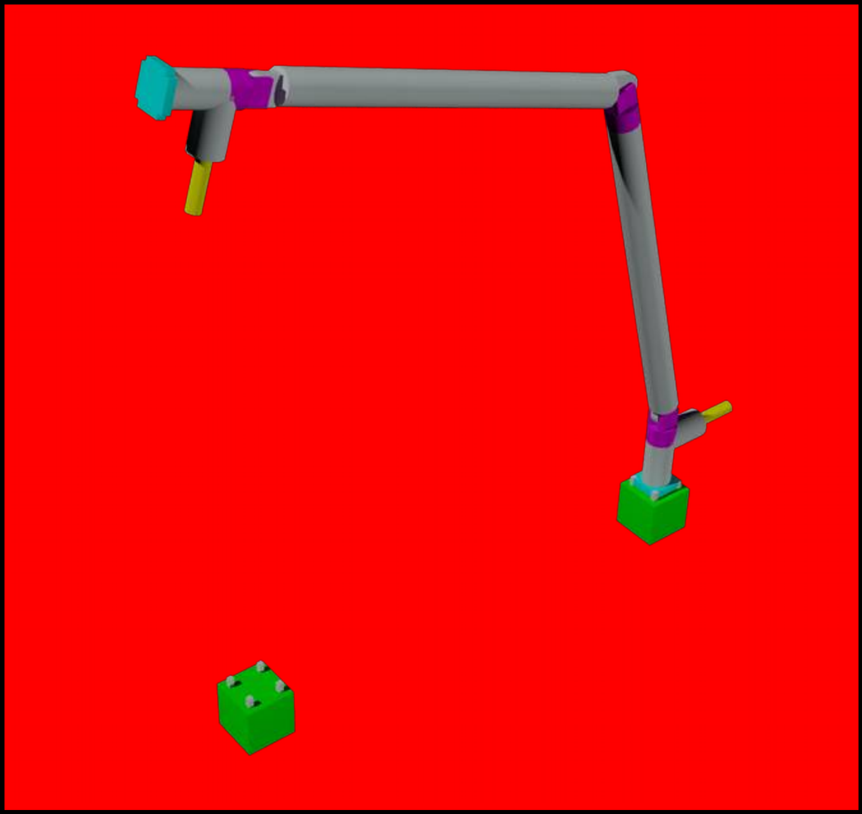


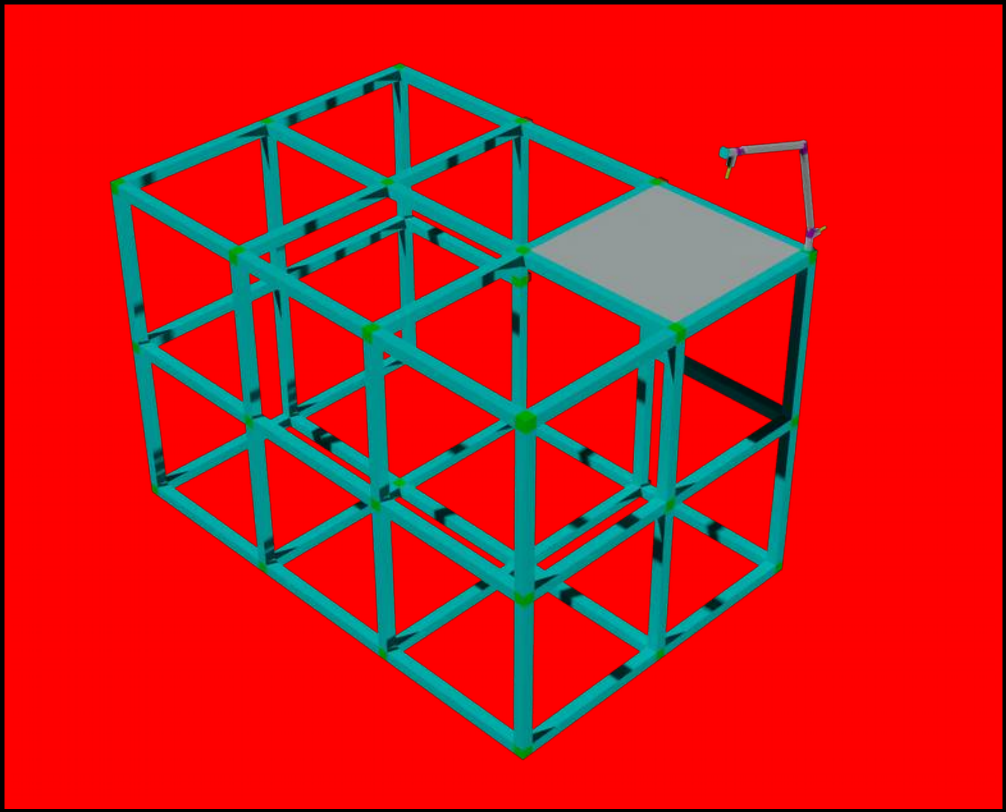
In parallel, the assembly of the module will begin, once every parts reunited. First without welding:



Step-2 : The different parts will be welded together with this machine :) or manually :(





It's an easy task to determined the time requirement to weld all this on Earth, but on Mars... Let's say 450 meters of welding for the dormitory only. At a speed of 3 cm/s, with five machines: 50 minutes. But some of this welding will have to be done manually, plus the welding inside the module (but under pressure), we get 2 hours for one of these module (approximately).

There is the equivalent of more than 20 module in the entire main complex of this version of the base, but the task may be operated in parallel. Let's say 2½-3 hours for the entire complex, but I will wait for the terrestrials test for the finals numbers, and the factors than could be applied to varied them.

An important factor, is the Human resources needed to accomplish the task. I believe in the progressive arrival of the Marsonautes for this fact: Exponential growth. There should be a decision team on board the vessels, for urgent need, and the Earth team for 20 minutes thinking... The possibility of problem and solutions are infinite :()

ASSEMBLY DETAILS

I. Following the computer and specialists analysis: Statement to where the specific location of the main complex will be. Each shipment will have it's own transponder, and some an emitter, so we will be aware of the situation before we leave Earth. For economic purpose, the power of those emitter will be hierarchic. The premium satellite network (see the budget), will be of great use. One option will be to send relay balloons, once ready to retrieve data.

II. Building of the recuperation procedure:

1) Energy
   - Nuclear reactor, needed for welding of the module
   - Gas turbines, needed for welding too
   - And, or, Pu-238 reactor with limited power, for the initial needs. (Pu-238 : 1.5 kg/year USA total production)
   - And, or, batteries, it's a limited solution, because welding require a lot of energy
   - Conductor
2) Life support
   - Marsonautes could have 4 hours of supply, with an one hour reserve
   - We need Oxygen to compensate for CO_2 loss
   - One bottle of 50 grams could hold 30 minutes
3) Food supply
   - Water, within few hours
   - Food, within 12 hours
4) Temporary shelter
   - within 12 hours
5) The main complex and it's structure
   - 24-36 hours
6) Truck-1 (First priority, if someone is lost...)
   - Depending on concept to be use, one hour of assembly: more or less with monetary cost
   - Fully battery working

III. Recuperation of parts:

1) Base tools:
   - Suction cup, to transport material without bending our self
   - Telescopic arm, for positioning suction cup and displace parts
   - Magnets and ropes, same thing
2) Work method
   - In team of three, if one is hurt, the second will help him, and the third will ask for some help
   - In team, again

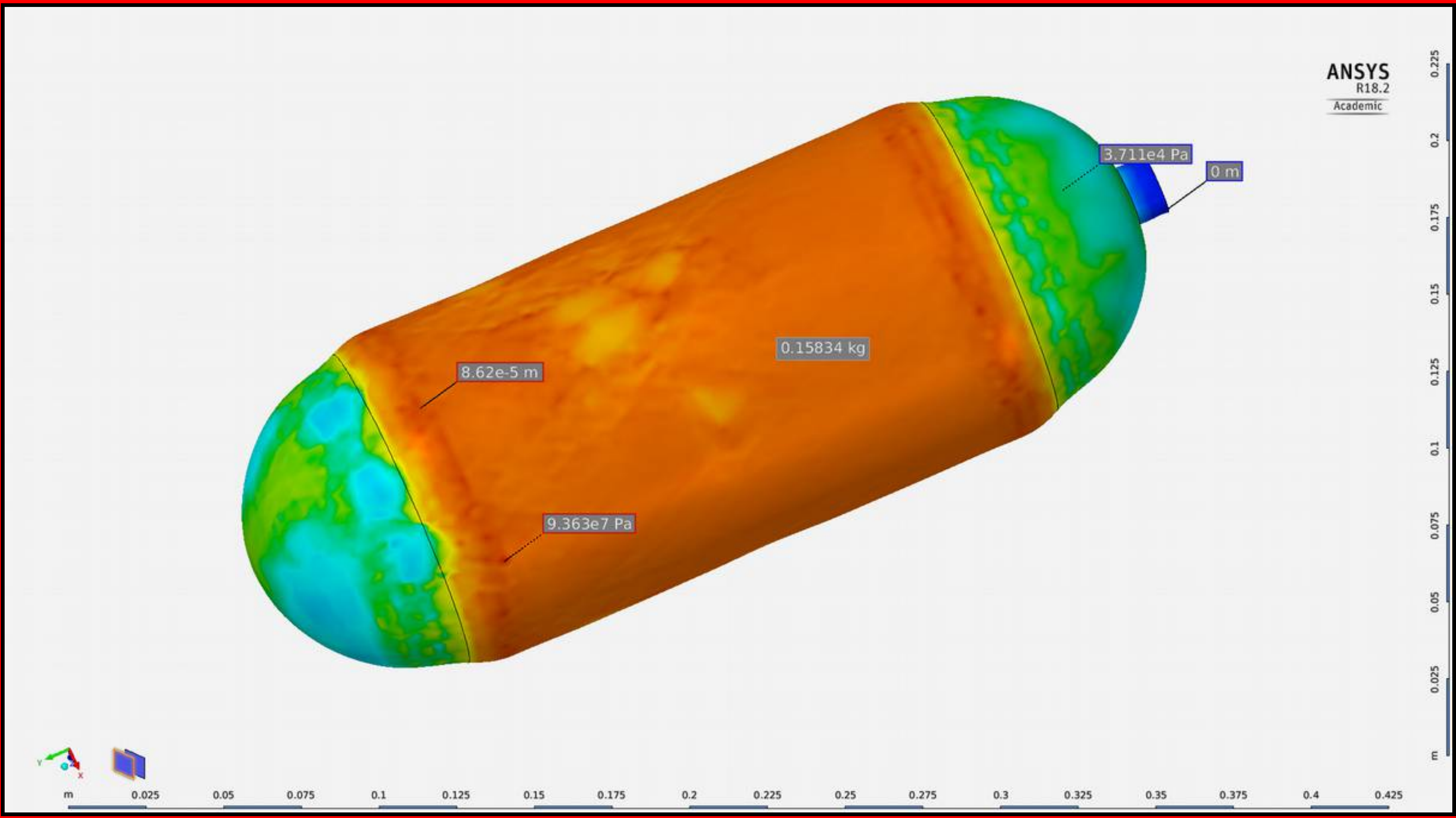
IV. Structure assembly :

- Prepare the assembly manually
- Installing the welding arms
- Watch carefully

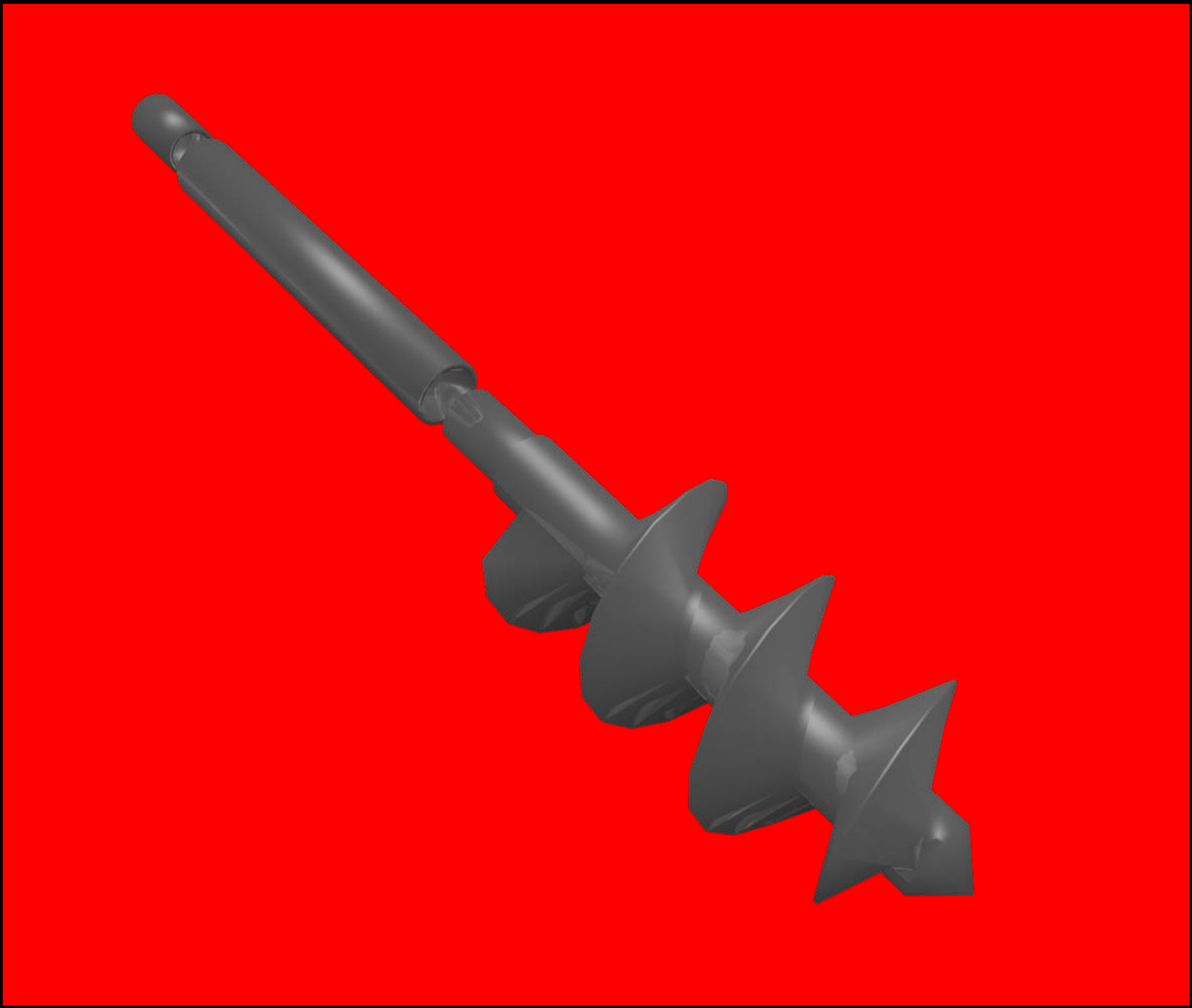
V. Tests :
   - Smoke test for air proof
   - Leveling test, for ground contacts

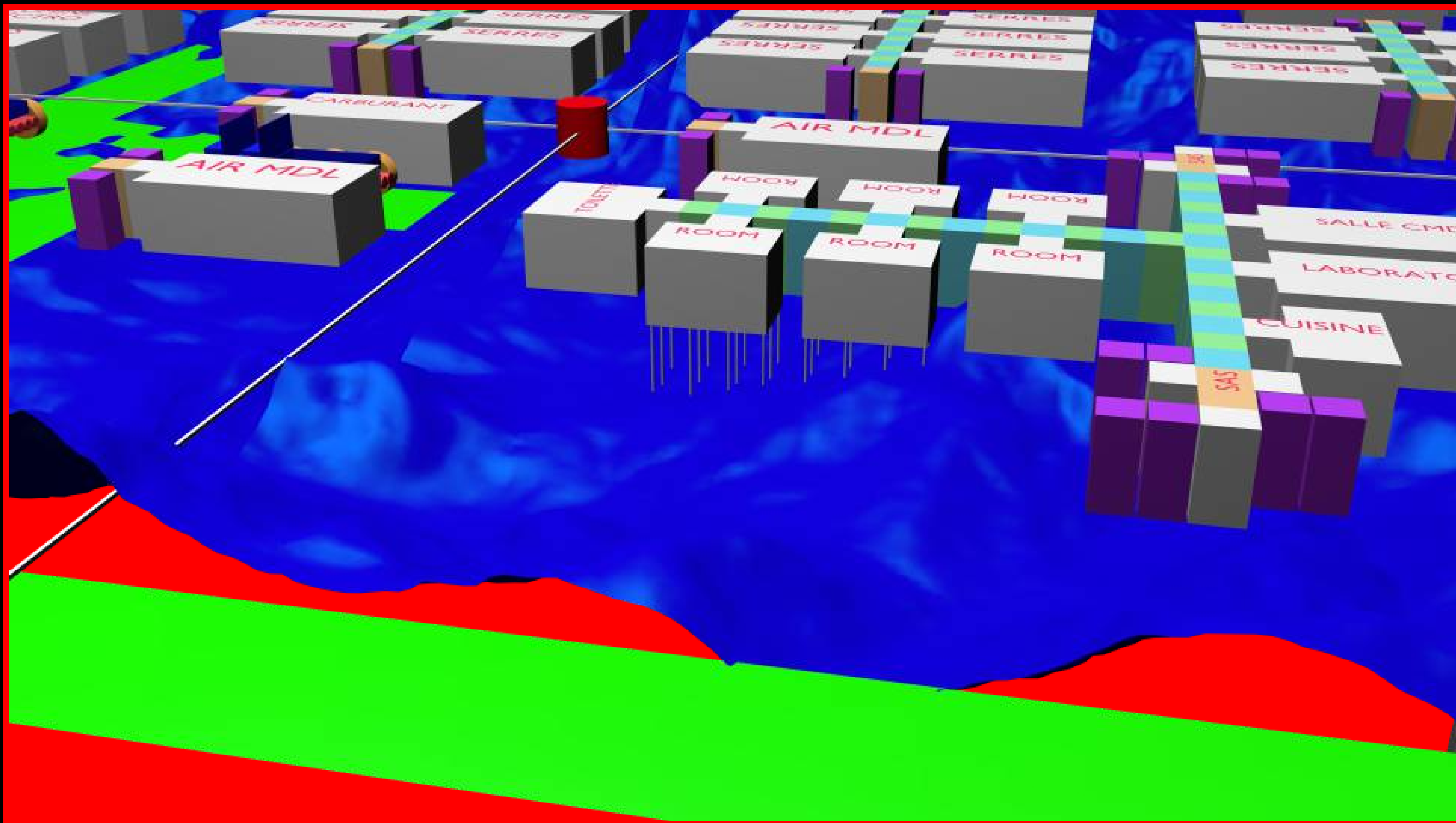
One possibility of Oxygen tank :)

With a volume of 2 Liter and a capacity of one mol (one hour of consumption), with a weight of 180 g: for a budget of 400 M USD, give 30 X 20 km, with a shipment every 50 meter.



The telescopic screw, very useful thing, if you don't want to displace 100 tons of ice :)

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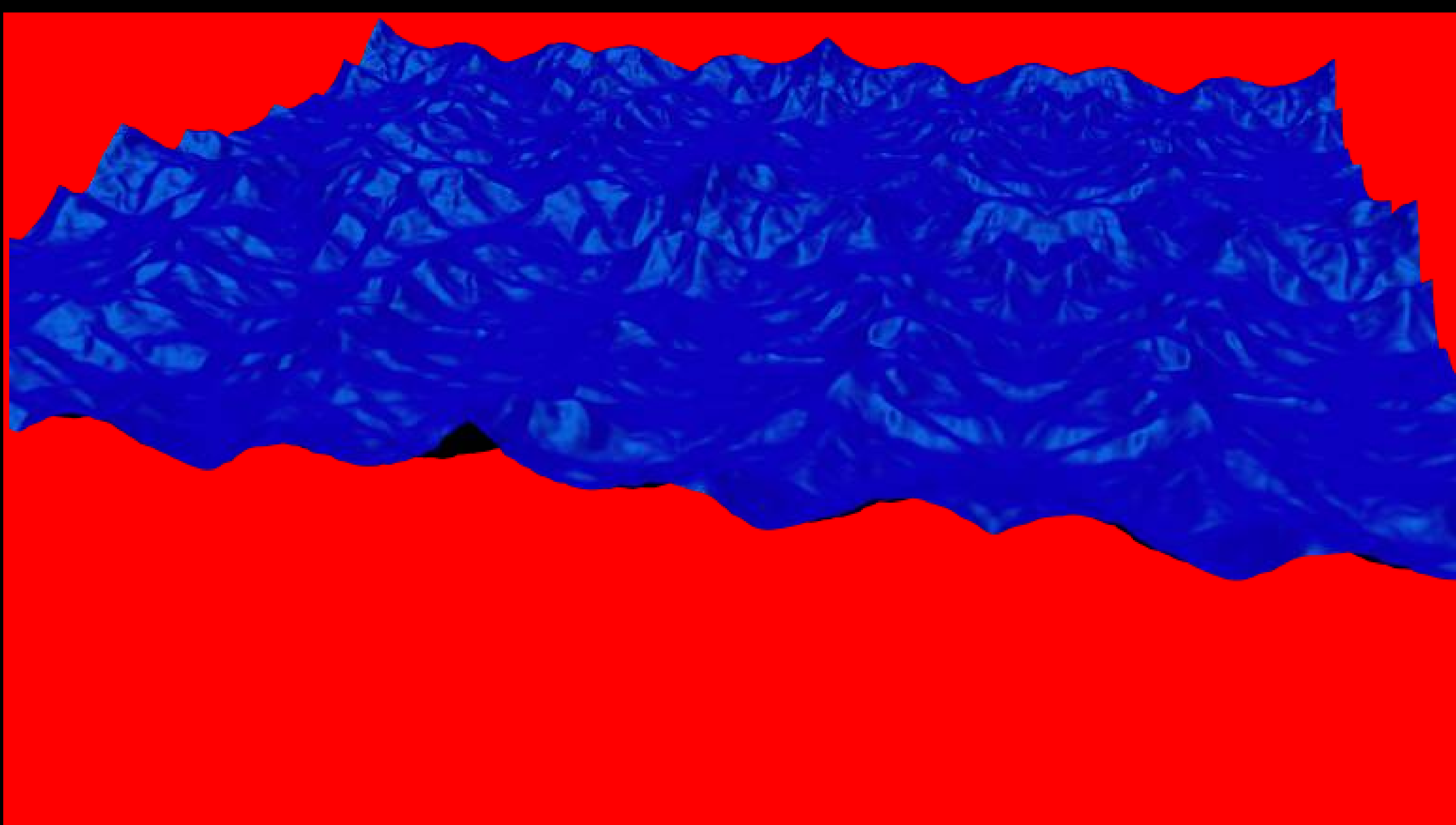
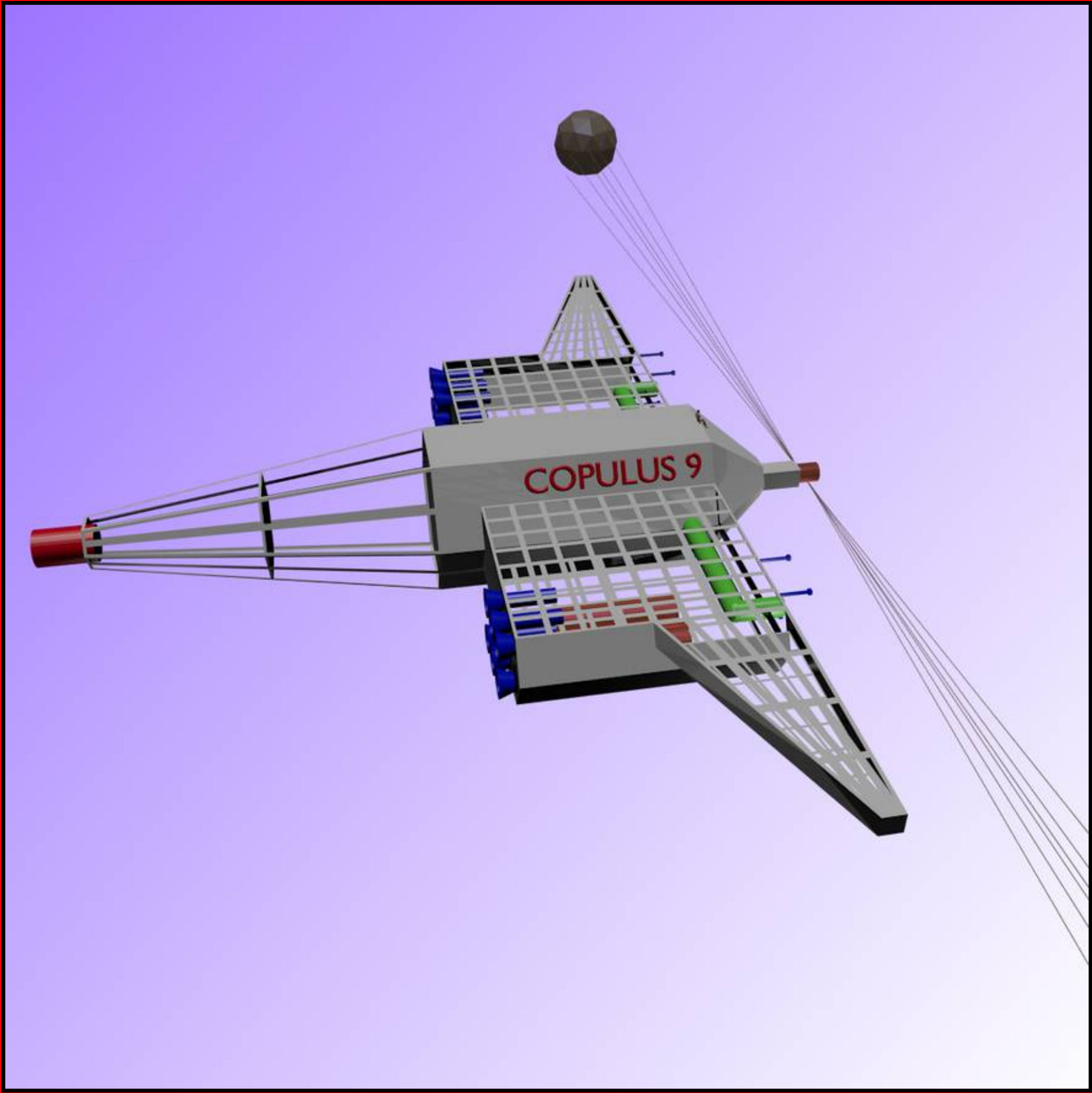
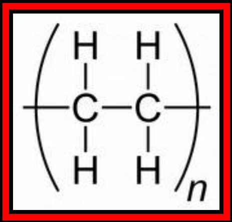


THE CREW SPACECRAFTS

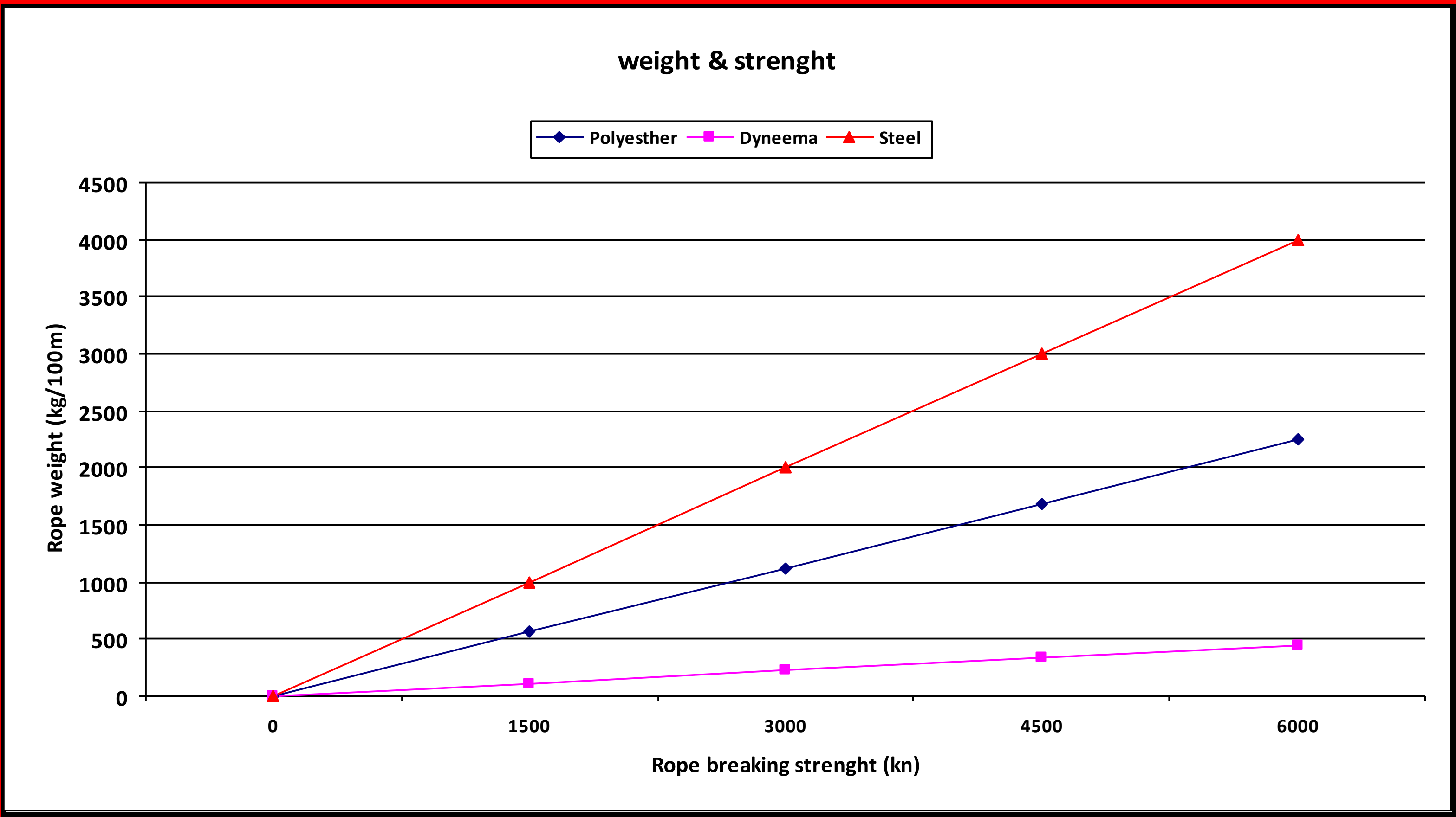


Following the rats centrifugal experiment, we will have to take the decision on, what concept of spacecraft must be sent. Here we can see the copulus-9 design, it's already an old one, but a lot of concept are in it. This one, have a better radiation protections and as you can see an artificial gravity system. The major issue, is to build that in space, we will need the optional terrestrial base to do it. By a cost analysis, it's not forbidden to think about it, because we could put in it a large bunch of Marsonautes. But actually, I'm to a more conservative design, the copulus-10, that will do the job too (see in the next chapter).

THE FLY (COPULUS-9)

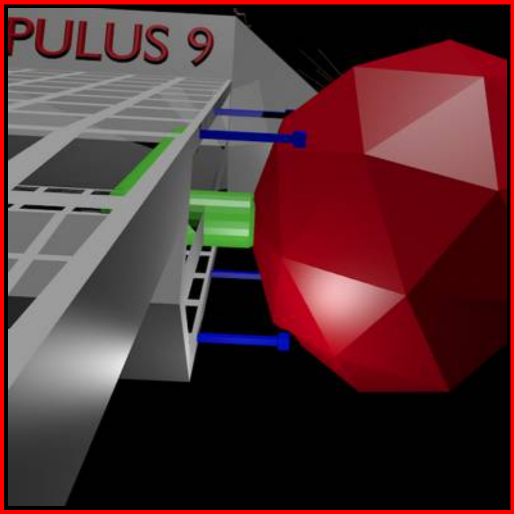


To maintain the sphere together, it need a great strength. After some web research, I retain cables of the Dyneema family. On the right image, we could see the molecular structure of the Ultra-high-molecular-weight polyethylene (UHMWPE, UHMW), let's notice that the n value is greater than 100,000. The chart below, shown the weight vs strength of different cables: Reference #2

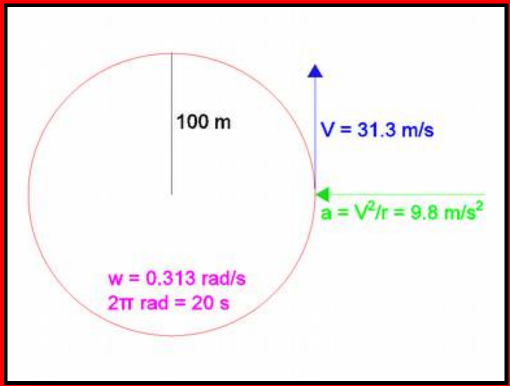


The biggest problem of the Dyneema is it temperature under a point where it could break easily, -150°C. This fact, will force us to protect the cable with reflective matter and maybe some sort of coolant (liquid or gaseous). But, the physical quality of those cables are great, the only alternative will be the use of steel cables.

In the case where the sphere will have a distance of 200 m between them, such a ray of 100 m. To achieve a artificial gravitation of 9.8 m/s^2, we need a linear speed of 31.3 m/s, where the period of one rotation will take 20 s.



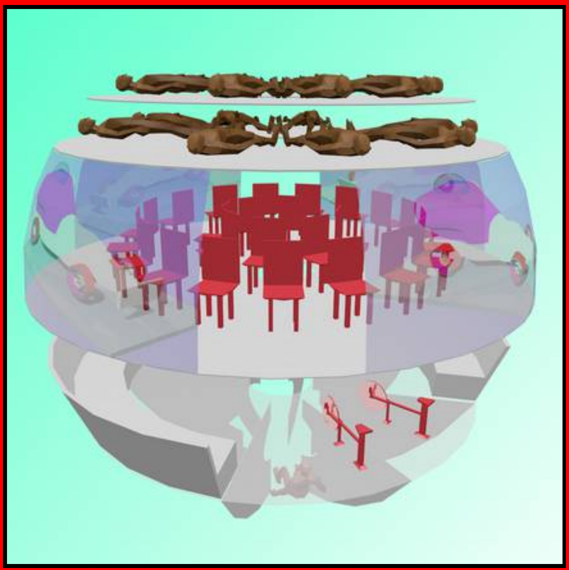
Also, we have to take into account that the friction inside the bearings will give a force momentum that will make the spacecraft rotate. That's why the wings, the opposite force to forbidden the spacecraft to turn on itself, will be optimal at long distance from the rotation axis. The acceleration of the sphere will also produce such force momentum.

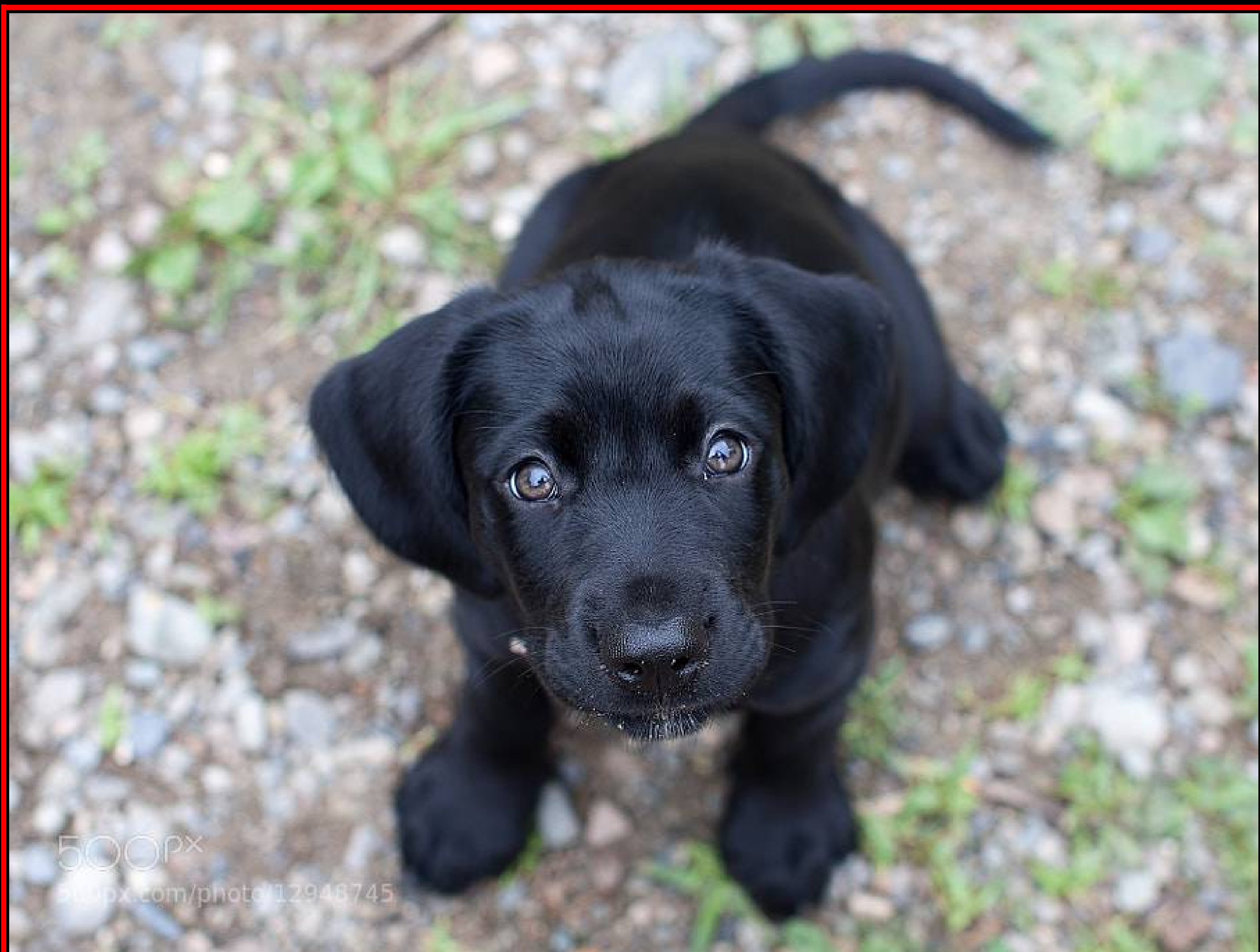


One possibility will be to have a sphere diameter of 3.82 m, that will allow 50 Marsonautes inside each sphere. Such the personals of an entire base site of 100 Marsonautes could take place in one ship. In that scenario, we will need 25 ships for the 25 base sites of the first landing on Mars.

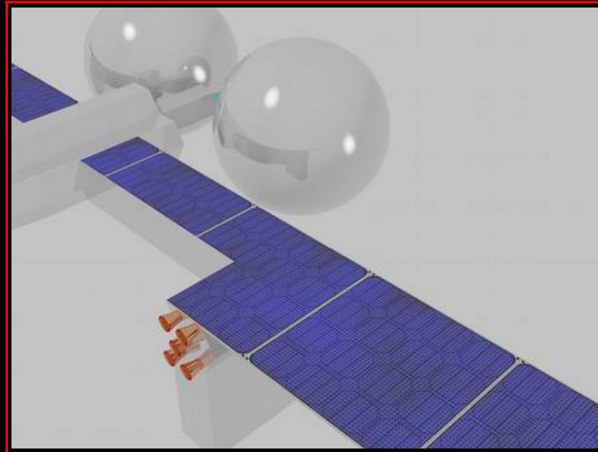
Each level of the sphere has an height of 2 m, and the total volume of it is 233 m^3. The proximity between each individual is a big problem. It could be revised with the cost of retrieving some shielding, or adding some more money to the project.

With some physical exercise and the artificial gravitation, the Marsonautes will stay healthy for all the 8 months of the space trip. But with some penalty on the Oxygen consumption, 10 time more that if they where at rest. Also, the effect of rotation on our self, wont be too much because of the 100 meter distance with the axis, they wont be stunt or need special medication :)





The wings and the body of the insect will be covered by solar panels, with about 25 kW of power. The rest of the power we be available by the use of a neutron moderate atomic reactor (or a Pu-238 reactor, costly solution)



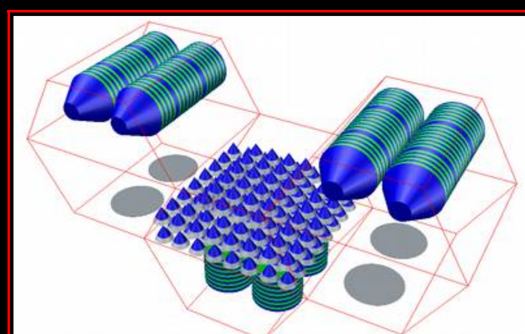
Caractéristiques de l' SSME	
Poussée (vide)	2 279 kN
Impulsion spécifique (vide)	452,3 s
Poussée (atm)	1 859 kN
Impulsion spécifique (atm)	363 s
Longueur	4,3 m
Diamètre	2,4 m
Masse	3 526 kg

The landing cone, are a little success by themselves, they will require assembly at the last step of the trip. This version of the ship will have a 12 Marsonautes by day capacity of launching.

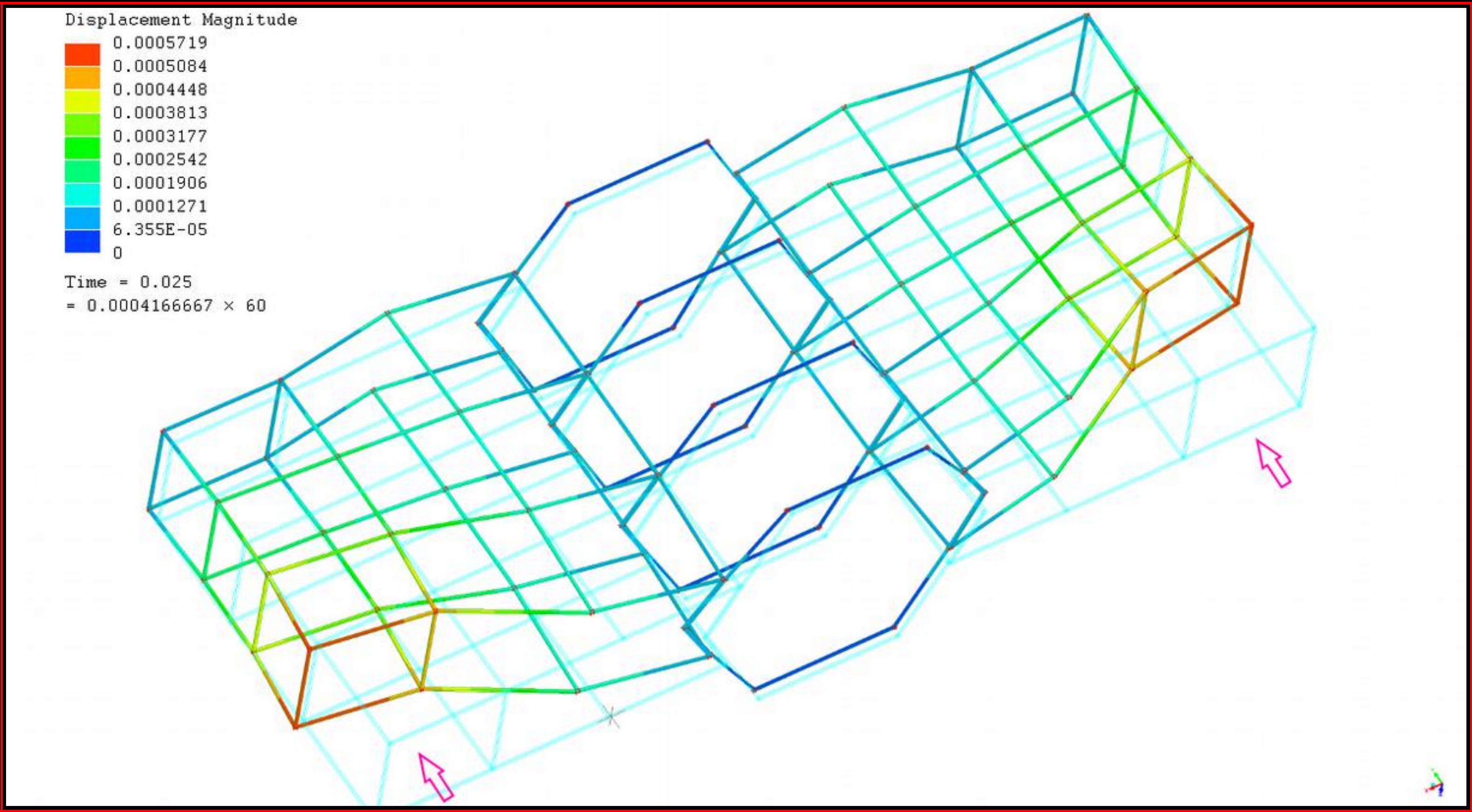
$$I_{sp} = \frac{F}{q \times g}$$

$$F = m \times a$$

I_{sp} : Impulsion spécifique (s)
F : Force (N)
q : Masse carburant par seconde (kg/s)
g : Constante de gravitation terrestre
m : Masse (kg)
a : Accélération (m/s^2)

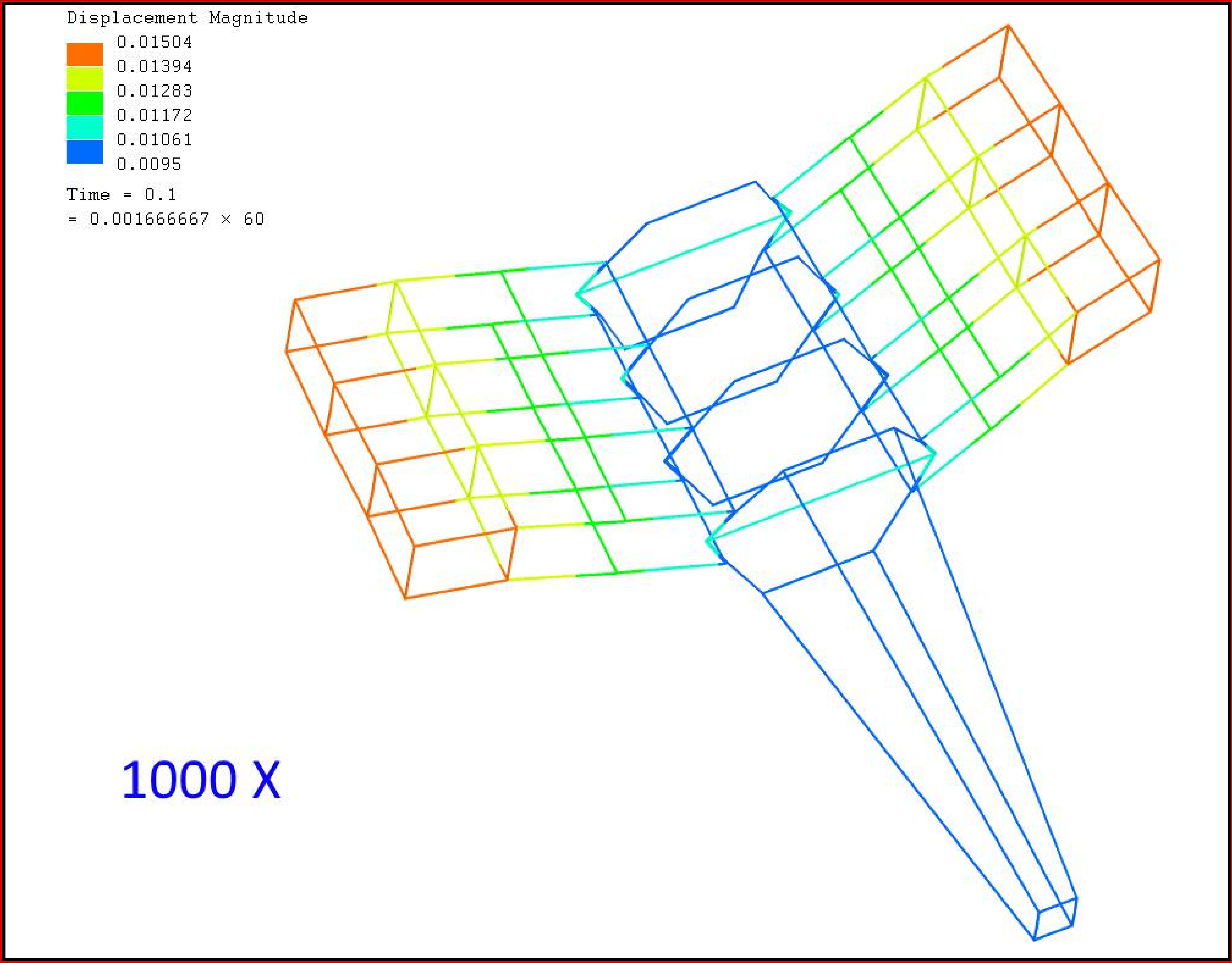


START STRUCTURAL ANALYSIS



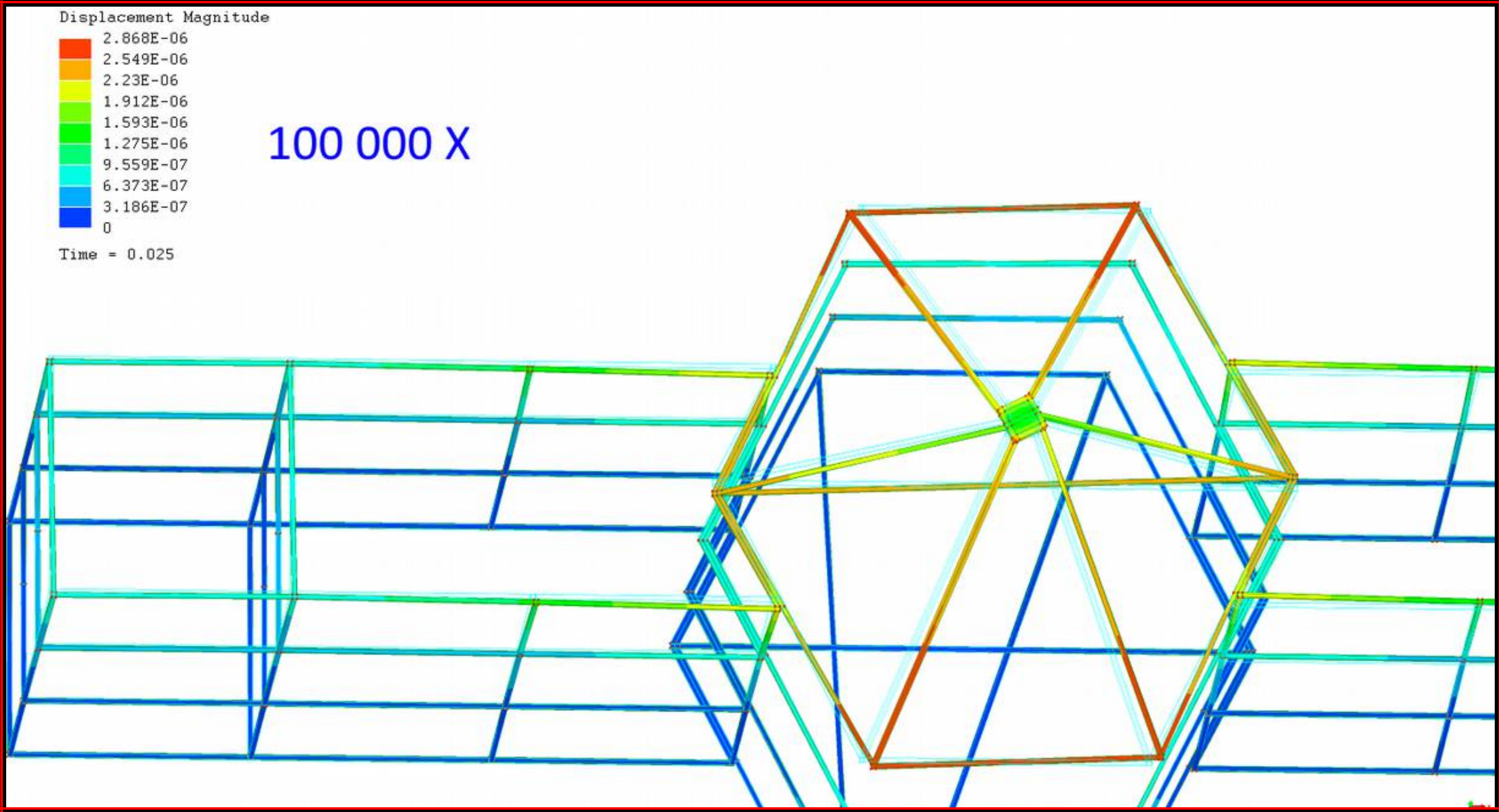
On this drawing of the fly, made on the freeware LISA 8.0, the amplification of displacement is 8878 X. The total volume of Aluminum is 8 m^3, for a mass of 23,000 kg. The thrust is 100 kN and the spheres mass is 400 metric ton total.

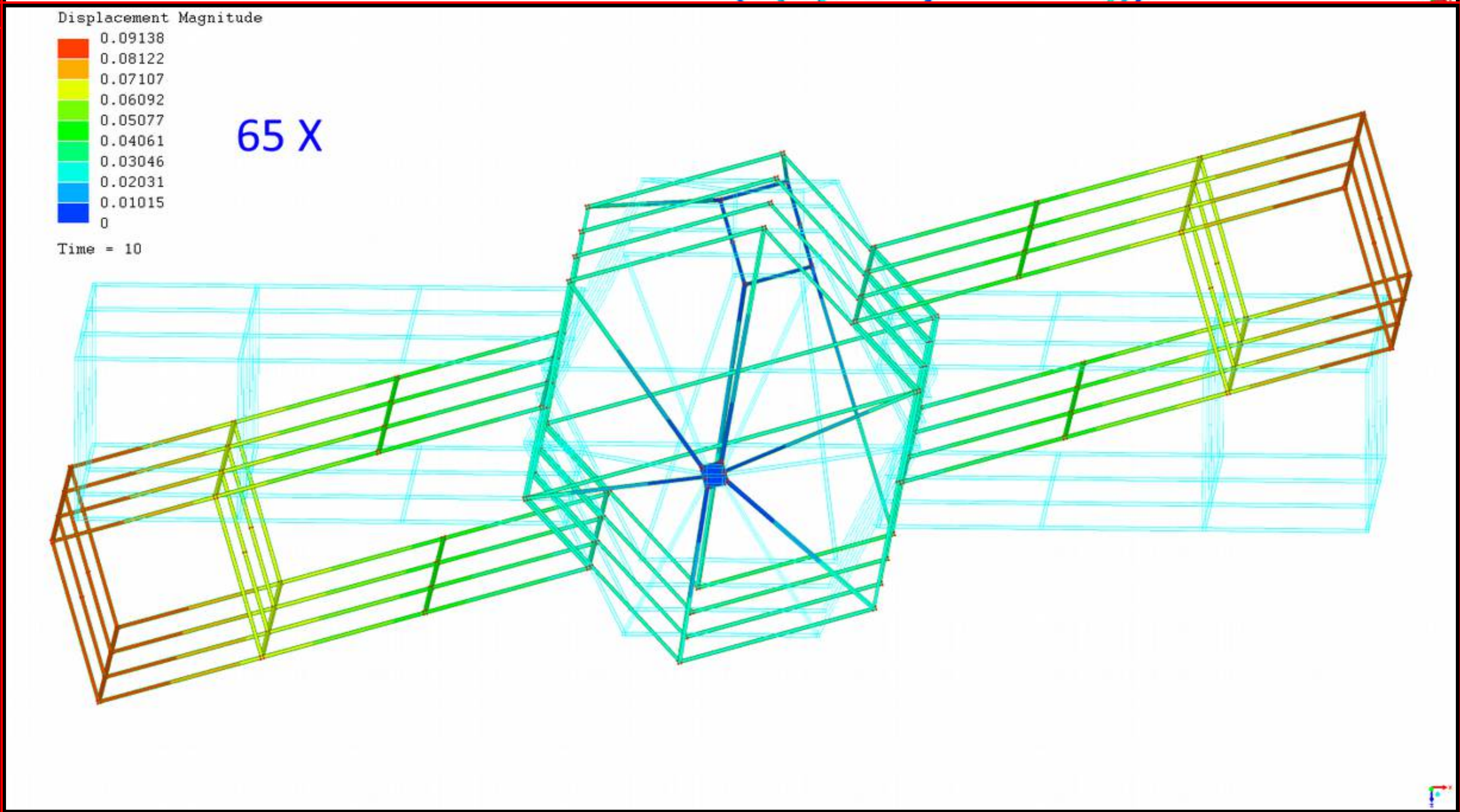
ARRIVAL STRUCTURAL ANALYSIS



The arrival phase is more problematic, without the spheres and a thrust of 100 kN, an acceleration of 2.25 m/s^2, for a duration of 478 seconds.

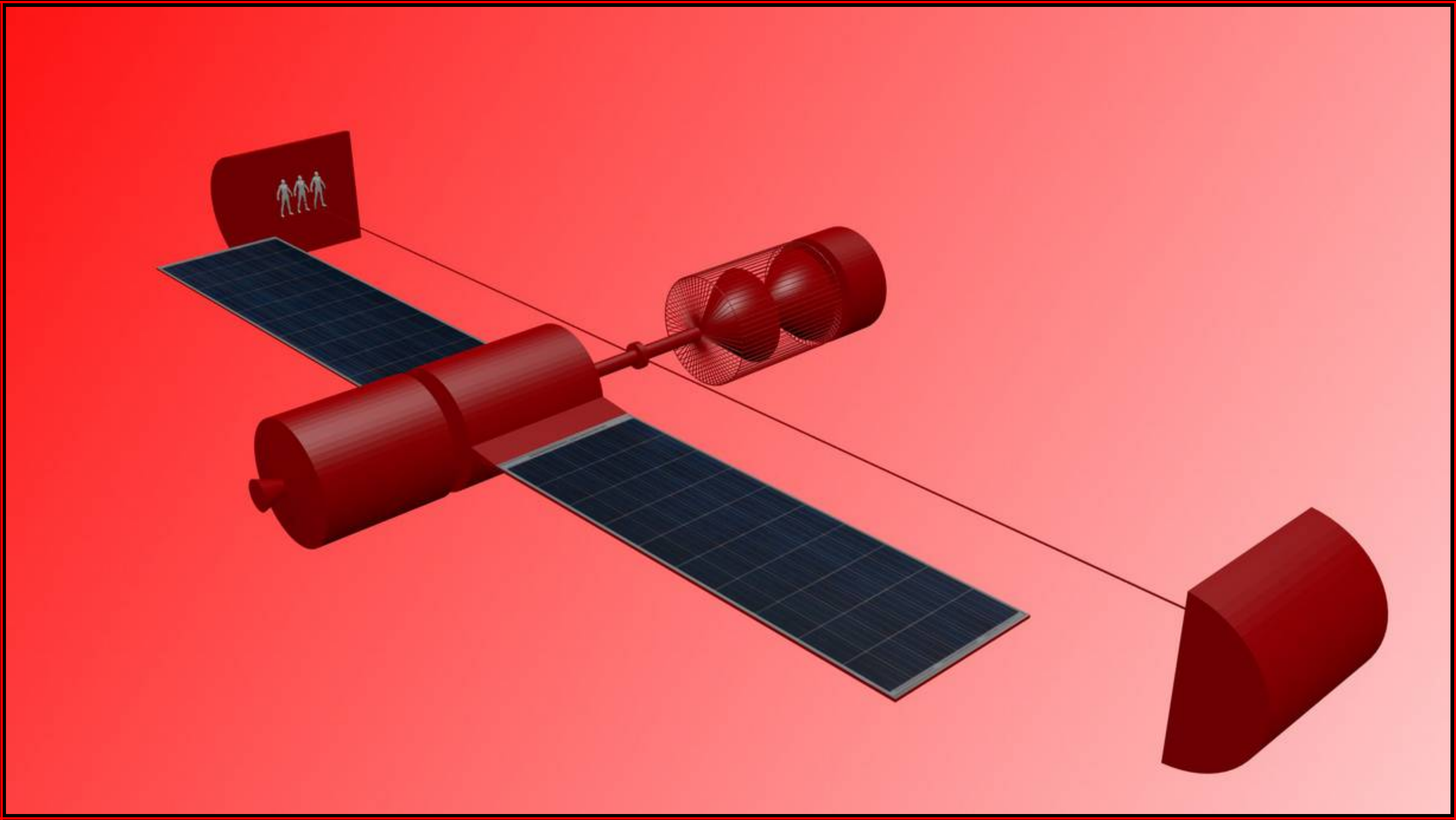
ROTATION ANALYSIS





The deformation related to the moment of force of 500 N*m, is ridiculous, and the rotation is happening over minutes.

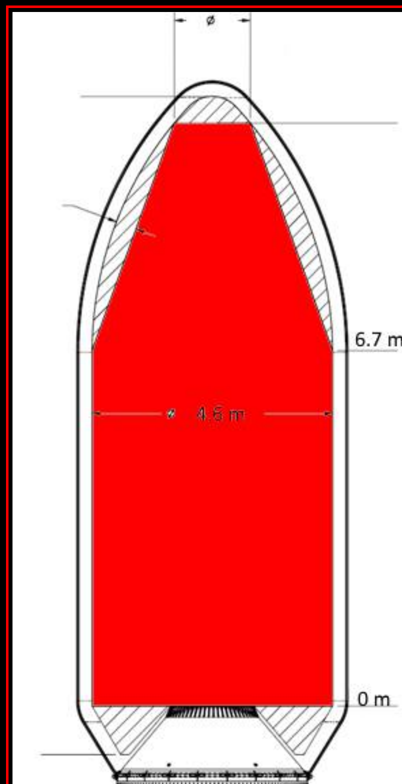
THE SPEAR (COPULUS-10)

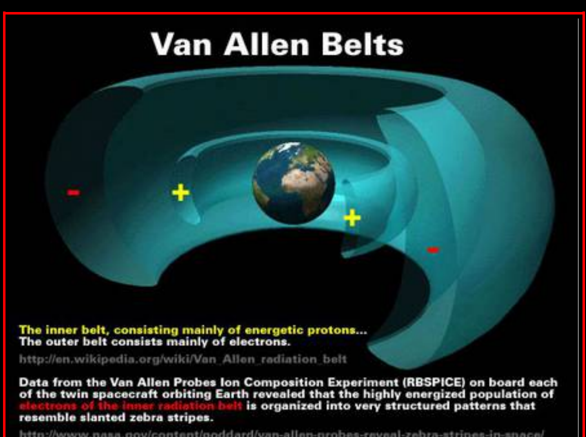


The wings of the spacecraft will consist of solar panel with a surface area of 186 m², that will give us 5.8 kW of electric power (base on ISS power ratio). The water electrolysis will consume 2,750 W, and the CO2 removal about 500 W. The Sabatier reaction may be use for economic reason, but we will need to add a little more water in the tank, for safety reasons (power requirement is not available for strategic purpose, but we could suppose 500 W). The need for Sun energy by concentrating light is a dangerous process.

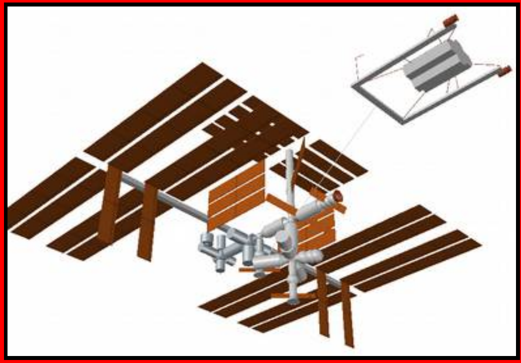
THE MAIN SPACECRAFTS

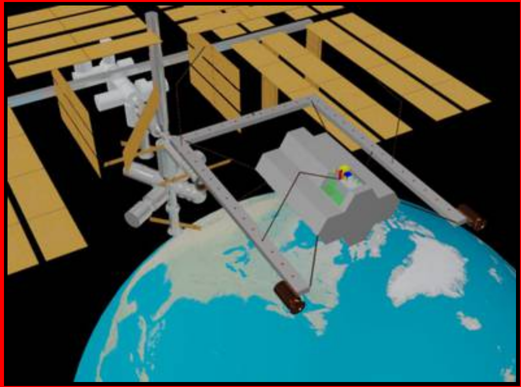
Without the need of centrifugal system, we could think about sending single rocket, to achieved the lower cost possible. On the right, the fairing of the spaceX program. With the cost of 90 M USD (worst case scenario, recycling cost is probably about 8 M USD per launch), the weight of the supplemental fuel need to go trough out the space without entering too much energetically space produced by Van Allen belt, will be possible. With a cost of 90 M USD per Marsonaute (8 M USD for recycling one) plus the spacecraft: 35 M USD, it will be also possible to send hundreds of them, combine with the modulated landing process, we are on Mars for a long time...





SUPER DUPER ISS





The ISS, with a mass of 450,000 kg, and an altitude of 350-410 km from the ground, could be a great asset after the 4 or 5 cycles (8-10 years), after the beginning of the colonization. The need for bigger spaceship, will undergoes a race to build in space. Already equip for 6 crew, the ISS or it's successor, could make obsolete the Main Spacecraft, because with a reusable concept, we could lowering the cost per man down to 5-10 M USD.

As described in past chapter (The spear), some Marsonautes will probably need to pass some time in the centrifugal unit to stay healthy. It will be great to do some test before sending them :)

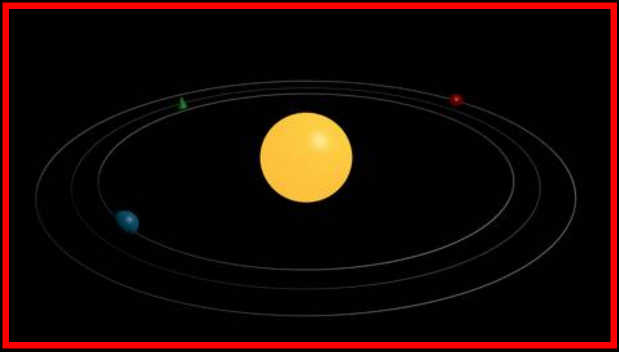
There is two option:

- The rats (see chapter Test: rats centrifugal)
- The experiment on real human

The Americans had an option on the ISS, that was a artificial gravity module, named the Nautilus-X, base on Hoberman structures. With a cost of 83-143 M USD (Reference #10), it wasn't bad! It looks like it never happened, but there still the rats option...

Another good project, will be the Bigelow space station, see the image at bottom. With a very low relative cost projected, this could do the job too. I don't know if it's already the case, but we could build those module like the socks are. I mean a big circular machine, that will prevent the use of too much sewing. Those machine are really fast, we could also build, some parts of the actually needed spacecrafts with those kind of module.

UNBREAKABLE COMMUNICATIONS

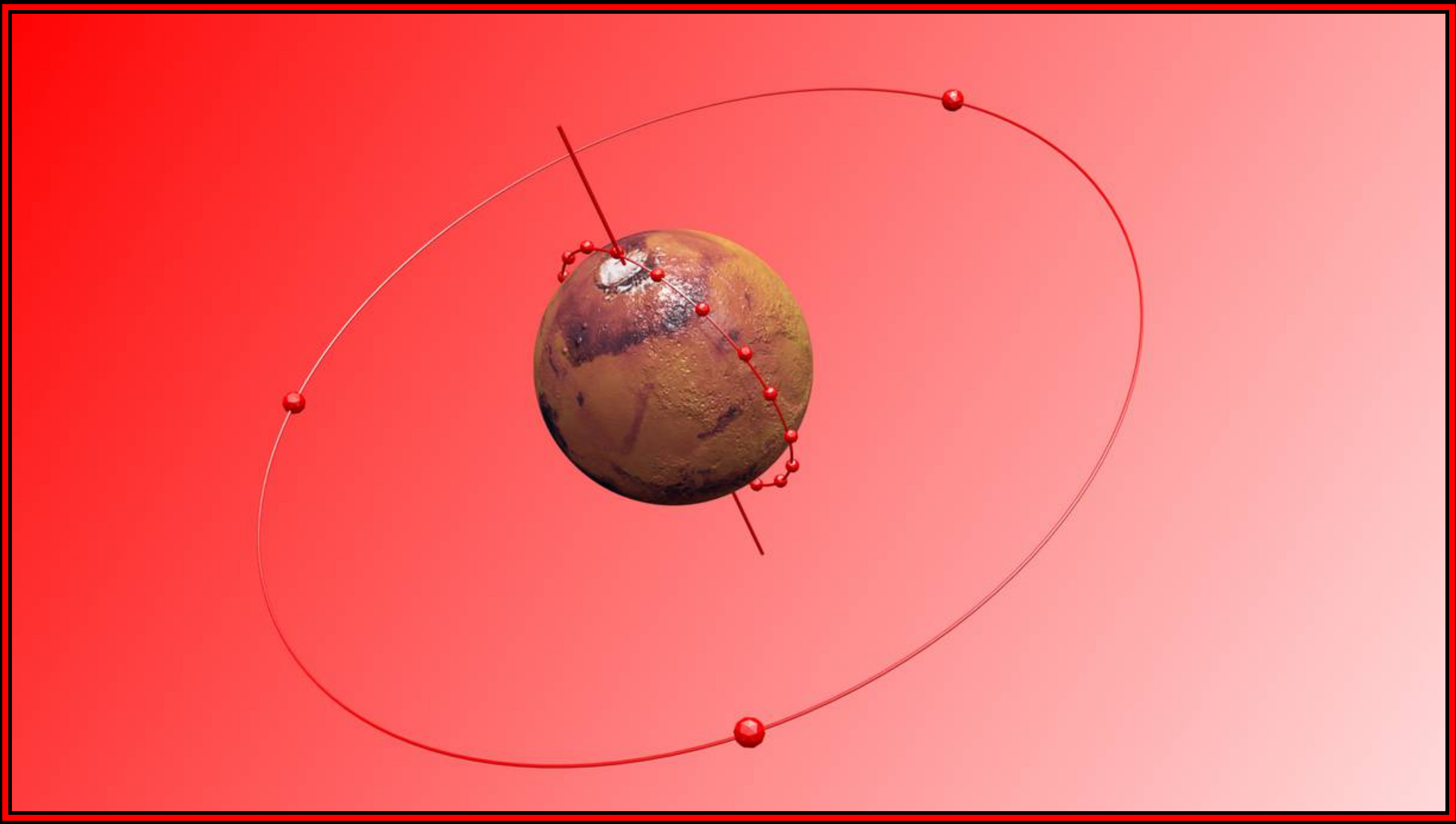


We could easily imagine the necessity to stay connected with the Martian base, It will be of great importance to place communications satellites around the Sun.

The green cone is a satellite, it allow the light to do a triangle around the Sun. With at least three of them it will be 100 % time possibility to establish communication with the red planet. The worst case scenario is when the Earth is at the opposite of Mars, in that case, since the light travel at the speed of light :)

$Sqrt(2 * Rt^2) + Sqrt(Rt^2 + Rm^2) = 483$ E6 km

So, the maximal distance to travel is 486 millions of km, that will take 30 minutes. In the minimal distance, it will be 5 minutes, and during the Mars landing phase, it will be 10 minutes (about that). It will be possible (with the cost of the premium satellites scenario), to place a minimum of 10 satellites, distant from each other, of 110 millions km or less. Such a system, could cost many billions USD, and last only 5-10 Martian cycles (10-20 years), but it is required. On Mars, we could make good use of a 25 units system, like illustrated on the image bellow. The 22 satellites on a low orbit of more than 135 km, for air drag reasons, will communicate with those at higher altitude.

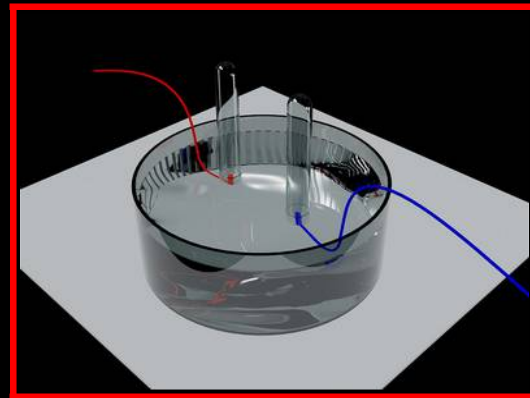


LE CHAT LUMIÈRE

Actually, we are limited with a communication bandwidth, between Mars and Earth, of about 6 Mbit/s. The best system, that I saw was with LASER, but it seem that it is not ready yet!

I will publish some new stuff about that in the next edition...

WATER ELECTROLYSIS



The human metabolism, absorb O_2 and reject CO_2. The CO_2 problematic is resolved by the use of zeolite (see the improve spacesuit). On Mars we need to us a vacuum pump or adding H_2 to be able to reject the CO_2 from the said zeolite, to reduce the partial pressure. This H_2 and the O_2 need for breathing, will be available by the electrolysis process.

The principle is simple, we need to add KOH to some distilled water, and use electric power to dissociate the Hydrogen and Oxygen. The potassium hydroxide allow the current to go trough the water, between the two electrode: $2\ H_2O(l) \Rightarrow 2\ H_2(g) + O_2(g)$

This reaction is exothermic, and the energy requirement is related to many factors such:

- Electrolyte amount
- Water temperature
- Pressure
- Distance between the electrodes
- Electrodes constituents

On the right, we can see the Hydrogenics conception. The reactor is made of a multitude of piles, one on each other.

Spécifications techniques	
Pression d'opération	10 bar gazeux
Flux maximal d'hydrogène	15 m³/h à TPN
Consommation électrique AC	4.9 kWh/m³ à TPN
Voltage	3 X 400 VAC +- 3%
Fréquence	50 Hz
Puissance installé	120 kW
Consommation d'eau distillé	< 1 l/m³
Électrolyte	Eau + 30% w/w KOH
Quantité d'électrolyte	300 L
Installation	+5 / +40 degrés Celsius
Dimension réacteur	1,7 X 1,85 X 2,6 mètres
Masse du réacteur	1500 kg

Tableau de la consommation de O_2 (Gaz) par marsonaute

Activités	Litre/min	Litre par jour O_2	Fraction quotidienne	O2 relatif (L)
repos	6	435	0.5	218
marche	15	1,089	0.3	327
marche rapide	30	2,177	0.15	327
course	60	4,355	0.05	218
			Total :	1,089

Only one of this unit will be sufficient for 150 Marsonautes. For a complete spacesuit autonomy we will need to liquefied 1.5 kg of Oxygen for 24 hours. The real problem, is the combustible for the trucks (see the chapter trucks technologies).

MY FAVORITE AUTHOR AND MYSELF