

Raumfahrt- Was ist das?



Internationale Junior Universität Salzgitter

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Acknowledgments

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Vorlesung Überblick

Unser Standort

Raumfahrtpioniere

Gefahren in der Raumfahrt

Wie kommt man in den Weltraum

Das Antriebssystem

Trajektorie (Flugbahn)

Aerodynamische Stabilität

Hitzeschutzschild

Computer Simulation

Diskussion und Ausblick, neue Antriebe



The Solar System

The Sun and all the other stars that we see in the sky are part of the solar system. The Sun is the largest, hottest, and heaviest body in the solar system, and is the source of all the energy that we feel.

The only other star in our solar system, the Sun, controls all of the other bodies around it. Even the planets, which are so much larger than the stars, are governed by the Sun.

Each of the stars in our solar system is a star in its own right.

Each star has its own planets, or worlds, around it. The Sun has eight planets, and the other stars have one or two planets.

The time it takes for one complete revolution around the Sun is called a year. A year on Earth is 365.25 days. A year on Mercury is the shortest—only 88 Earth days. A year on Pluto is the longest, equal to 248 Earth years.

All of the planets except Mercury and Venus have moons. The largest is Ganymede, a moon that orbits Jupiter. Jupiter, Saturn, Uranus, and Neptune also have rings.

The planets are the bodies that orbit the Sun. There are eight planets, and many moons, which are smaller bodies that orbit the planets.

Mercury, Venus, Earth, and Mars are the inner planets. Jupiter, Saturn, Uranus, and Neptune are the outer planets.

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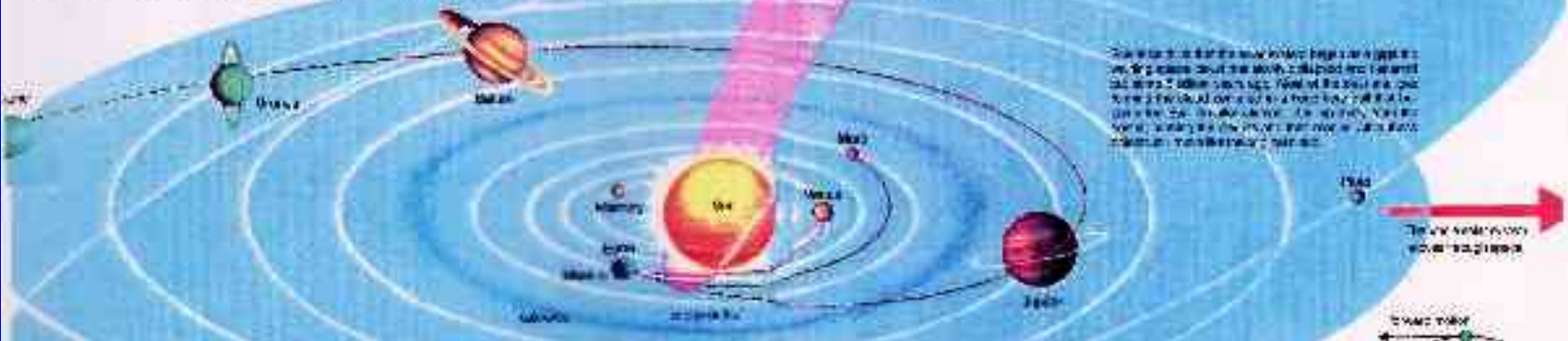


Diagram of the solar system showing the Sun at the center and the eight planets orbiting in elliptical paths. The planets are labeled: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

Diagram showing the solar wind, a stream of charged particles that flows outward from the Sun. The solar wind is made up of electrons and protons, and it travels at a speed of about 400 kilometers per second.

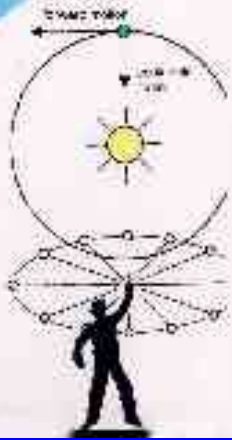


Diagram showing a person holding up a model of the solar system. The model shows the Sun at the center and the planets orbiting in elliptical paths. The person is standing on a surface, and the model is held up in front of them.





Raumfahrtpioniere

TWENTY-FIVE CENTS

FEBRUARY 17, 1956

TIME

THE WEEKLY NEWSMAGAZINE



MISSILEMAN
VON BRAUN

MAR 28 A YEAR

VOL. XXXI NO. 7

Collier's

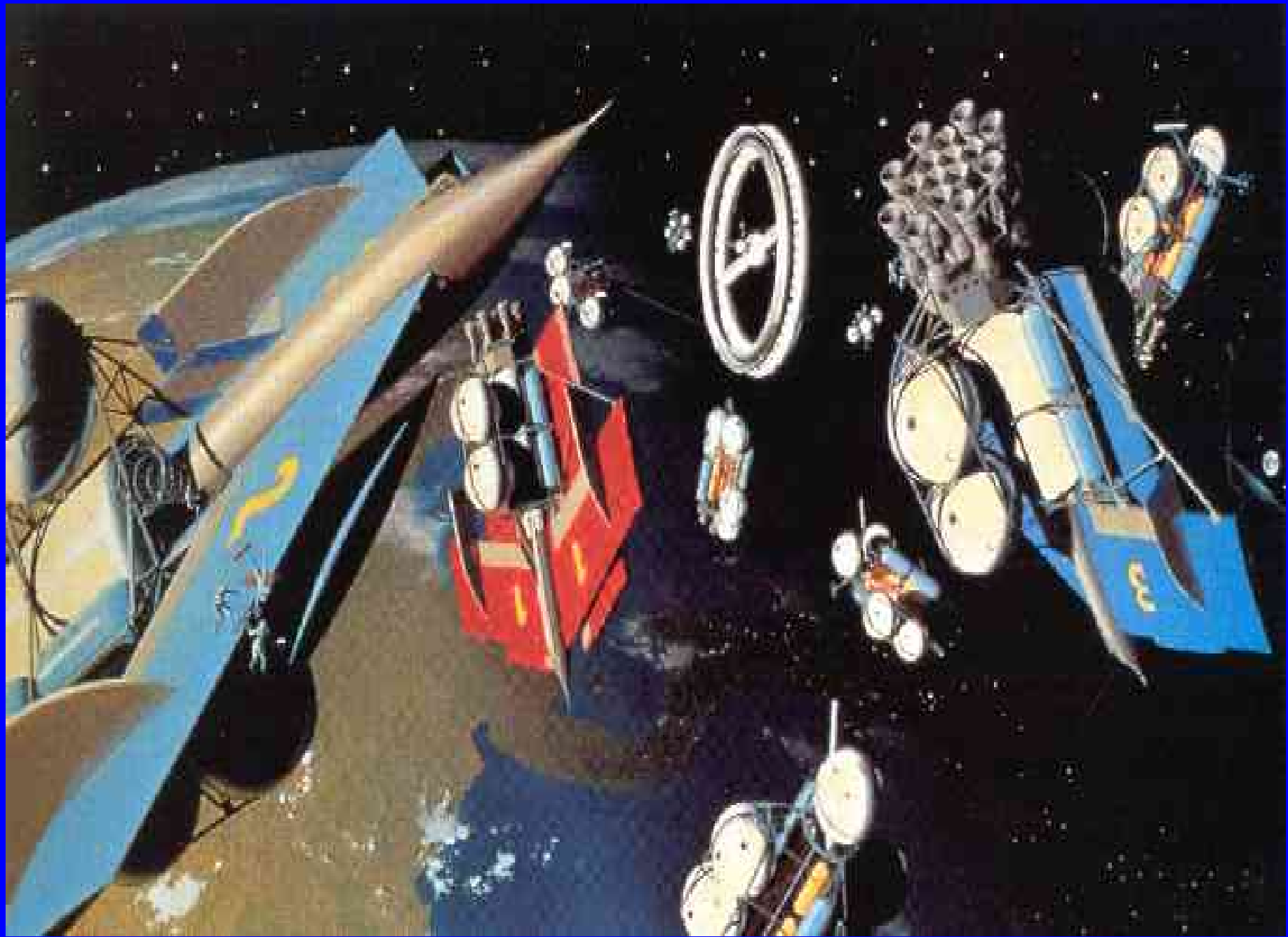
March 22, 1952 • Fifteen Cents

**Man Will
Conquer
Space Soon**

**TOP SCIENTISTS
TELL HOW IN
15 STARTLING PAGES**







April 20, 1961

MEMORANDUM FOR

VICE PRESIDENT

In accordance with our conversation I would like for you as Chairman of the Space Council to be in charge of making an overall survey of where we stand in space.

1. Do we have a chance of beating the Soviets by putting a laboratory in space, or by a trip around the moon, or by a rocket to land on the moon, or by a rocket to go to the moon and back with a man. Is there any other space program which promises dramatic results in which we could win?
2. How much additional would it cost?
3. Are we working 24 hours a day on existing programs. If not, why not? If not, will you make recommendations to me as to how work can be speeded up.
4. In building large boosters should we put out emphasis on nuclear, chemical or liquid fuel, or a combination of these three?
5. Are we making maximum effort? Are we achieving necessary results?

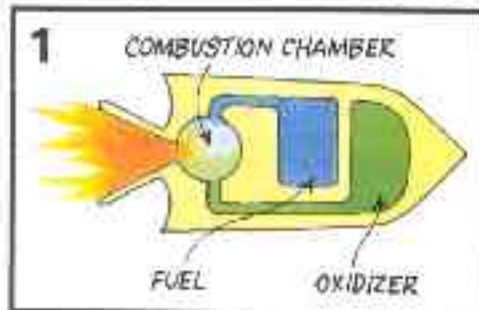
I have asked Jim Webb, Dr. Weisner, Secretary McNamara and other responsible officials to cooperate with you fully. I would appreciate a report on this at the earliest possible moment.



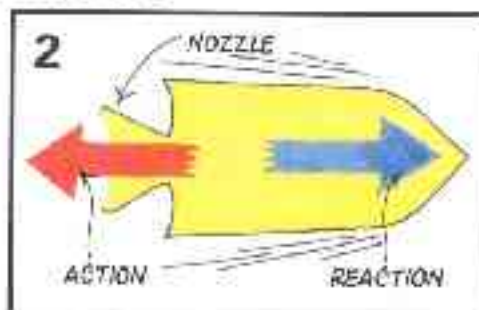
Wie kommt man in den Weltraum

Das Antriebssystem

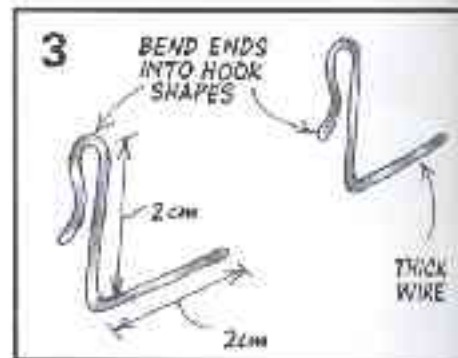
Action, reaction and rocket racers



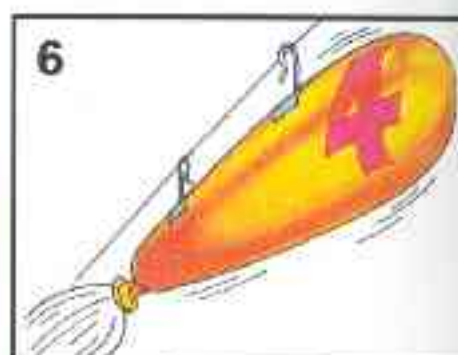
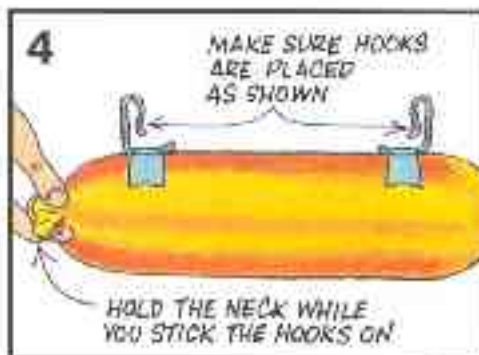
▲ A liquid fuel rocket has fuel and an oxidizer, which are fed to the combustion chamber by gas pressure or, more often, by pumps. They ignite there. The oxidizer is needed to provide oxygen, without which nothing can burn.



▲ The burning liquids produce a powerful exhaust, which expands backwards through a nozzle. The action of the exhaust causes a reaction of equal pressure pushing in the opposite direction that drives the rocket forward.



▲ This experiment is a quick and simple way of demonstrating the principle of action and reaction. You will need a few sausage-shaped balloons, some thin wire, and a length of nylon fishing-line or thread. Bend the wire as shown.



Gefahren in der Raumfahrt



The Columbia STS-107 mission lifted off on January 16, 2003, for a 17-day science mission featuring numerous microgravity experiments. Upon reentering the atmosphere on February 1, 2003, the Columbia orbiter suffered a catastrophic failure due to a breach that occurred during launch when falling foam from the External Tank struck the Reinforced Carbon Carbon panels on the underside of the left wing. The orbiter and its seven crewmembers (Rick D. Husband, William C. McCool, David Brown, Laurel Blair, Salton Clark, Michael P. Anderson, Ilan Ramon, and Kalpana Chawla) were lost approximately 15 minutes before Columbia was scheduled to touch down at Kennedy Space Center. This site presents information about the STS-107 flight, as well as information related to the accident and subsequent investigation by the formal Columbia Accident Investigation Board.



SPACE SHUTTLE

THE FIRST US SPACE SHUTTLE was launched on April 12, 1981. The Shuttle is

reusable, and since that first journey, many more missions have been flown, teaching astronauts a lot more about living and working in space. The Shuttle Orbiter is a cross between a space station and a space plane. People can live inside it as it orbits the Earth. It can land its nose safely back home and then, after being refueled and adapted, it can fly on another mission. It is mainly used to launch satellites and to recover them for repair.

Getting up there
The giant part of the Shuttle, shown here, is called the Orbiter. When it is finished, it is attached to a fuel tank and two rocket boosters, which help lift it into orbit. After the launch, the boosters are jettisoned. They parachute back to Earth to be used again for another launch.

Getting to work
All the Orbiter's systems are controlled by computers. The crew checks these systems by looking at controls on the flight deck, high up in the nose. The computers are constantly monitored by Mission Control back on Earth.

Living on board
The Shuttle has a small kitchen called a galley, where they heat up their food. It is packed into containers. Four people can live in the Shuttle. They "sleep" themselves into sleeping bags. They also spend their time and one sleeps standing up. It's not like a normal bed, it feels no different than normal.

Keeping cool

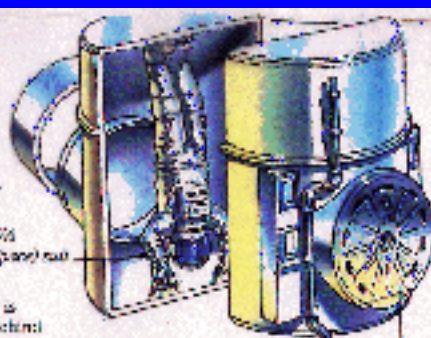
Hot absorbing liquid is pumped through pipes around the Orbiter, absorbing heat. Typically the pipes pass through radiators. Inside the packed bag doors, which are left open in orbit to keep the cabin free from space.

The nose

The window can open up to 180 degrees. The crew members, including the commander, do most things that are done on private. However, they can never disembark, using straps that attach them to their seats.

RAM

A 32 ft (10 m) long robot arm is installed in the payload bay behind the nose. It is called the RAM (Remote Manipulator System) or Canadarm, because it was made in Canada. A gripping mechanism on the end can be used to grab satellites.



ET (External Tank)

Air lock door

Getting down again

Reaching home, the Orbiter reenters the atmosphere at 17,000 mph (28,000 km/h) → nose and wings glow white hot, but the Orbiter is protected by heat-proof silica tiles. It glides the whole way down to Earth.

TECHNICAL DATA

ORBITER LENGTH: 132 ft 2 in (40.28 m)
ORBITER HEIGHT: 36 ft 8 in (11.18 m)

WINGSPAN: 78 ft 1 in (23.79 m)
PAYLOAD CAPACITY: 28,000 lb (12,700 kg)



SHUTTLE ORBIT SPEED: 17,000 mph (28,000 km/h)

ORBIT ALTITUDE: 110 to 125 miles (177 to 201 km)



REENTRY ALTITUDE: 110 to 125 miles (177 to 201 km)

REENTRY SPEED: 17,000 mph (28,000 km/h)

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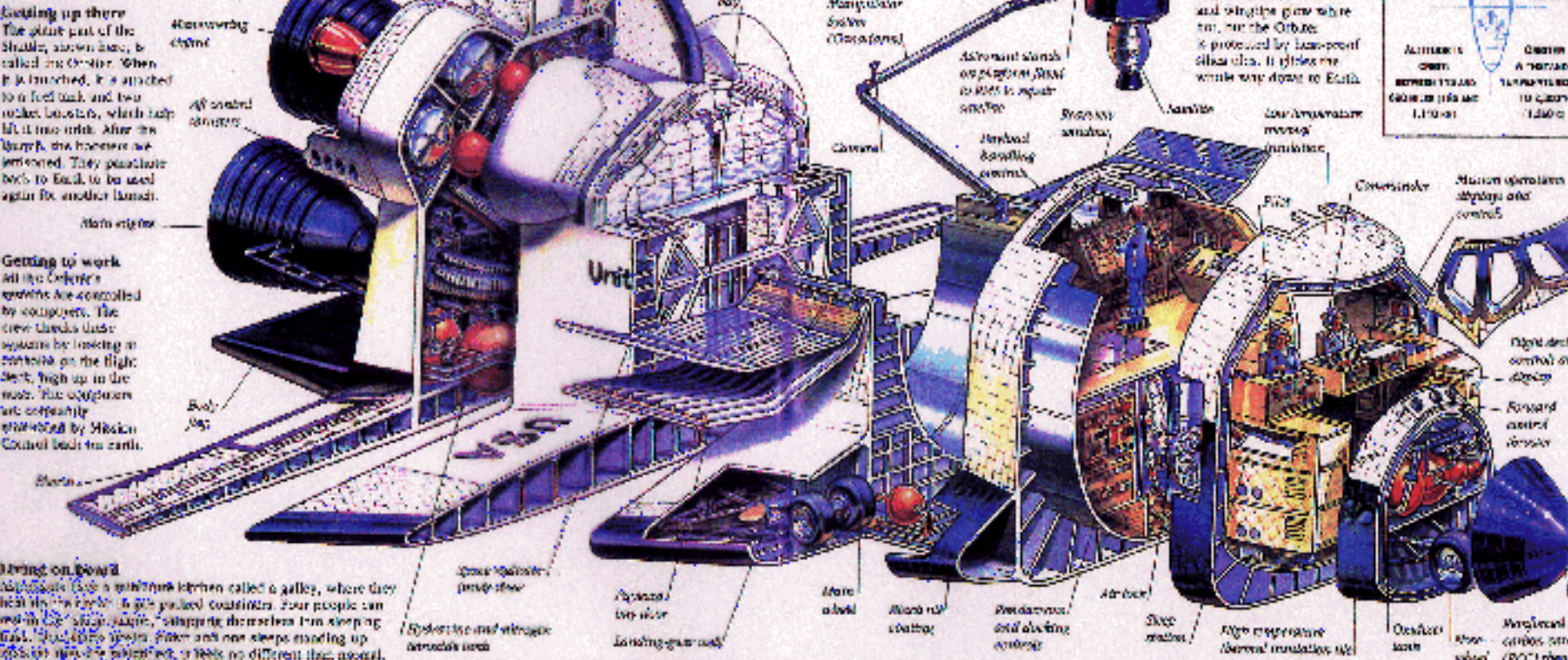
REENTRY ALTITUDE: 110 to 125 miles (177 to 201 km)

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REENTRY SPEED: 17,000 mph (28,000 km/h)

REENTRY ALTITUDE: 110 to 125 miles (177 to 201 km)



Attaching orbiter
Air lock door
Main engine

Getting to work
Mission operators displays and controls
Flight deck control console
Forward control console

Living on board
Galley
Sleeping quarters
Waste and nitrogen disposal unit

Reinforced carbon-carbon
Reinforced carbon-carbon
Reinforced carbon-carbon

RAM
RAM
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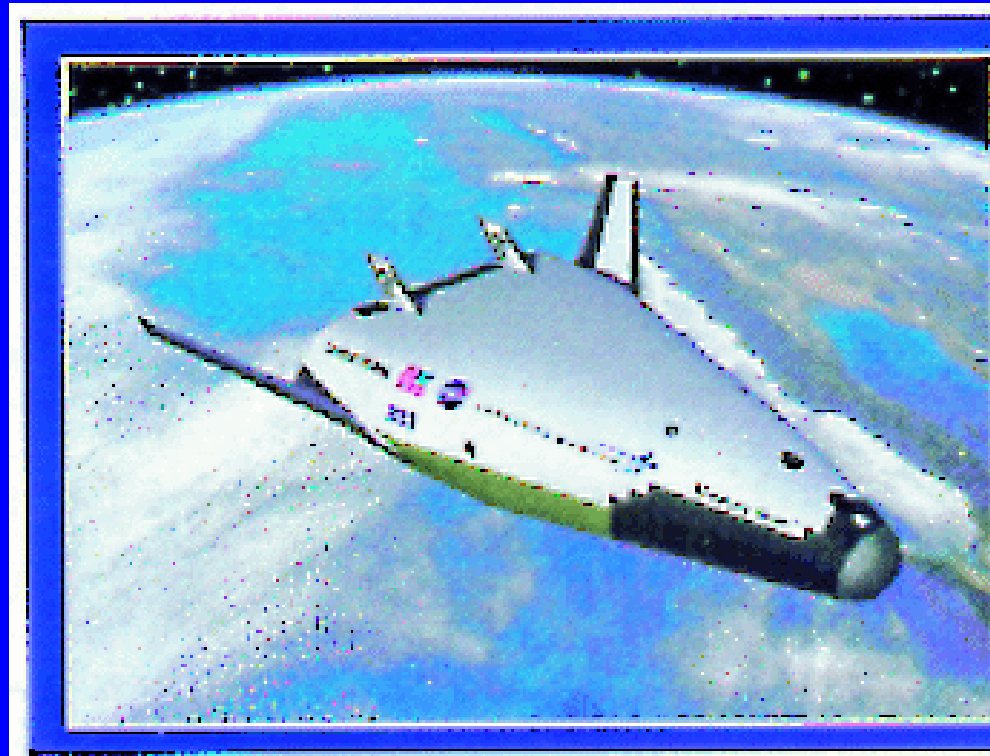
RAM
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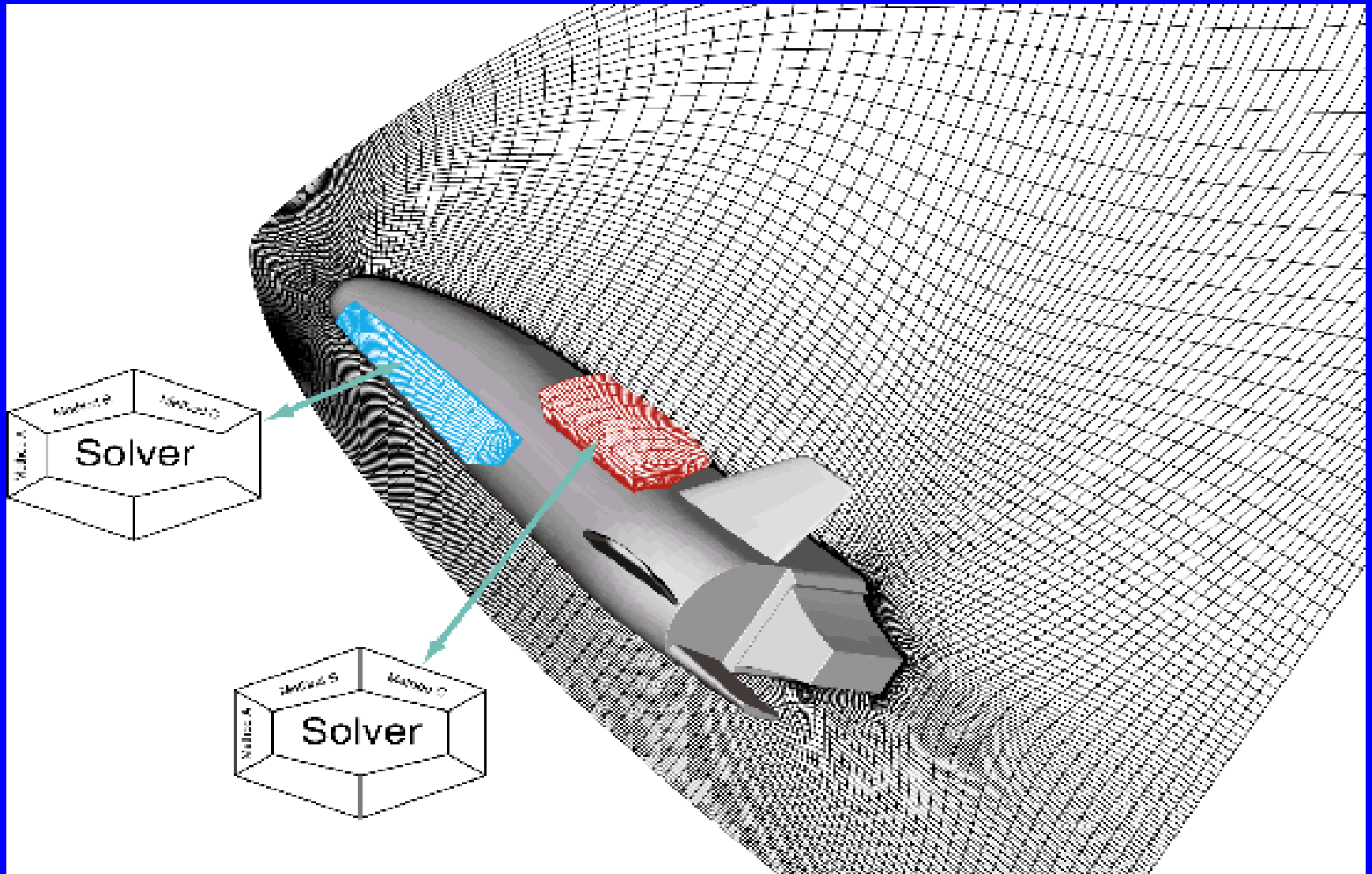
New Concept

Complex Aerothermal/TPS

Vertical Launch and Horizontal Landing - $M < 15$

Cost \$ 1.25 B

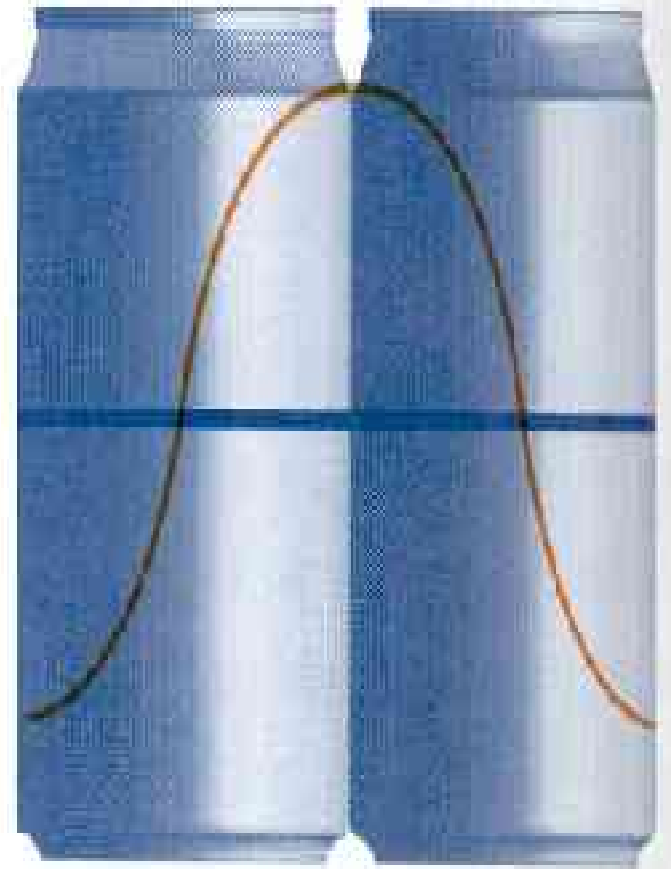
Schedule - 3+ years

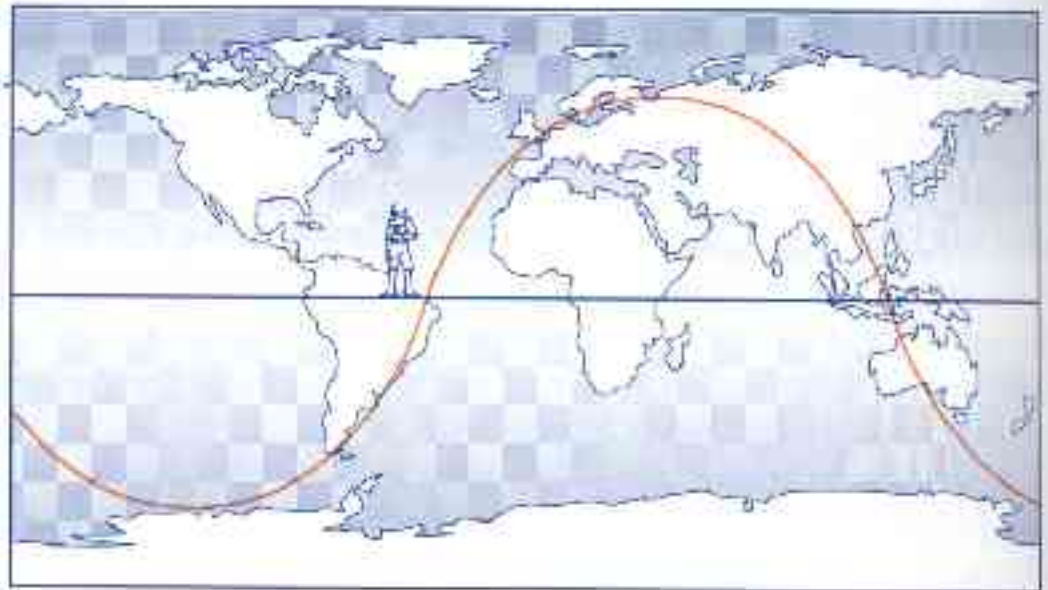
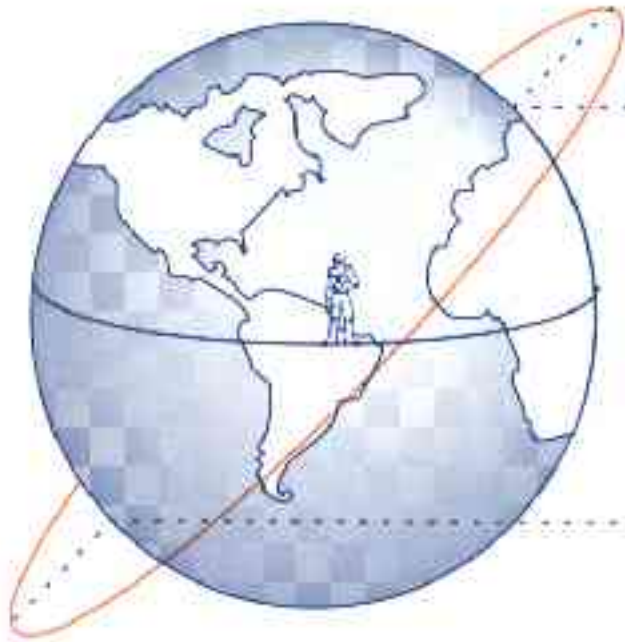


Every solver object contains the data of and the numerics for one block. The solver class is sent from the client to the server that is, different users may use different solvers.

Trajektorie (Flugbahn)







LES ORBITES

UN OBJET SUR ORBITE
EST EN EQUILIBRE
ET NE PEUT ETRE DEVIÉ
PARCE QU'IL A UNE VITESSE
SUFFISANTE.



ORbite BASSE
 $V_0 = 7,8 \text{ km/s}$

ORbite ELLIPTIQUE
 $7,8 \text{ km/s} \leq V_0 \leq 11,2 \text{ km/s}$

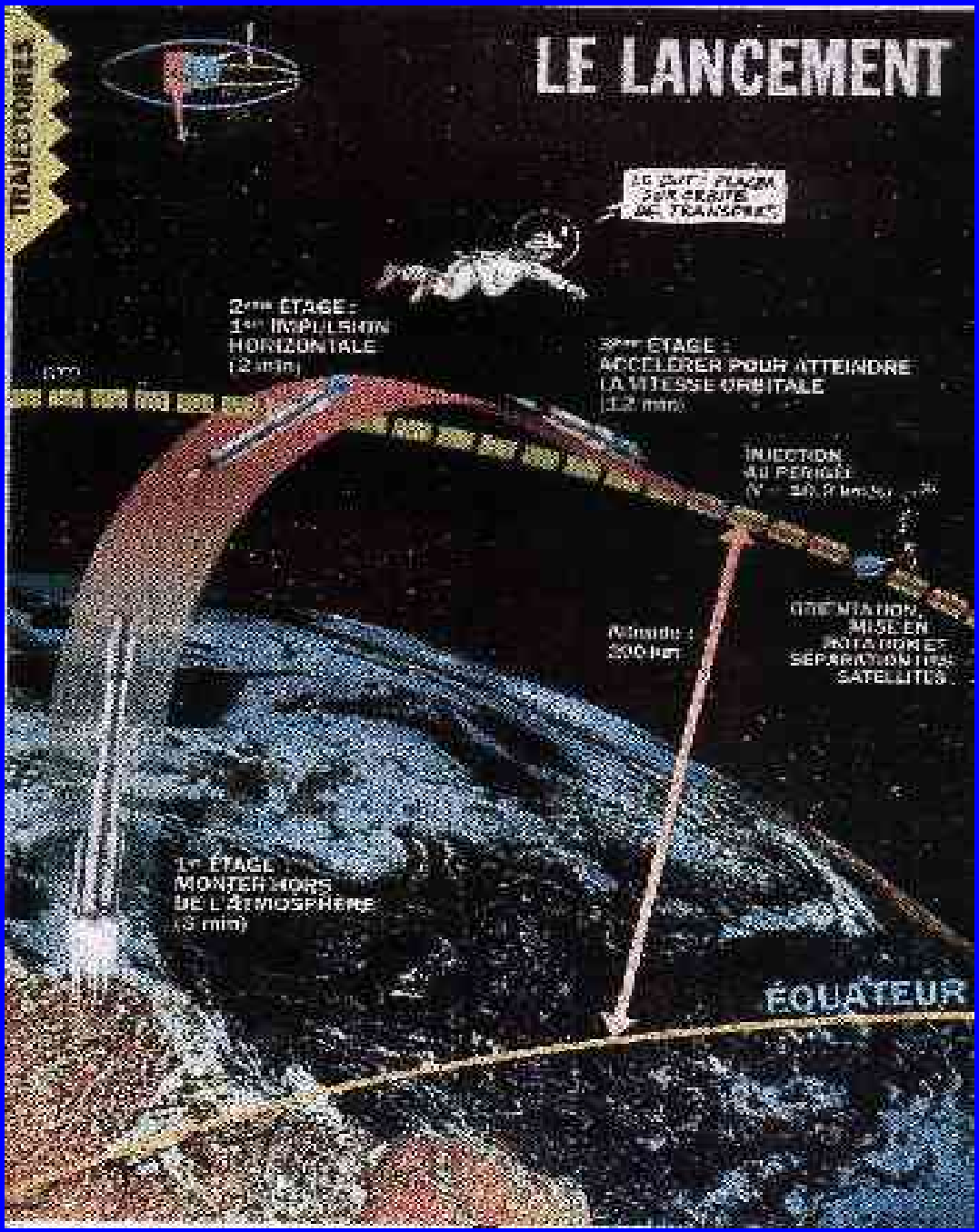
EN VOIE PLUS VITE -
ENTRÉE PLUS LOIN -
 $V_0 = \text{VITESSE D'ÉCHAPPEMENT}$

TRAJECTOIRE
HYPERBOLIQUE
 $V_0 \geq 11,2 \text{ km/s}$

sur une trajectoire
à vitesse constante
la distance à la terre
est en vitesse constante
et en ligne droite.

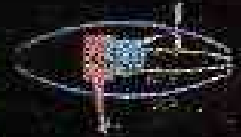


LES VITESSES D'ÉCHAPPEMENT
SONT EN RAISON DU CARRÉ DE LA DISTANCE



LE LANCEMENT

TRAJECTOIRES



LE DOTE PLUMIN S'OPÈRE LA TRANSMISSION

2nd ÉTAGE :
1^{re} IMPULSION
HORIZONTALE
(2 min)

3rd ÉTAGE :
ACCELERER POUR ATTEINDRE
LA VITESSE ORBITALE
(1,2 min)

0 100 200 300 400 500 600 700 800 900 1000

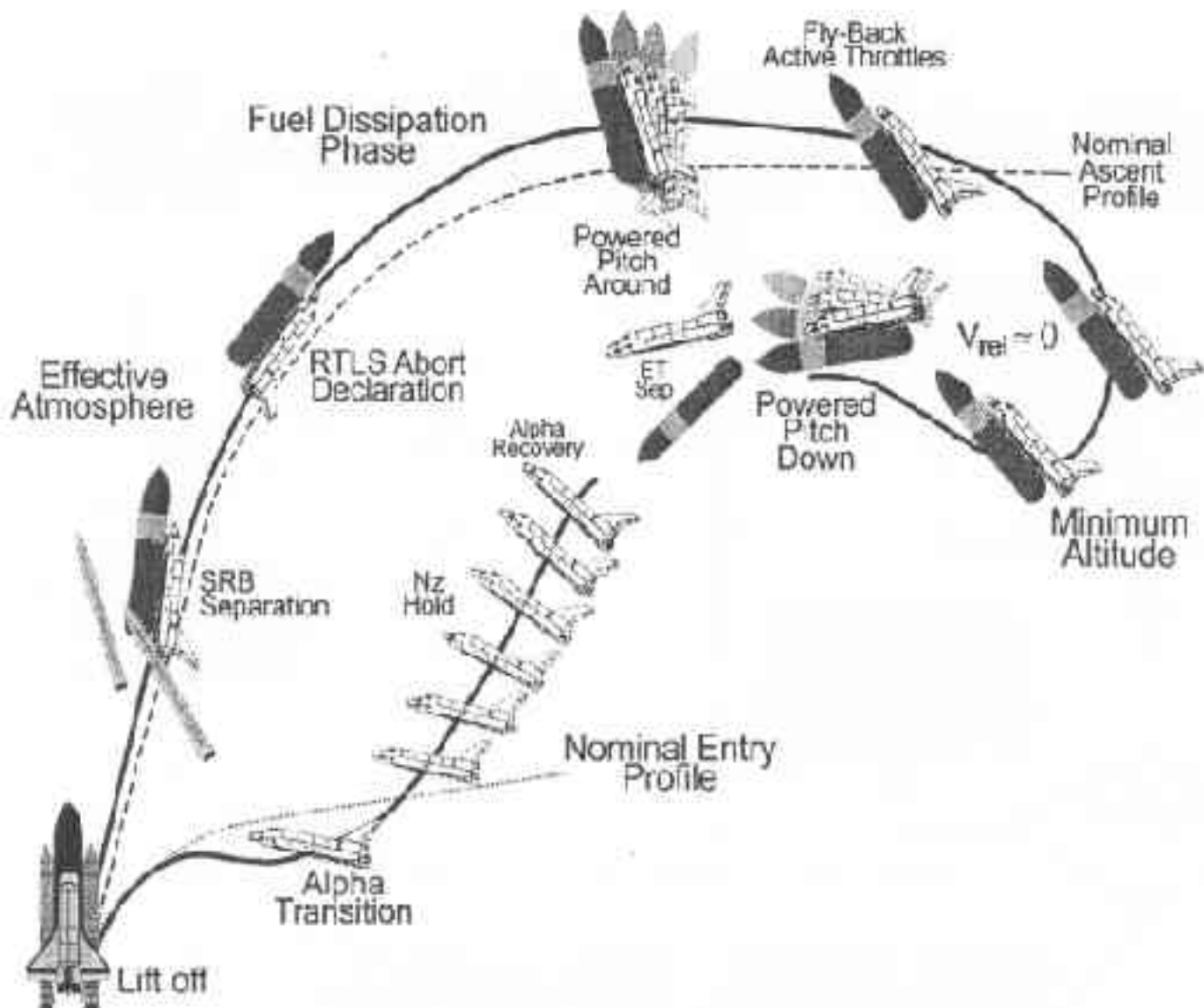
INJECTION
AU PERIGÉE
(V = 28 200 km/h)

Altitude :
200 km

ORIENTATION,
MISE EN
ROTATION ET
SEPARATION DES
SATELLITES

1^{er} ÉTAGE
MONTER HORS
DE L'ATMOSPHERE
(3 min)

EQUATEUR

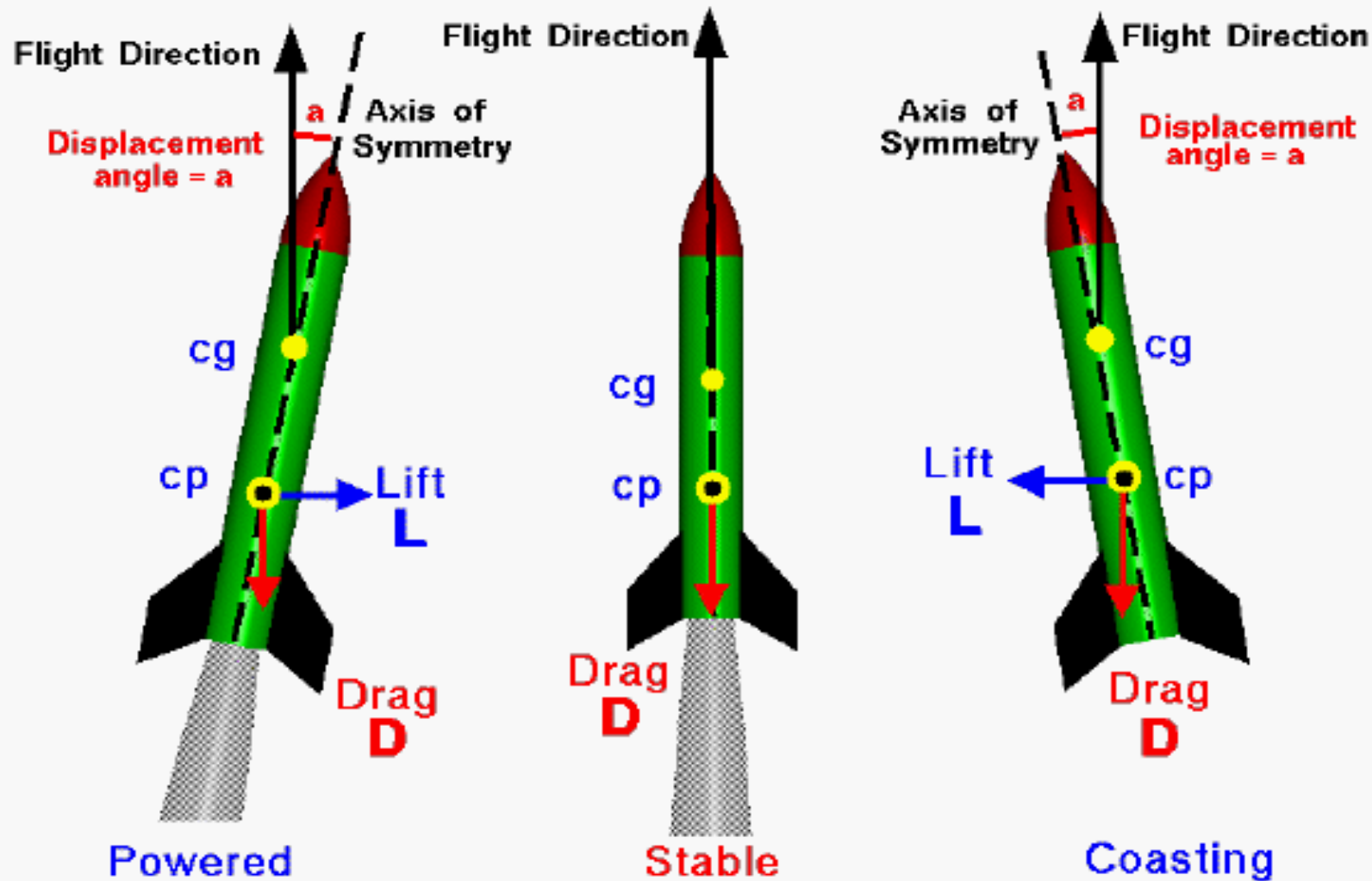


Aerodynamische Stabilität



Stability of a Model Rocket

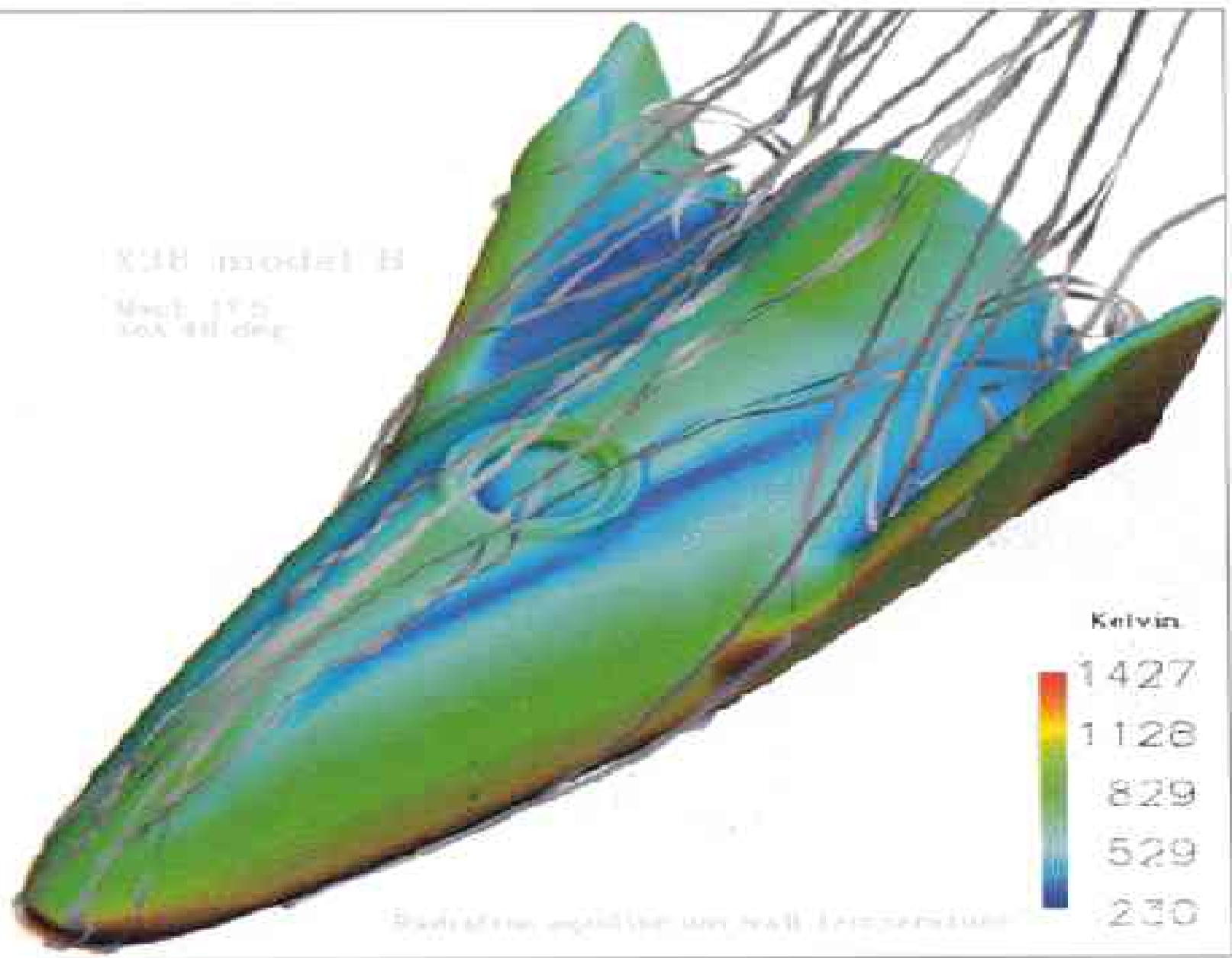
Glenn
Research
Center



Hitzeschutzschild

R38 model B

Nov 195
20X 40 deg



Kelvin

1427

1128

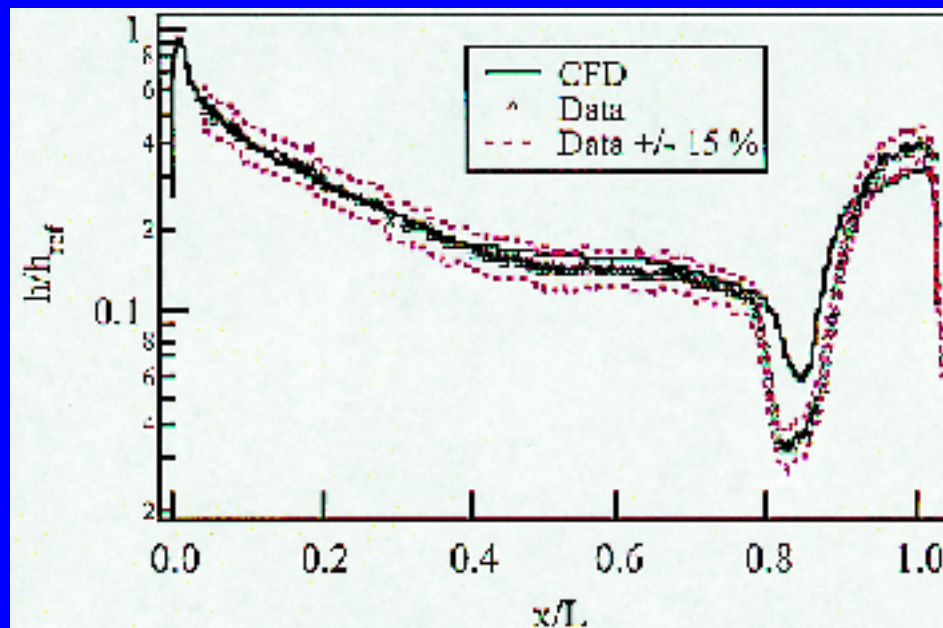
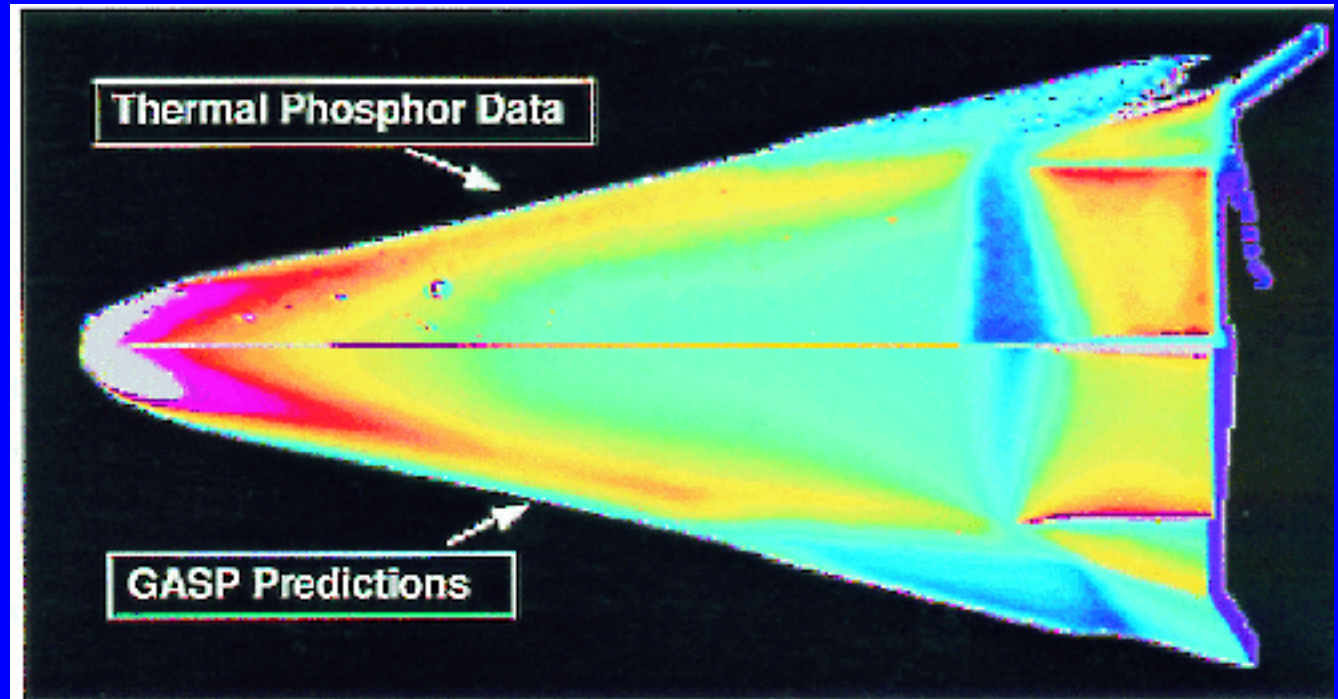
829

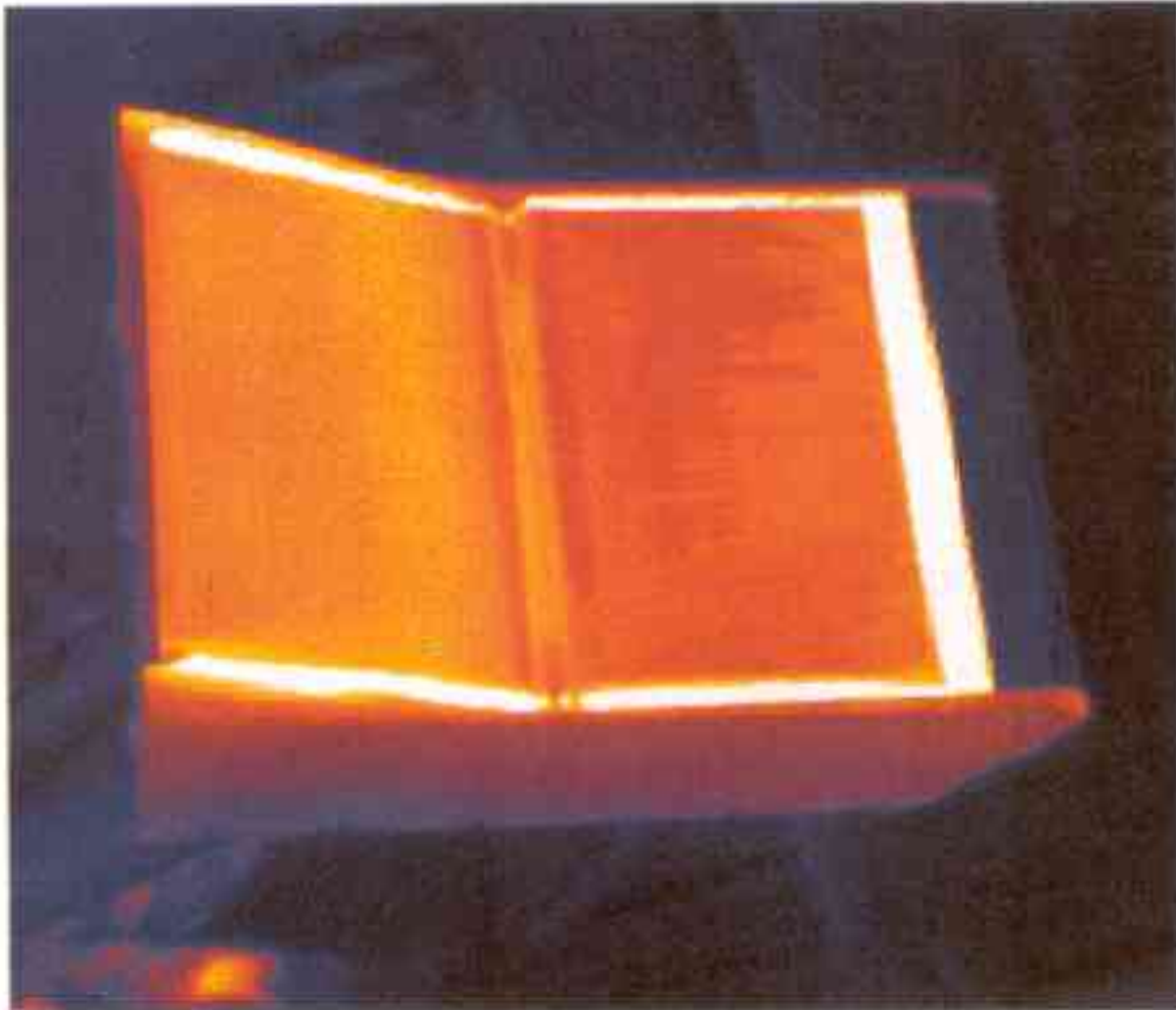
529

230

Temperature gradient on wall (K)

X-38 Comparisons M=10





2200.0 K

2000

1000

500.0 K

Nose Cap, Chin and Skirt-
Carbon/Carbon

Leading Edge-
Carbon/Carbon

End Cap-
Carbon/Carbon

Nose L/G-
Metallic

Elevons-
Carbon/SiC

Main T/G-
Metallic

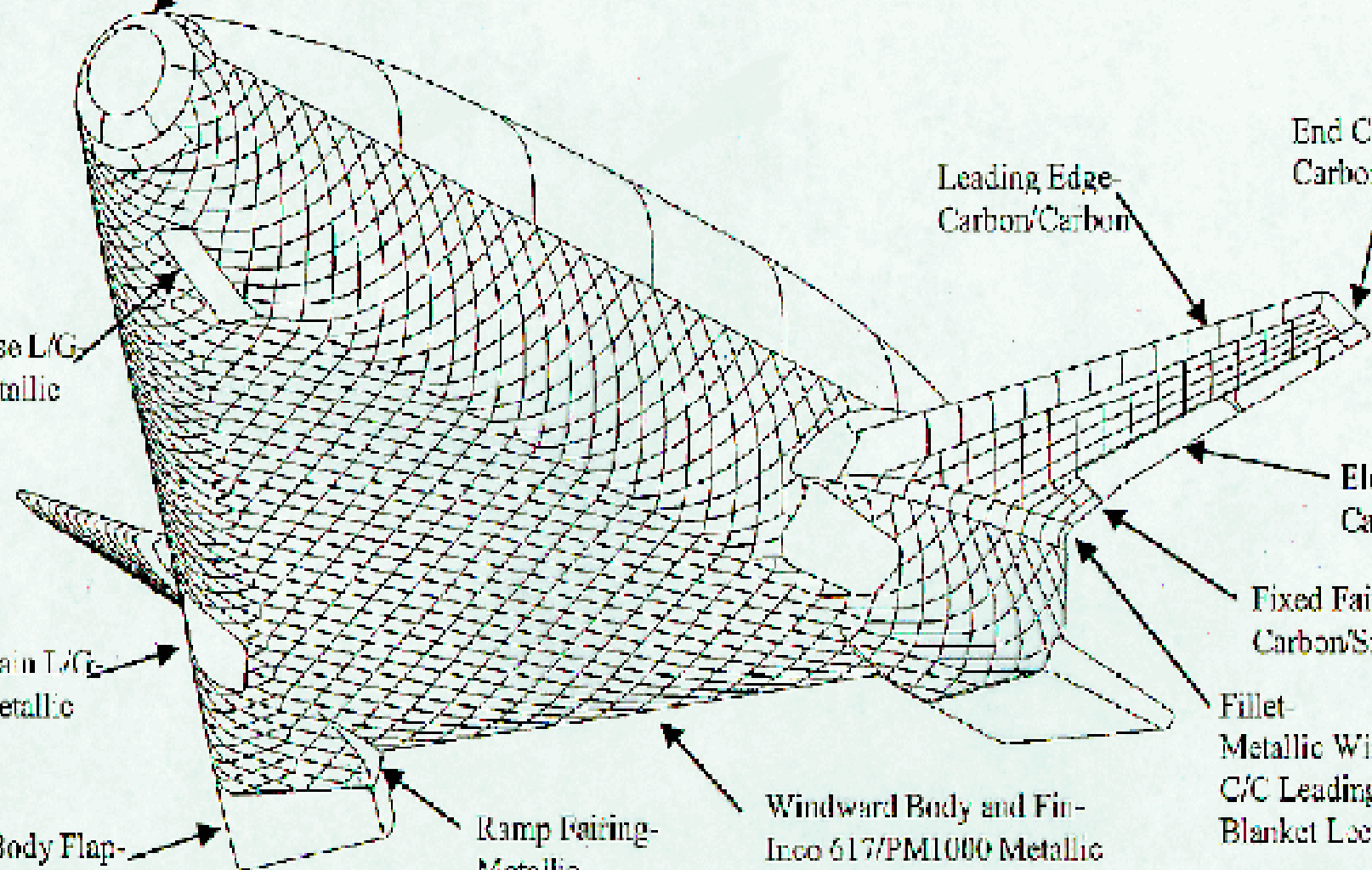
Fixed Fairing-
Carbon/SiC

Body Flap-
Ceramic Tile

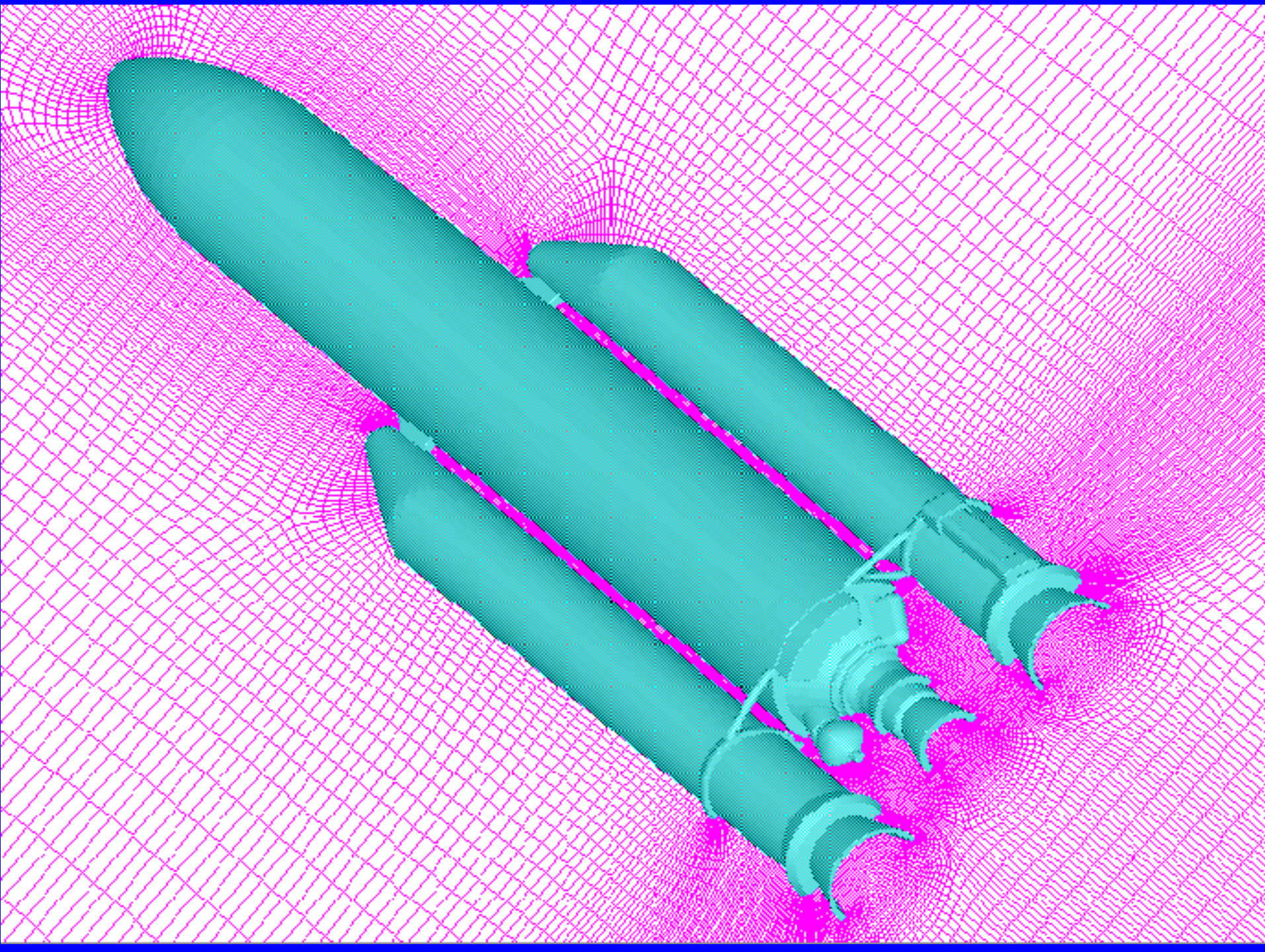
Ramp Fairing-
Metallic

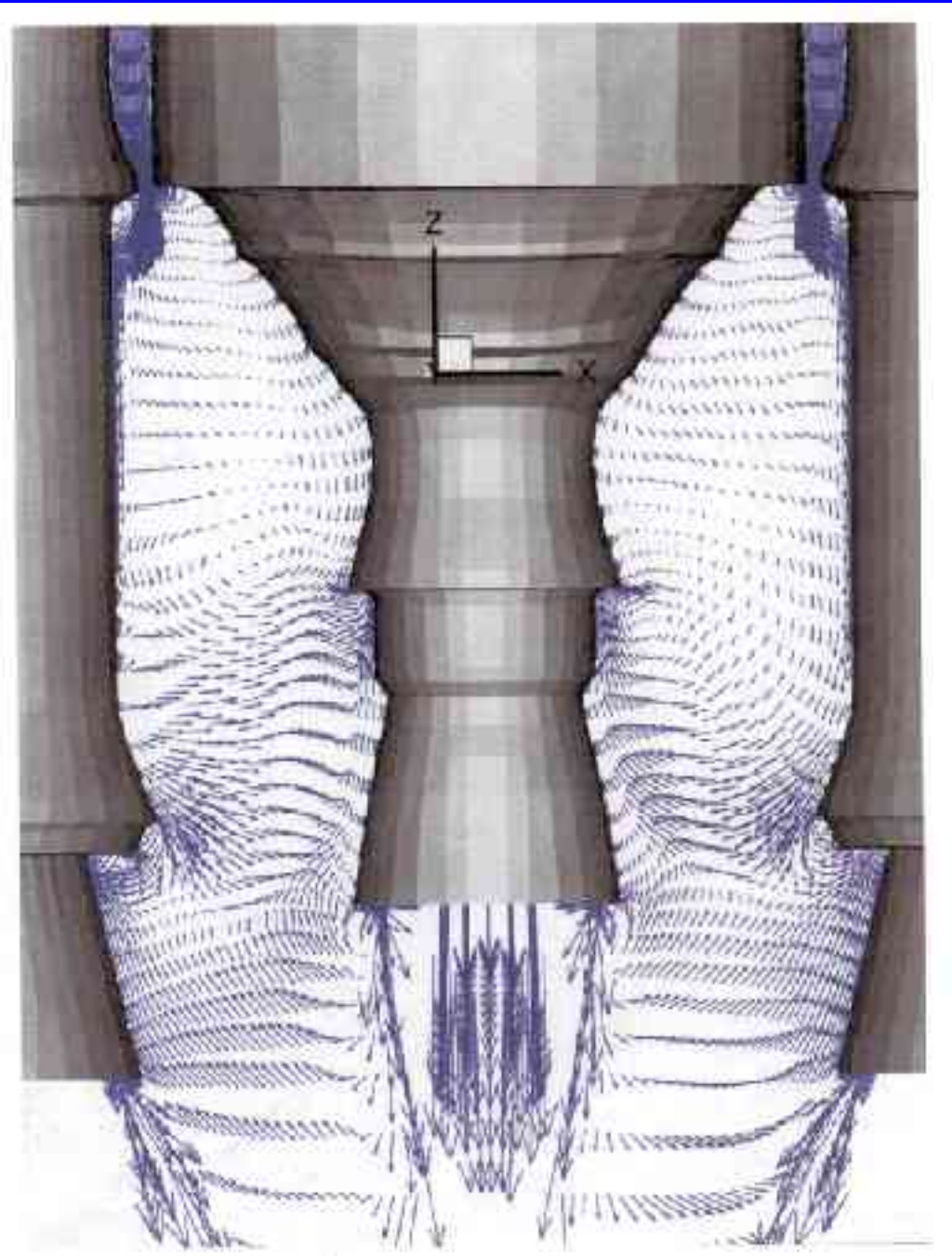
Windward Body and Fin-
Inco 617/PM1000 Metallic
(1234 Panels)

Fillet-
Metallic Windward
C/C Leading Edge
Blanket Leeward



Computer Simulation







Diskussion und Ausblick

European Expert Program European Space Agency

The EXPERT (European eXPERimental Re-entry Testbed) in-flight research programme aims to improve understanding of critical aerothermodynamic phenomena and includes wind tunnel, flight and CFD simulations. The EXPERT programme is setup to enhance the aerothermodynamic tools for design. Three launches with the Volna launcher are proposed with three expendable ballistic, re-entry test vehicles. EXPERT has been examined by EADS under the FESART study (Feasibility study for low cost flight validation).

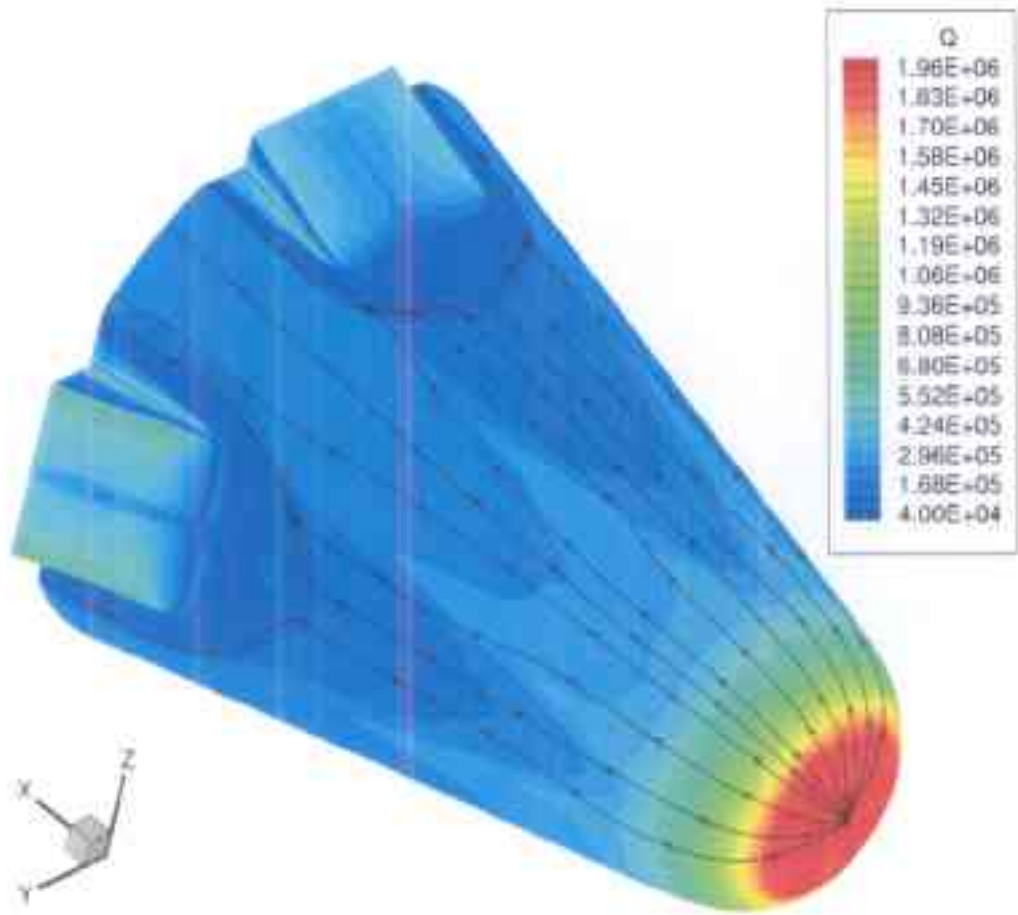


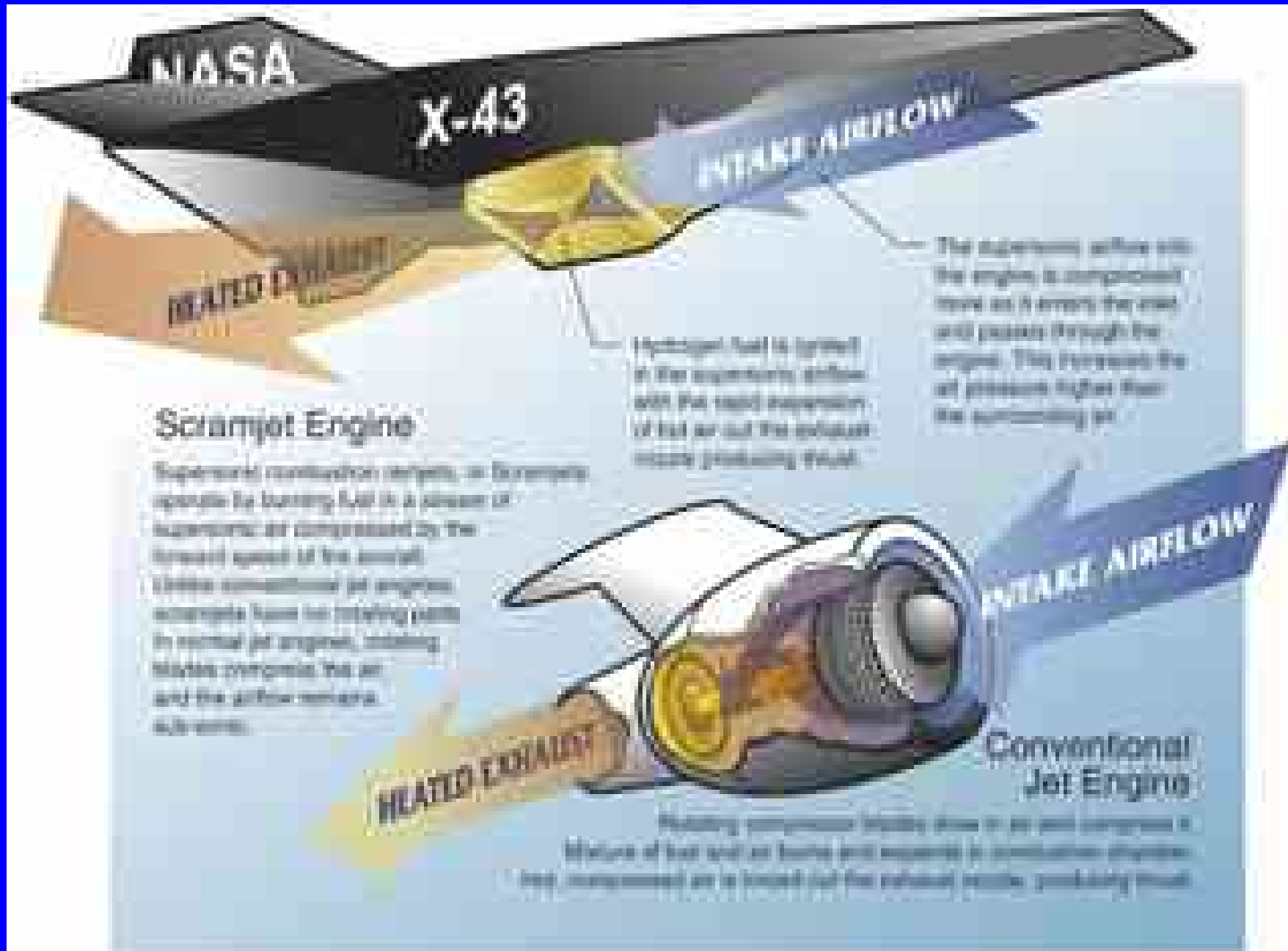
(a)



(b)







Scramjet Engine

Supersonic combustion engines, or Scramjets, operate by burning fuel in a stream of supersonic air compressed by the forward speed of the aircraft. Unlike conventional jet engines, scramjets have no rotating parts. In normal jet engines, rotating blades compress the air and the airflow remains subsonic.

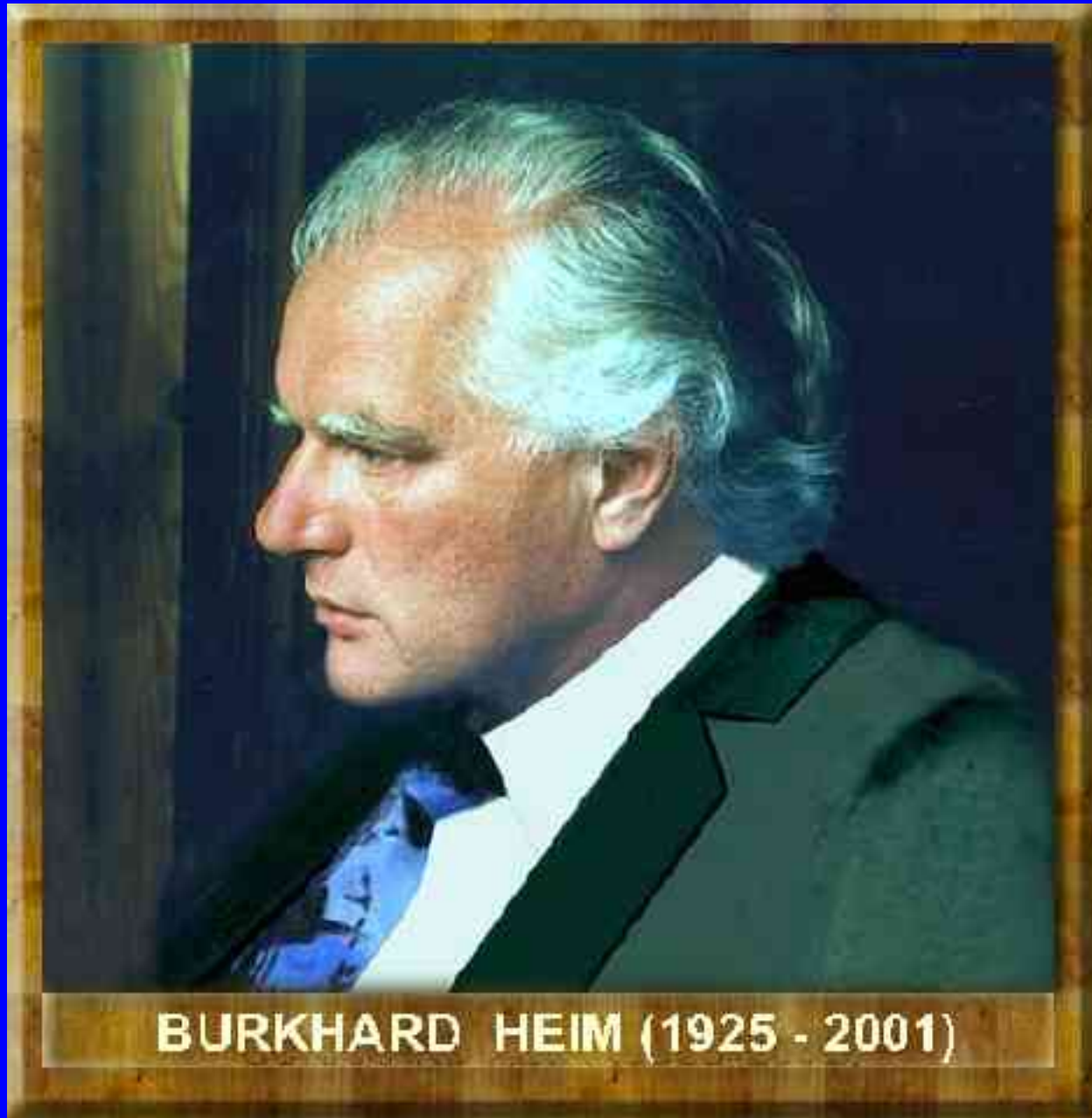
Hydrogen fuel is burned in the supersonic airflow, with the rapid expansion of hot air out the exhaust nozzle producing thrust.

The supersonic airflow into the engine is compressed first as it enters the inlet and passes through the engine. This increases the air pressure higher than the surrounding air.

Conventional Jet Engine

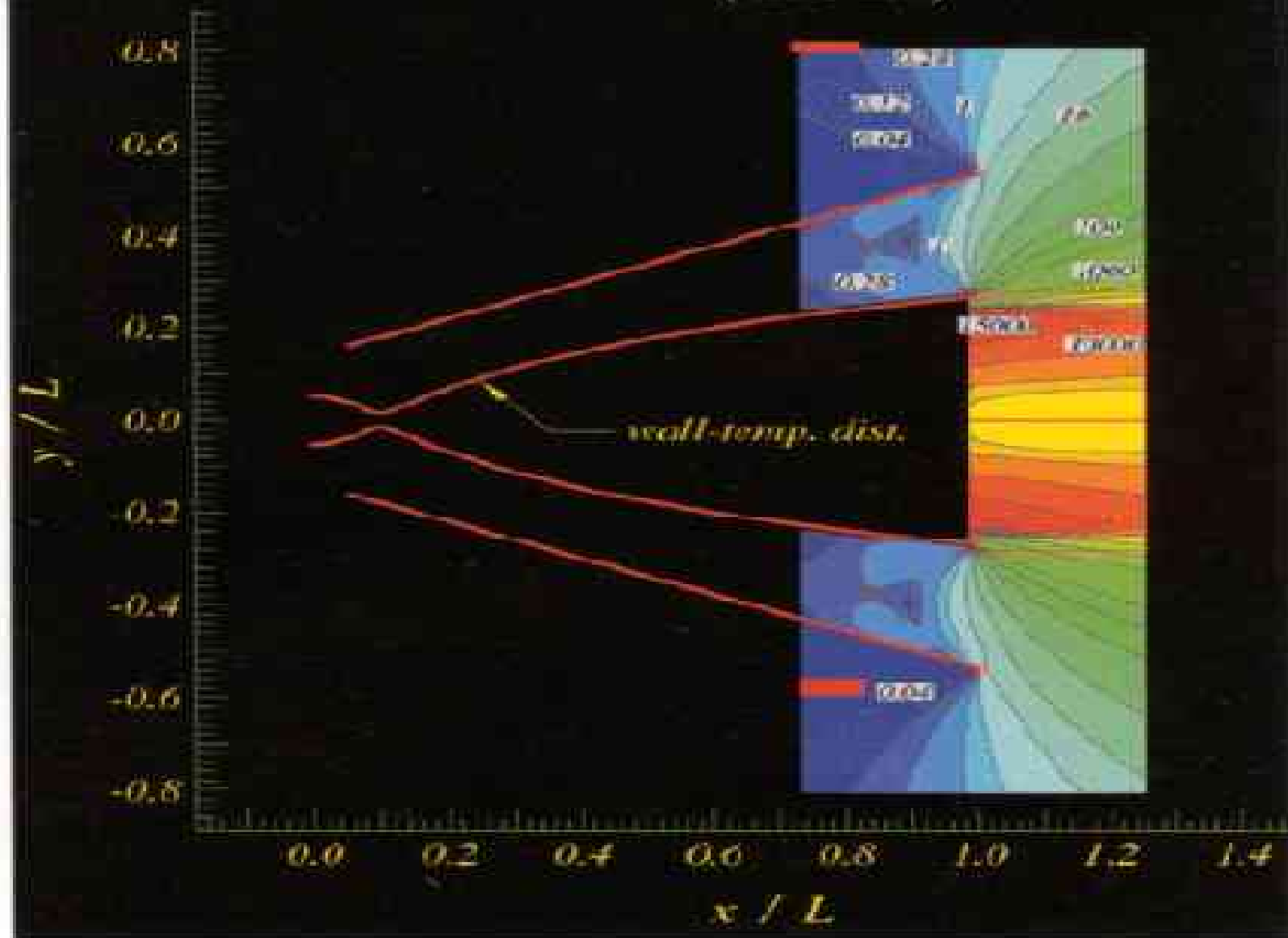
Rotating compressor blades draw in air and compress it. A mixture of fuel and air burns and expands in combustion chamber. Hot, compressed air is forced out the exhaust nozzle, producing thrust.

Space Transportation Revolutionary?

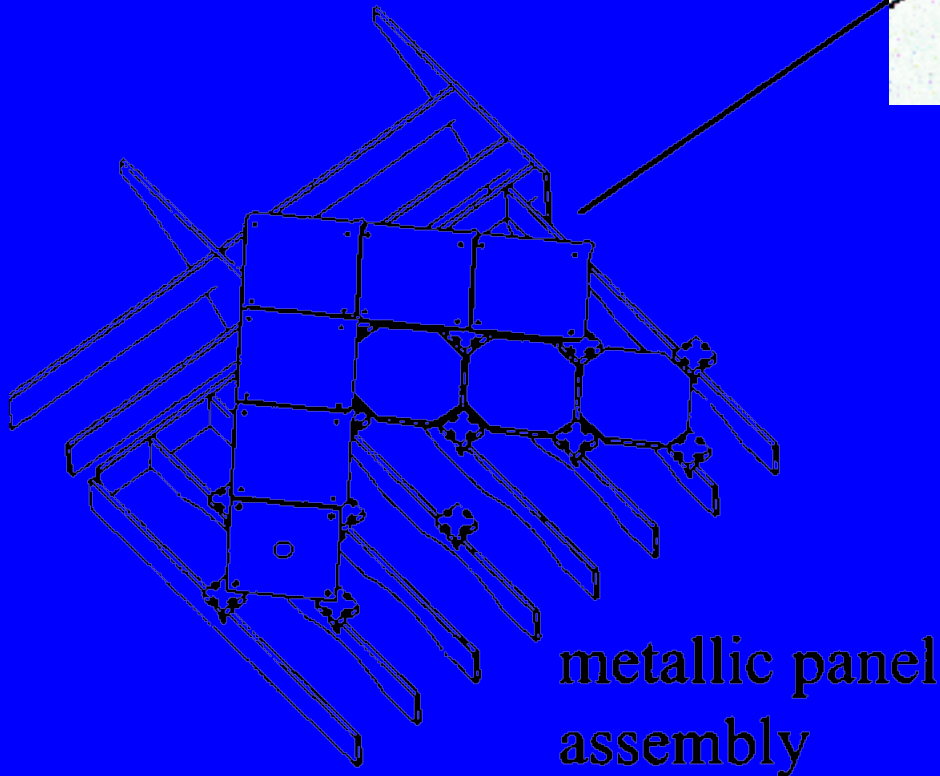
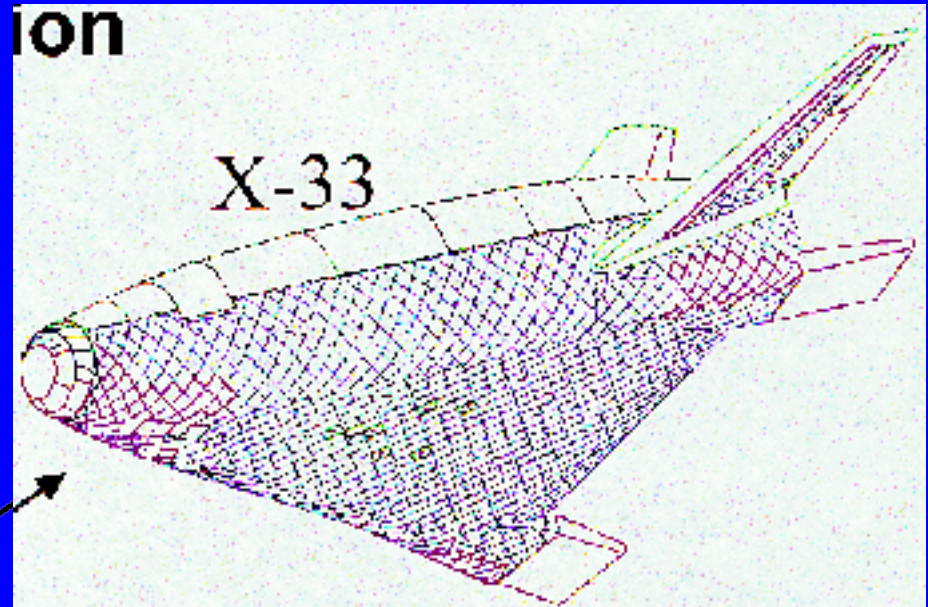




*total-energy flux isolines
(kw / m²)*



**Metallic Panels are components of X-33 TPS
Panels are of sandwich honeycomb construction**

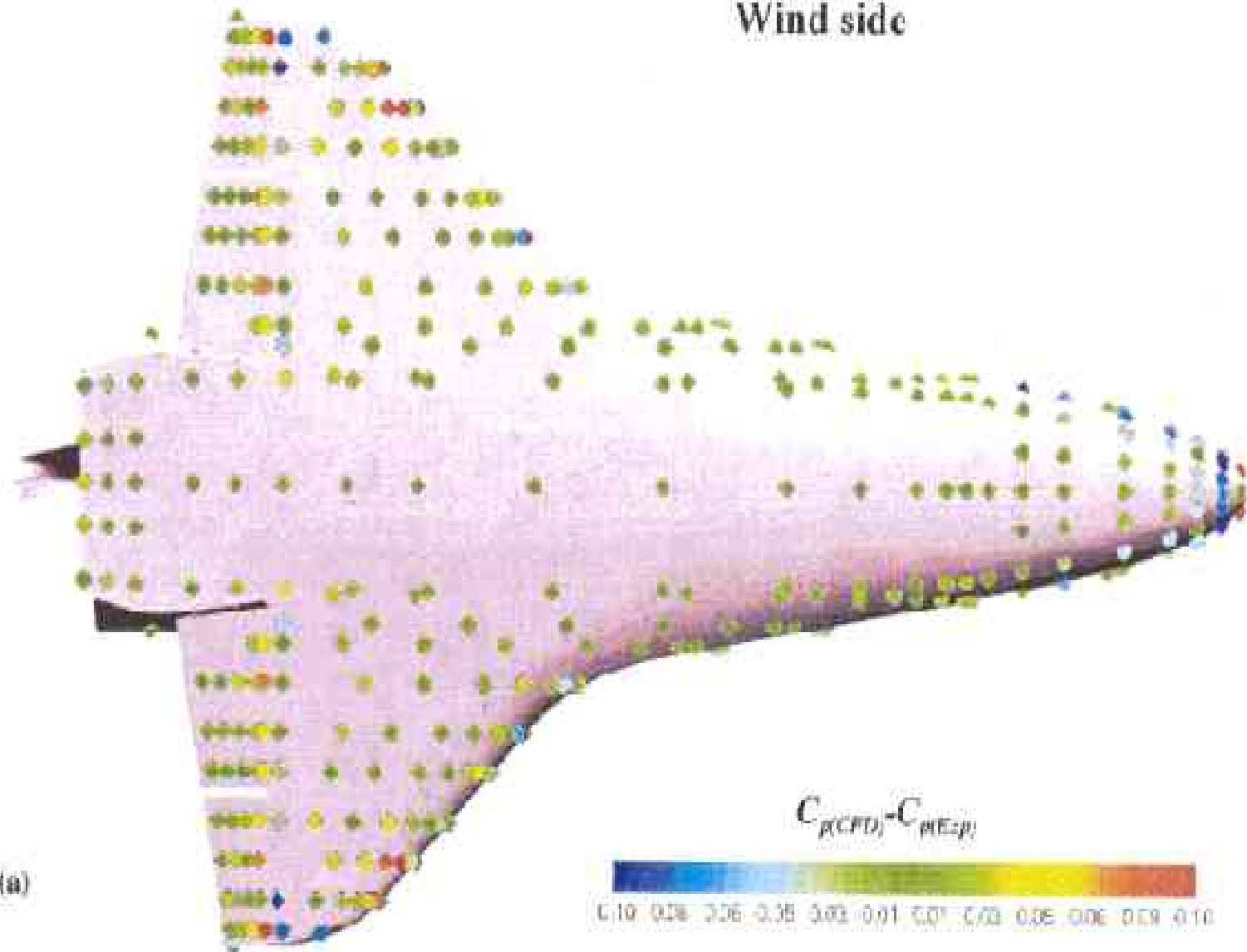


metallic panel assembly

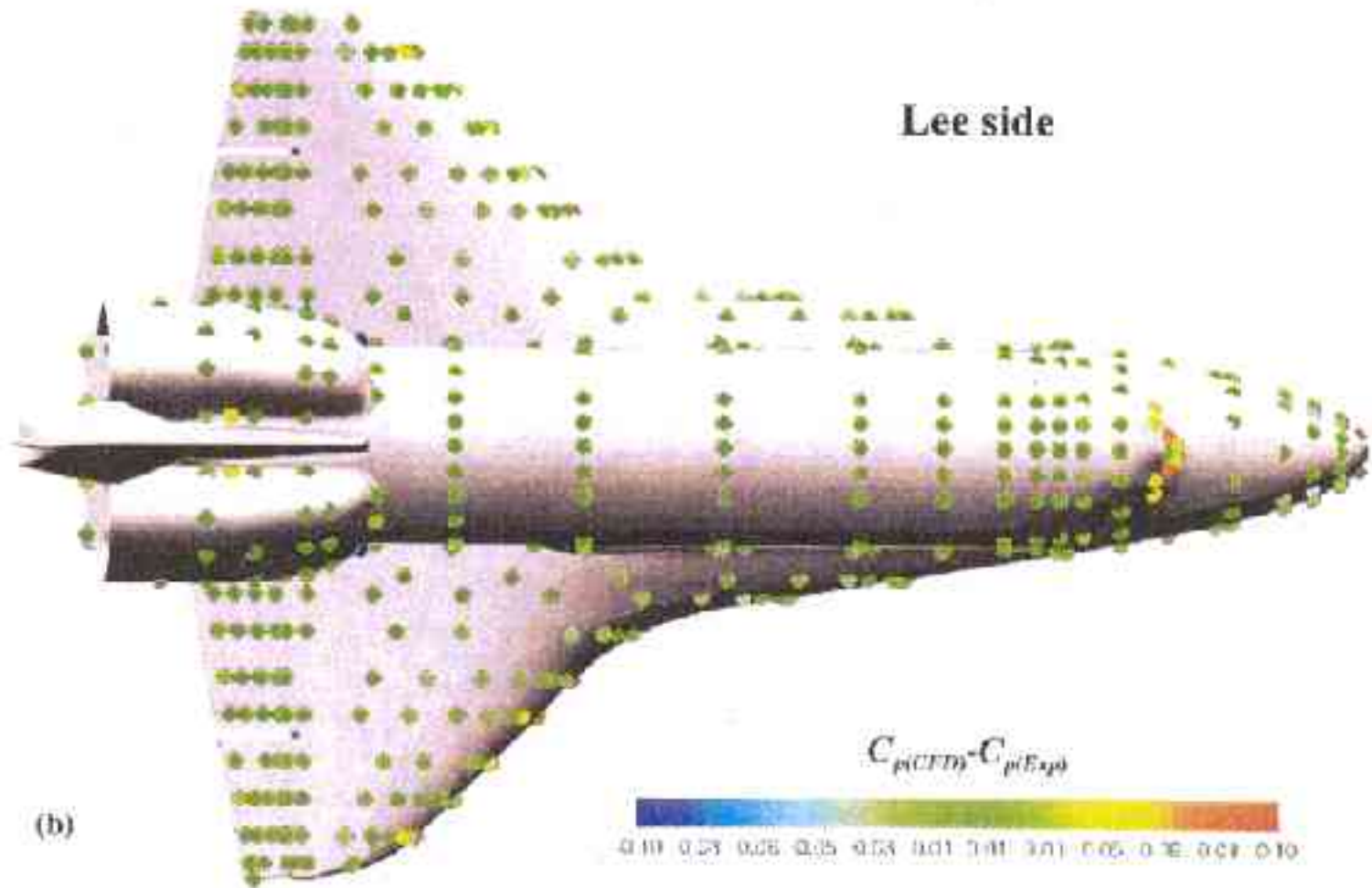
Panels thermoelastically deform due to aerothermal heating

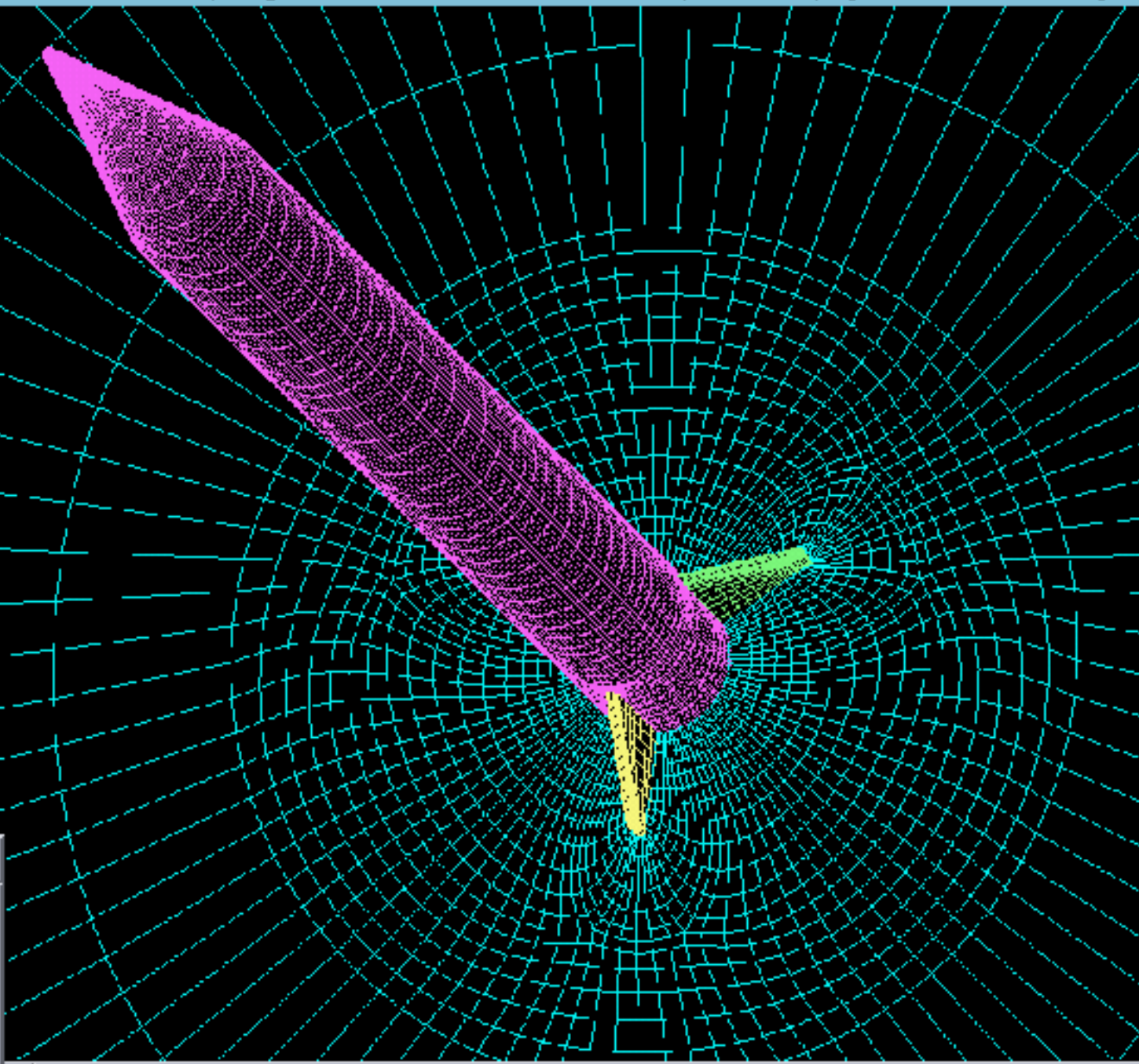
Change in surface shape due to bowing affects hypersonic flowfield *coupled fluid-structure interaction*

Wind side



(a)





ROTATE:sys clr
snap scrn pk fix

SHIFT: stop move
 stop H R point.

SHOW: axis cut id lb
SURF ort

TOPO vec x&a e&h pos
GRID blk she ort

CUI-P: pos ctr norm
hand clip side fill

UN-REDO: unzoom 4.0

topo ◀▶ view ◀▶
view grp rec

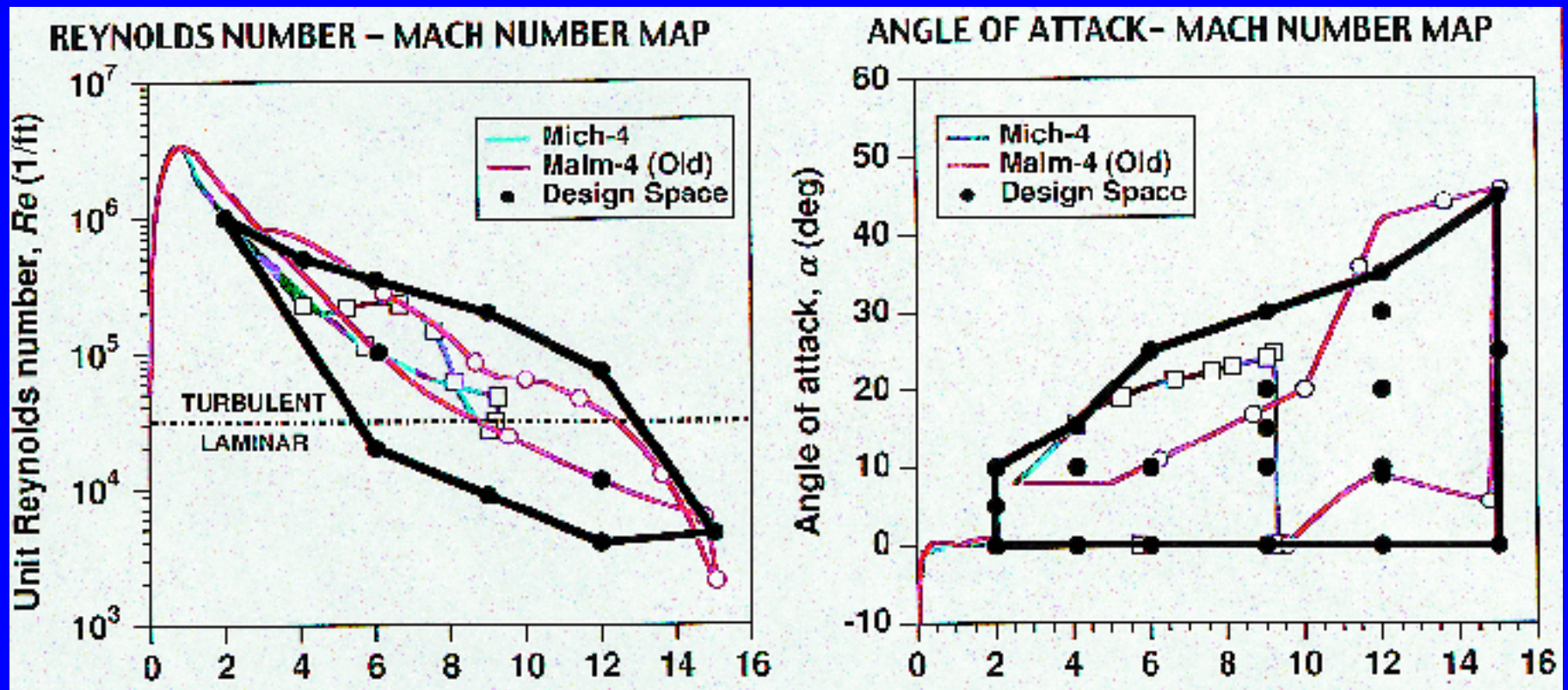
IRIN B. +- * all ~

SF. +- * all ~

CUR: sheet ◀▶ step ▶▶
grid ◀▶ b ort she
she ◀▶ pick del

MAKE SHEET: shell
surf ◀▶ all | edge

C: she None space



Wall assumed to be fully catalytic

**Surface emissivity of 0.8 for C-C (Nosecap/Canted.Fin
L.E./Elevons) and**

0.6 for Metal/Blanket

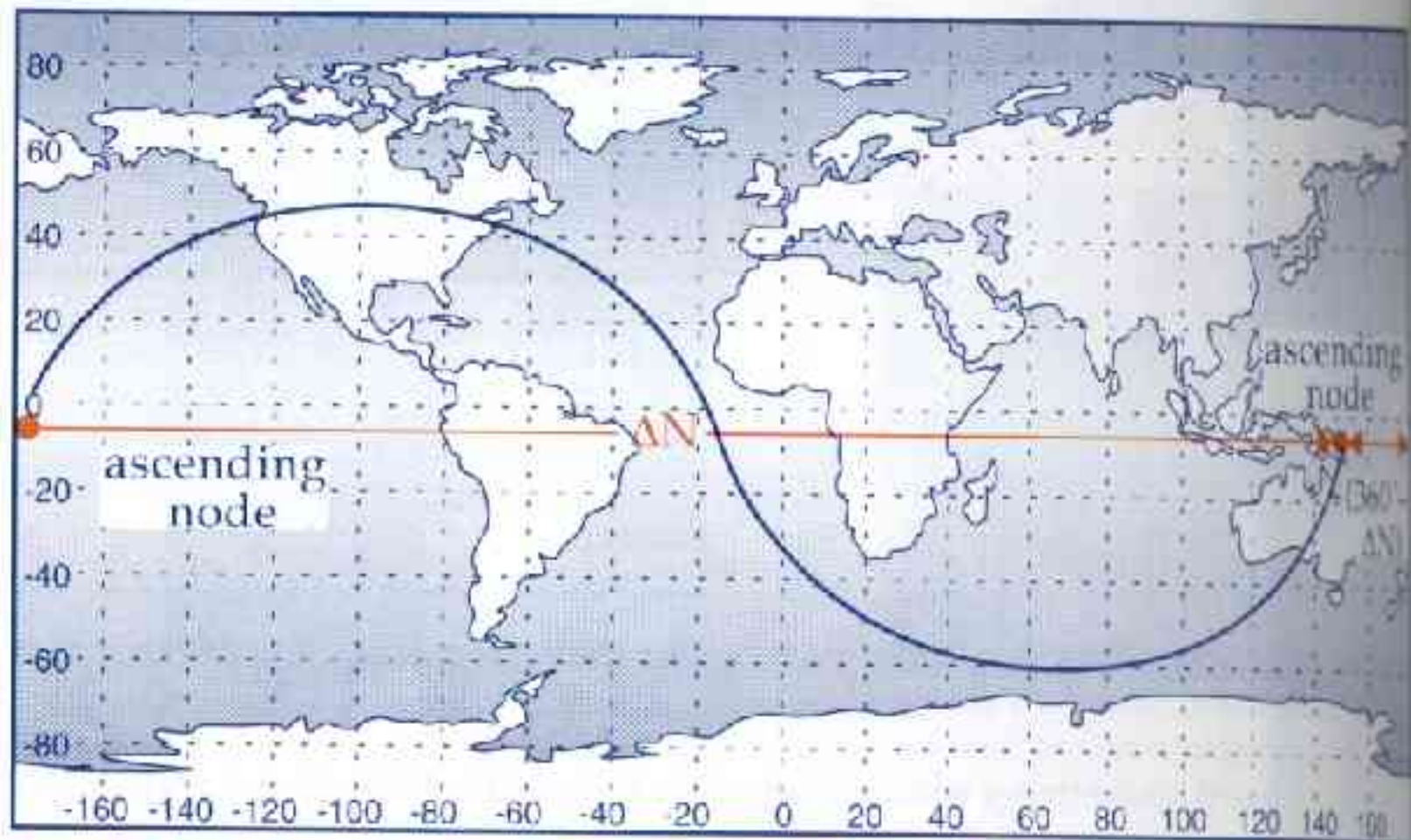


Figure 5.22 A satellite orbit with two ascending nodes.