NASA Space Radiation Summer School

"A Brief History of Manned Spaceflight"

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Loma Linda University

with thanks to Marcelo Vazquez, Ph.D. for some slides and suggestions

June 17, 2008

U.S., Russia, and China Human Space Flight History

Mercury

Gemini

Apollo

Skylab

Apollo-Soyuz

Space Shuttle

Space Shuttle-Spacelab

Space Shuttle-Mir

Space Shuttle-ISS

Shenzhou

CEV

Vostok

Voskhod

"Moon Race"

Soyuz

Salyut

Mir

Buran

Soyuz-ISS

World Manned Spaceflight Launch Sites

Google Maps

Spaceports

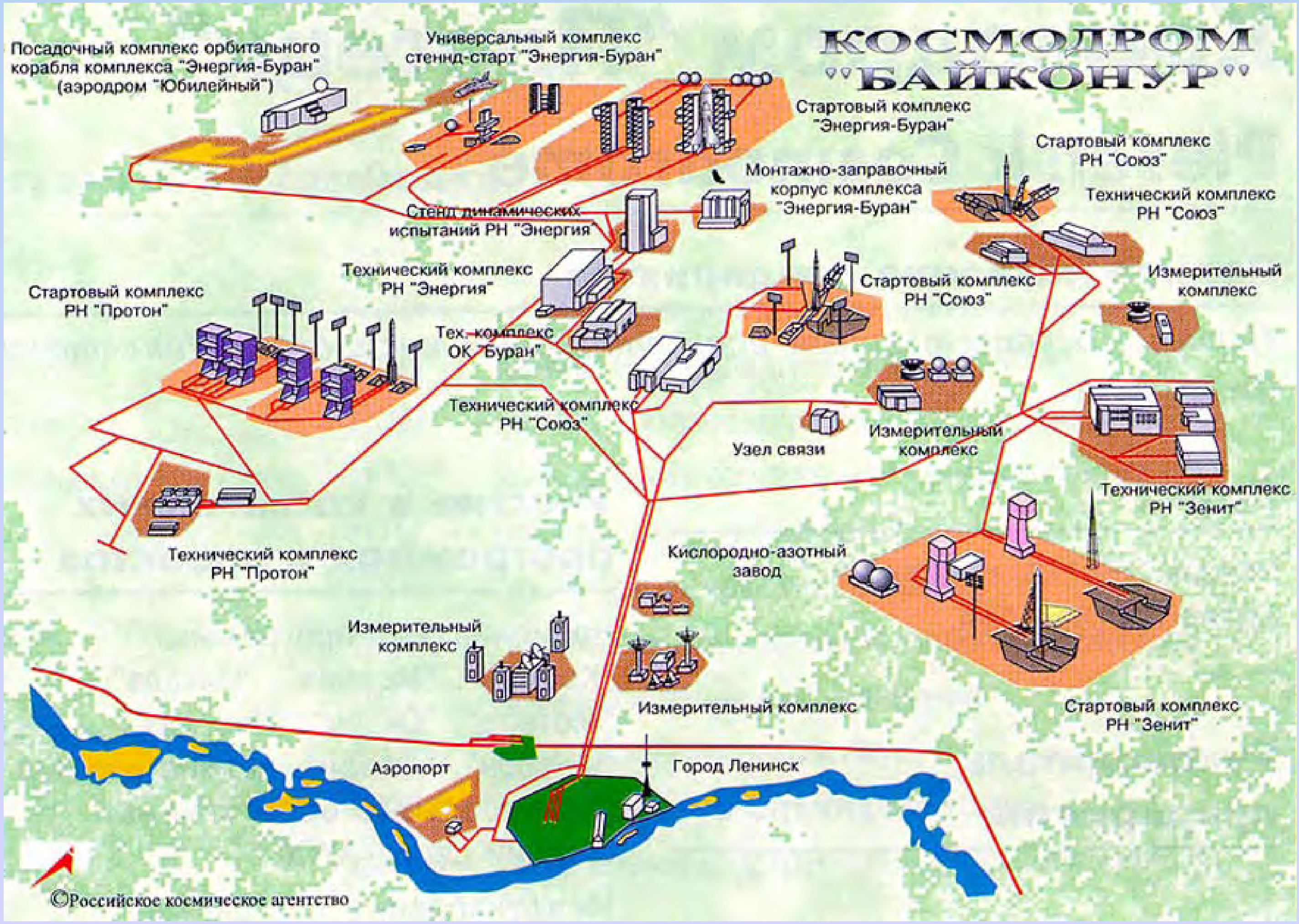
Brazil (FAB, AEB)	Alcantara Launch Center
Canada (CAF, CSA)	Fort Churchill
China (CNSA)	Jiuquan Satellite Launch Center • Taiyuan Satellite Launch Center • Wenchang Satellite Launch Center • Xichang Satellite Launch Center
Europe (ESA) France (CNES)	Guiana Space Centre (in French Guiana)
India (ISRO)	Satish Dhawan Space Centre
Israel (ISA)	Palmachim Airbase
Italy (ASI)	San Marco platform (coastal sublittoral of Kenya)
Japan (JAXA)	Tanegashima Space Center • Uchinoura Space Center
South Korea (KARI)	Naro Space Center
Sweden (SSC)	Esrange
Pakistan (SUPARCO)	Sonmiani Launch Center
Russia (RKA)	Baikonur Cosmodrome (in Kazakhstan) • Dombarovskiy • Kapustin Yar • Plesetsk Cosmodrome • Svobodny • Vostochny Cosmodrome
USA (NASA, DoD)	in USA: Kennedy Space Center • Wallops Flight Facility • Cape Canaveral Air Force Station • Vandenberg Air Force Base • elsewhere: Reagan Test Site
Private	in USA: Corn Ranch • Kodiak Launch Complex • Mid-Atlantic Regional Spaceport • Mojave Airport & Spaceport • Oklahoma Spaceport • Spaceport America • elsewhere: Ocean Odyssey

Wikipedia

Baikonur Cosmodrome

Google Maps

Baikonur Cosmodrome

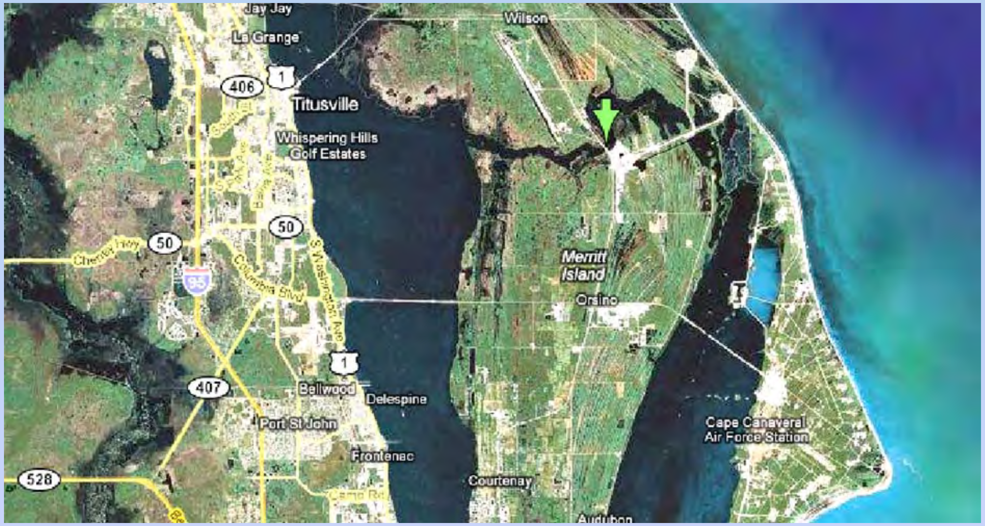


Soyuz Rocket and Spacecraft

Soyuz Apollo Soyuz Test Project NASA

Soyuz TMA-9 launch RSA

Kennedy Space Center

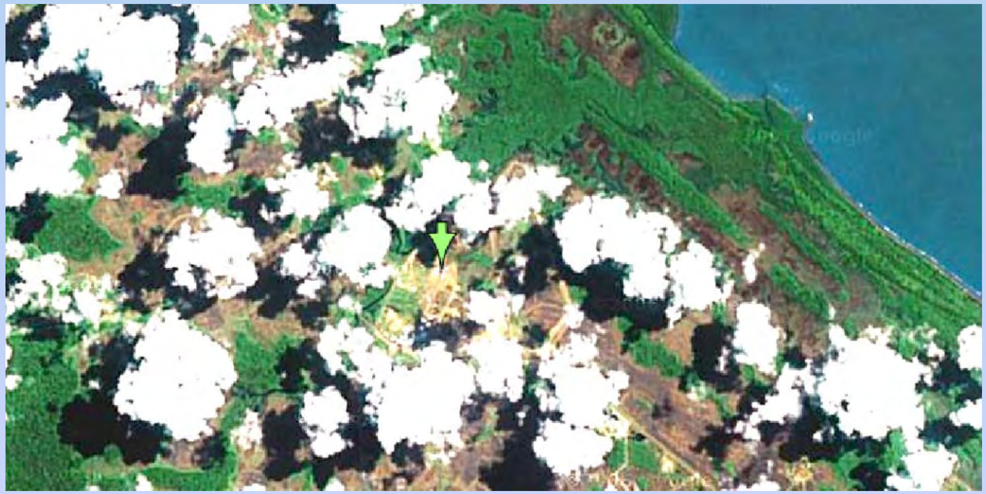


Google Maps

Kennedy Space Center

NASA KSC

Centre Spatial Guyanais
ESA Kourou Facility



Google Maps

Kourou

ESA

Jiuquan Satellite Launch Center

Google Maps

Mojave Spaceport & Edwards AFB

Google Maps

Wikipedia

Yuri Gagarin

Gagarin in his space suit

1st Man in Space

12 April 1961

Wikipedia

Valentina Tereshkova

1st Woman in Space

16 June 1963

Wikipedia

Mercury Program Astronauts

A. Shepherd, W. Schirra, J. Glenn

V. Grissom, S. Carpenter, D. Slayton, G. Cooper

NASA

Apollo 11 Crew: Neil Armstrong, Edwin Aldrin, Michael Collins

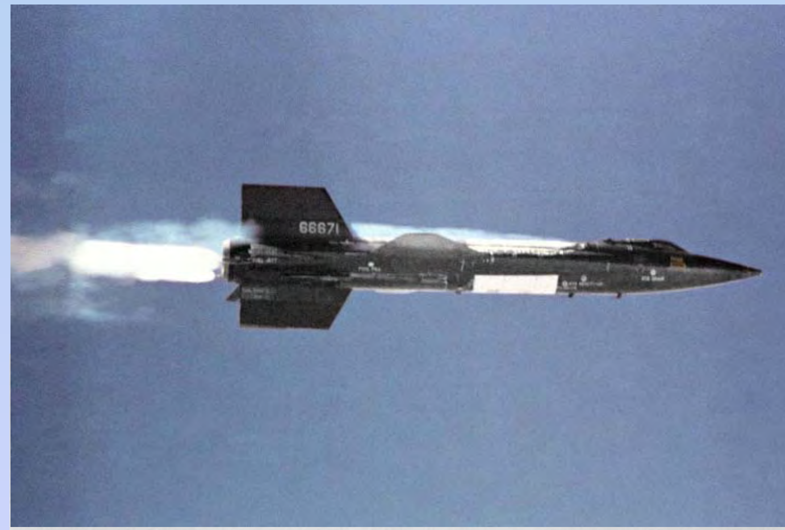
NASA

Yang Liwei 杨利伟

1st Taikonaut

CNN: October 16, 2003

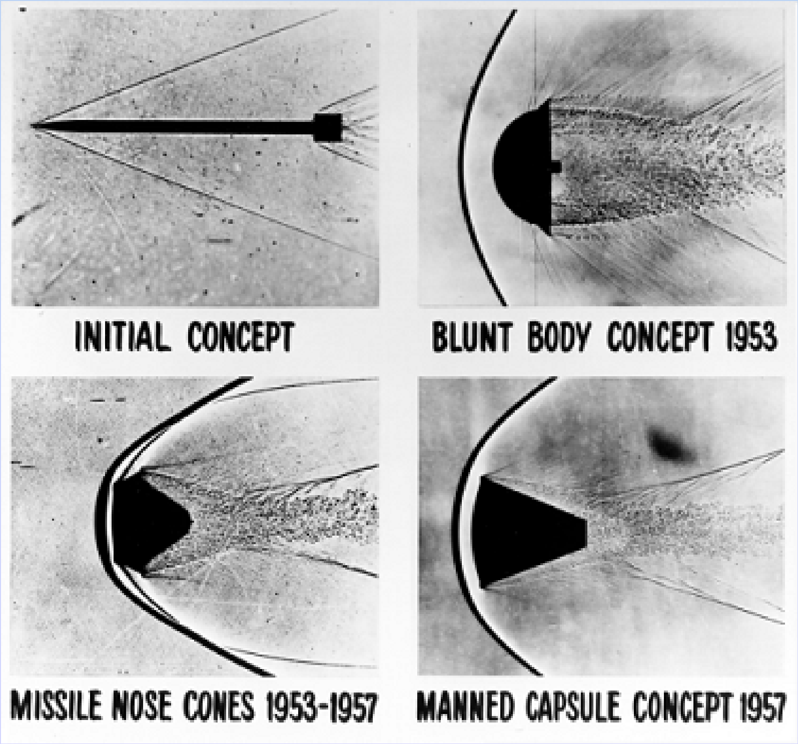
X-15 Spaceplane

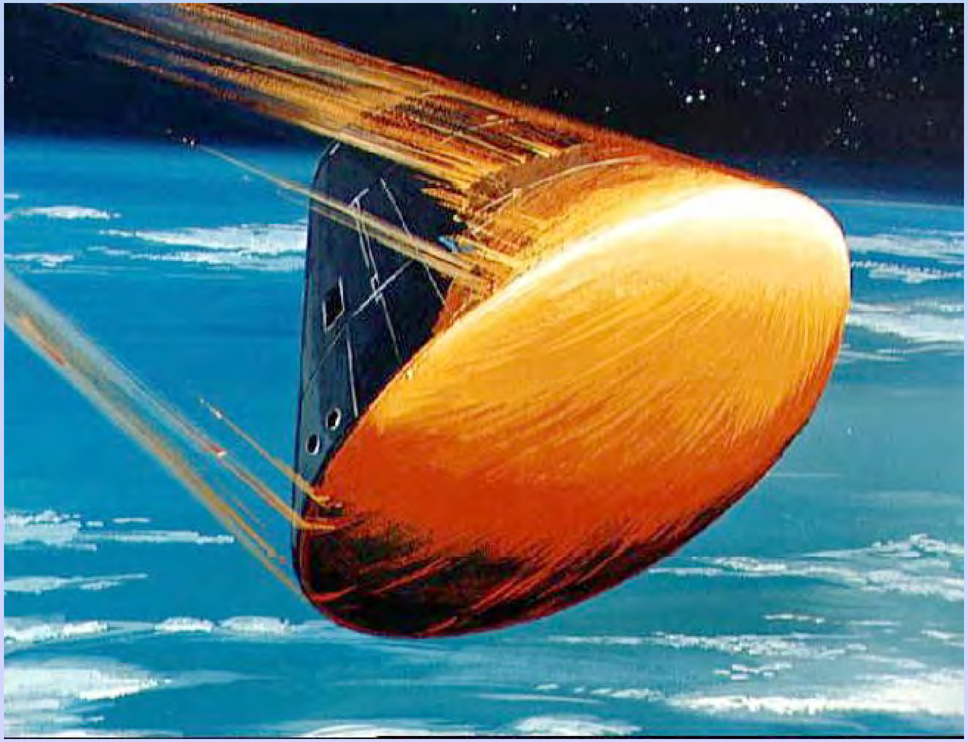


Launch from B52 bomber
Ascent to > 100 km
Landing at EAFB

US Air Force, North American Aviation, Wikipedia

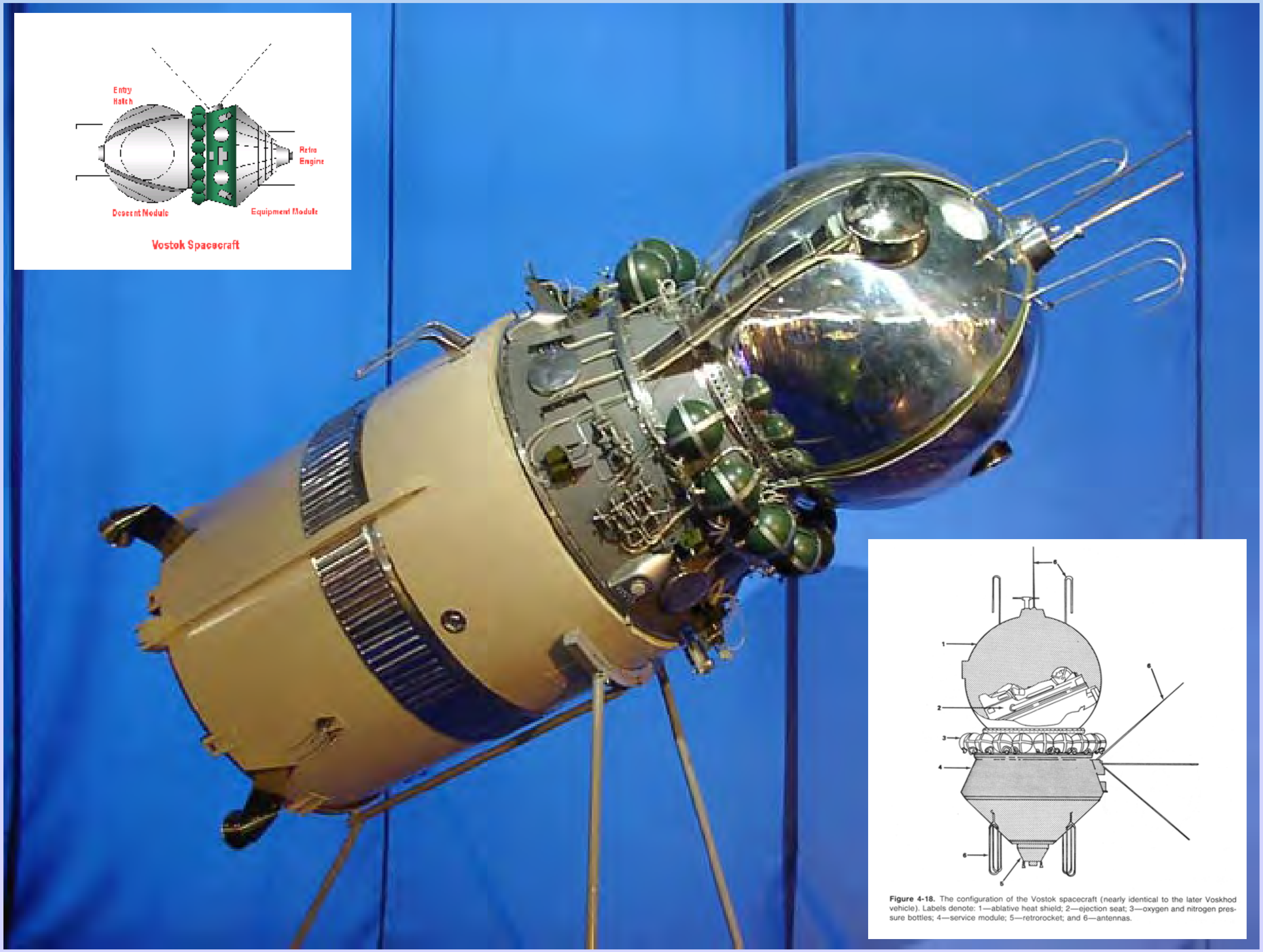
Ballistic Re-entry





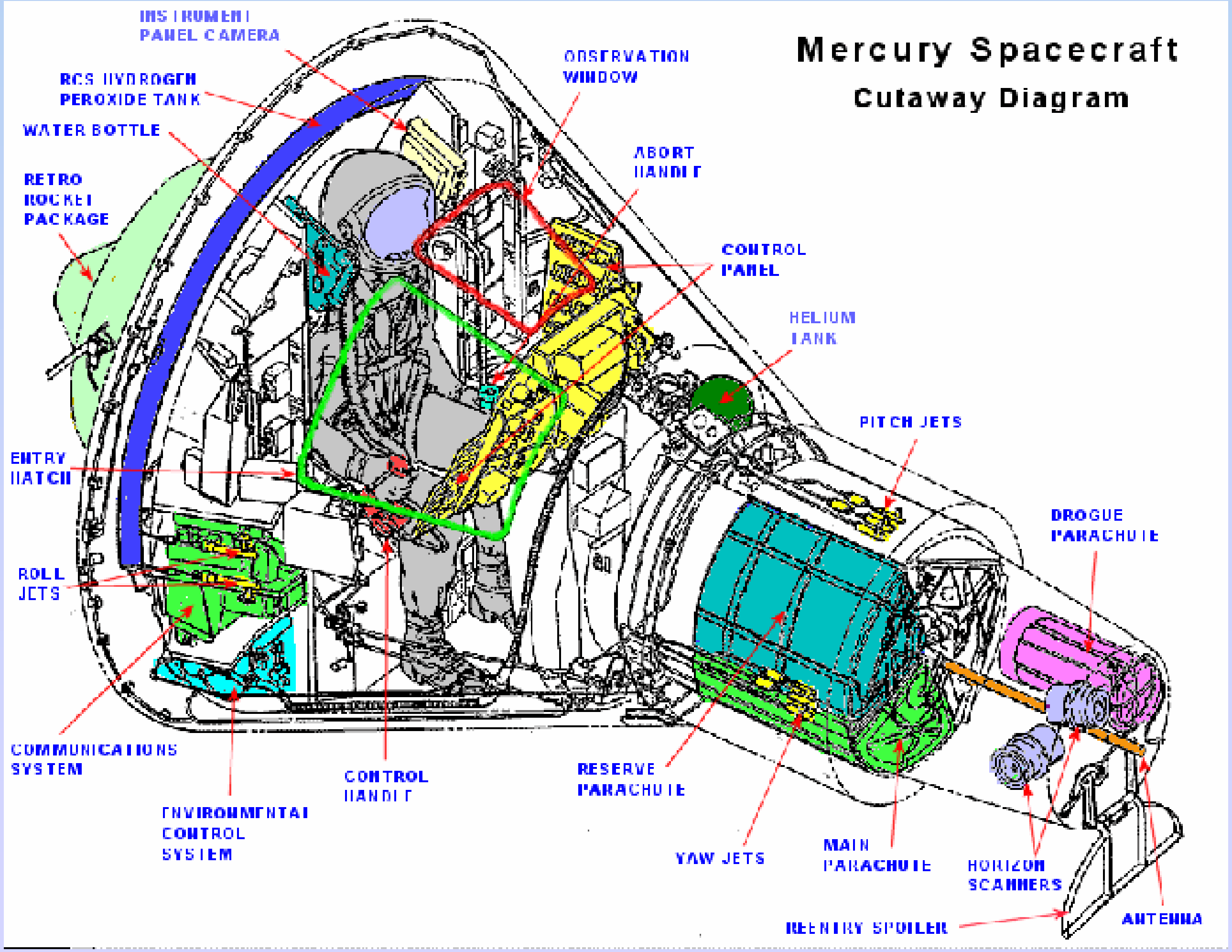
Schlieren optics photos from wind tunnel tests and concept of blunt ballistic re-entry vehicle with ablative heat shield

Vostok: 1st Manned Spacecraft



RSA
Wikipedia
Nicogossian *et al.* 1989.

Mercury Spacecraft "Capsule"



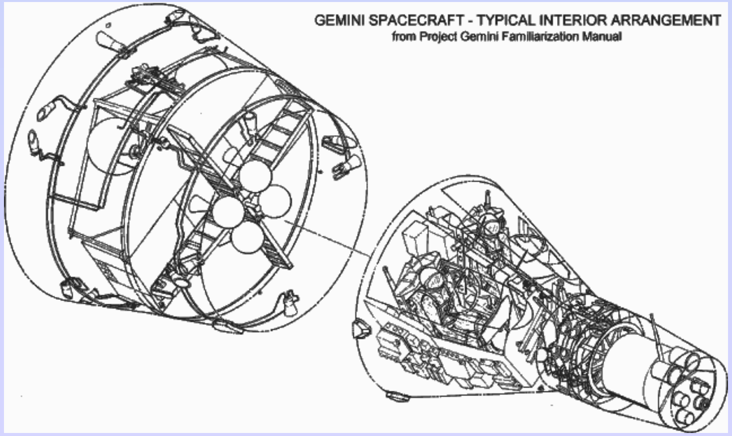
NASA

Mercury Launch Vehicles

Redstone and Atlas

NASA

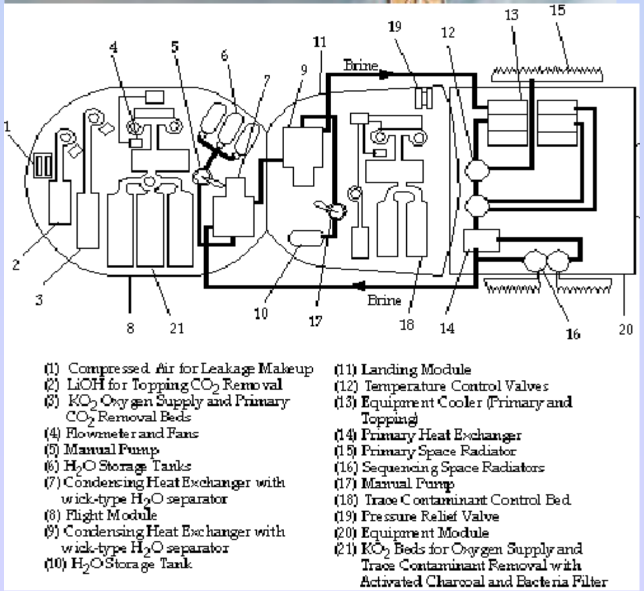
Gemini Spacecraft



NASA
Nicogossian
et al. 1989.

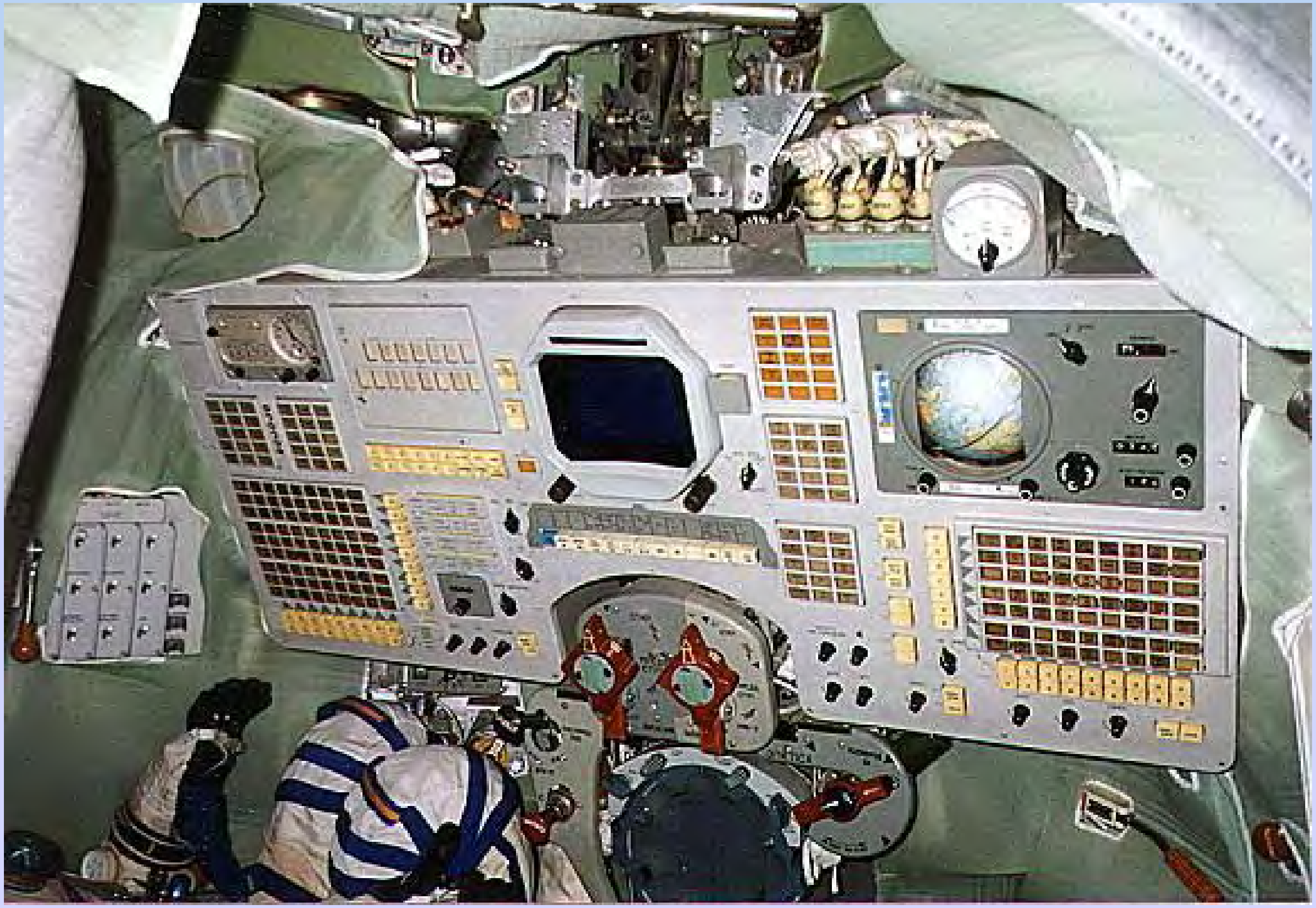
Soyuz Spacecraft

Soyuz TMA-6



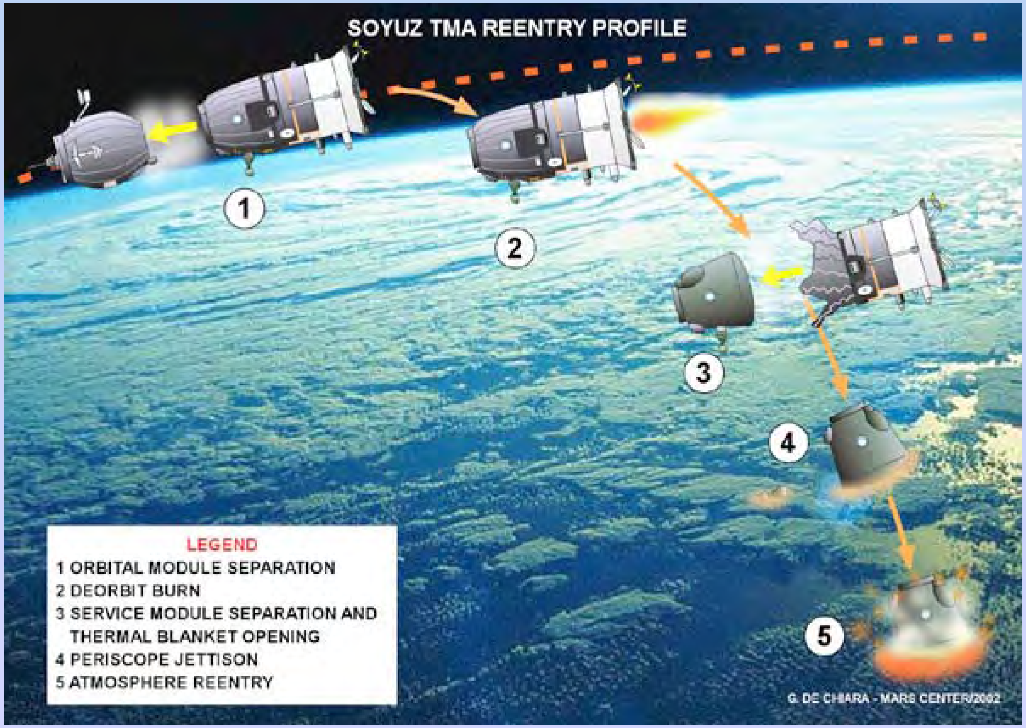
RSA, Nicogossian *et al.* 1989

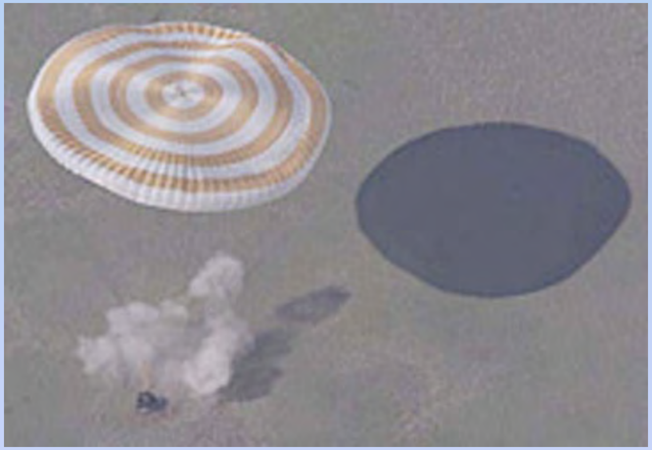
Soyuz Interior



RSA

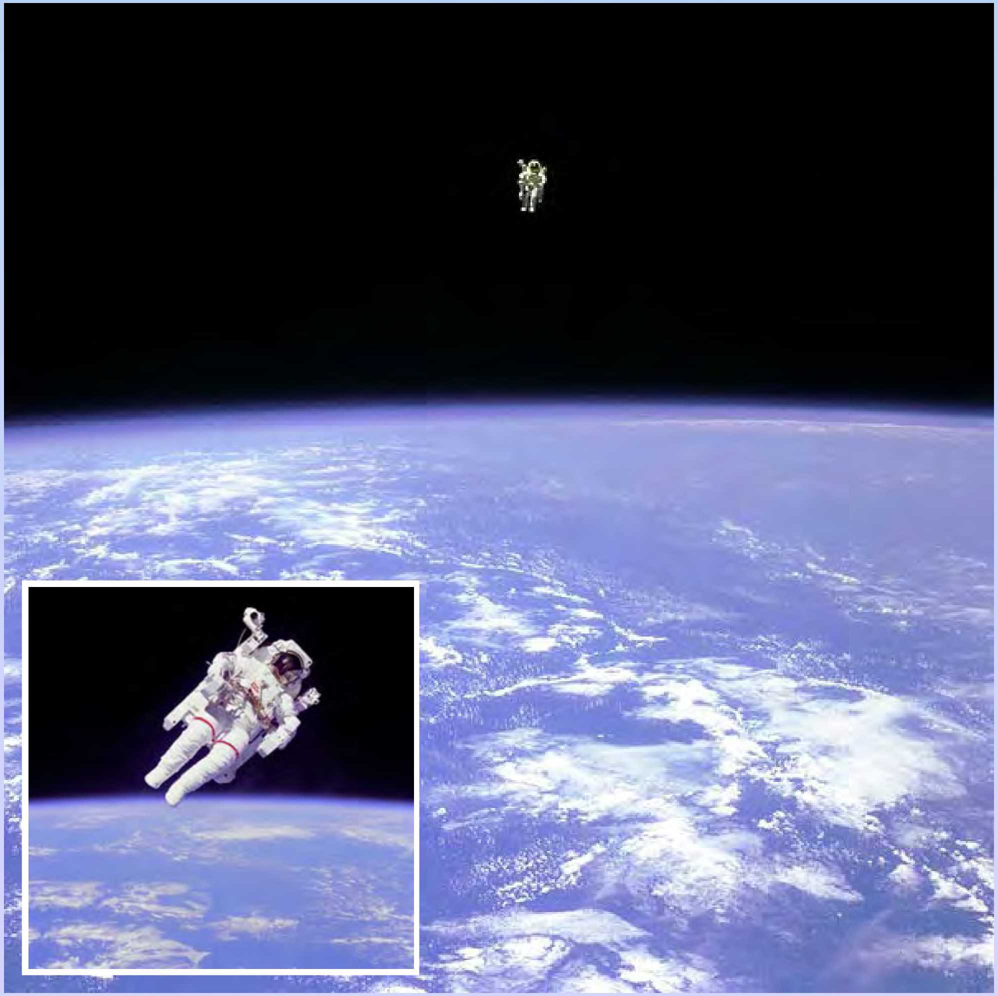
Soyuz Landing





ESA: TM33 landing and Soyuz mission profile

Extravehicular Activities, EVAs



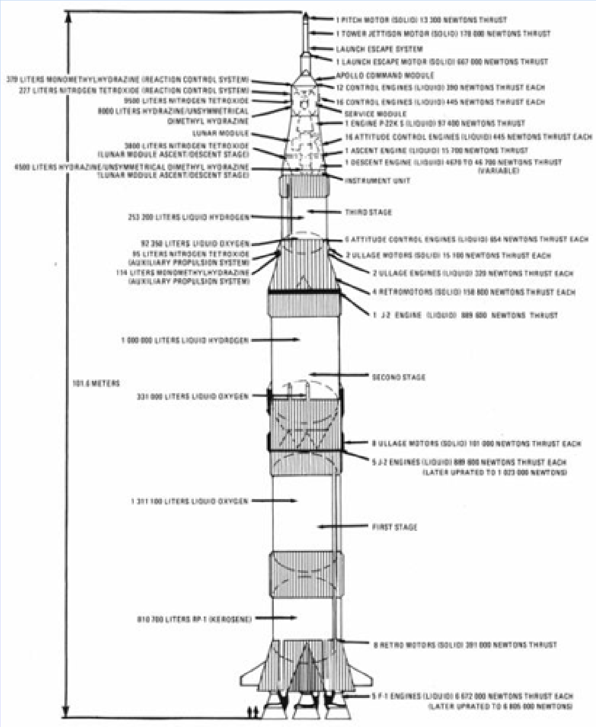
Voskhod 2

Gemini 4

First Russian and first American space walks (EVA's) plus modern STS maneuvering unit

NASA

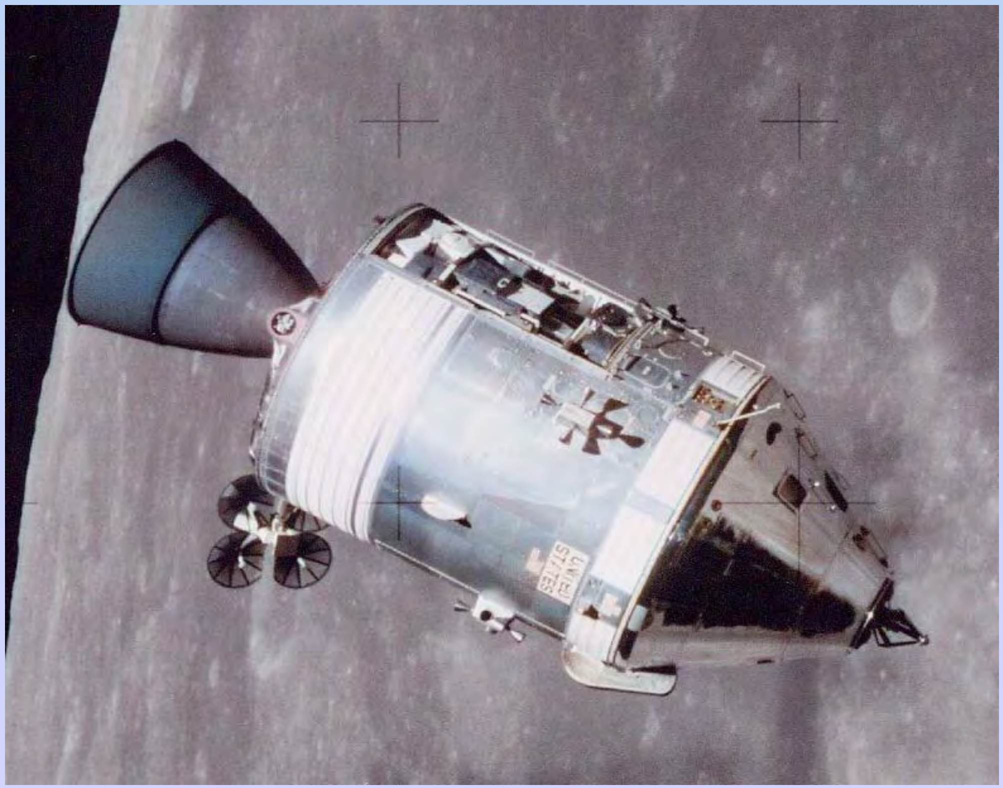
Saturn V



Saturn V was the largest rocket and launched the Apollo spacecraft and SkyLab

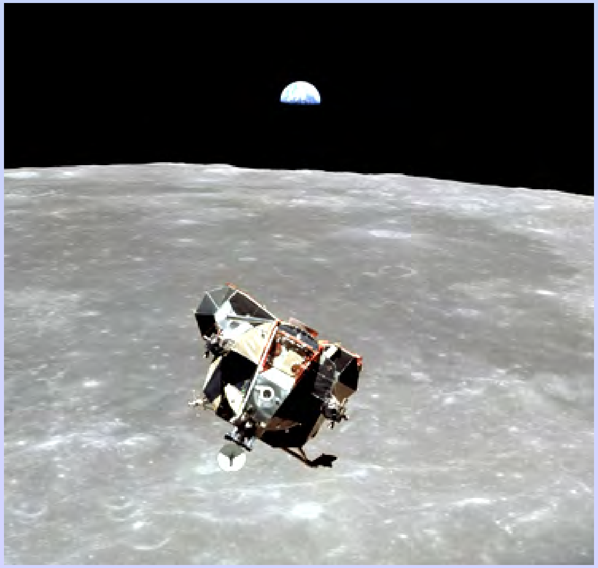
NASA, Nicogossian *et al.* 1989

Apollo Command & Service Modules



NASA

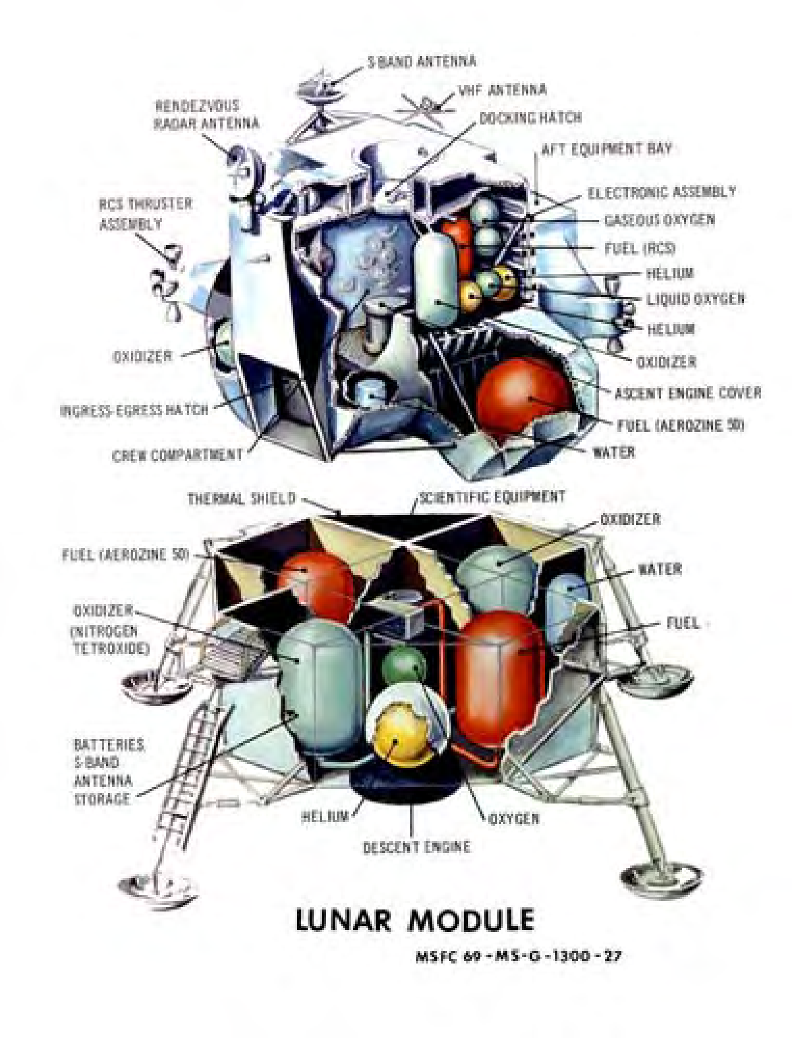
Apollo Lunar Module



Apollo 11 LM on lunar surface and returning to command module.
Apollo 16 lift-off from moon.

NASA

Apollo Lunar Module



NASA

Lunar Surface Activities: Apollo 17

Rover activities in lunar highlands and note potentially biohazardous dust on astronaut E. Cernan

NASA

Apollo Command Module
Landing & Recovery

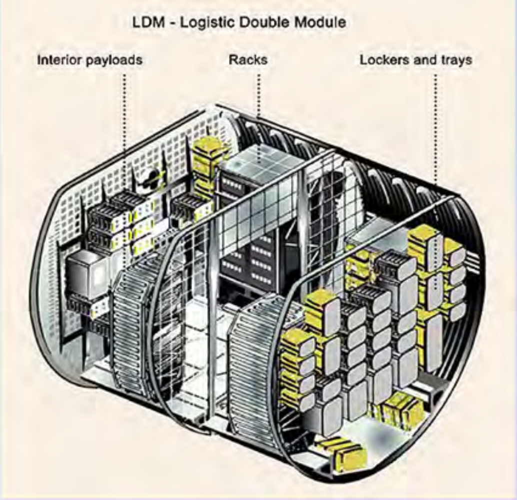

Apollo 17 Landing and Recovery Operations

NASA

STS Launch and Landing

NASA

Space Shuttle Configuration



Shuttle components for the cargo bay and a view of the mid-deck

NASA

Lifting Bodies

Lifting body aircraft were gliders used to test
aerodynamics of unpowered re-entry vehicles

NASA

Buran

The Russian
version of the
Shuttle only
flew once
in an
unmanned
mode

Energia
RSA

Shenzhou Spacecraft

Shenzhou spacecraft

Shenzhou 5 in the preparation.

Modules

Modular design of *Shenzhou* spacecraft

CNN: Monday, October 6, 2003
Wikipedia

Shenzhou Landing

CNN: Monday, October 6, 2003

Salyut 7 Space Station

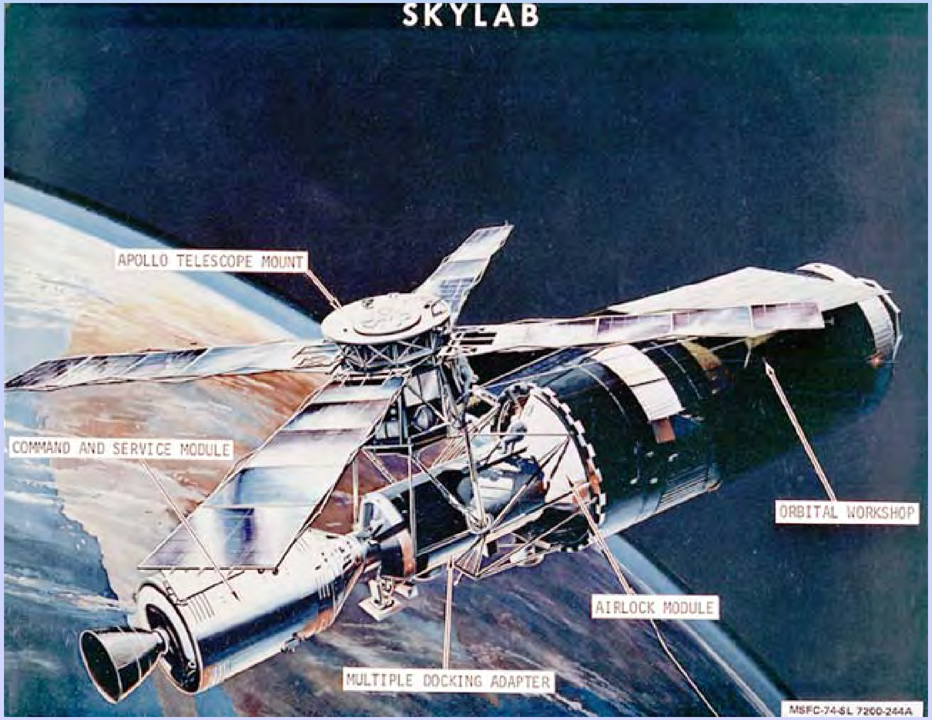
Salyut 7 from Soyuz TM13 RSA & Wikipedia

Progress Cargo Vehicle

Progress M52

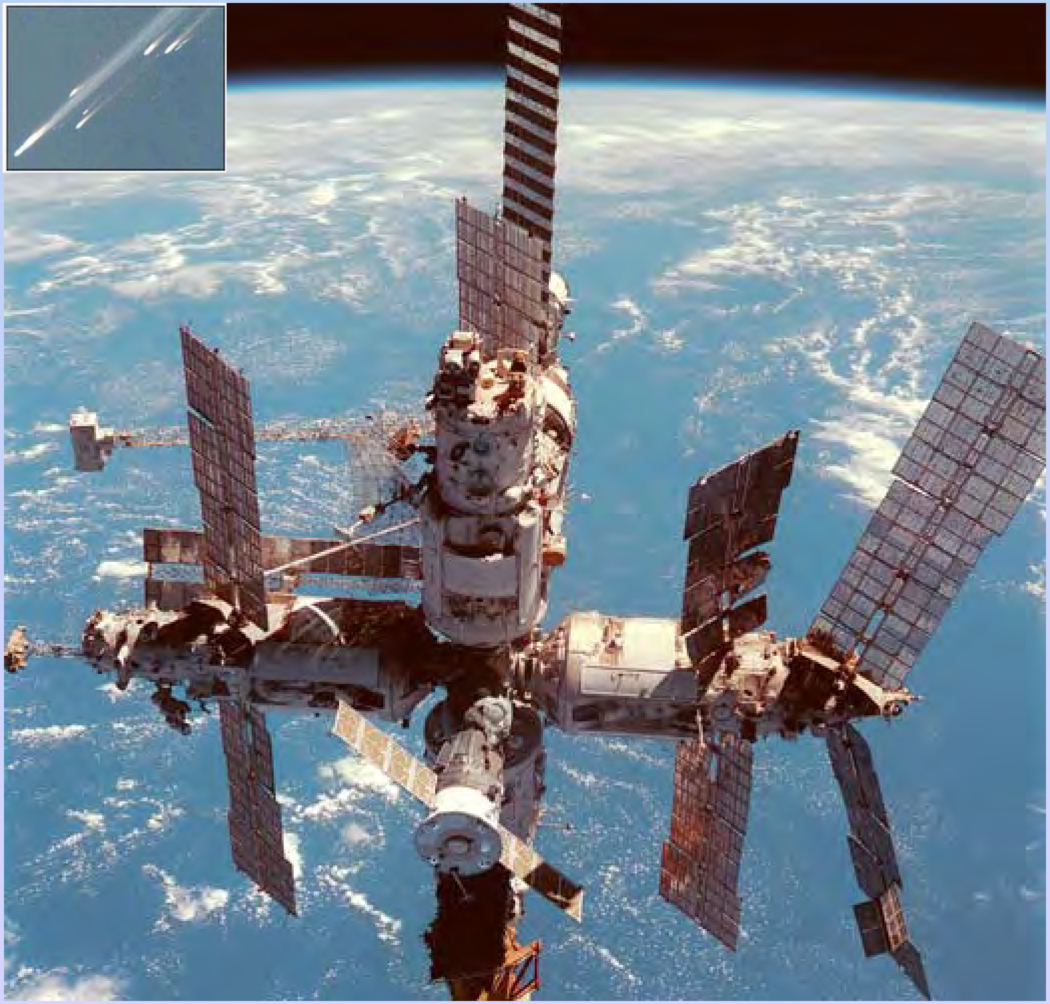
RSA

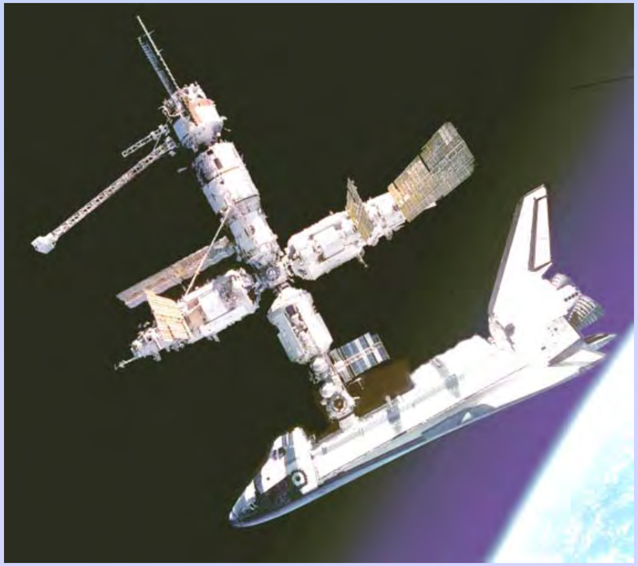
Skylab: Converted Saturn IVB Stage



NASA
Wikipedia

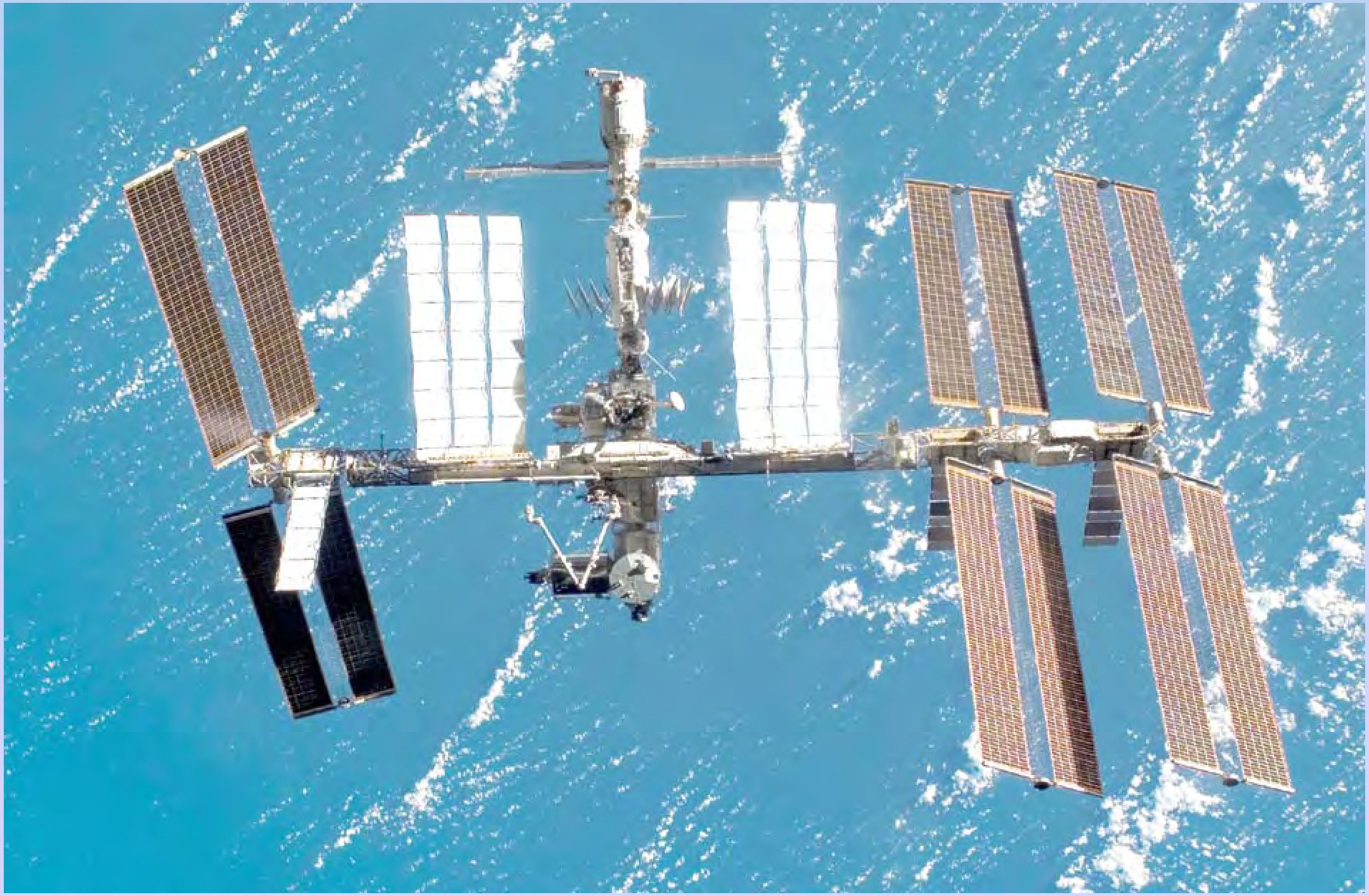
Mir Space Station





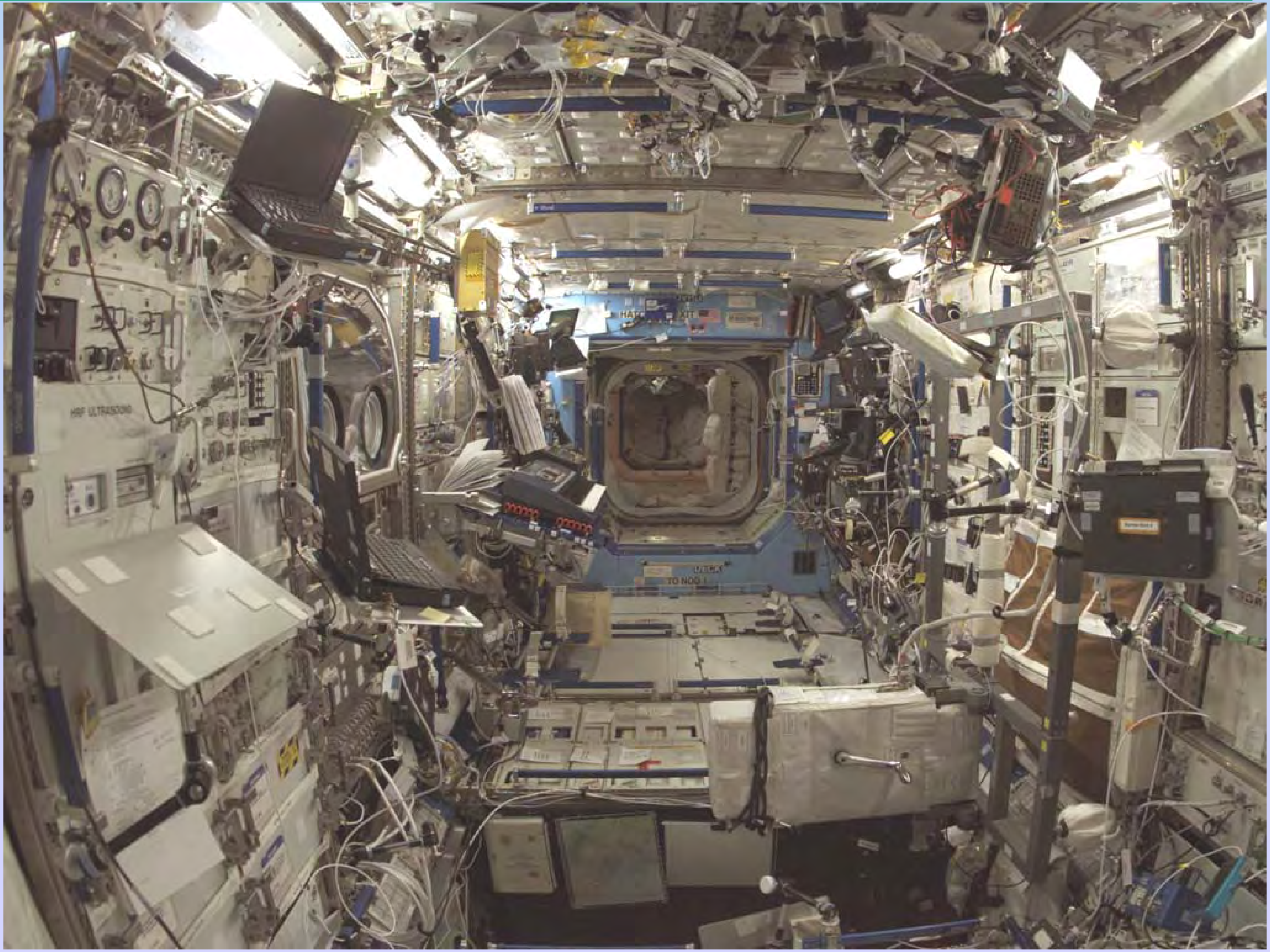
Mir on June 12, 1998; Re-entry 3-23-2001; Mir docked to Atlantis and Soyuz. Wikipedia

International Space Station
after STS 123 Mission



NASA

ISS Interior



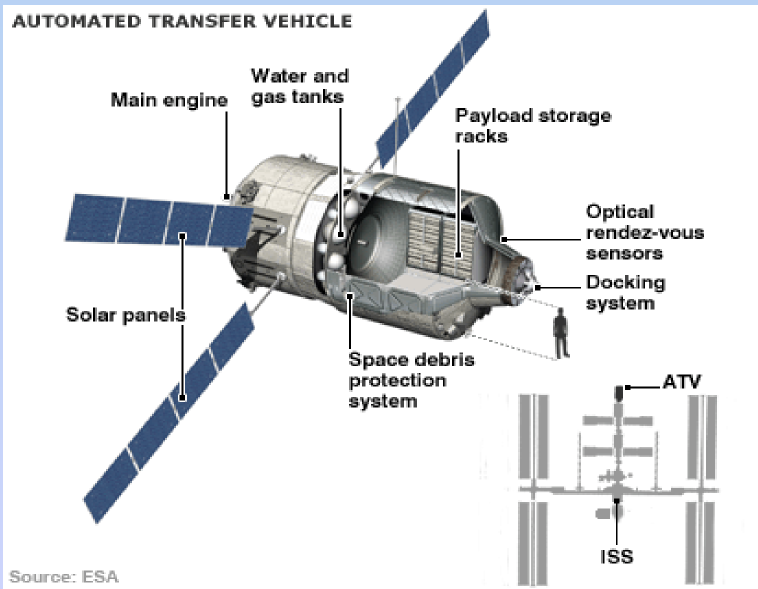
NASA

STS / ISS Integration & Assembly

Shuttle, Soyuz, Progress, Jules Verne / ATM Logistics

NASA

Jules Verne / Automated Transfer Vehicle



European Space Agency, ESA and BBC News 9 March 2008

U.S. Space Radiation Monitoring System

EV-CPDS: *Extra-Vehicular Charged Particle Spectrometer*

IV-CPDS: *Intra-Vehicular Charged Particle Spectrometer*

TEPC: *Tissue Equivalent Proportional Counter*

RAM: *Radiation Area Monitors* (TLDs)

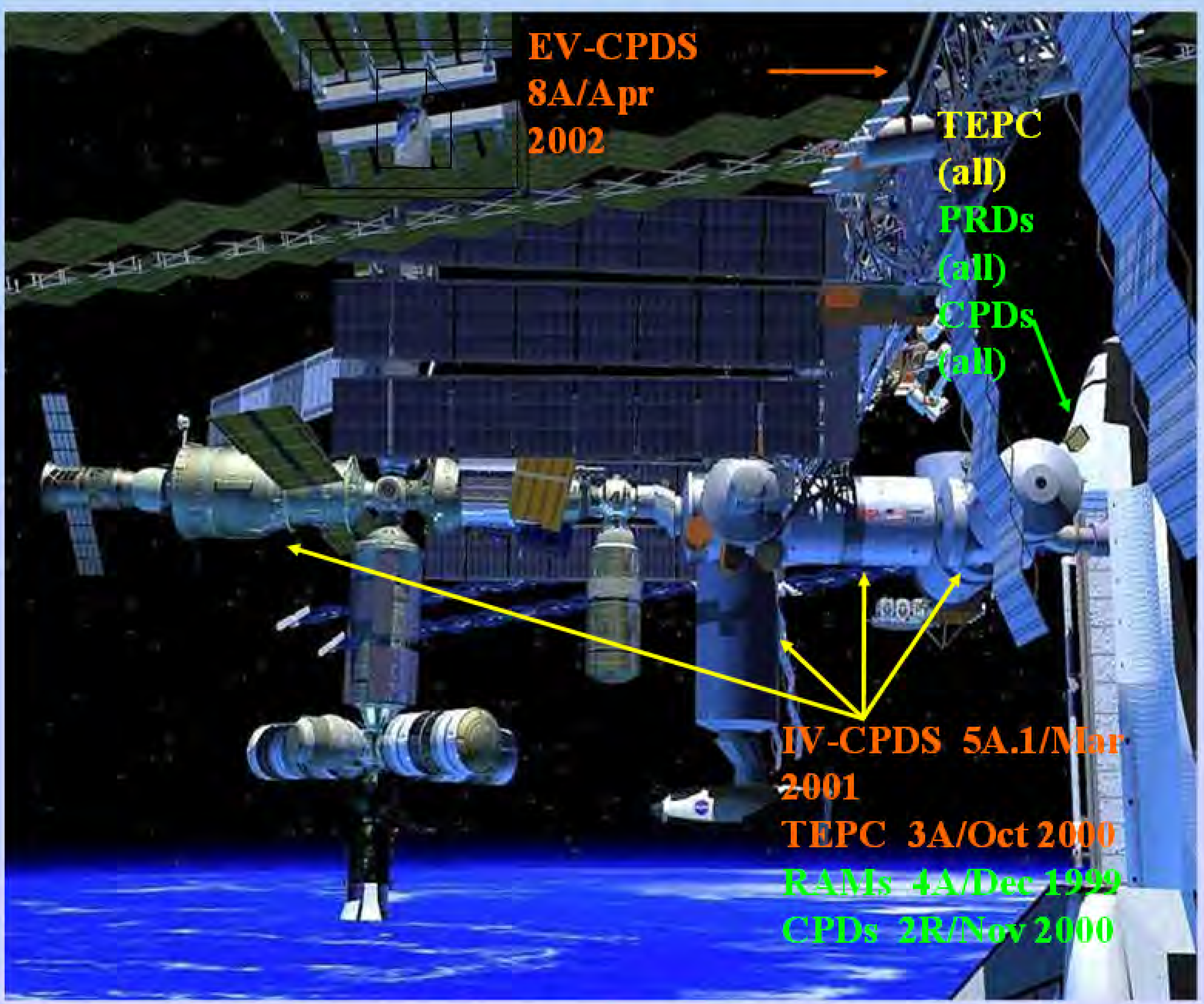
PRD: *Passive Radiation Dosimeter* (TLDs)

CPD: *Crew Passive Dosimeter* (TLDs, PNTD)

Active instrument real-time telemetry

Active instrument no real-time telemetry

Passive instrument



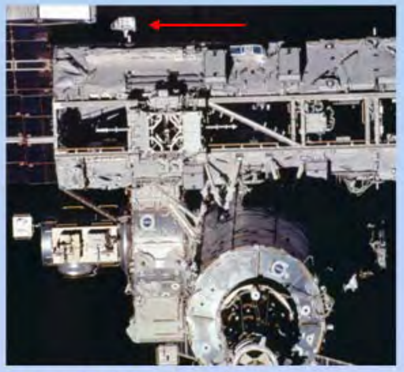
Radiation Monitoring on ISS

Crew Passive Dosimeter

Radiation Area Monitor

Intra-Vehicular Charged Particle Directional Spectrometer (IV-CPDS)

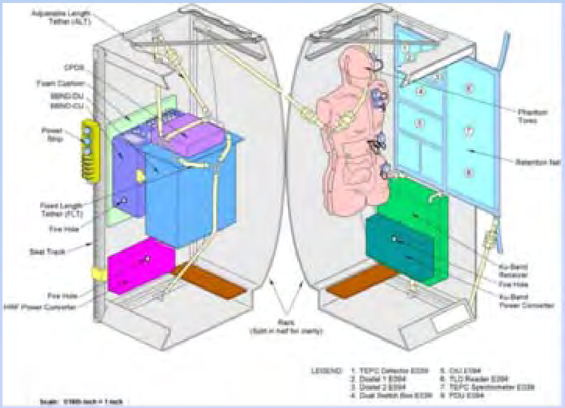
Tissue Equivalent Proportional Counter (TEPC)

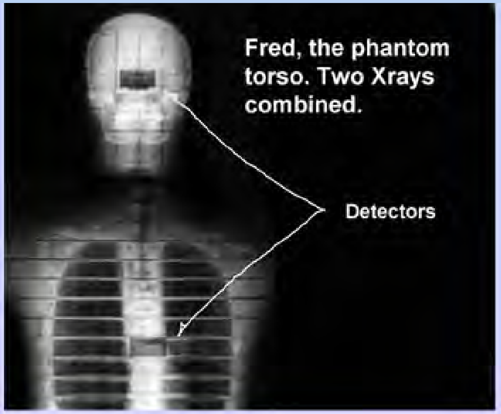


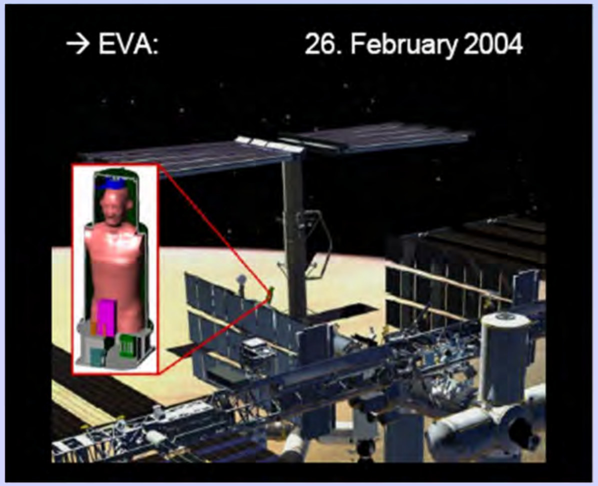
Extra-Vehicular Charged Particle Spectrometer (EV-CPDS)

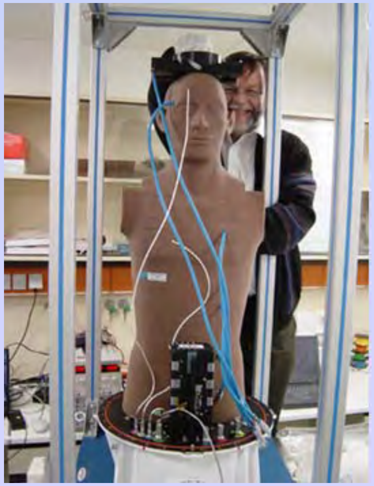
NASA

Instrumented Phantom Studies









NASA
ESA

SpaceShipOne

Astronaut Mike Melvill after the September 29, 2004 spaceflight.

SpaceShipOne landing after June 21, 2004 space flight

1st Commercial Manned Spaceflight
Scaled Composites, Inc.
Launch from White Knight Aircraft
Ascent to > 100 km
Landing at Mojave Spaceport

Wikipedia

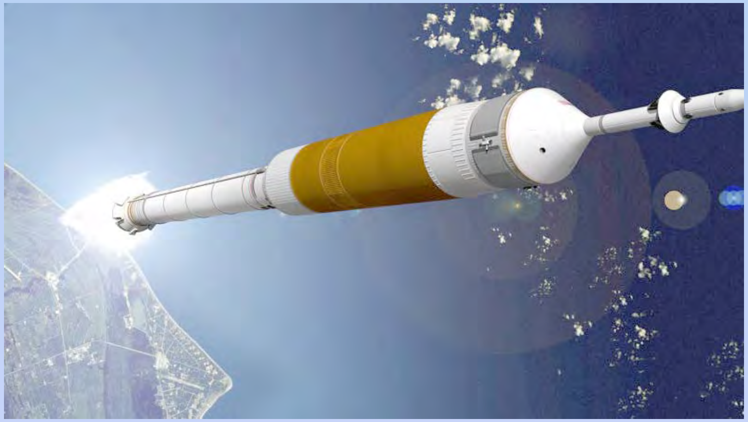
CEV CHARACTERISTICS

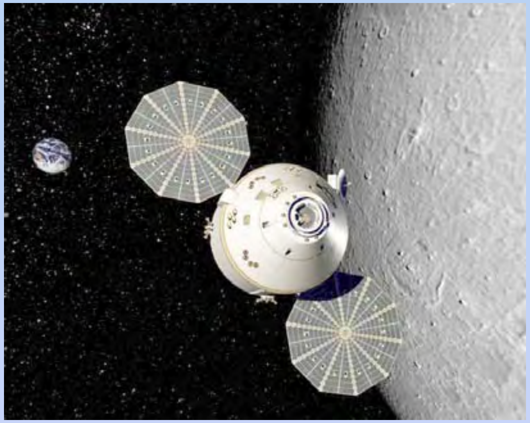
- The CEV will be part of a Crew Transportation System (CTS) that consists of the CEV, the CEVLV, and a launch escape system.
- The CEV shall dock in Earth orbit with the Earth Departure Stage (EDS)
- The CEV shall be capable of rendezvous and docking with the Lunar Surface Access Module (LSAM), which appears to perform the same function as the Apollo Lunar Module.
- The CEV propulsive capability must be capable of returning the spacecraft from lunar orbit to re entry and landing on Earth.
- The CEV shall utilize either parachutes or parafoils.
- The initial crew size will be no less than four
- The CEV shall contain a health monitoring system, a galley, and a waste management facility.
- Launch escape capability must include on-the-pad, throughout the complete booster ascent, and Earth orbit in the event of a failure of the EDS.
- Thus it would appear that the CEV/CTS/EDS/LSAM combination would be launched into orbit separately, docked together, depart for the Moon, the CEV/LSAM would dock in lunar orbit and the CEV return to an earth or water landing.
- The EDS may be reusable or may be stored on orbit elsewhere and be re-fuelable.
- The requirements description also mandates that the CEV design be expandable. All four elements shall be called Constellation space vehicles.

NASA

Constellation Program Concepts

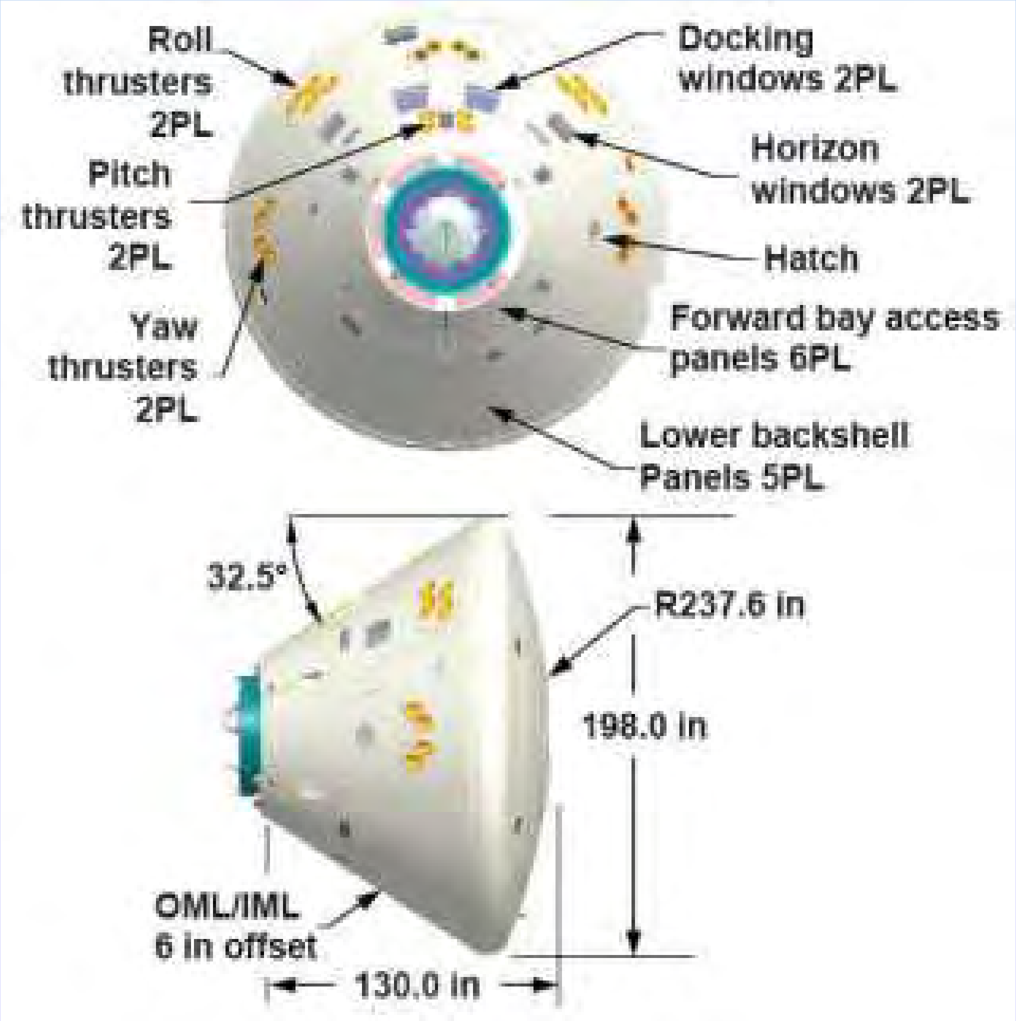
NASA





Ares Rocket, Earth Departure Vehicle, Lunar Surface Module and Crew Exploration Vehicle

Orion: Crew Exploration Vehicle



NASA