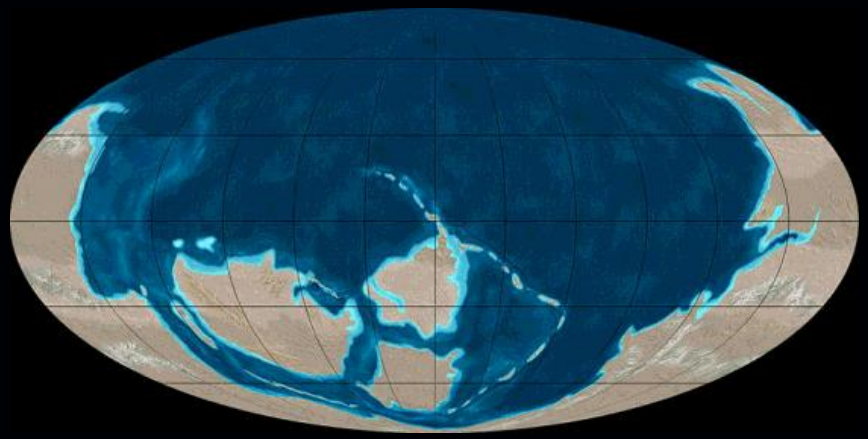
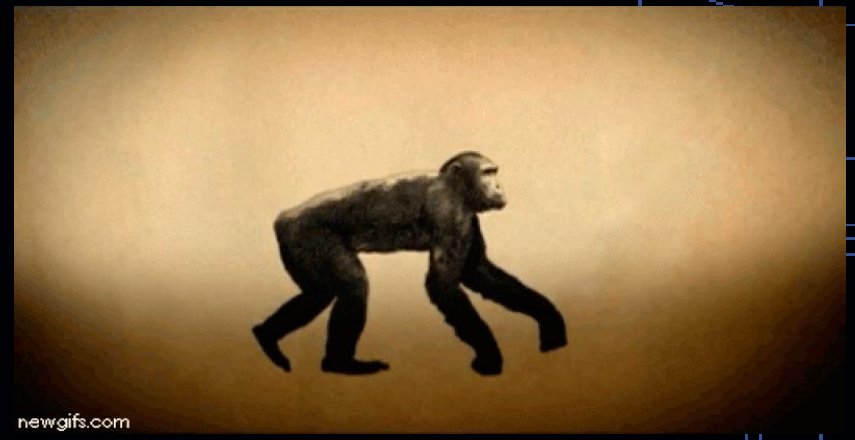
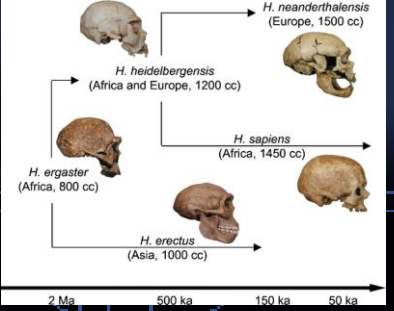
A *Brief* History of… Everything

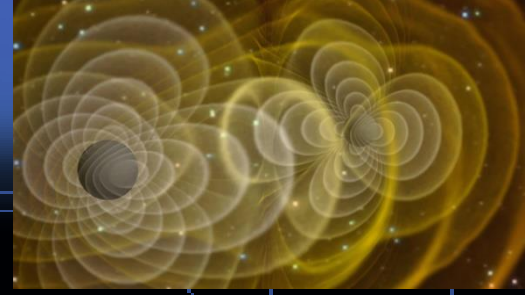




Karl Steffin
Astronomy, 2006
8/9/2024



Always and Forevermore

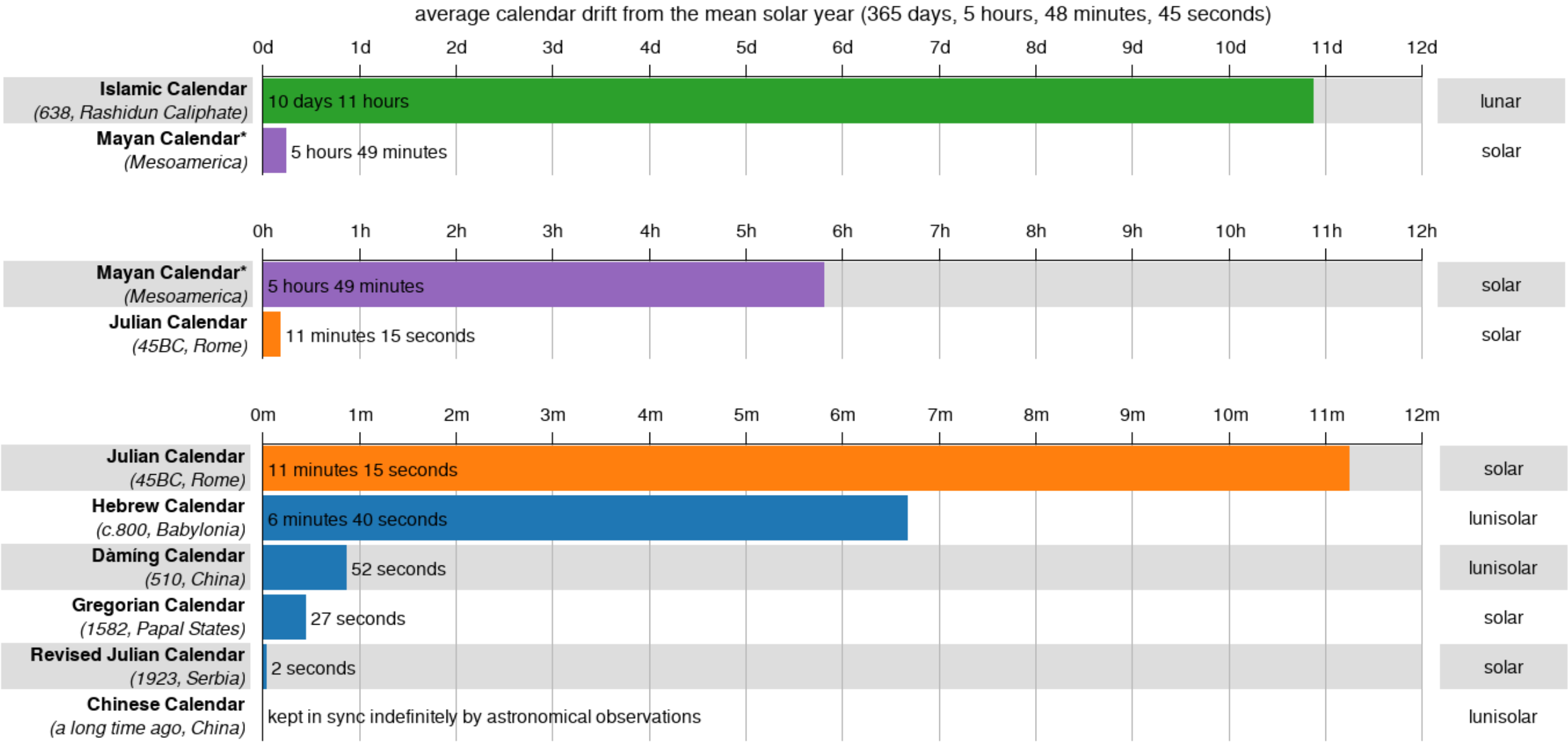


- ‘When did Astronomy begin,’ is a debatable question.
  - Since stars are used for navigation, then an argument could be made that before recorded history proto-humans used the moon/sun stars to find their way.
  - 5000 years ago, the first cataloged astronomical findings can be traced back to Mesopotamia.
  - 700 years ago, Copernicus revolutionized our thoughts on space bringing in a new era of understanding.
  - 100 years ago, Black holes and Dark Matter ‘come to light’
  - 10 years ago, Gravity is detected… Are we still in the dark?

A second is not enough.

- There are many calendars:
  - Egyptians marked the start of the year when Sirius rose in the same place as the Sun.
  - Greeks based their calendar (Metonic) on the moon's cycle
  - The Chinese, Hebrew and Hindu calendars are widely used for religious and/or social purposes.
  - A Fiscal Calendar is used for businesses to keep track of money.
  - The modern-day commonly used calendar is the 'Gregorian'.

COMPARING THE ACCURACY OF DIFFERENT CALENDARS



* the Mayan Calendar used a 365-day 'vague year' cycle (*Haab'*), as well as a 260-day ritual cycle (*Tzolk'in*) and a 360-day (*tun*)-based Long Count cycle.

/u/Udzu

Gregorian Calendar

- A modification of the Julian calendar.
- First proposed by Dr. Aloysius Lilius
  - Julian Calendar too long, causing the vernal equinox to slowly drift.
- Put in place by Pope Gregory XIII on 2/24/1582.
  - Many countries took a while to adopt and had to ‘miss days’ (eg. England, the last to adopt, went to bed on Wednesday 9/2/1752, and woke up on Thursday 9/14/1752)

Gregorian Calendar: Months

Name	Days	Entemology
January	31	Janus: Two faced god of doorways and gates.
February	28-29	Februum (Latin), month of Atonement
March	31	Mars, Greek God of War
April	30	Aperire (Latin), ‘to open’ (plants/trees)
May	31	Maia, Greek Goddess of Spring and Growth
June	30	Juno, Goddess of Wisdom and Marriage
July	31	Julius Caesar
August	31	Augustus Caesar
September	30	Septem, 7 in Latin
October	31	Octo, 8 in Latin
November	30	Novem, 9 in Latin
December	31	Decem, 10 in Latin

Gregorian Calendar: Days

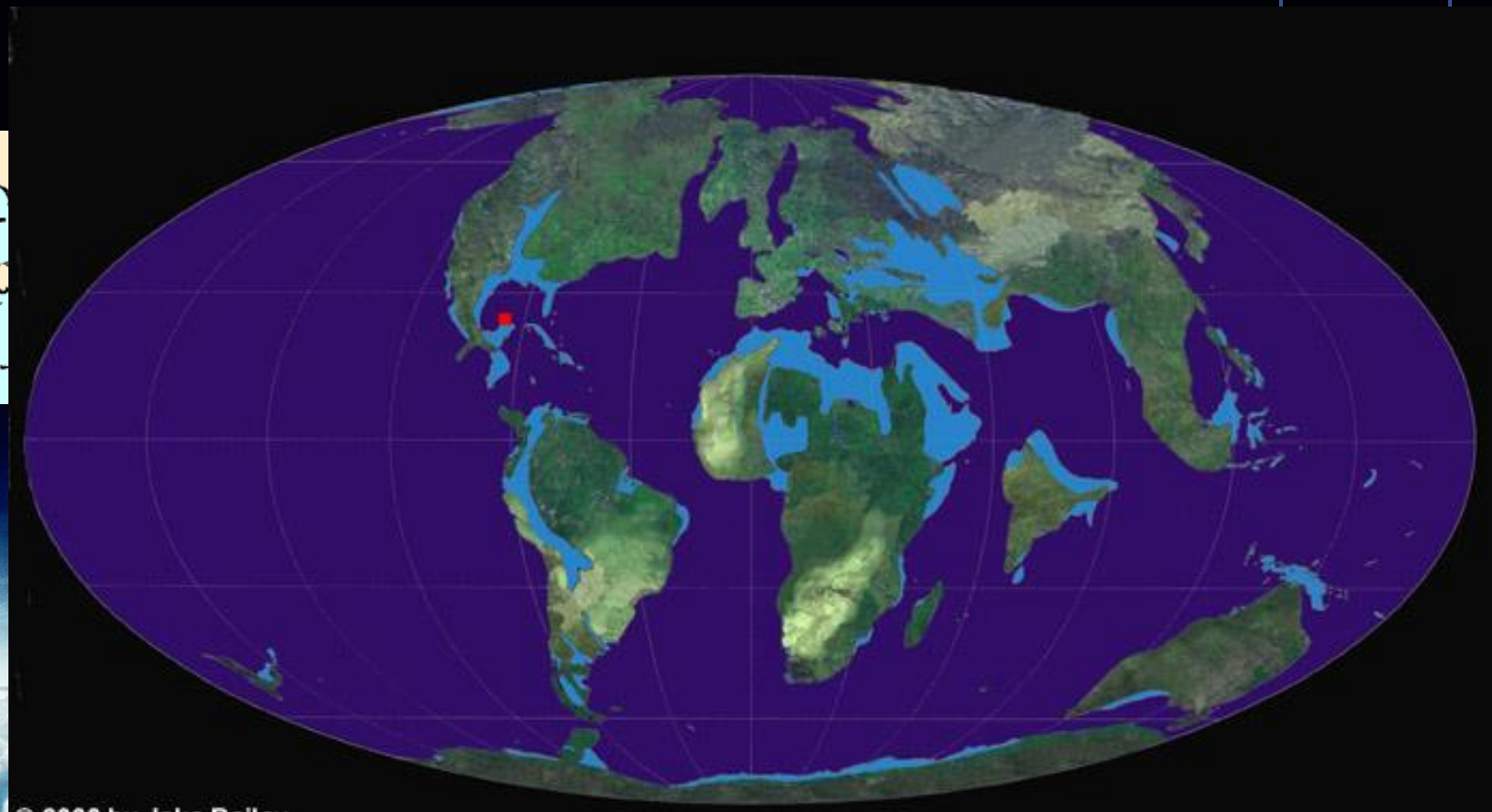
Name	Entemology (Old and Middle English)
Sunday	Day of the sun (sol)
Monday	Day of the moon
Tuesday	Day of Tiw/Tyr (Norse god victory/heroics ~ Mars)
Wednesday	Day of Wodanaz (translates to Mercury)
Thursday	Day of Thor (Norse god thunder ~ Jupiter)
Friday	Day of Frigg ~ Venus
Saturday	Day of Saturn

Timelines

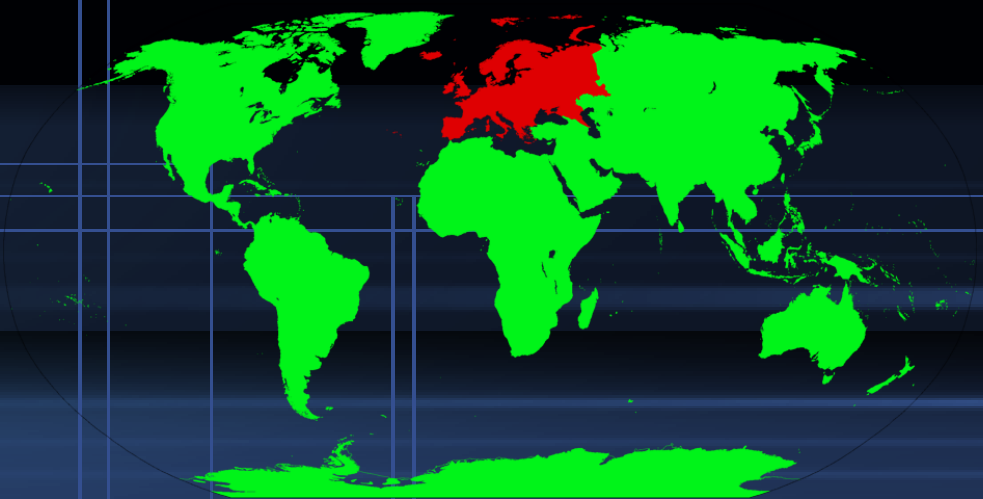
- BC-Before Christ Birth (Julian and Gregorian)
- AS-Anno Salutis (Year of Salvation)
  - Used until the 18th Century
- AD-Anno Domini (In the Year of the Lord)
- BCE/CE- (Before) Common Era
  - Used in China among others.
- Historical timelines don't use 0 BC/AD
- In math calculations '0' is needed so an Astronomers year is -1 off from normal.

- **ca. 14,000,000,000 BCE**
  - The universe emerges from a state of extremely high temperature and density in an event known as the Big Bang.
- **ca. 10,000,000,000 BCE**
  - Our Galaxy, the Milky Way, is probably formed around this time.
- **ca. 4,600,000,000 BCE**
  - Our Sun and our Solar System are formed.
- **ca. 4,400,000,000 BCE**
  - Oldest known rocks on Earth formed, found in Australia.

- **ca. 65,000,000 BCE**
  - A impact in the Yucatan with a force of $1x10^{14}$ tons of TNT (2 million times any tested H-bomb) leaving the Chicxulub Crater (Mayan: The devils tail). This contributed to the K/T extinction event in which about 50% of all species became extinct. It ended the reign of dinosaurs and opened the way for mammals to become the dominant land vertebrates.

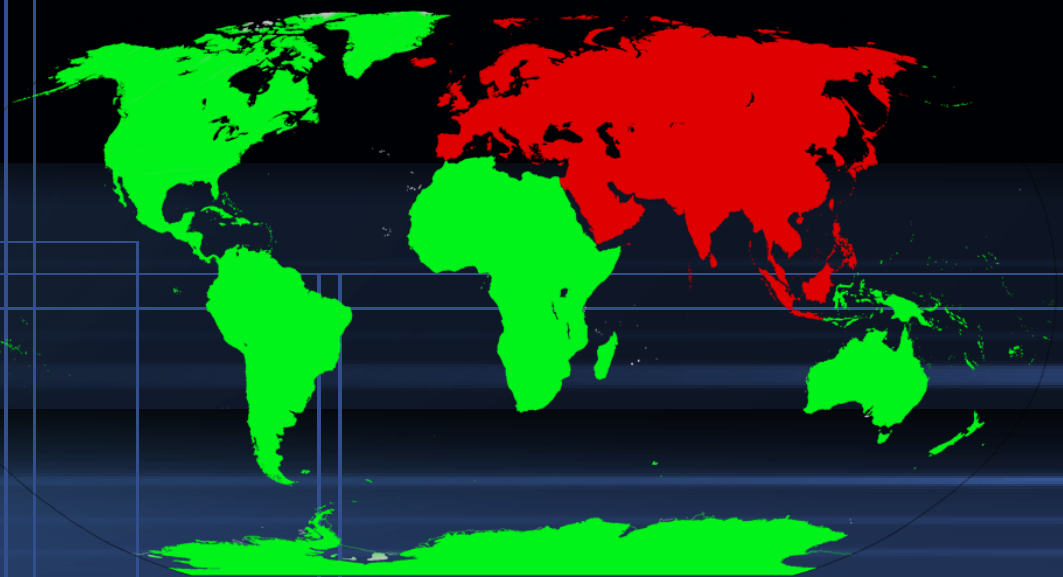


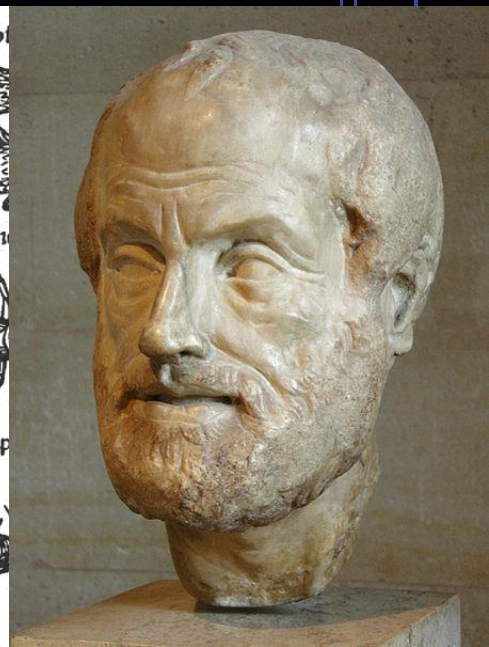
- **3200 BCE**
  - The Newgrange tomb is built in Ireland. During the winter solstice light shines down the main corridor for 15 minutes.
- **3000 BCE**
  - The Sacred Circle used to track lunar cycles is constructed in Callanish, Scotland.
- **2800-1500 BCE**
  - Stonehenge used to keep track of the motions of the Sun and Moon is constructed in Wiltshire, England.



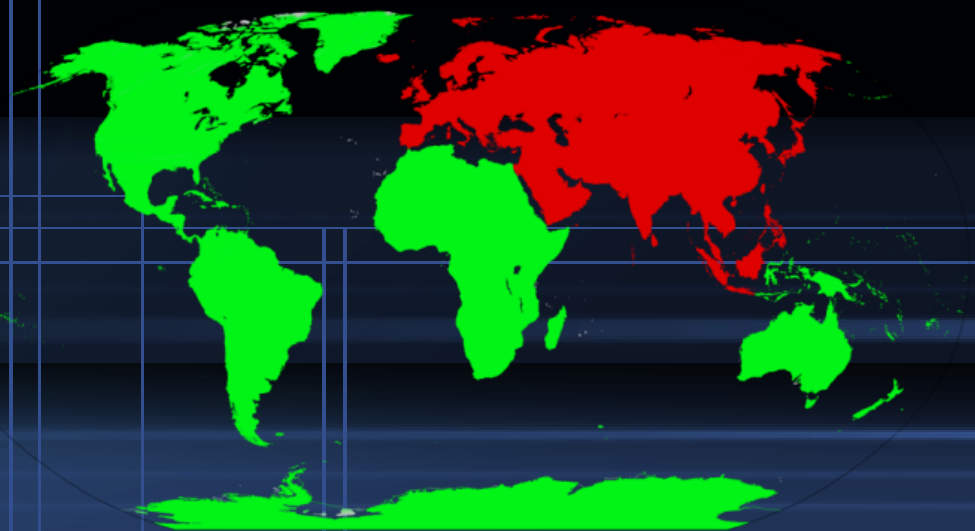
- **2296-1217 BCE**
  - The Chinese record the earliest sighting of a comet (2296), Lunar eclipse (1361), Solar eclipse (1217).
- **1500 BCE**
  - Egyptians abandon star clocks for a more accurate timer; clepsydra (Water Thieves).
- **1300 BCE**
  - The Egyptians have identified forty-three constellations and are familiar with those planets visible to the naked eye: Mercury, Venus, Mars, Jupiter, and Saturn.

- **ca. 1000 BCE**
  - Babylonian astronomers at some point during the 1st millennium BC divided the ecliptic into twelve equal zones of celestial longitude to create the first known celestial coordinate system: The Zodiac
- **384-322 BCE**
  - Aristotle discusses the phases of the moon. Worked with eclipses: led to thoughts about distances, and that the earth was round.

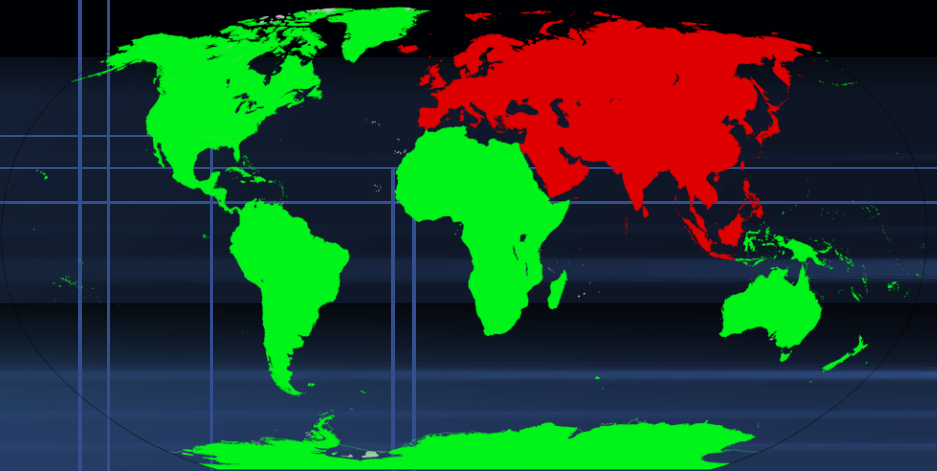




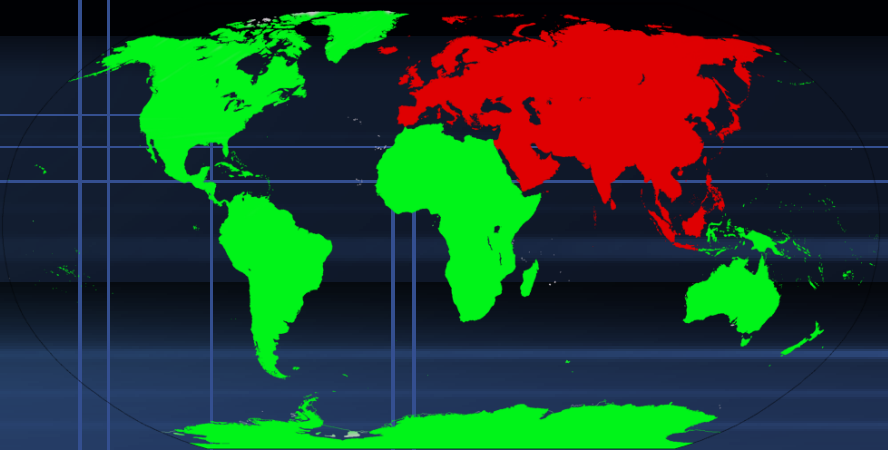
- **352 BCE**
  - Chinese astronomers make the earliest known record of a supernova.
- **300 BCE**
  - Babylonian astronomer Berosus invents the hemispherical sundial used to tell time by the shadow of the sun.
- **280 BCE**
  - Greek astronomer Aristarchus of Samos writes ‘On the Size and Distances of the Sun and the Moon’. He is the first to maintain that the Earth rotates and revolves around the Sun.
- **240 BCE**
  - Eratosthenes measures the circumference of the Earth with amazing accuracy.



- **200 BCE**
  - Chinese scholars recognize a relationship between tides and the phases of the Moon.
- **139 CE**
  - The Egyptian astronomer Claudius Ptolemy makes observations in Alexandria. Proposes the geocentric (earth-centered) universe model in his book Mathematike Syntaxis.
- **400 CE**
  - Egyptian astronomer and mathematician Hypatia, one of the first women scientists, is a widely consulted authority on matters of physics and mathematics.

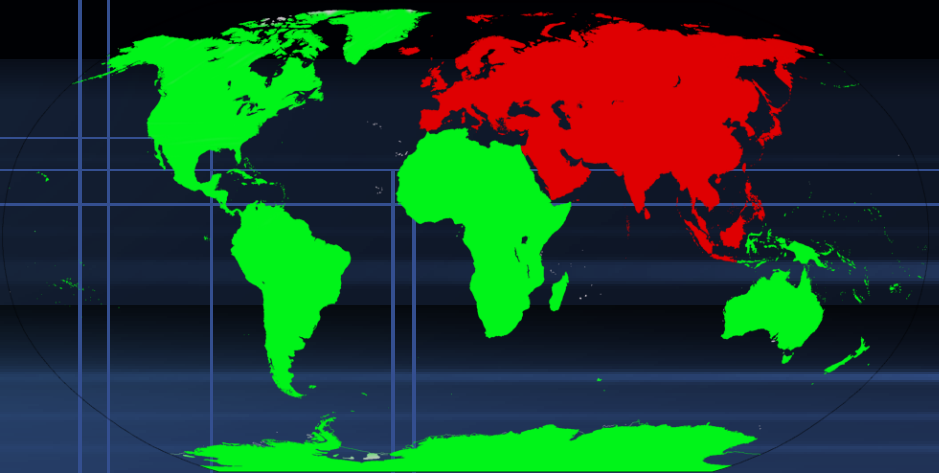


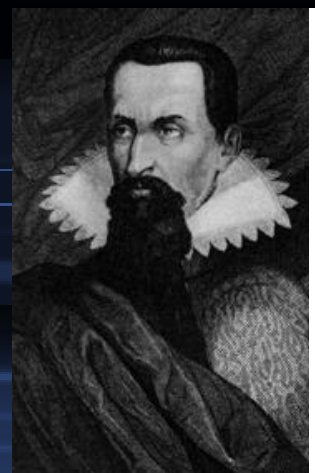
- **750-1000**
  - Muslim, Peruvian, Arabian astronomers spend time documenting and archiving astronomical phenomenon, including the existence of the Andromeda galaxy.
- **1054: 4 JULY**
  - A bright new star, visible in daylight, appears in the constellation Taurus. The supernova (which now forms the Crab Nebula) is observed in China,Korea and is recorded in rock paintings in southwestern America.
- **1178**
  - Monks from Canterbury, England, report seeing fire issue from one of the horns of the new moon. It is the only authenticated record of a lunar meteor impact.

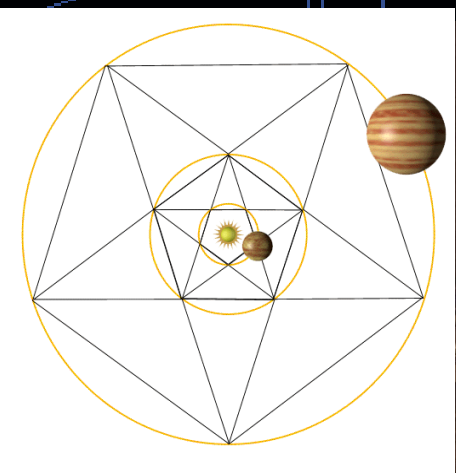


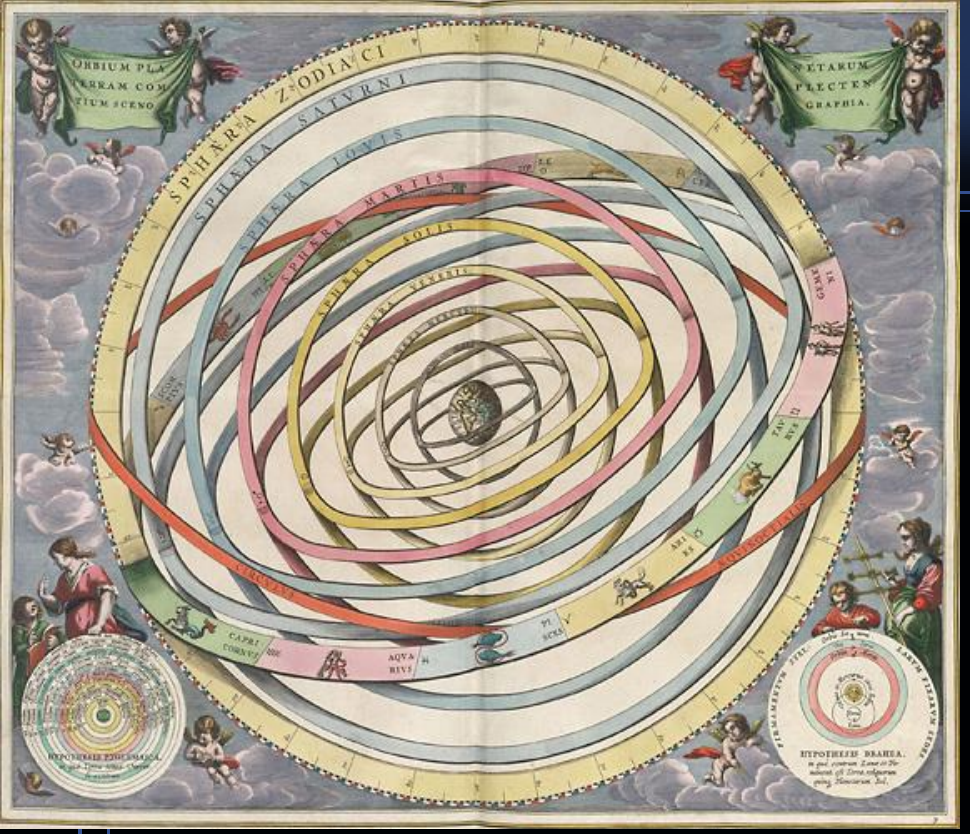
- **600**
  - Mayans form a calendar that tracked passage of time. Used to determine astronomical events like the transit of Venus.
- **800**
  - The Peruvian city of Machu Picchu, contains an astronomical altar, ‘The hitching post of the Sun', which measure solar and lunar movements with great accuracy.
- **987**
  - Toltecs of the Central American Mayan city of Chichén Itzá construct monuments with ritual astronomical alignments to the rising and setting of the Sun and the sacred planet Venus.
- **1250**
  - The Anasazi carve the Sun Dagger in the Chaco Caynon, New Mexico.

- **1514**
  - Polish astronomer Nicolaus Copernicus writes about the problems of the Geocentric (Earth-centered) view of the universe, the Universe in De Revolutionibus Orbium Coelestium, which promotes a heliocentric view. In 1533 he lectures in Rome with the approval of Pope Clement VII.
- **1563**
  - Danish astronomer Tycho Brahe observes the alignment of Jupiter and Saturn, one month earlier than predicted by available tables. He sets about producing new, more accurate, tables of his own.
- **1596**
  - German astronomer Johannes Kepler publishes The Cosmographical Mystery, to prove that the planets orbits the Sun. In 1609 he publishes his three laws of planetary motion in Harmonice Mundi.





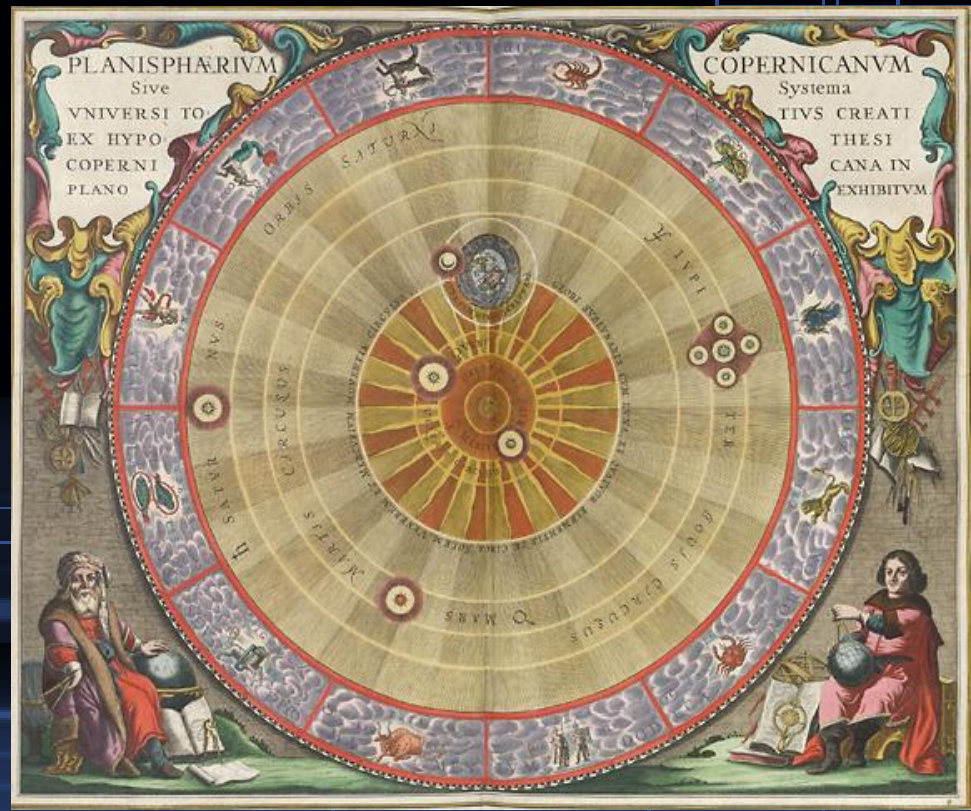




Heliocentric
Sun Centered Universe
Pioneered:
Aristarchus (~200 BCE)
Favored By:
Copernicus, Galileo

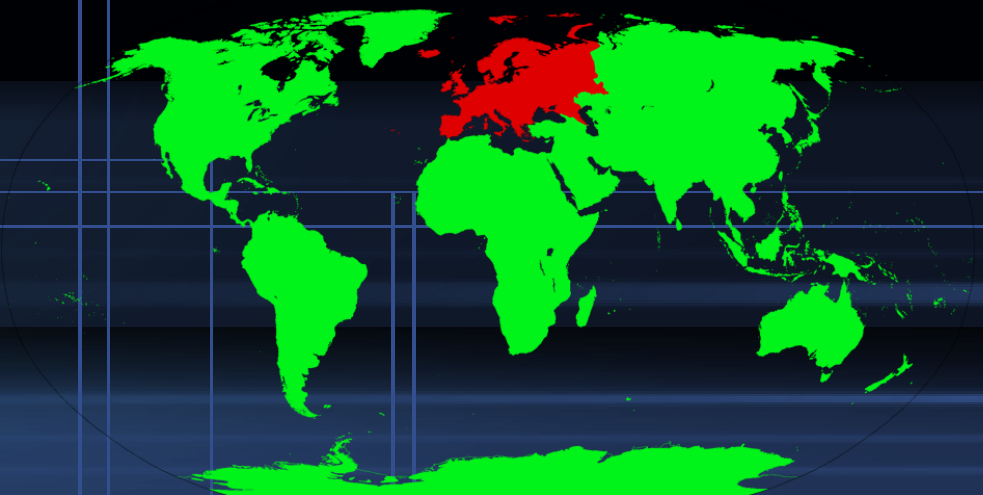
Vs.

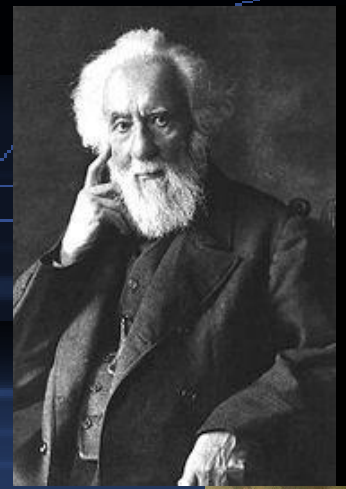
Geocentric
Earth Centered Universe
Pioneered:
Aristotle (~300 BCE)
Favored By:
Ptolemy, Catholic Church

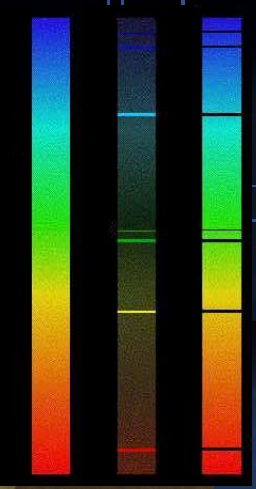


- **1610**
  - Italian astronomer Galileo Galilei discovers three moons around Jupiter, putting more doubt in the geocentric model. Galileo goes on to promote the Copernican model (heliocentric).
- **1616**
  - The Holy Office in Rome threatens Galileo with the severest penalties of the Inquisition unless he agrees not to teach the Copernican model.
- **1633**
  - Galileo is tried before the Inquisition, forced to retract his views of the universe, and sentenced to house arrest where he died in 1642.

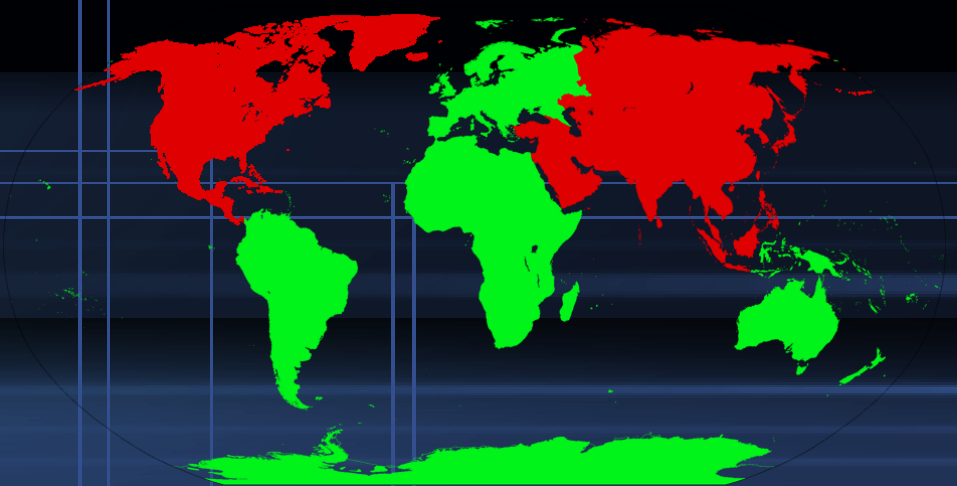
- **1672**
  - Calculating the distance to Mars, Italian-born French astronomer Giovanni Cassini calculates other astronomical distances, including the astronomical unit.
- **1682**
  - English astronomer Edmond Halley observes a comet that he later concludes orbits every 76 years.
- **1863**
  - English astronomer William Huggins uses the spectra of stars to show that they are made of the same elements as the Earth and the Sun.



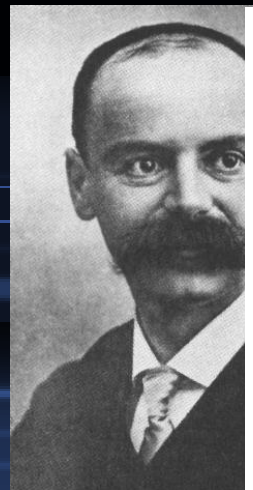




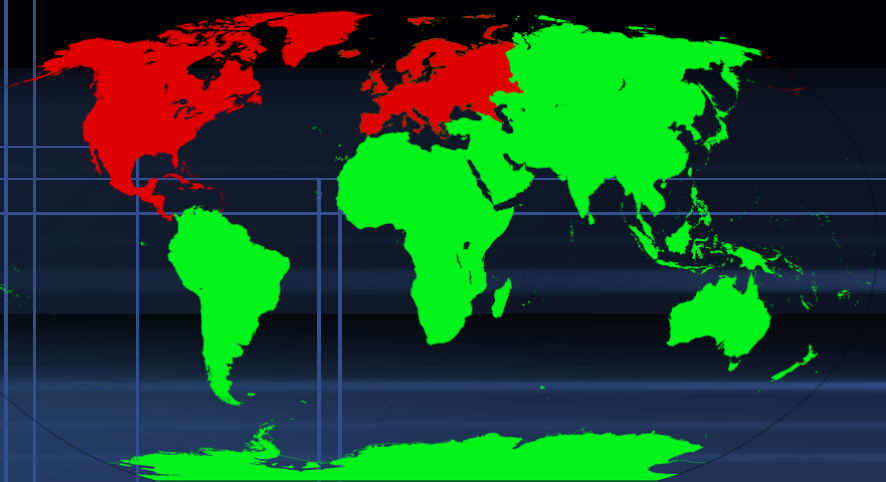
- **1895**
  - Soviet scientist Konstantin Tsiolkovsky is dubbed the ‘Father of Astronautics’ after he publishes Gryozy o zemle i nebe (Dreams of Earth and Sky), which is about using liquid-fueled rockets to travel in space.
- **1897**
  - US geologist Thomas Chamberlin, develops planetesimal theory.
- **1905**
  - German physicist Albert Einstein publishes four papers revolutionizing the basic understanding of space, time mass and energy. No Nobel prize was awarded for this.



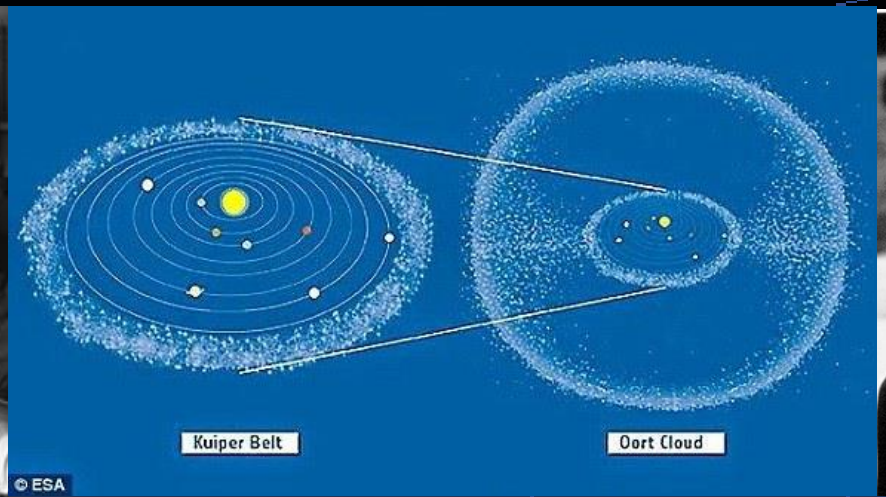
- **1907**
  - US Physicist Robert Goddard, the father of modern rocketry, proved that rockets could produce thrust in a vacuum.
- **1916**
  - During WW1 German astronomer Karl Schwarzschild predicts the existence of black holes.
- **1919**
  - The International Astronomical Union (IAU) is founded to promote international cooperation in astronomy.

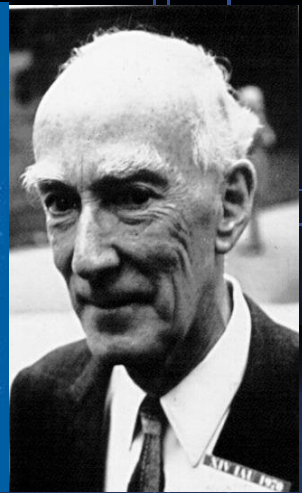


- **1927**
  - Belgian astronomer Georges Lemaître proposes that the universe was created by an explosion of energy and matter from a "primeval atom“.
- **1925**
  - US Astronomer, Edwin Hubble, announces that ‘nebulae’ in the Milky Way are other galaxies.
- **1929**
  - Hubble and Milton Humason (US) use the doppler effect with light; galaxies moving away are red shifted while those moving towards are blue shifted. Since most are red shifted this supports Big Bang theory.

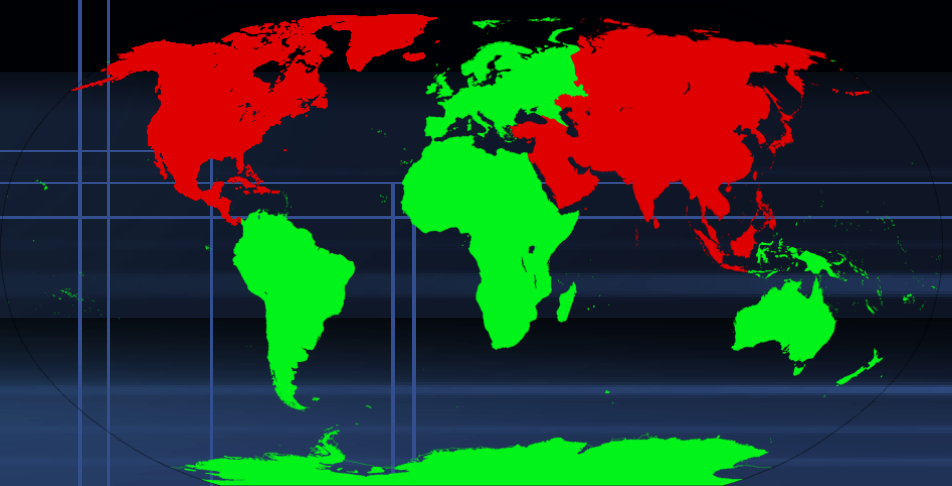


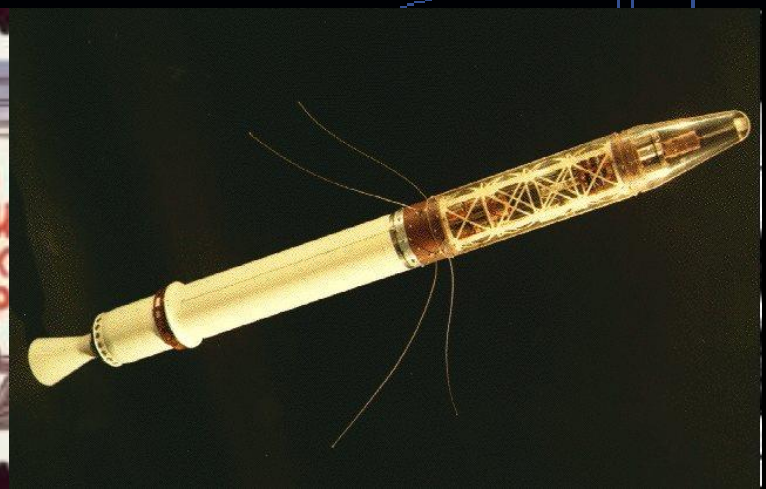
- **1950**
  - Dutch astronomer Jan Oort determines comets come from the "Oort cloud“ about one light year away.
- **1951**
  - US astronomer Gerard Kuiper predicts another birthplace for comets, inside the orbit of Pluto (found 1990’s and named ‘Kuiper Belt.)
- **1951**
  - The US Air Force successfully recovers a monkey and eleven mice from a rocket flight that reached an altitude of 72-km (45-mi).



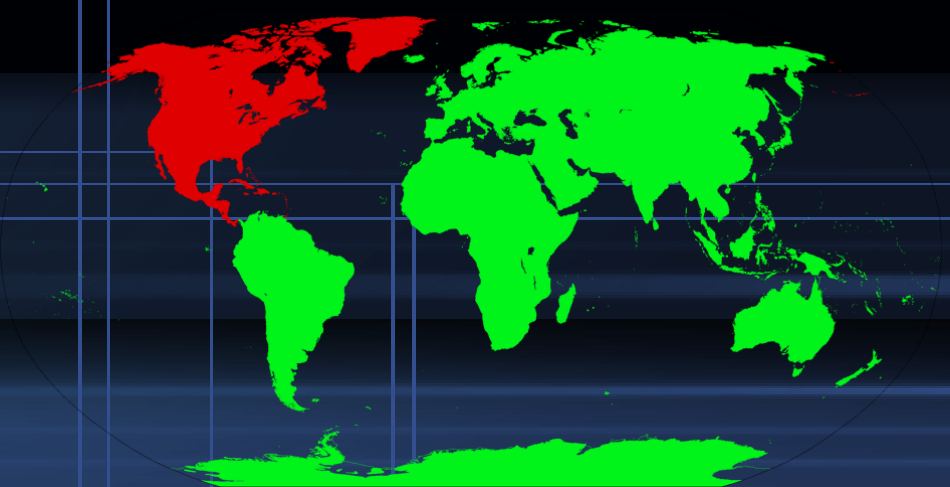


- **10/4/1957**
  - USSR (Soviets) launch Sputnik 1, the first artificial satellite. It circles the Earth in 95 minutes, beginning the space age/space race.
- **11/3/1957**
  - Soviet spacecraft Sputnik 2 is placed into orbit carrying a dog, Лайка (Laika), the first animal in space (over 50 miles above earth). She survived for four orbits before overheating issues.
- **1/31/1958**
  - The US Army launches its first satellite, Explorer 1, into Earth orbit to study radiation from the Sun.





- **4/29/1958**
  - US NACA is dissolved, and the civil National Aeronautics and Space Administration (NASA) is formed to join the space age.
- **1959**
  - US Astronomer Freeman Dyson theorizes building an enclosed structure around a star allows a civilization to capture all the stars energy.
- **1960**
  - US Astronomer Frank Drake develops an equation to possibly determine the number of extraterrestrial civilizations that could be out there.



$N = R^* \cdot f_p \cdot n_e f_l \cdot f_i \cdot f_c \cdot L$

N: The number of civilizations in our galaxy with which we might expect to be able to communicate at any given time.

*R**: The rate of star formation in our galaxy. (1 per yr)

f_p: The fraction of those stars that have planets. (.2-.5)

n_e: The average number of planets that can potentially support life per star that has planets. (1-5)

f_l: The fraction of the above that actually go on to develop life. (1)

f_i: The fraction of the above that actually go on to develop intelligent life. (1)

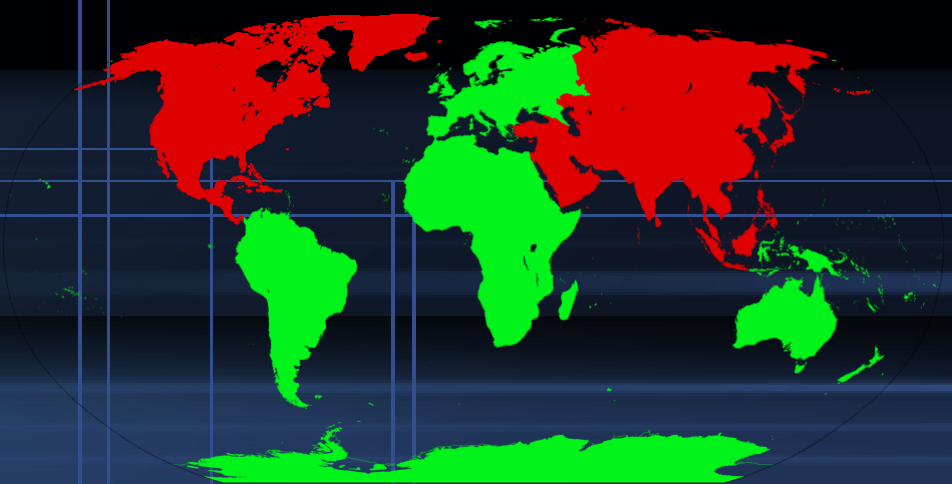
f_c: The fraction of the above that are willing and able to communicate. (.1-.2)

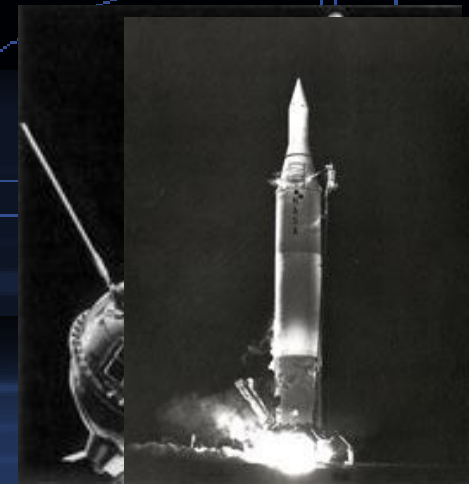
L: The expected lifetime of such a civilization. (1k-100-M)

Drake thought there could be 1000-100,000,000 in MWG

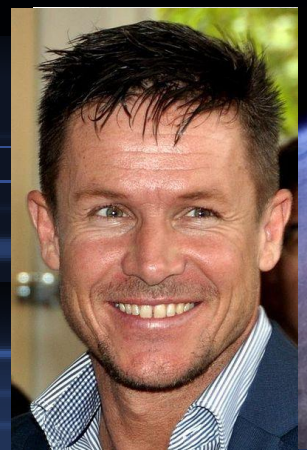
Current estimates put it anywhere from 1 (just us) to 15.6 million

- **1959**
  - 2 JANUARY: The USSR launches Lunik 1. It escapes Earth's gravity and passes within 6,400 km/4,000 mi of the Moon.
  - 3 MARCH: The US launches the Moon probe Pioneer 4; it passes within 59,000 km/37,000 mi of the Moon.

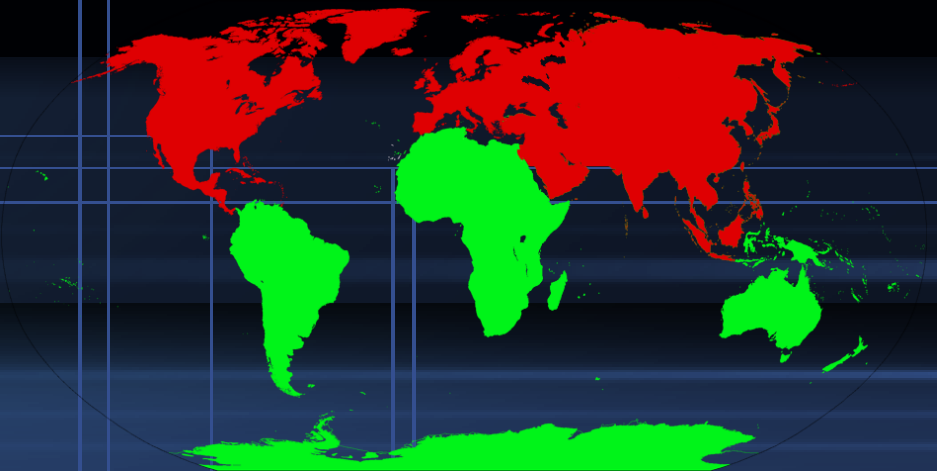




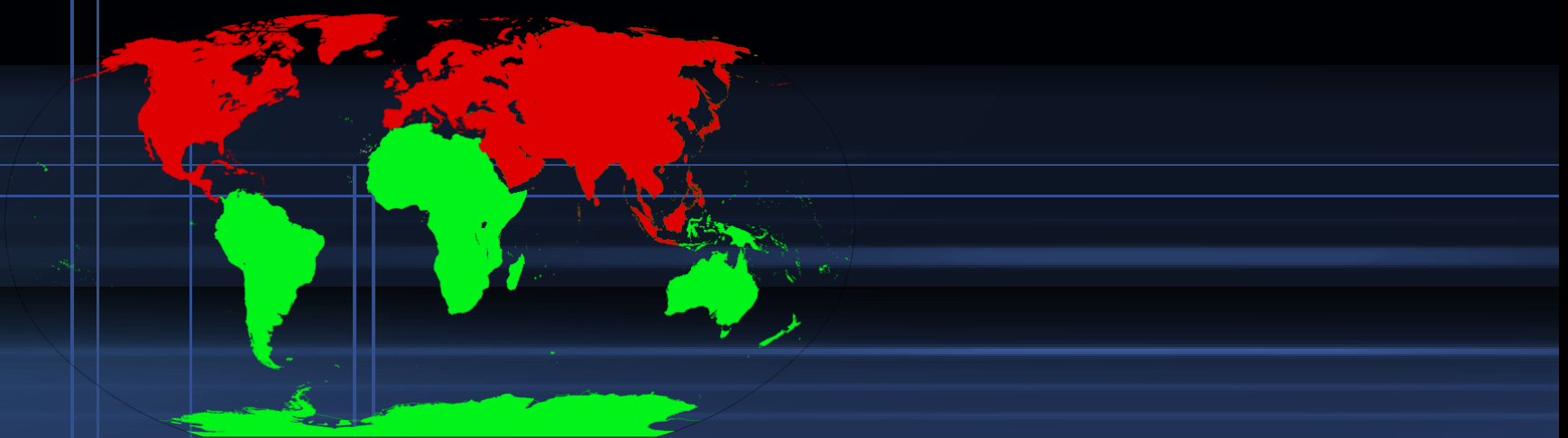
- **1960**
  - US Colonel Joseph Kittinger, with aid of a drogue chute, steps out of Excelsior III at a height of 31.3-km (19.5-mi). While the accent took 1.5-hrs the decent lasted a total of almost 14 minutes (4.5 of free fall).
  - Without aid Eugene Andreev (USSR) had the longest free fall (set 1962) of 24.5-km (15.25-mi)
  - In 2012 Austrian Felix Baumgartner broke both with a 39-km (24-mi) fall, speeds may have reached 840-mph.

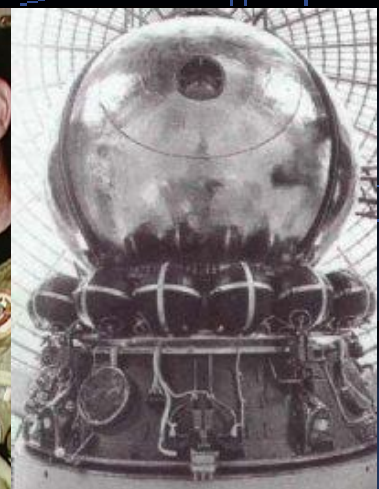


- **1961**
  - 4/12: Soviet cosmonaut Yuri Gagarin, travels in space for 108 minutes in Vostok 1.
  - 5/5: US astronaut Alan Shepard, in the Mercury capsule Freedom 7, makes a 14.8-minute single suborbital flight. He is the first US astronaut into space.
- **2/20/1962**
  - US astronaut John Glenn, in Friendship 7, becomes the first US astronaut to orbit the Earth three times.

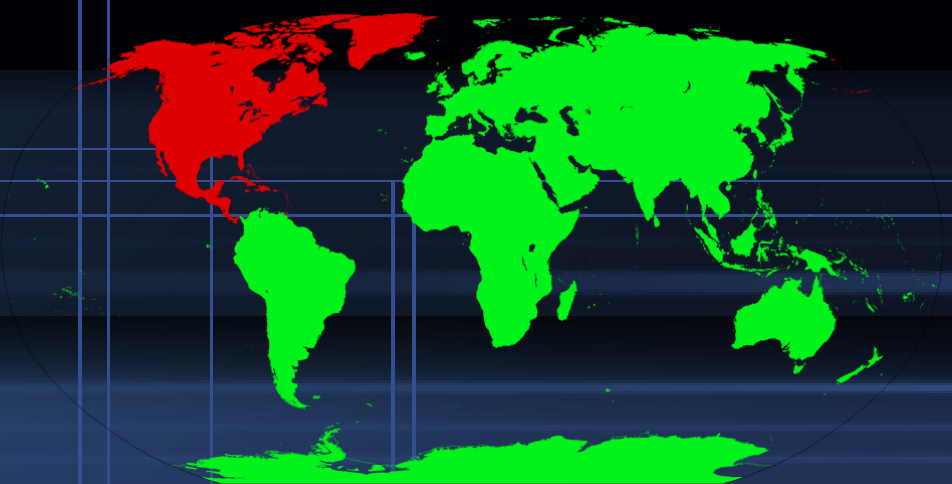


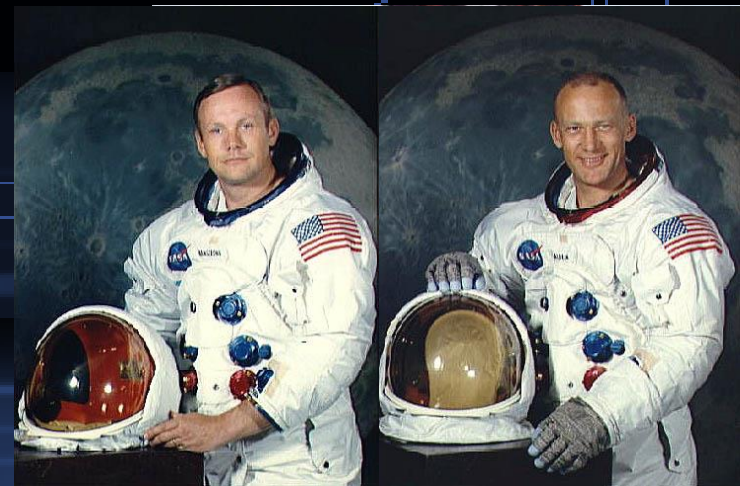
- **4/26/1962**
  - US and UK launch Earth satellite Ariel a cooperative launch between countries.
- **6/16/1963**
  - Female Soviet cosmonaut Valentina Tereshkova, spends three days aboard Vostok 6, the first female and only to go solo.
- **3/18/1965**
  - Soviet cosmonaut Alexsi Leonov leaves spacecraft Voskhod 2 performs a twenty-minute spacewalk.

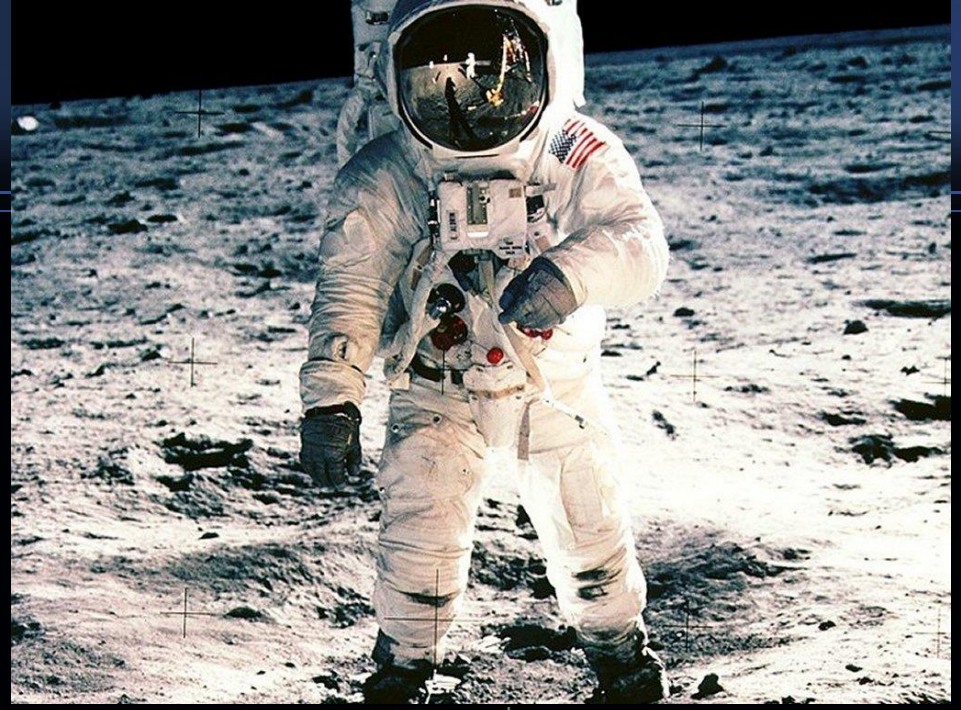




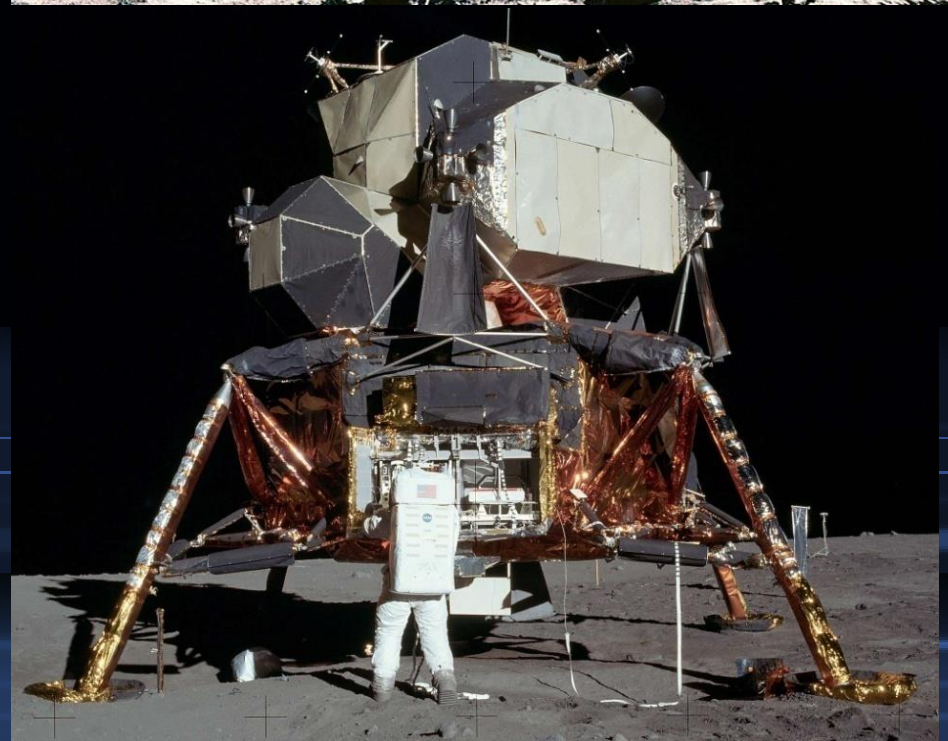
- **1/27/1967**
  - US astronauts, Virgil ('Gus') I Grissom, Edward White, and Roger B Chaffee, die in a fire during a countdown rehearsal on the Apollo 1 spacecraft at Kennedy Space Center, FL, the first human casualties of the US space program.
- **7/20/1969**
  - Four days after Launching from Cape Canaveral, FL, Apollo 11 lands on the Sea of Tranquility, the Moon. Neil Armstrong and Buzz Aldrin become the first humans to step onto another world.

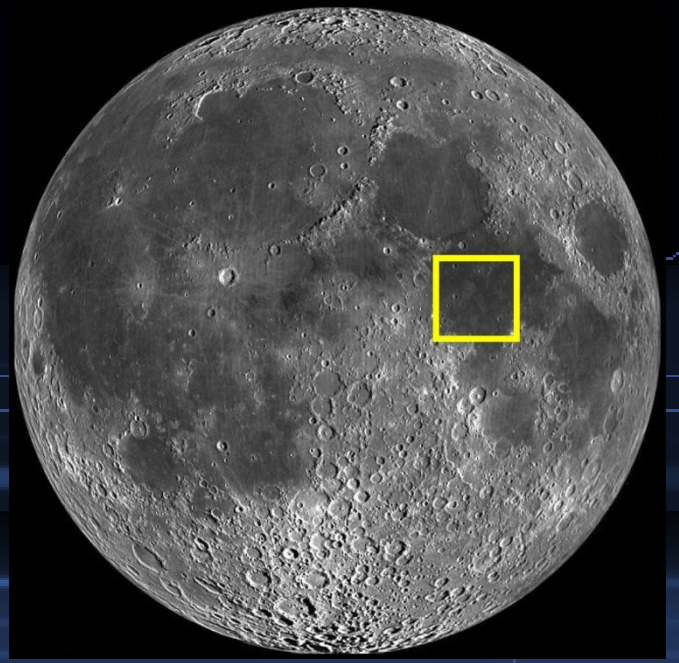




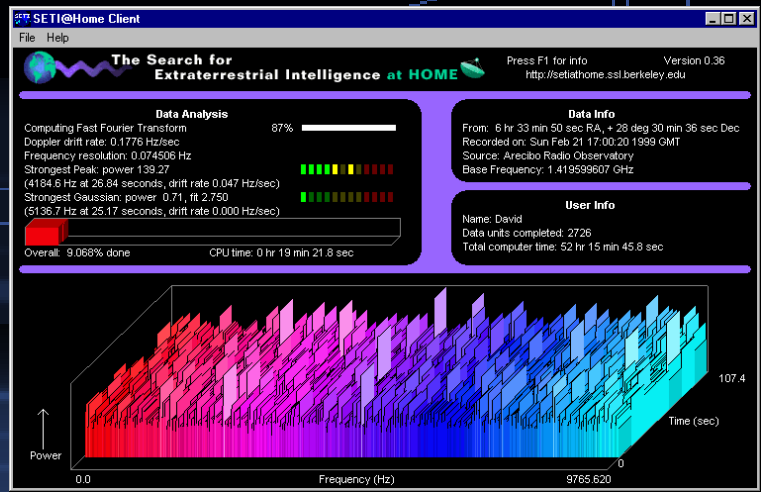



APOLLO 11



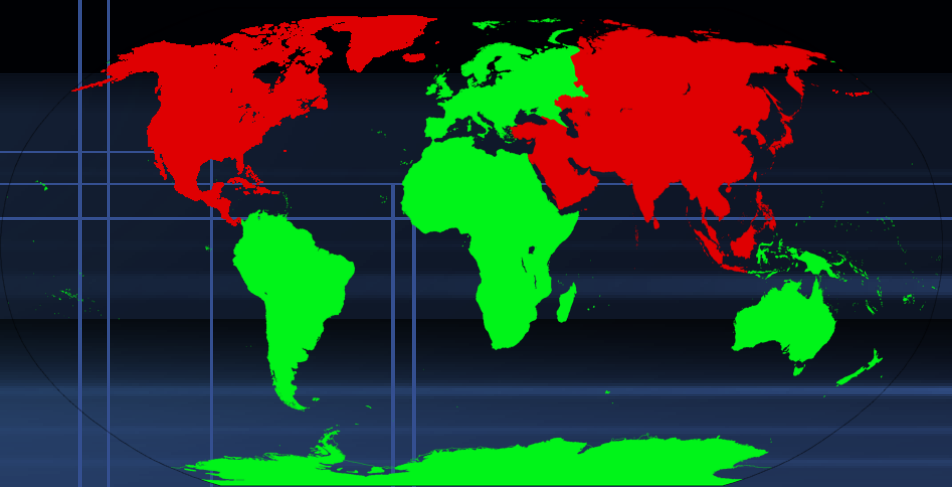


- **1974**
  - English physicist Stephen Hawking (1/8/42-3/14/18) predicts that black holes can emit radiation.
- **1980**
  - US astronomer Carl Sagan (11/9/34-12/20/96) publishes Cosmos, the most watch PBS program.
- **1983**
  - The Search for Extraterrestrial Intelligence (SETI) program is established at NASA's Ames Research Center, Mountain View, California.

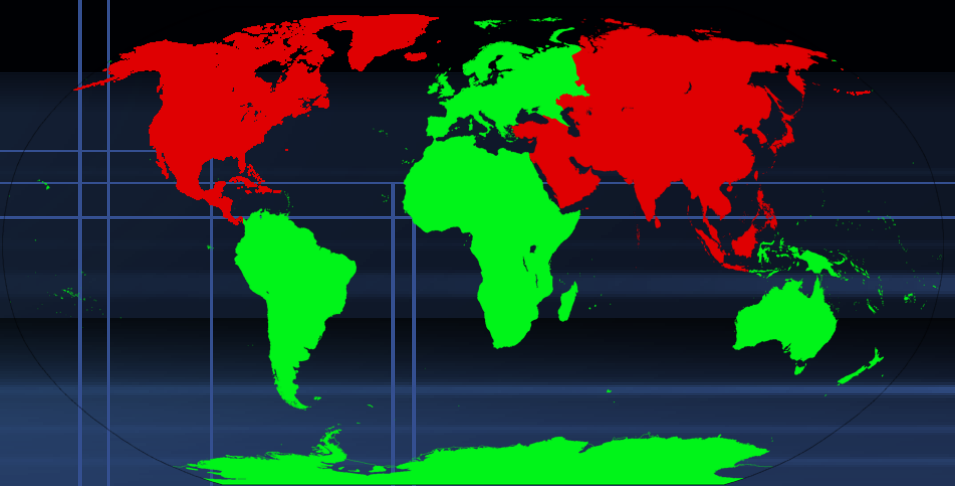


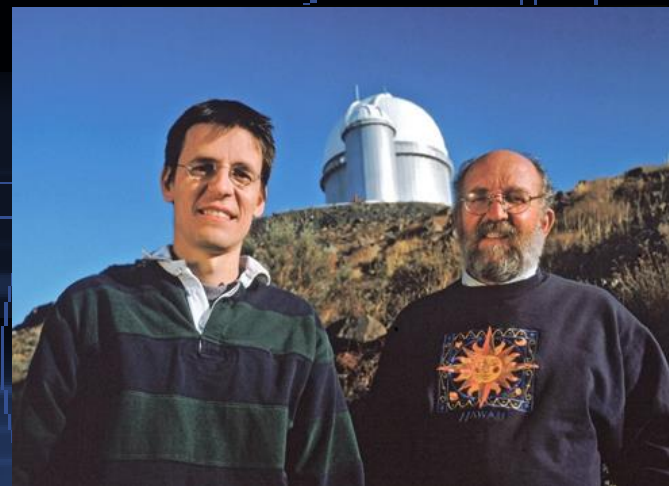
- **1983**
  - 13 JUNE: US space probe Pioneer 10 leaves the Solar System (launched March 3, 1972).
  - 18–24 JUNE: The US Challenger mission includes female Sally Ride.
  - 30 AUGUST-5 SEPTEMBER: The Challenger mission includes African American Guion Bluford.
- **1986**
  - 28 JANUARY: Challenger explodes shortly after take-off, killing the crew of seven and stalling the US space program for two years.

- **1986**
  - 19 FEBRUARY: USSR launches the core unit of the Mir (Peace/World) space station. It housed three crew members. It was crashed over the Pacific 3/23/2001.
- **1990**
  - 24 APRIL: US space shuttle Discovery places the Hubble Space Telescope in Earth orbit; the main mirror proves to be defective.

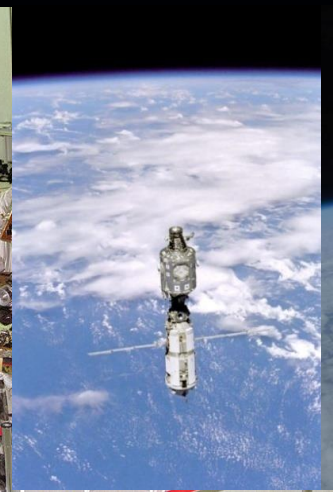


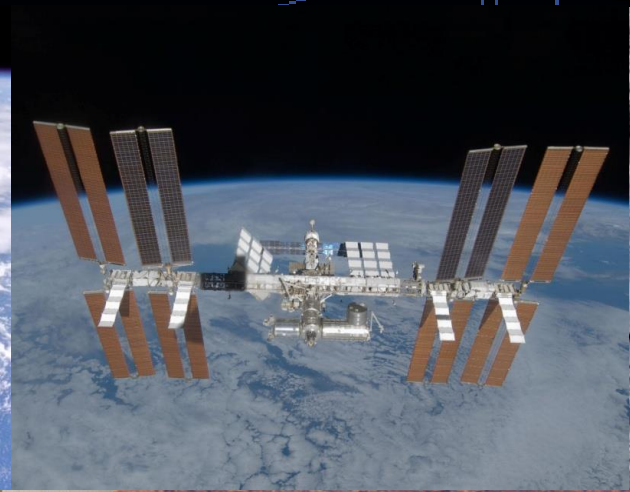
- **1995**
  - 29 JUNE–4 JULY: The US space shuttle Atlantis docks with the Russian Mir space station in the first superpower linkup in space since 1975.
- **1995**
  - Studying in Geneva, Switzerland Didier Queloz and Michel Mayor discover the first Exoplanets around main sequence star. Since 3890+ have been confirmed… we are not alone!

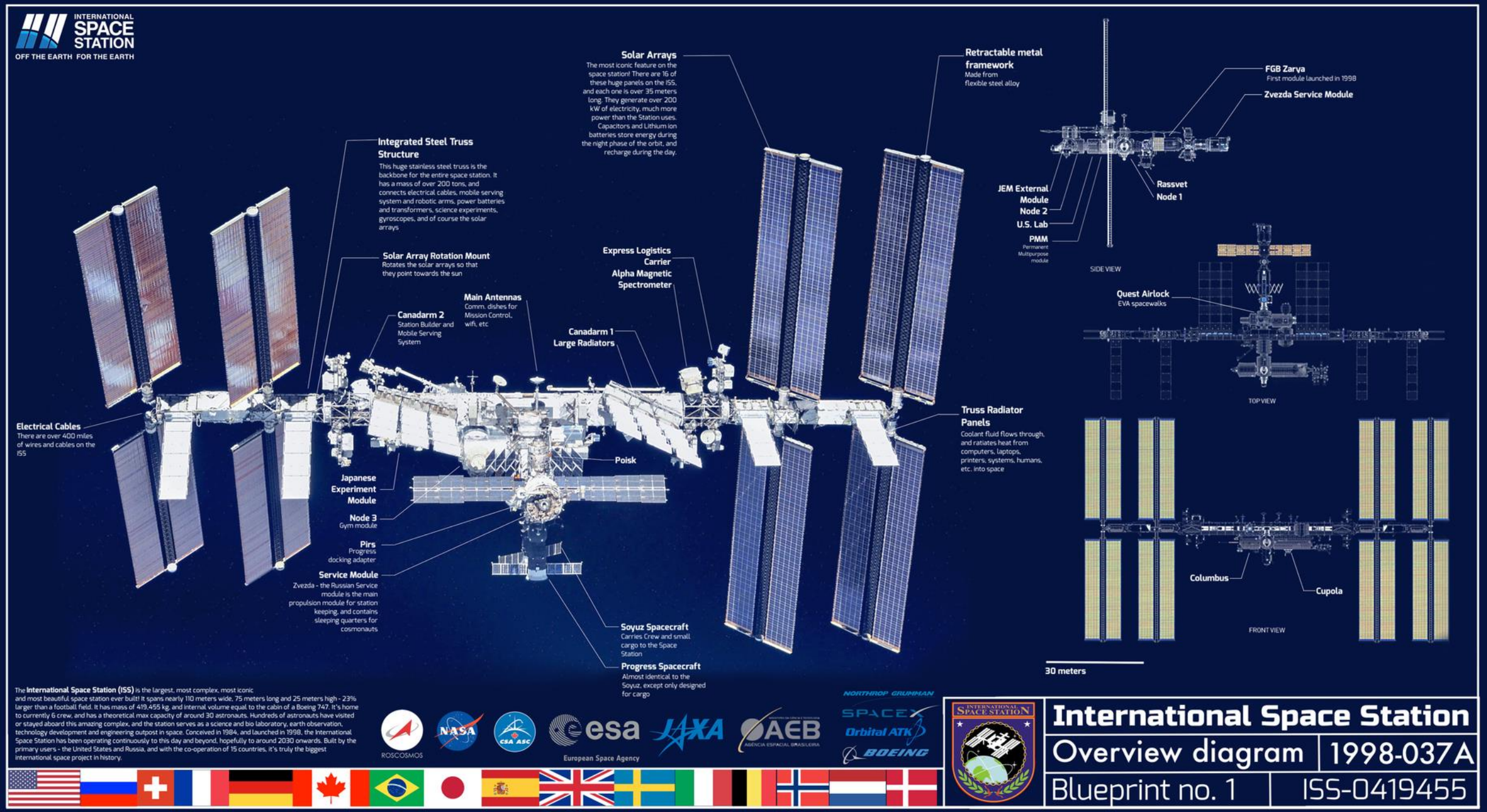




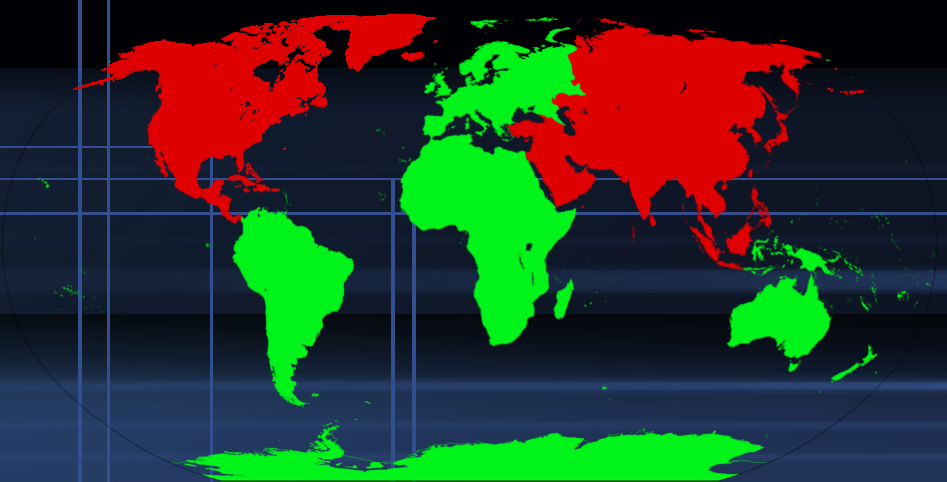
- **1997**
  - 7/4: The US spacecraft Mars Pathfinder lands on Mars. Controlled from Earth, rover Sojourner, begins to explore.
- **1998**
  - 11/20: Sixteen countries collaborate and launch the first module of the International Space Station. The ISS orbits the Earth every 1.5 hours and can hold seven people (2023: 269 people from 21 countries). Planed decommission in 2031.

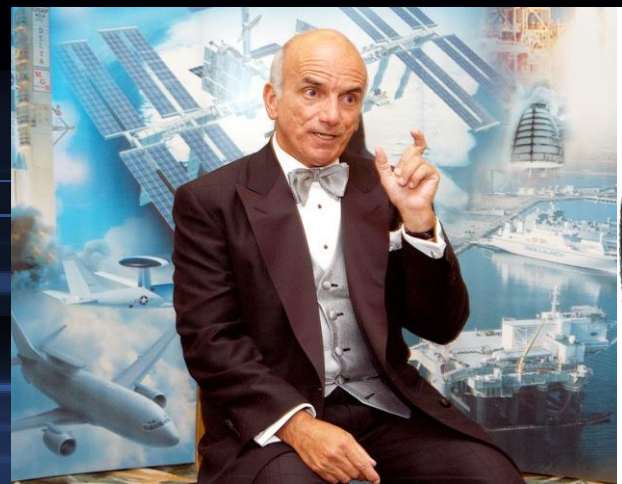




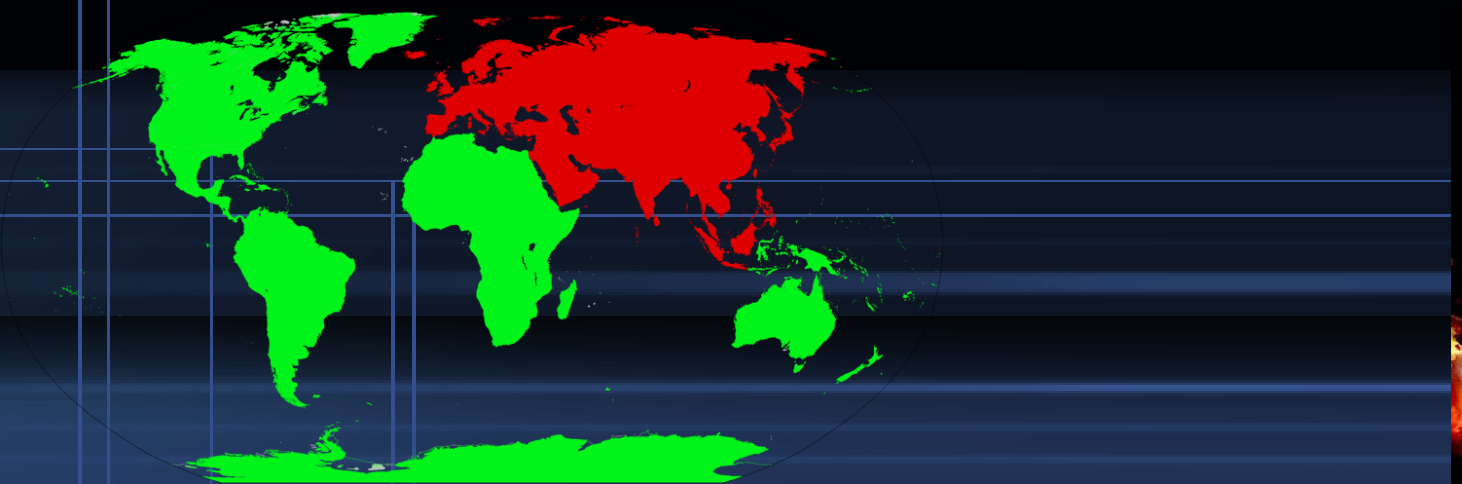

INTERNATIONAL SPACE STATION
OFF THE EARTH FOR THE EARTH
Solar Arrays
The most iconic feature on the space station! There are 16 of these huge panels on the ISS, and each one is over 35 meters long. They generate over 200 kW of electricity, much more power than the Station uses. Capacitors and Lithium ion batteries store energy during the night phase of the orbit, and recharge during the day.
Retractable metal framework
Made from flexible steel alloy
FGB Zarya
First module launched in 1998
Zvezda Service Module
Integrated Steel Truss Structure
This huge stainless steel truss is the backbone for the entire space station. It has a mass of over 200 tons, and connects electrical cables, mobile serving system and robotic arms, power batteries and transformers, science experiments, gyroscopes, and of course the solar arrays
JEM External Module
Node 2
U.S. Lab
PMM
Permanent Multipurpose module
Rassvet
Node 1
SIDE VIEW
Solar Array Rotation Mount
Rotates the solar arrays so that they point towards the sun
Express Logistics Carrier
Alpha Magnetic Spectrometer
Main Antennas
Comm. dishes for Mission Control, wifi, etc
Canadarm 2
Station Builder and Mobile Serving System
Canadarm 1
Large Radiators
Quest Airlock
EVA spacewalks
TOP VIEW
Electrical Cables
There are over 400 miles of wires and cables on the ISS
Truss Radiator Panels
Coolant fluid flows through, and ratiates heat from computers, laptops, printers, systems, humans, etc. into space
Poisk
Japanese Experiment Module
Node 3
Gym module
Pirs
Progress docking adapter
Service Module
Zvezda - the Russian Service module is the main propulsion module for station keeping, and contains sleeping quarters for cosmonauts
Columbus
Cupola
FRONT VIEW
Soyuz Spacecraft
Carries Crew and small cargo to the Space Station
Progress Spacecraft
Almost identical to the Soyuz, except only designed for cargo
30 meters
The International Space Station (ISS) is the Largest, most complex, most iconic and most beautiful, space station ever built! It spans nearly 110 meters wide, 75 meters long and 25 meters high - 23% larger than a football field. It has mass of 419,455 kg, and internal volume equal to the cabin of a Boeing 747. It's home to currently 6 crew, and has a theoretical max capacity of around 30 astronauts. Hundreds of astronauts have visited or stayed aboard this amazing complex, and the station serves as a science and bio laboratory, earth observation, technology development and engineering outpost in space. Conceived in 1984, and launched in 1998, the International Space Station has been operating continuously to this day and beyond, hopefully to around 2030 onwards. Built by the primary users - the United States and Russia, and with the co-operation of 15 countries, it's truly the biggest international space project in history.
ROSCOSMOS
NASA
CSA ASC
esa
European Space Agency
JAXA
AEB
NORTHROP GRUMMAN
SPACEX
Orbital ATK
BOEING
International Space Station
Overview diagram
1998-037A
Blueprint no. 1
ISS-0419455

- **1999**
  - 11/20: China launches its first spacecraft, Shenzhou, an un-crewed vehicle that travels for 21 hours in space. Four years later the first Taikonauts are sent to space.
- **2001**
  - 4/30: Russian Soyuz spacecraft carrying space tourist, US financier Dennis Tito, docks with the International Space Station. Tito pays $20 million for the privilege.

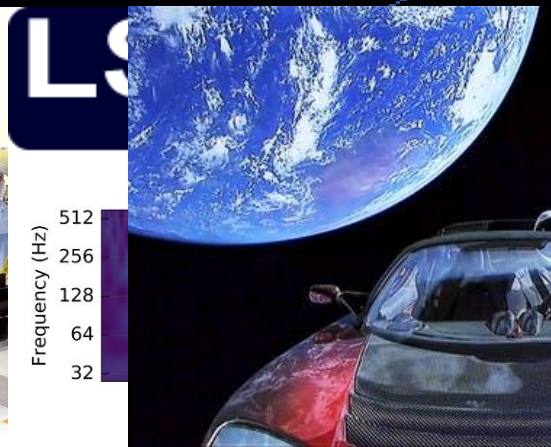




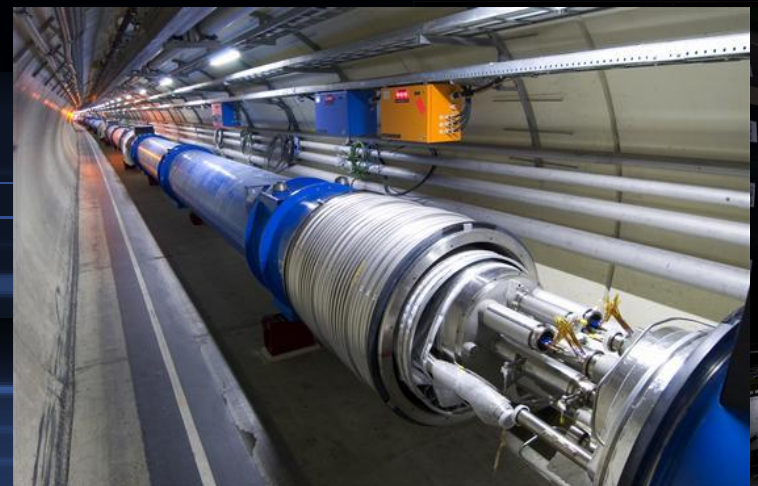
- **2006**
  - 8/24: IAU redefined the term "planet", and classified Pluto, Ceres, and Eris as dwarf planets.
- **2013**
  - **12/2:** China launches Long March 3B. Twelve days later it lands on the moon with rover Yutu (Jade Rabbit).
- **2014**
  - **8/6:** European Space Agency's Rosetta (launched 2004) matches it orbit with a comet to study its nucleus as it approaches the sun.

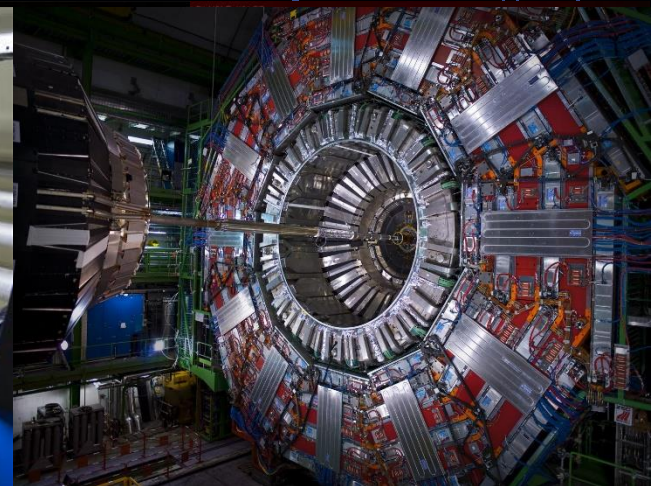


- **2015**
  - **7/14:** NASA's New Horizons makes its closest approach to Pluto. Sending back photos and chemical data. Currently looking at KBO's (has fuel till 2030's).
- **2016**
  - **2/11:** US based LIGO detects the gravity wave disturbance of two black holes merging. INDIGO construction to complete in 2030.
- **2018**
  - SpaceX, a US company, launches a Falcon Heavy with test payload including a prototype spacesuit and Tesla into a heliocentric orbit.



- **2019**
  - 4/10: Taken 2 years earlier Event Horizon publishes first image of a black hole (6.5 billion x Sun) in Messier 87.
  - 8/13 Switzerland's CERN produces temperatures 250,000 hotter than the center of the sun. (Higgs Boson disc. 2011)





- **2020**
  - European Space Agency's Gaia spacecraft creates most detailed 3D map of Milky Way (plotted 1.8 billion stars: just over 1%).
- 2024
  - Berkeley National Laboratory's DESI completes a 3D map of the Universe hypothesizing that dark Energy may not be a constant. If so 70% of the Universe may change and not be ripping the other 30% apart…