

## Today's Class: The Space Shuttle & ISS

- For next class on Commercial Space Projects, read: <https://www.nasa.gov/exploration/commercial/index.html>.



Astronomy 2020 – Space Astronomy & Exploration

1

## Class on Sep. 18

- Goals of Apollo
- Saturn V rocket and Spacecraft
- Apollo 11 – first landing on the Moon
- Apollo 17 – Science-driven mission


Astronomy 2020 – Space Astronomy & Exploration

2

## The Meaning of Apollo

- Apollo forced people of the world to view Earth in a new way (e.g., 1<sup>st</sup> pictures of Earth from afar). Gave birth to modern environmental movement. Archibald MacLeish said *“To see the Earth as it truly is, small and blue and beautiful in that eternal silence where it floats, is to see ourselves as riders on the Earth together”*.
- But, Apollo left a divided legacy for NASA & aerospace industry. Created an unrealistic expectation that NASA had broad support, abundant resources, and license to dispense them. However, Apollo was NOT conducted under normal political circumstances and these circumstances would NOT be repeated.

The Earth as seen from the Japanese Kaguya satellite.

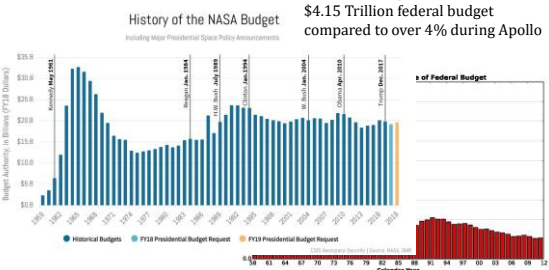


Astronomy 2020 – Space Astronomy & Exploration

4

## Historical NASA Funding

NASA currently receives 0.4% of the \$4.15 Trillion federal budget compared to over 4% during Apollo



Astronomy 2020 – Space Astronomy & Exploration

6

### Space in the News: U.S. Military eyes a role in the great power competition for lunar resources

By Sandra Erwin

Presentation by Woody Vokt



What are some positive and negative implications of a heightened military presence and their involvement in the establishment of a base on the moon? Do you think that the first Nation to the moon will take control? Or will an International organization be put in place?

Astronomy 2020 – Space Astronomy & Exploration

9

## Today's Class


- Overview of Space Shuttle Program
  - History of Shuttle Program
  - Space Shuttle mission profile
- The International Space Station (ISS)
- Tragic accidents: Challenger & Columbia
- Costs to launch the Space Shuttle

Astronomy 2020 – Space Astronomy & Exploration

10

## Overview of Space Shuttle Program

- Partially re-useable Earth orbital spacecraft officially known as *Space Transportation System*.
- Operated from 1981-2011.
- Highlights include:
  - Launching & servicing Hubble Space Telescope, numerous satellites.
  - Conducted 2-week duration experiments in space (including 15 CU Bioserve Life Science experiments).
  - Built & serviced International Space Station (ISS).



Astronomy 2020 – Space Astronomy & Exploration

11

## Launching the Space Shuttle





Astronomy 2020 – Space Astronomy & Exploration

12

## History of the Shuttle Program

- In 1969-72 time frame, President Nixon approved Space Shuttle & terminated Apollo.
- By being partially re-useable, Shuttle was **supposed** to reduce costs of payloads to orbit.
- 5 operational Shuttles were built (Columbia, Challenger, Discovery, Atlantis & Endeavour).
  - Challenger & Columbia were lost in separate accidents.

Astronomy 2020 – Space Astronomy & Exploration

13

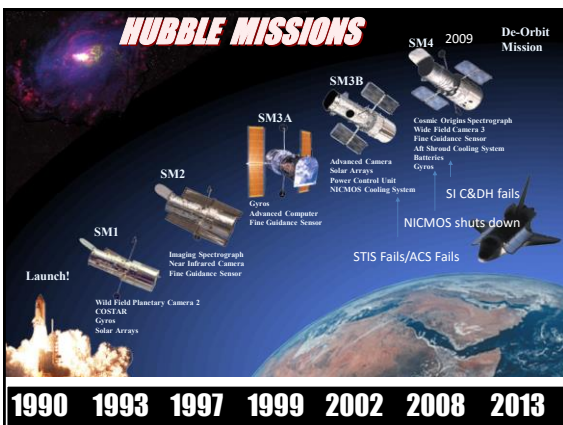
## Space Shuttle Mission Profile



Astronomy 2020 – Space Astronomy & Exploration

14

## HUBBLE MISSIONS



**1990 1993 1997 1999 2002 2008 2013**

Astronomy 2020 – Space Astronomy & Exploration

15

## The International Space Station (ISS)

- Shuttle was really designed to build & support ISS. But, construction didn't begin until 1998.
- ISS supports research of the microgravity & space environment, human biology, physics, astronomy.
- Intended to study problems of long duration exploration missions.
- Individual modules "owned" by U.S., Russia, Europe, Japan – truly international!
- Over \$3 billion/yr cost for U.S.
- U.S. and international partners agreed in 2016 to extend ISS until 2024.
- [Tour of the ISS.](#)



Astronomy 2020 – Space Astronomy & Exploration

17

## The International Space Station (ISS)

FISKE PLANETARIUM NETWORK

SPECIAL TO THE FISKE PLANETARIUM NETWORK  
COURTESY OF FISM & PAUL STODOLSKY AND TIME STUDIOS  
NOT FOR PUBLIC CONSUMPTION

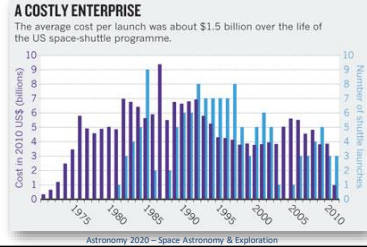
TIME  
1984 & 1985

Astronomy 2020 – Space Astronomy & Exploration

18

## Costs

- NASA spent \$192 billion on Shuttle from 1971 to 2011, launching 131 flights.
- The Shuttle never achieved the promise of reducing cost per pound to LEO.



20

## Class Exercise

Did President G.W. Bush make the right decision to cancel the Space Shuttle? Why or why not?



Astronomy 2020 – Space Astronomy & Exploration

21

## What did we learn today?

- Overview of Space Shuttle Program
  - History of Shuttle Program
  - Space Shuttle mission profile
- Servicing the Hubble Space Telescope
- The International Space Station (ISS)
- Tragic accidents: Challenger & Columbia
- Costs to launch the Space Shuttle

Astronomy 2020 – Space Astronomy & Exploration

22