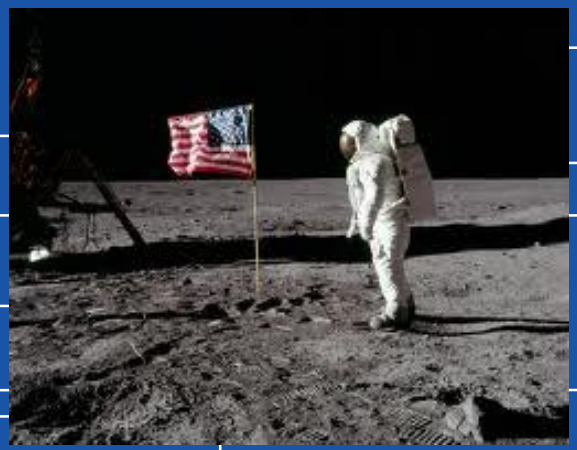
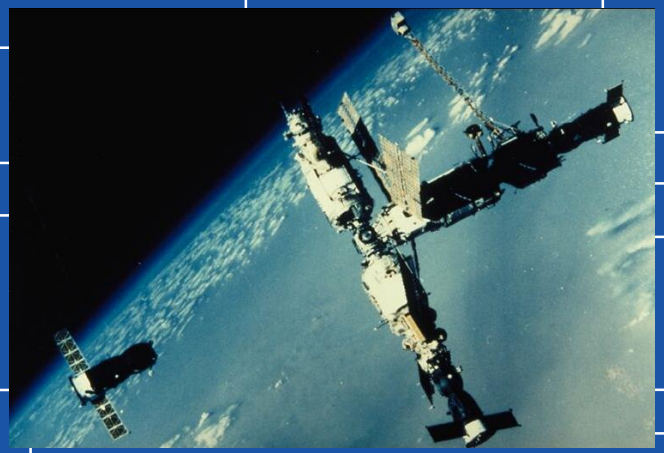
SD2905 Human Spaceflight

Lecture 2, 24-1-2014

A brief history of human space flight





HUMAN SPACE FLIGHT - A BRIEF HISTORY

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Abstract

The history of human spaceflight began on 12 April 1961 when Yuri Gagarin was launched into orbit by the USSR. Early human spaceflight was set in the context of the Cold War between the USSR and USA. Until now, only three countries (China, Russia and USA) have developed a human space flight capability; while several other countries have sent astronauts to space through these programs. This poster presents the major milestones of human spaceflight from the launch of Yuri Gagarin to the present day.

Introduction

"That's one small step for man, one giant leap for mankind."
– Neil Armstrong

For the duration of recorded history, humans have looked at the stars and marveled. The space race between the United States and USSR, which began after Sputnik was launched in 1957, propelled mankind into space. While the USSR accumulated many firsts in the race, including the first manned launch in 1961, the US eventually sent manned missions to the moon and developed the first reusable orbiter. Subsequently, a period of international cooperation began. Eventually, China developed the capability to launch manned flights as well. The pursuit of human spaceflight has contributed immensely to our understanding of science, engineering, and the human body.

19 April 1971
Launch of Salyut-1 Space Station

30 June 1971
Soyuz 11 failure of space-craft after undocking from Salut-1. Casualties - Three

1986

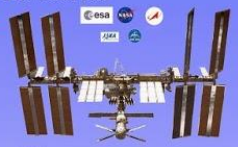
First Module for Mir Space Station

24 April 1967
Soyuz 1 failure of Escape Module. Casualties - One

17 July, 1975
Apollo-Soyuz Test Project (ASTP). Ended space race

3 February 1994
Space Shuttle Docks with Mir Space Station

2 November 2000



Continuing most of human space flights for NASA, ESA, JAXA, CSA and ROSKOSMOS

18 March 1965
Alexei Leonov — First space walk

16 June 1963

Valentina Tereshkova — First woman in space

28 January 1986
Space Shuttle Challenger failure during Launch. Casualties - Seven

1 February 2003
Space Shuttle Columbia failure during Re-entry. Casualties - Seven

20 July 1969
Neil Armstrong — First man on the Moon

25 September 2008

Chinese Taikonauts, performed their first EVA ShenZhou-7 (神舟七号)

16 June 2012

Three Taikonauts in the ShenZhou-9 (神舟九号) docked with TianGong-1 (天宫一号) in orbit

12 April 1961

Yuri Gagarin — First man in space

20 February 1962

John Glenn — First American in orbit

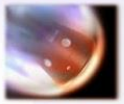
20 November 2003
China Launched Yang Liwei, the first Taikonaut, into orbit for 21 hours in the Shen-Zhou-5 (神舟五号)

Critical Technologies for Human Spaceflight

Crew Escape System

Flight Suit

Staged Parachute Recovery System

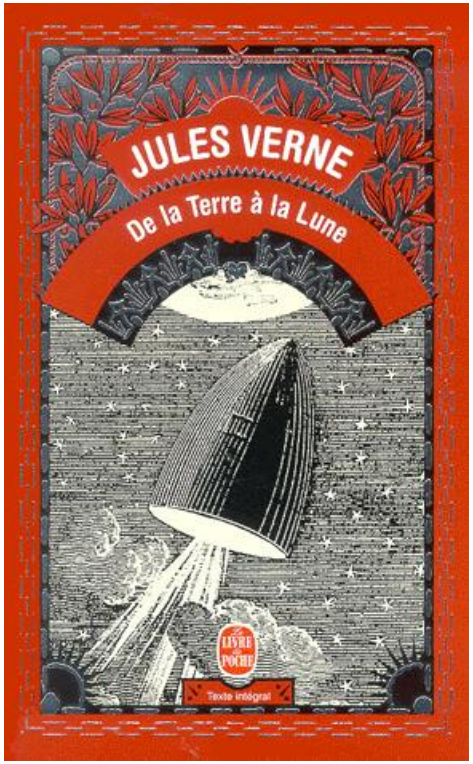


Thermal Protection

Life Support and Environment Control

http://dallaskasaboski.blogspot.se/2013/10/poster-conference-at-isu.html

From the Earth to the Moon in 1865

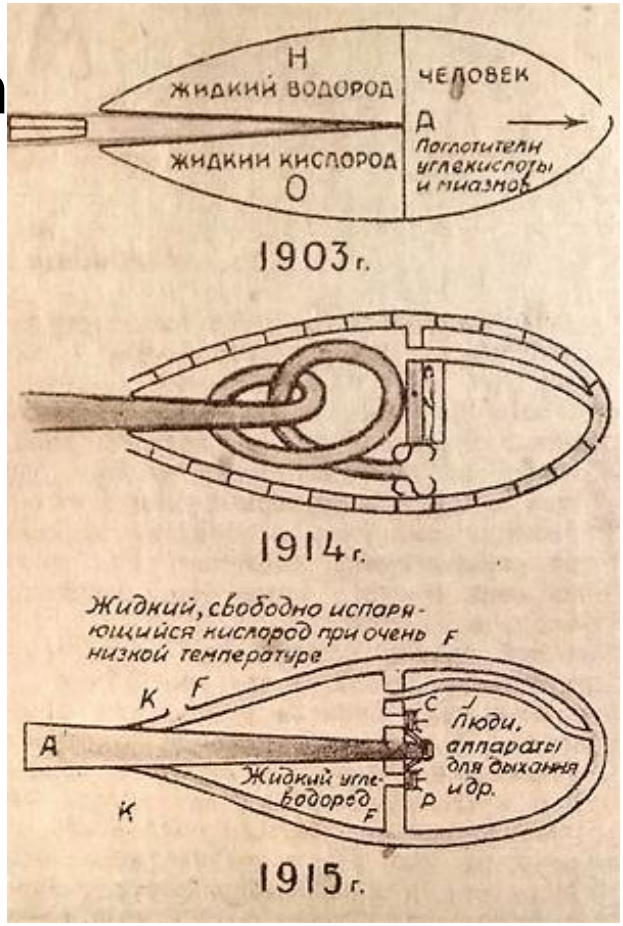


Konstatin Edvardoich Tsiolkovsky (1857-1935)

Grand-father of space fligth

Fore-saw the future space flights of humans.

Made theoretical calculations and described the principles of multi-stage rockets, space flights, liquid fuel, life support systems, space walks.



http://calvertjournal.com/comment/show/1487/roscosmos-proton-m-tsiolkovsky

Rocket Pioneers

USA: Robert Goddard (1882-1945): 16/3 1926 First rocket with liquid fuel (2.5 sec, 56 m long and 12 m high flight)

Germany: Herman Oberth (1894-1989) ”Die Rakete zu den Planetenräumen” 1923; worked on the V-2 Rocket

Germany-> USA: Wernher Magnus Maximillian Freiherr von Braun (1912-1977): Technical chief for V-2; later NASA and the Saturn rockets.

Peenemünde Museum replica of V-2
http://en.wikipedia.org/wiki/V-2

Rocket Pioneers

Russia: Sergei Pavlovich Korolev (1907-1966): ”The Chief Designer”, a legendary ikon, but total secret until long after his death

Talking with Gagarin in space
http://defence.pk/threads/sergei-korolev-the-lead-soviet-rocket-engineer-and-spacecraft-designer.261761/

Sputnik: 4 October 1957

Scared the hell out of the Americans!

Follwed by Laika in Sputnik-2 on 3/11/1957

She did not live long, but long enough to prove that big animals (mammals) could live in weightlessness, and thus most likely humans also!

Belka and Strelka survived in Aug 1960

A puppy of Strelka, Pushkina, was given by Nikita Chrustchev to John F. Kennedy's daughter Caroline.

12th April 1961: Vostok 1

First human in space: Yuri Gagarin ”Poehali”

Gagarin on the way to launch pad with backup German Titov behind.

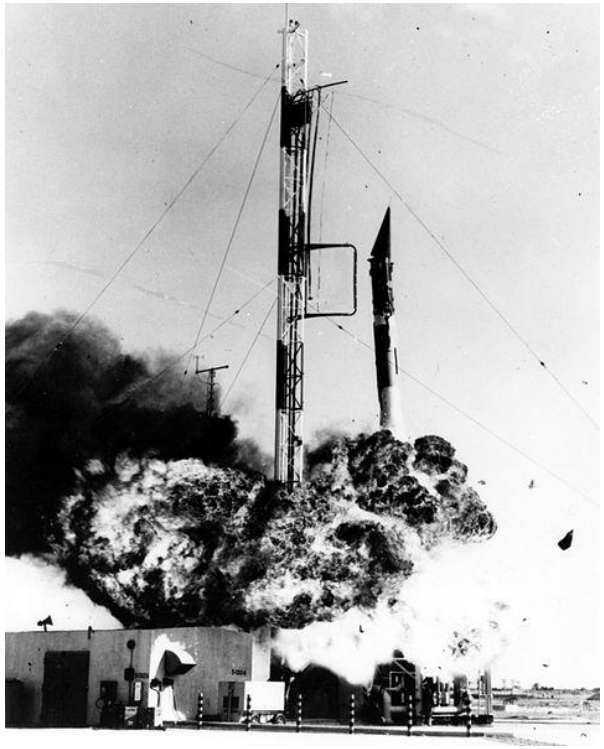
Titov was 2nd in orbit, 25h18m on 6-7 Aug 1961.

Launch from Baikonur, Kazakhstan. Ejected with parachute at 7 km altitude 108 min later.

Now US was REALLY behind. Something had to be done!

”We have Sputnik, they have kaputnik”

US had many failures in the beginning, but the first sucesful satelitte Explorer-1 in Feb 1958 discovered the Van Allen radiation belts.



Test of Vanguard launch. Malfunction in first stage caused vehicle to lose thrust after two seconds and destruction.

The Mercury Seven, Apr 1959

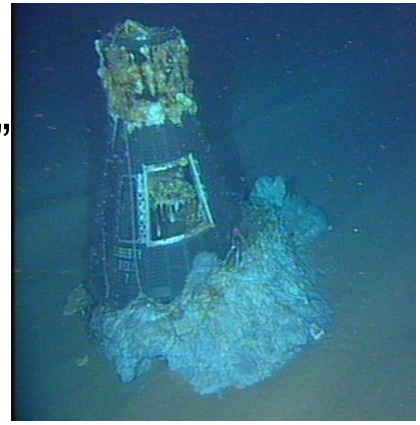
Kennedy’s famous challenge

The Decision to Go to the Moon:

President John F. Kennedy's May 25, 1961 Speech before a Joint Session of Congress

US First human space flights: The Mercury Prog.

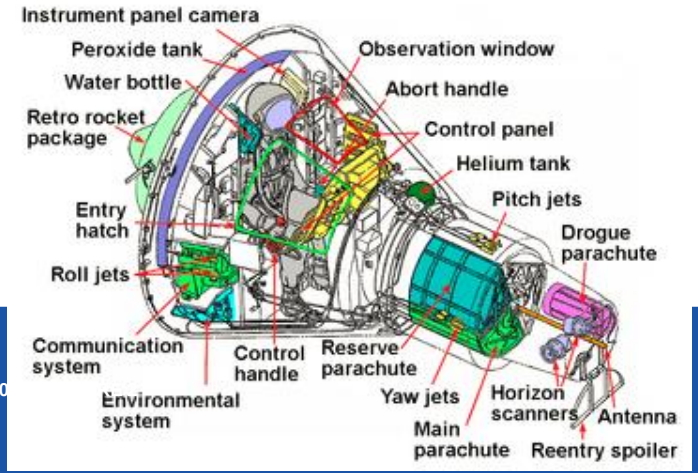
5/5 1961 Mercury-Redstone 3 ”Freedom 7” Alan Shepard – Suborbital (15 min; 190 km alt.)



21/7 1961 Mercury-Redstone 4 ”Liberty Bell 7” Gus Grissom - Suborbital

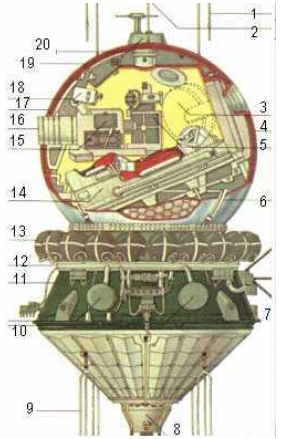
Almost drowned

20/2 1962: Mercury-Atlas 6 ”Friendship 7” John Glenn – first US orbital flight



1. Retropack. 2. Heatshield. 3. Crew compartment. 4. Recovery compartment. 5. Antenna section 6. Launch escape system

US vs Soviet Union



Mercury 1961-63

Gemini 1964-66 (12 flights)

VIII: Armstrong & Scott

First docking, but combined system started to roll uncontrolled, led to emergency landing

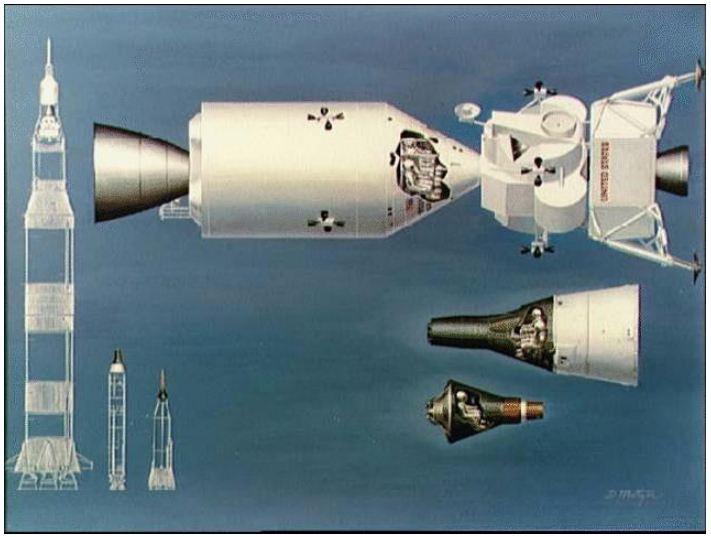
Vostok 1961-63

Valentina Tersechkova on 6th and last.
First woman in space

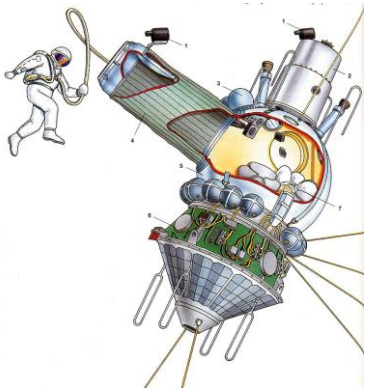
Voshxod 1964-65

-1 Crew of 3 w Yegorov, 1st physician
-2 First space walk, by Alexey Leonov
Barely made it back inside – had to deflate press in suit
Landed 386 km wrong after several re-entry problems

Apollo 1968-72 (75)



http://exploration.grc.nasa.gov/education/rocket/payload.html



Soyuz 1967-today

First deadly accidents – in 1967

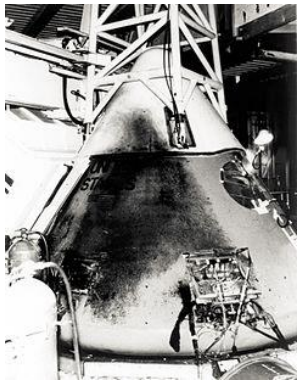
Apollo-1 on 27 Jan

Fire on launch pad during launch rehearsal test

(real launch planned for 21/2)

Several problems; main cause due to pure O_2 in cabin and a spark.

The Apollo 1 crew were concerned about their spacecraft's problems. White, Grissom, Chafee.



Soyuz-1 on 24 Apr

Vladimir Komarov died when parachute failed to open properly

But many other problems during fligth also, which made it shorter than planned.

In addition, failures during unmanned tests – still launched due to political pressure.

A planned launch of Souyz-2, that would have docked with Komarov, was cancelled.

http://www.geschichteinchronologie.ch/atmosphaerenfahrt/08_wosschod-gemini-soyus-ENGL.html

http://www.astronautix.com/flights/soyuz1.htm

”A small step for a man...” Neil Armstrong 20/7/1969

Apollo 7: Oct-68 Orbit test

Apollo 8: Dec-68 Circumlunar flight

Apollo 9: Mar-69 Lunar module tested in Earth orbit

Apollo 10: May-69 ”Sniffed” the lunar surface (14 km alt.)

Apollo 11: Jul-69 First human on the Moon

Apollo 12: Nov-69

Apollo 13: Apr-70 Near catastrophe! O2 tank onboard explodes on the way to the moon

Apollo 14: Jan-71

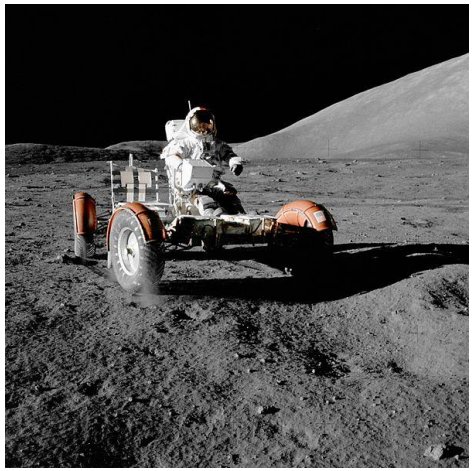
Apollo 15: Jul-71 First lunar rover

Apollo 16: Apr-72

Apollo 17: Dec-72

Armstrong seen mirrored in Buzz Aldrin’s visor

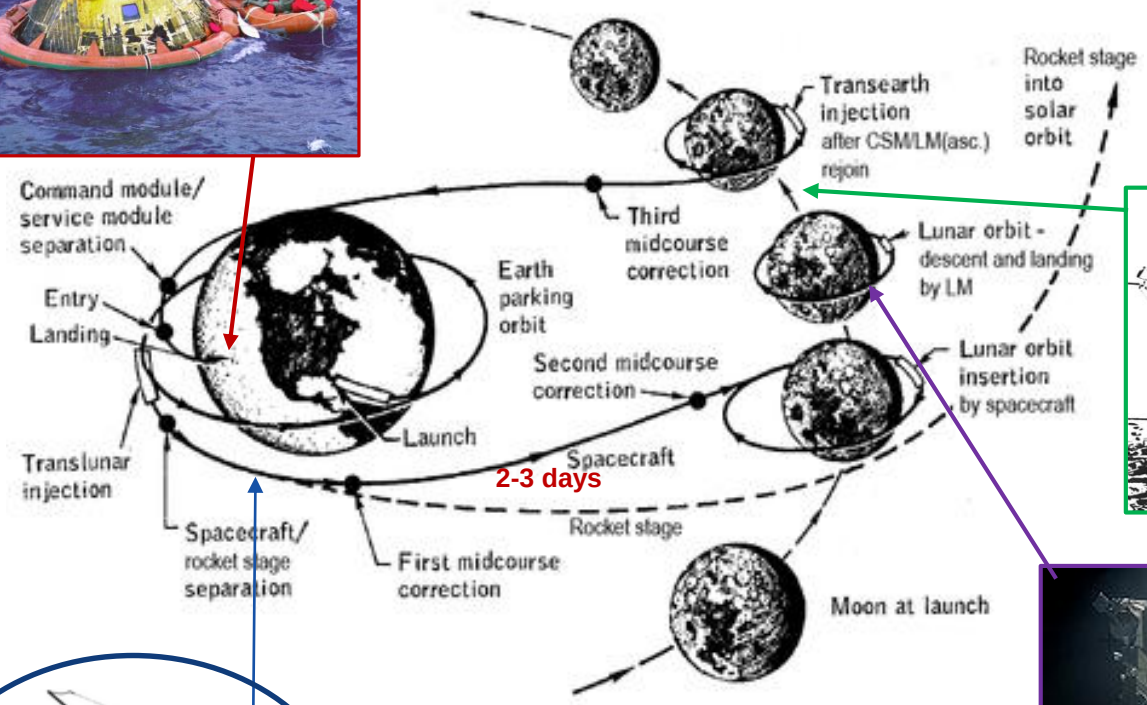
http://www.dailygalaxy.com/my_weblog/2012/08/neil-armstrong-the-lost-apollo-11-footage-.html

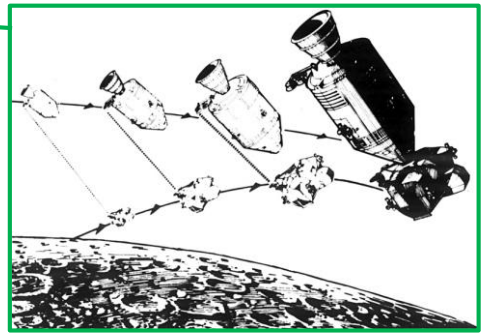


Gene Cernan, latest man on the moon, aboard the Lunar Rover during the first EVA of Apollo 17

Apollo Moon flights profile

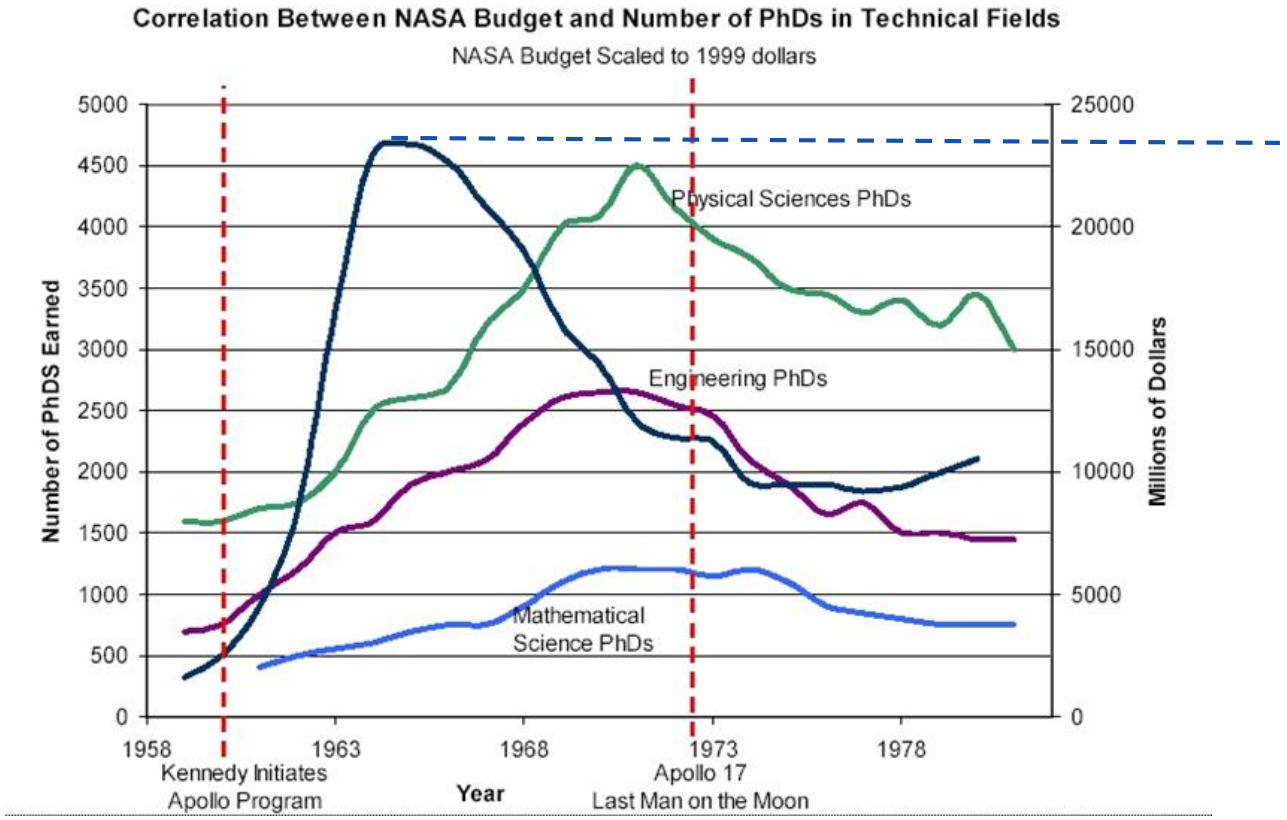
Apollo 11 landing





Apollo 16 lunar module ”*Orion*”

The inspiration factor - and a bit of budget



4.4 % of the federal budget in 1966

Down to 1% in 1975

Today, about 0.5 %

Space stations

US: Skylab 1973-1979; 77 tons

Skylab was almost lost after launch due to solar array problems. Saved by EVAs by first crew.

Three missions of 3-men crews

25 days May-Jun 1973

59 days Jul-Sep 1973

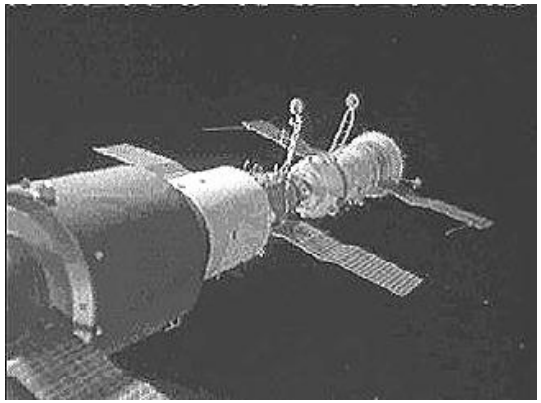
84 days Nov-73 – Feb-74

24-hour mutiny triggered by the astronauts' complaints of excessive workloads

Soviet Union / Russia:

Salyut 1 – 7 1971 – 1986

Two types: DOS (civil) and Almaz (military)
Salyut 2 failed in orbit before manned
Salyut 6 (DOS) first with two docking ports



Salyut 1, the first space station in the history of space flight, is seen here with the docked Soyuz 10 spacecraft.

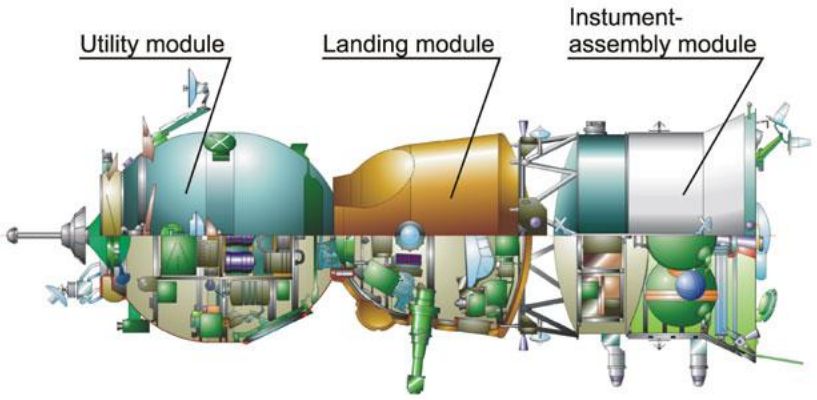
Mir: 1986-2001

Interstation flight Salyut 7-Mir
Titov & Manarov 1 yr in space 1988
Polyakov 438 days in space 1994/95

ISS – the International Space Station: 1998 -

Soyuz-11 disaster 30 Jun 1971

- Vladislav Volkov, Georgi Dobrovolski, and Viktor Patsayev was the backup crew.
- Had spent 23 successful days on Salyut 1, as first ever space station crew.
- After de-orbit burn, during modules separation, a vent valve opened prematurely (still in space)
- Air escaped, crew had no space suits, died quickly



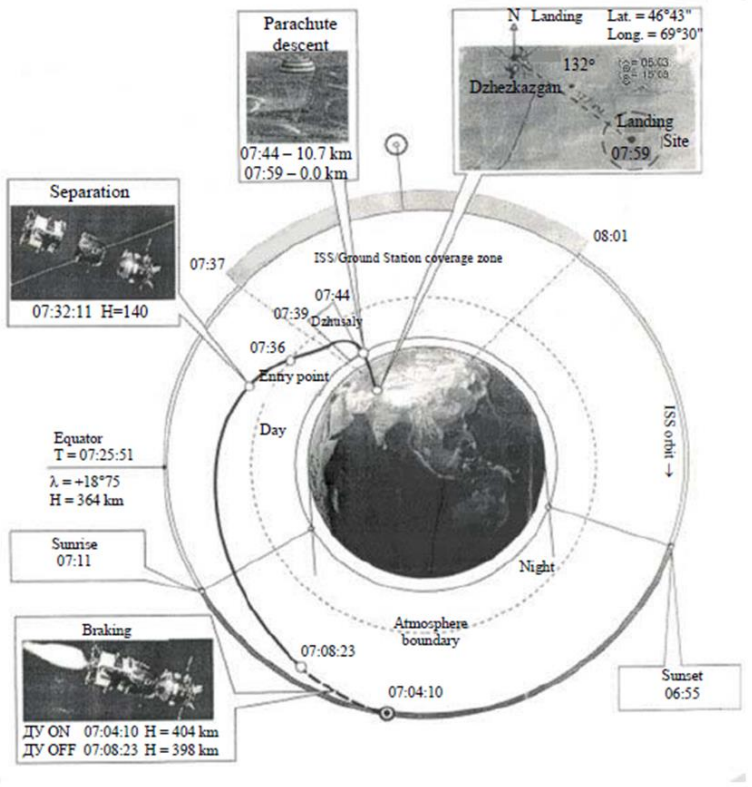


Figure 5.13. Diagram of Soyuz Descent

Mir – first multi-modular space station

- Core module in 1986
- 7th module (”Kristall”) in 1996
- 28 ”expeditions”
- Astronauts from 12 countries; 7 Americans
- Shuttle-Mir program 1995-1998
- Endured fire & de-pressurisation in1997

Apollo-Soyuz Test Project 1975

The first joint U.S.–Soviet space flight, and the last flight of an Apollo spacecraft.

Symbol of the end of the space race

Left to right: Slayton, Stafford, Brand, Leonov, Kubasov

Space Shuttle 1981 - 2011

- Program approved in 1972 (STS – Space Transportation System)
- 12/4 1981: maiden flight by *Columbia* (Young & Crippen)
- 135 flights until 2011 – with two fatal disasters
- An awsome, amazing vehicle – but too complex and too expensive
- 5 orbiters built: *Columbia, Challenger, Discovery, Atlantis, Endeavour*
- 3 cathegoreis of astronauts: Pilots, Mission specialists, Payload specialists
- 355 different people, out of wich 23 were non-Americans, flew on a shuttle

OV-101 *Enterprise* takes flight for the first time over Dryden Flight Research Facility, Edwards, California in 1977 as part of the Shuttle program's Approach and Landing Tests (ALT).

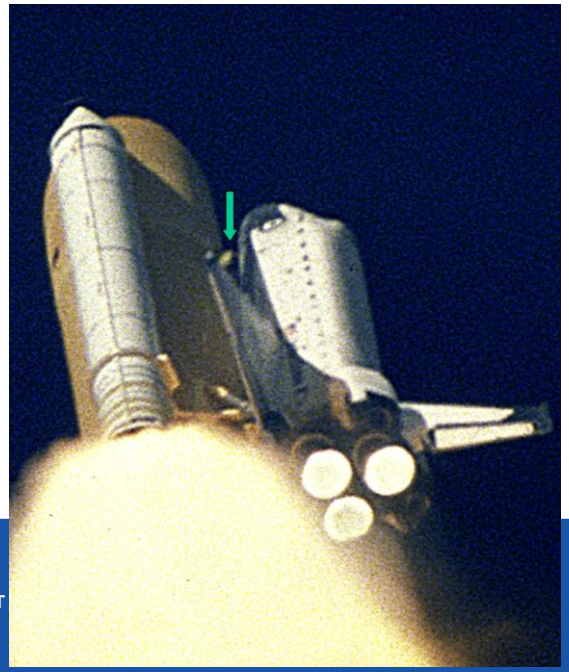
Launch as a rocket – land as an airplane

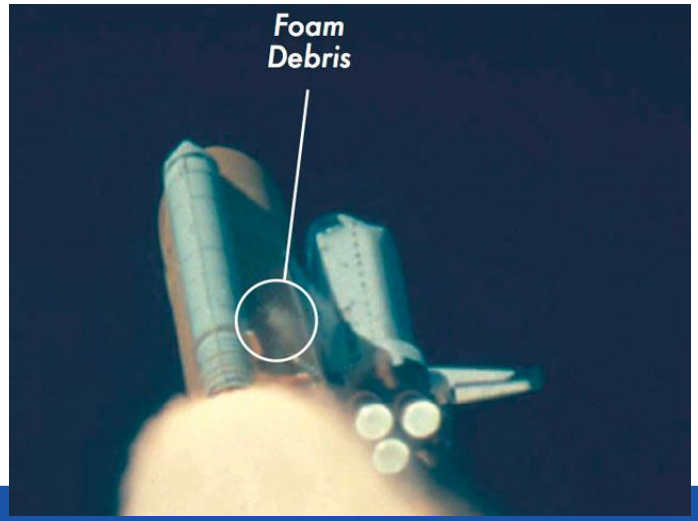
Challenger disaster 28 Jan 1986

- 73 seconds after launch it blew up, due to the leak in a O-ring of the right SRB (booster), killing all seven astronauts on board
- Repeated warnings from design engineers voicing concerns about the lack of evidence of the O-rings' safety when the temperature was below 53 °F (12 °C) had been ignored by NASA managers
- Many changes led to the shuttle grounded for 2.5 yr. E.g. escape possibilities (in principle) during launch and landing

Columbia (STS107) disaster on 1 Feb 2003

- 82 s after launch, at altitude 20 km and speed ca 740 m/s a foam piece with mass about 0.8 kg fell off.
- Relative impact speed was ca 240 m/s.
- It hit a wing edge, creating a hole in the critical heat shield.
- This was noted, but the possible consequences underestimated / warnings from engineers ignored, by managers. (Again!)
- During re-entry, heat penetrated the wing, melting the structure, leading to disintegration





Actions after *Columbia*

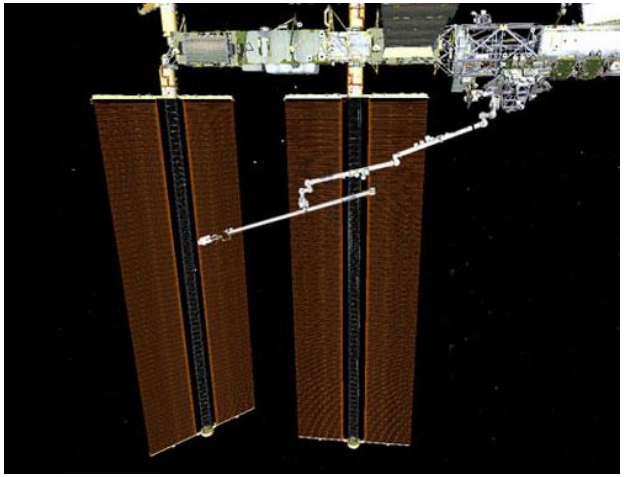
A lot of recommendations from detailed independent investigation, including management changes

Careful observations during launch with cameras and sensors

Inspections in-flight – after launch *and* before re-entry

Decision to finish assembly of ISS, then retire the shuttle fleet

Best estimate of risk for another disaster: ca 1/70 per flight



A special boom developed for heat shields inspection, was also used to repair ISS solar array

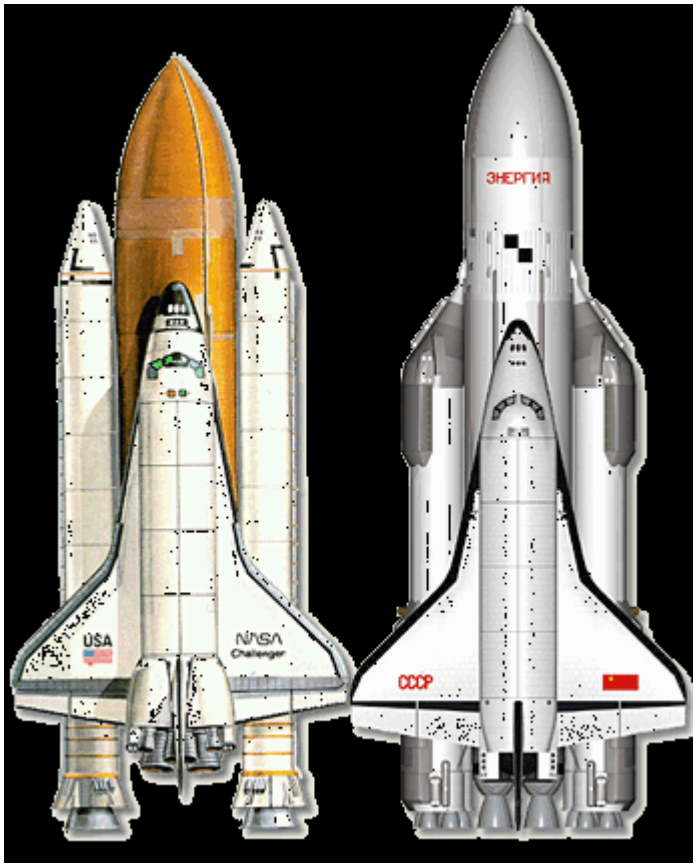
Buran – the Soviet space shuttle

Soviet feared potential military capability of US Shuttle

Buran very similar to US shuttle, but no own engines

Launched on a huge rocket: Energia

Only flew once (1988) – successful, but unmanned. Too expensive.

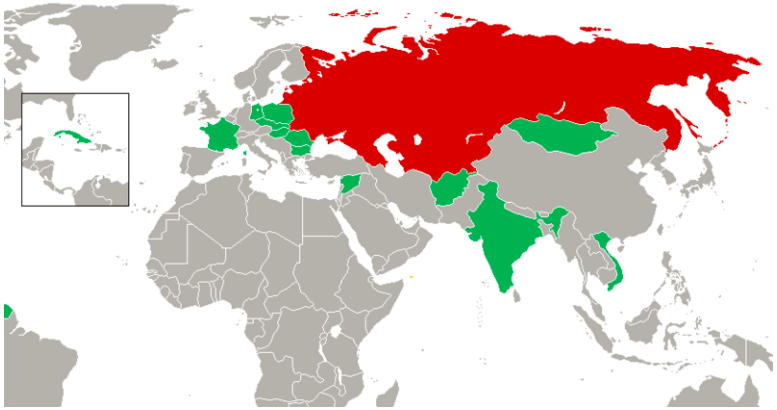


http://www.buran.ru/htm/molniya5.htm

Interkosomos 1978-1988

Soviet union invited ”friends” to fly an astronaut with them

http://itsfullofstars.tumblr.com/post/42299140914/fyeah cosmonauts-a-group-portrait-of-cosmonauts



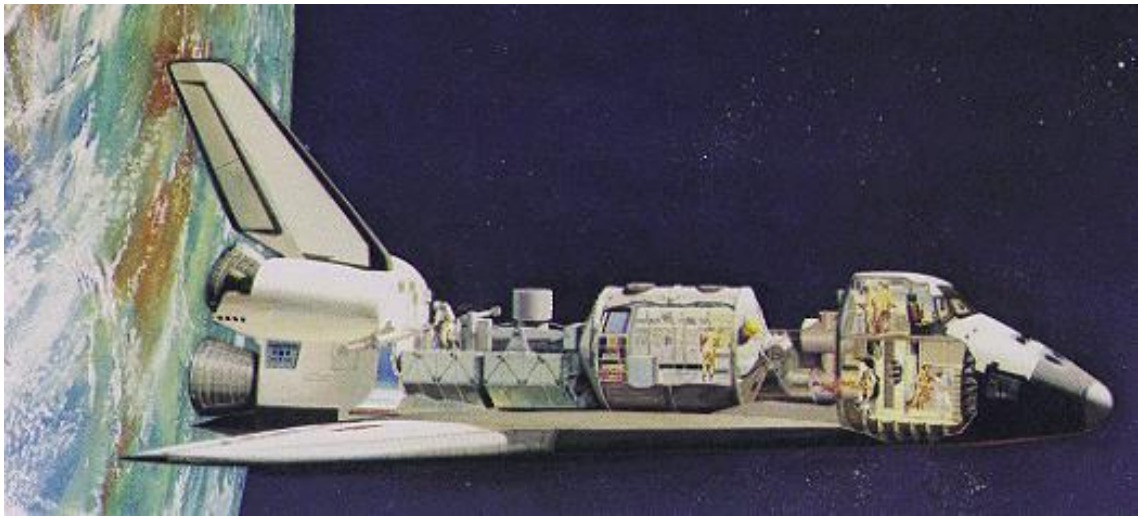
With the Shuttle, US started doing the same thing.
ESA ’83, Canada ’84, Saudia-arabia ’85, France ’85, Mexico ’85

ESA – European Space Agency

Founded 1975 by 10 countries – today 20 member states

Human space program much smaller than US's or Russia's (ca 10% of total budget)

First astronauts (3) in 1978, for the Spacelab program – a lab that flew in the shuttle's payload and provided by ESA



China: Shenzhou and Tiangong

A lot of similaities to Russians

Long March launcher

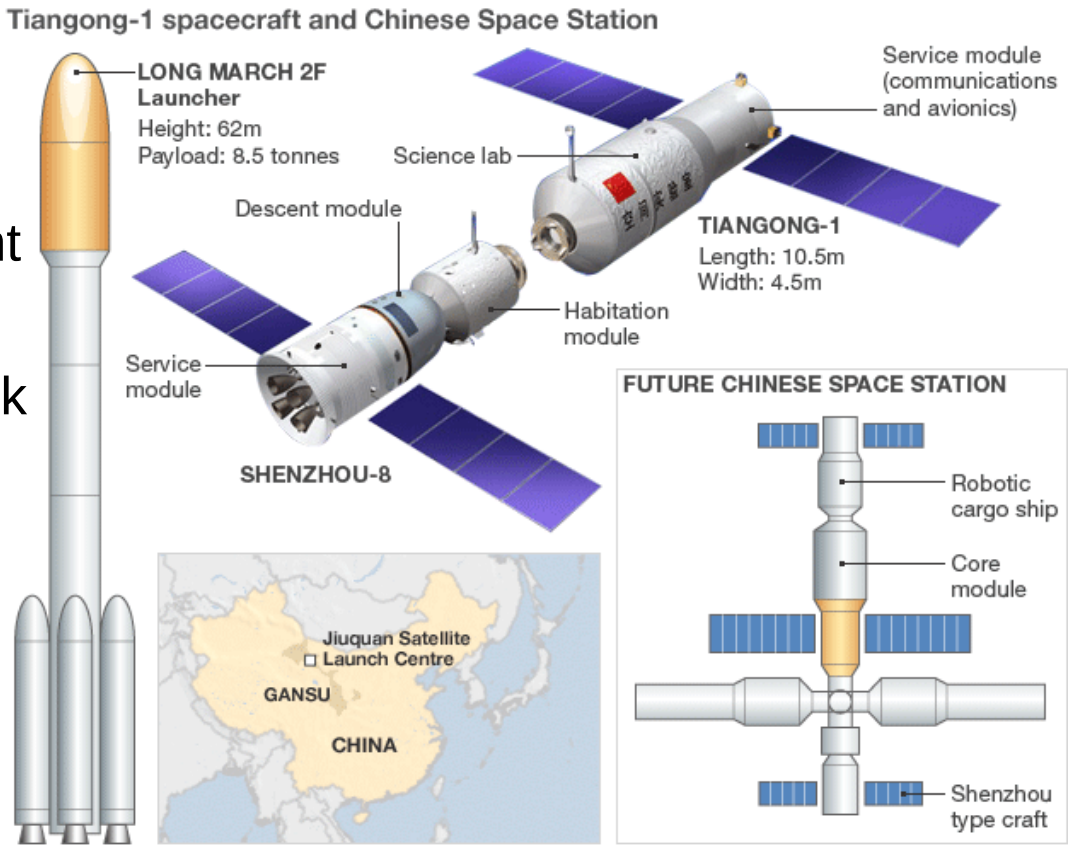
S-5 Oct-03: Yang Liwei, 21 h flight

S-6 Oct-05: 2-crew for 5 days

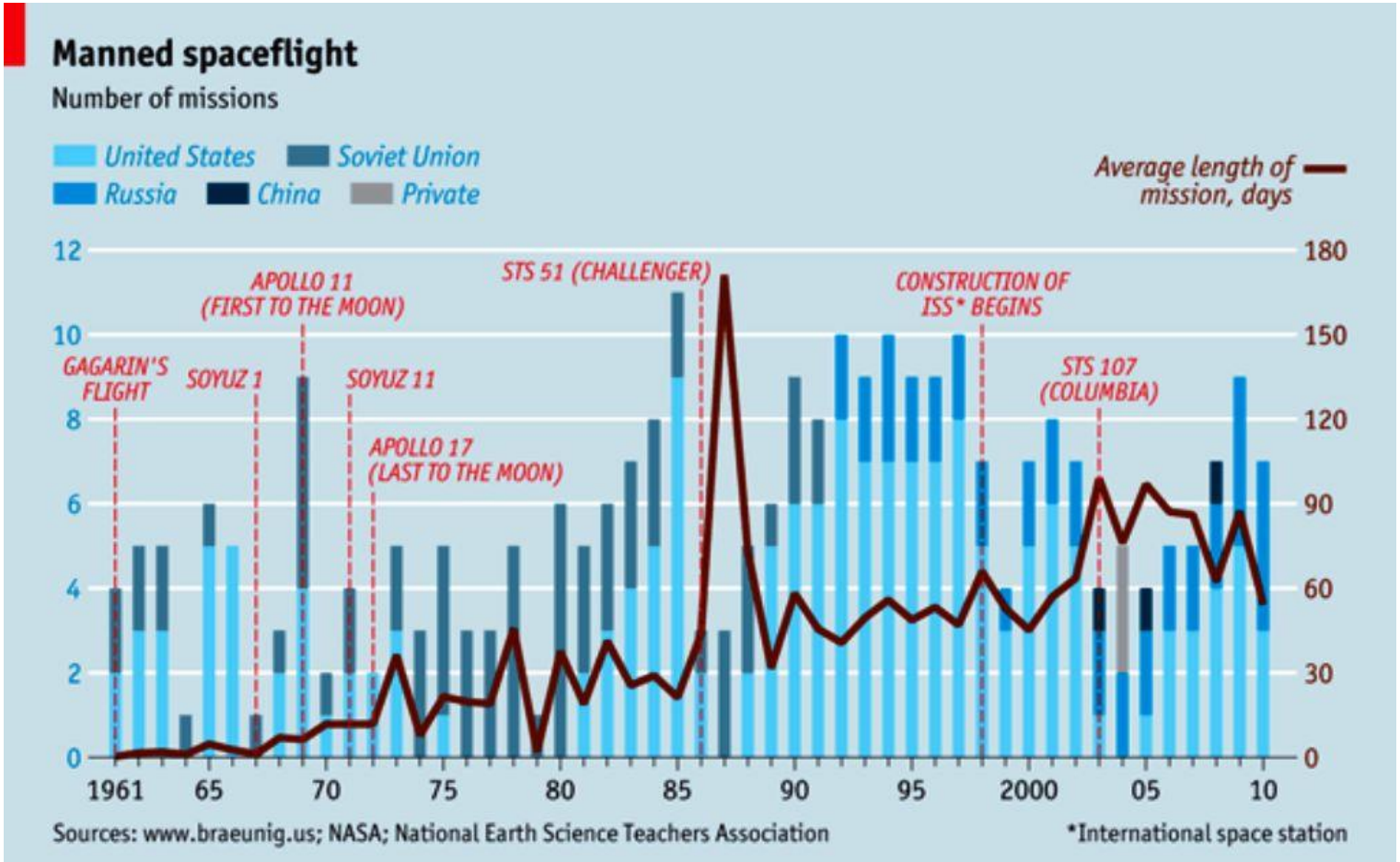
S-7 Sep-08 3-crew; did spacewalk

S-9 Jun-12: 3-crew, one woman, docked to Tiangong-1; 13 days

S-10 Jun-13: As S-9; 14 days

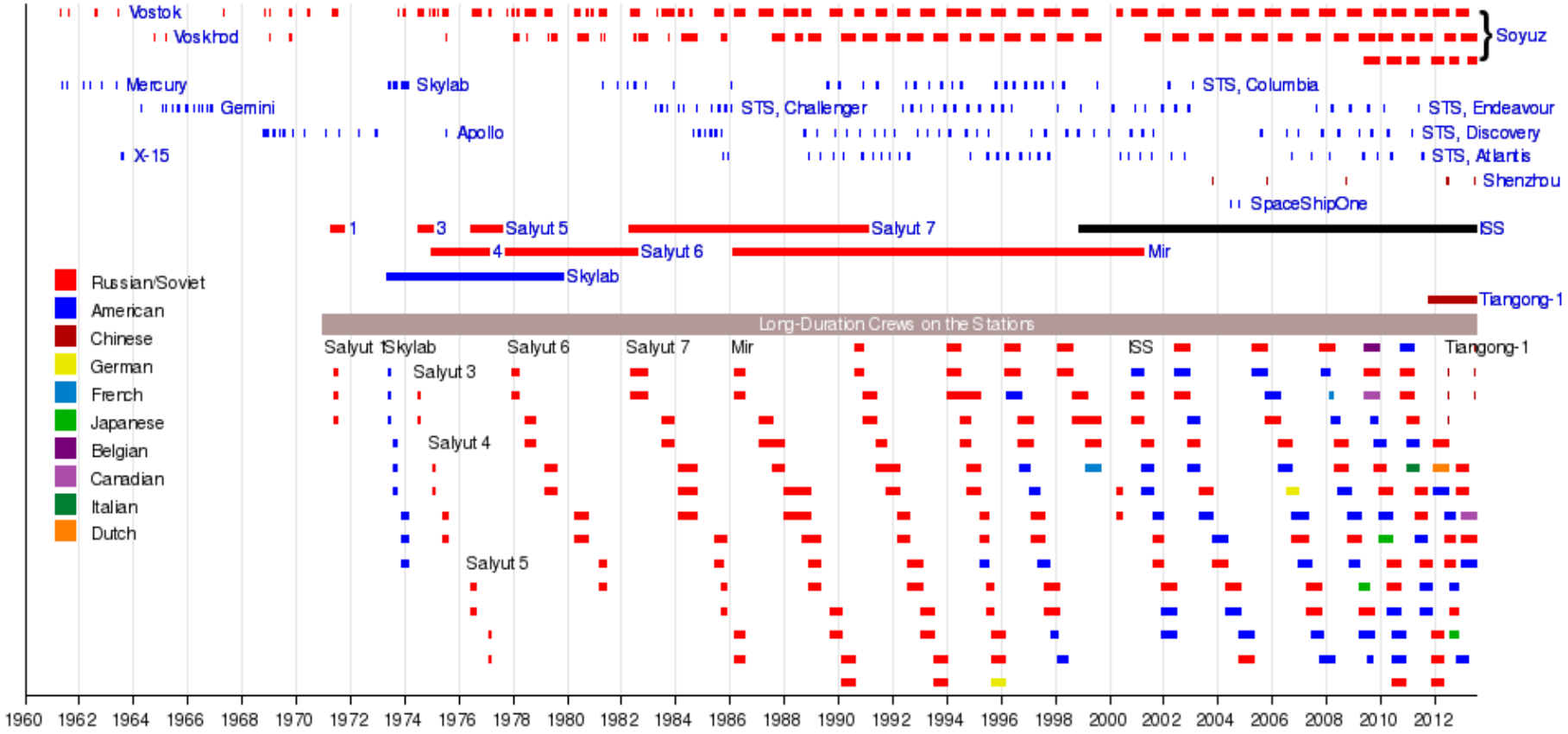


Summary of all manned space mission - 1



http://www.smartkpis.com/blog/2011/04/13/50-years-of-manned-spaceflight-performance-a-brief-history/

Summary of all manned space mission - 2



http://en.wikipedia.org/wiki/Human_spaceflight