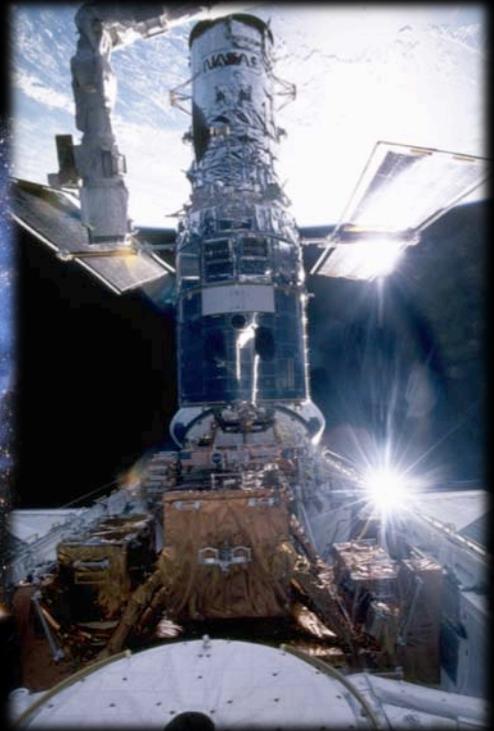




It's Hubble Time!

Insights from Hubble and Other Adventures in Partnership Between Human Spaceflight and Science



Laurie Leshin
Deputy Center Director for Science & Technology
NASA Goddard Space Flight Center



THE COSMIC CALENDAR

Modified from "The Dragons of Eden" by Carl Sagan

Imagine the 13.7 billion-year lifetime of the Universe since the Big Bang compressed into the span of a single year. To get some of our own impressions out on the table, estimate the following:

(The answers are dates between Jan 1 and Dec 31 in our Cosmic Year)

When did Earth form? *August 29*

When did dinosaurs roam the Earth? *December 23-28*

When did humans come on the scene? *December 31,
10:30 PM*

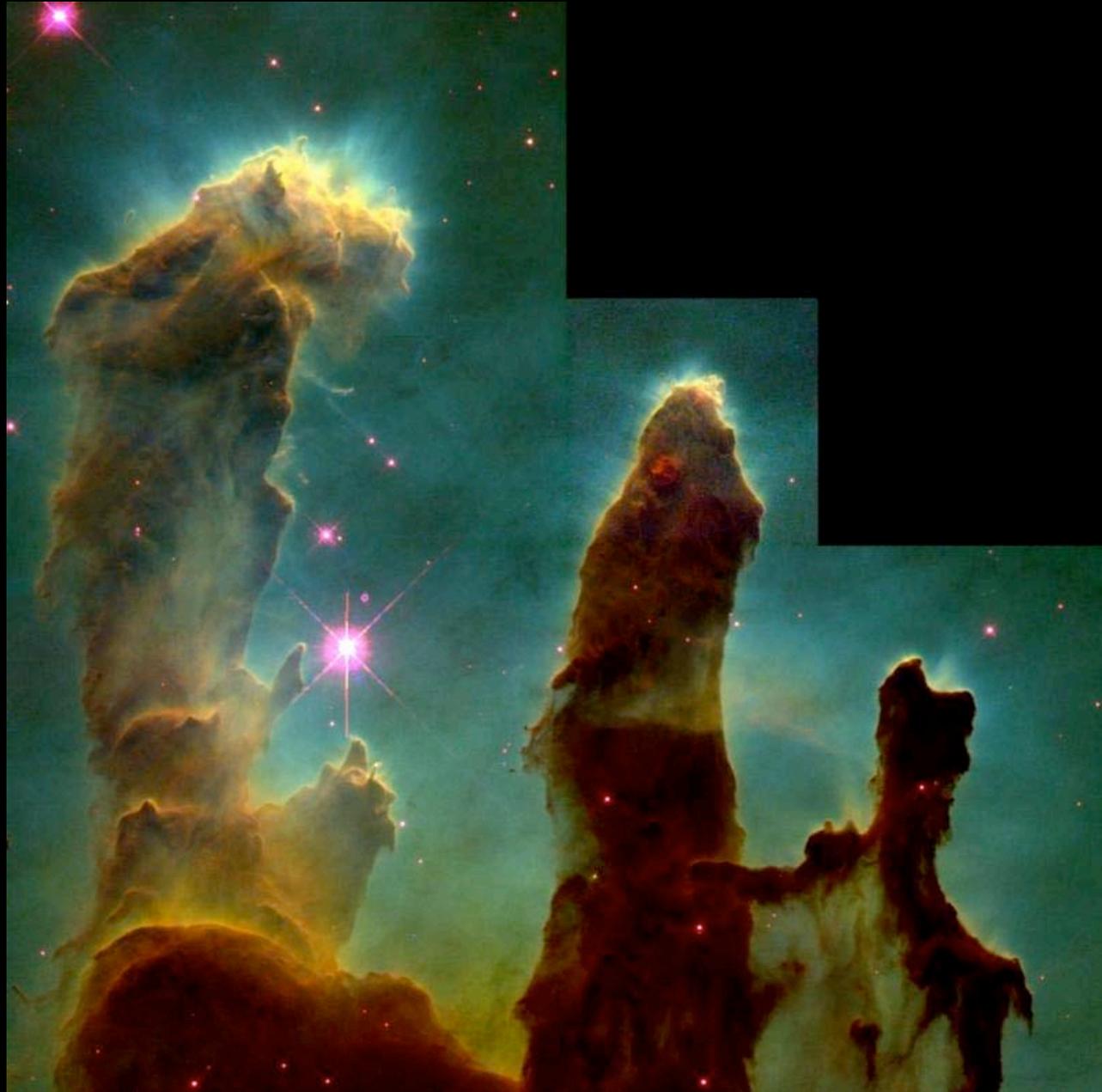
An ambitious agenda...

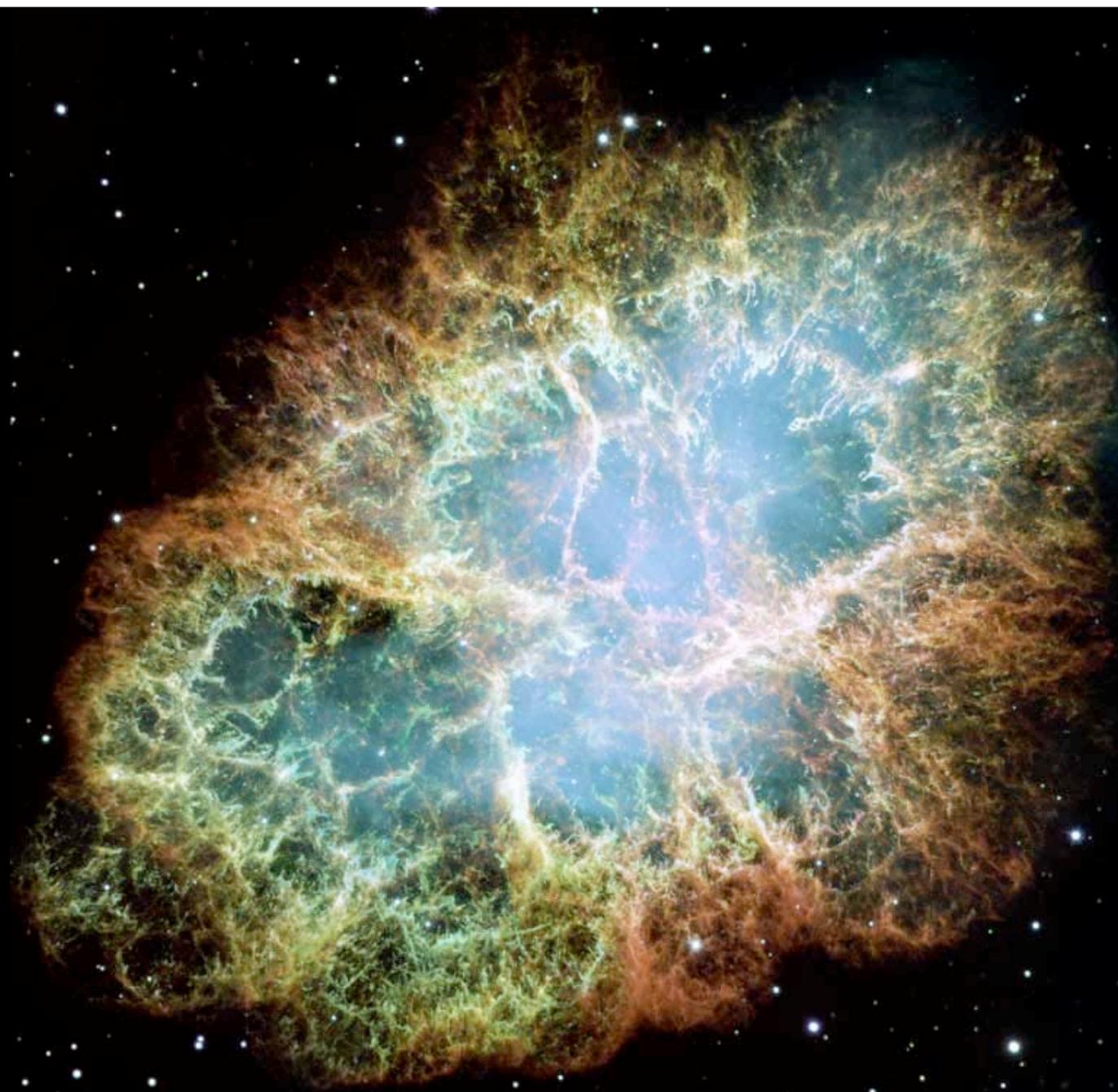


- WFC3
- COS
- ACS Repair
- STIS Repair
- SI C&DH

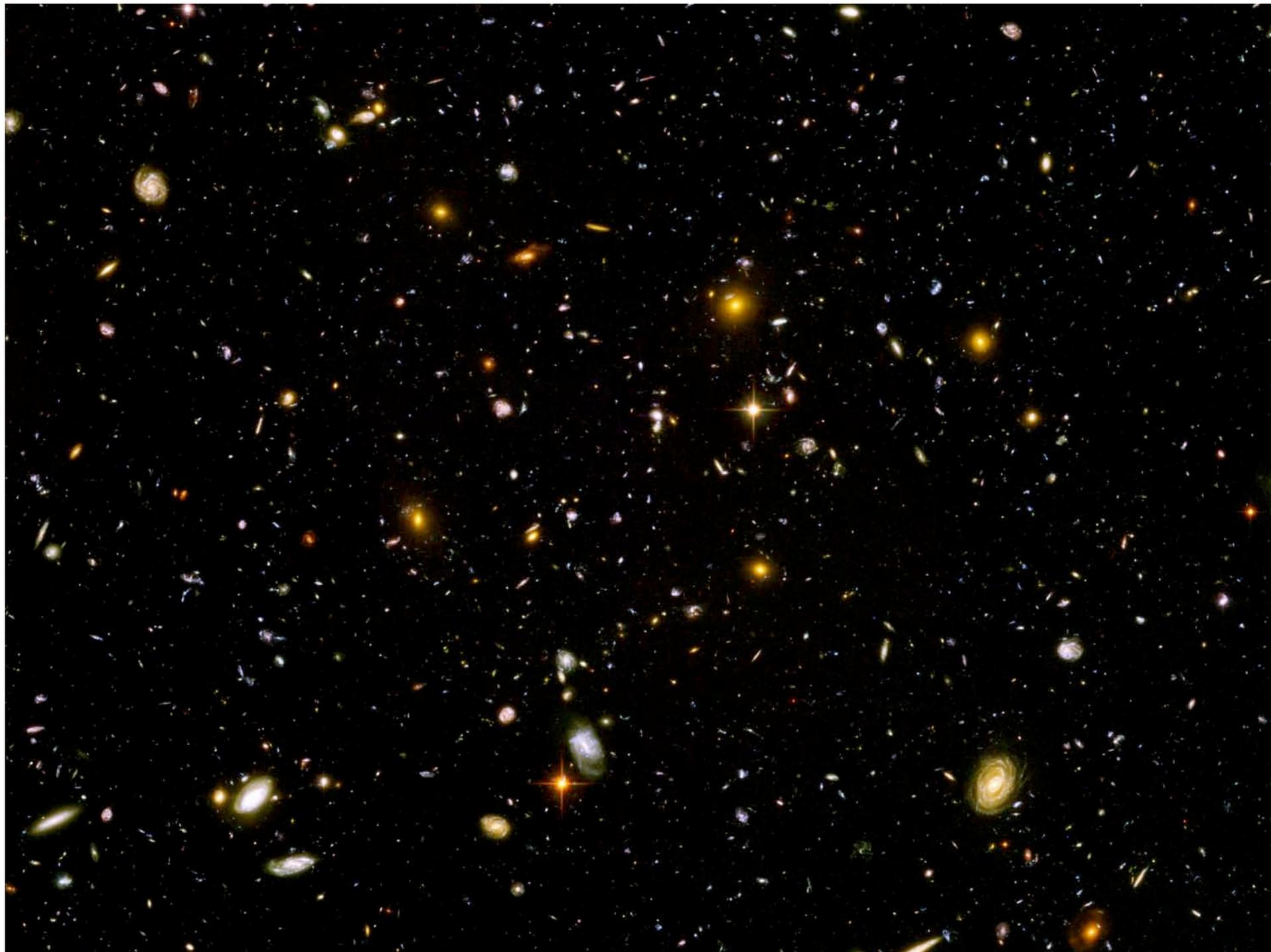
- Gyroscopes
- Batteries
- FGS
- NOBL's
- Soft Capture Mechanism

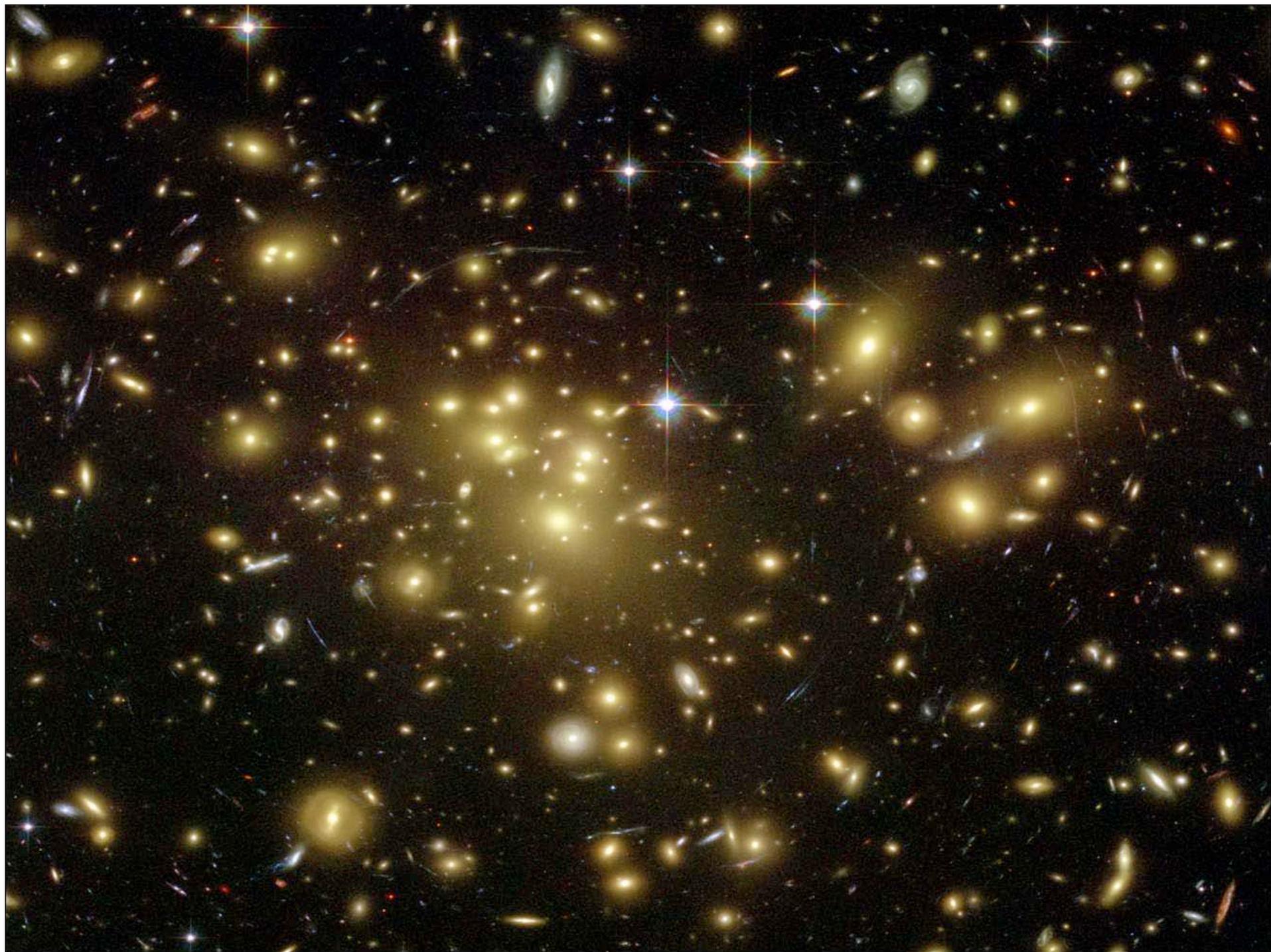
...to continue the legacy

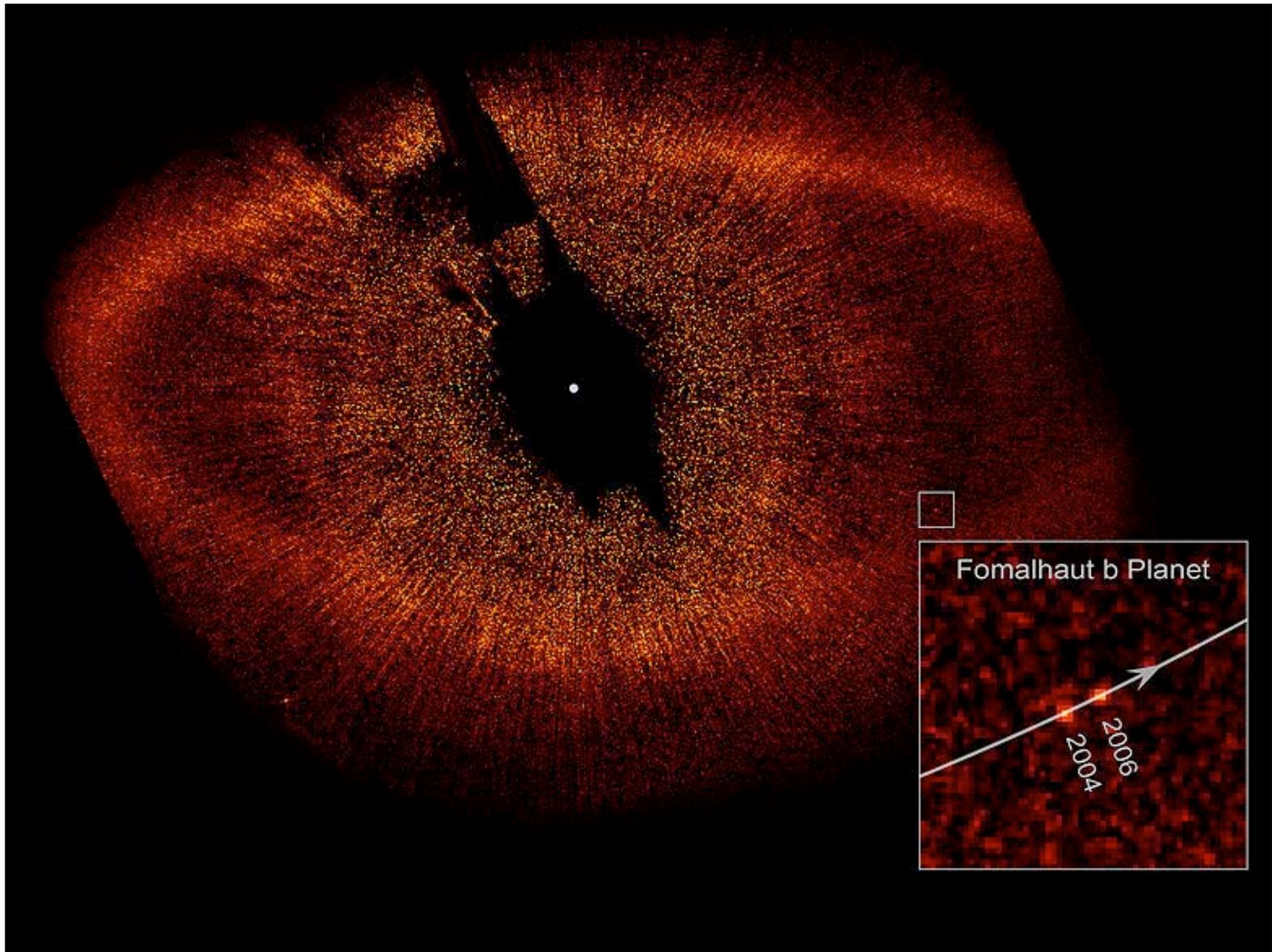






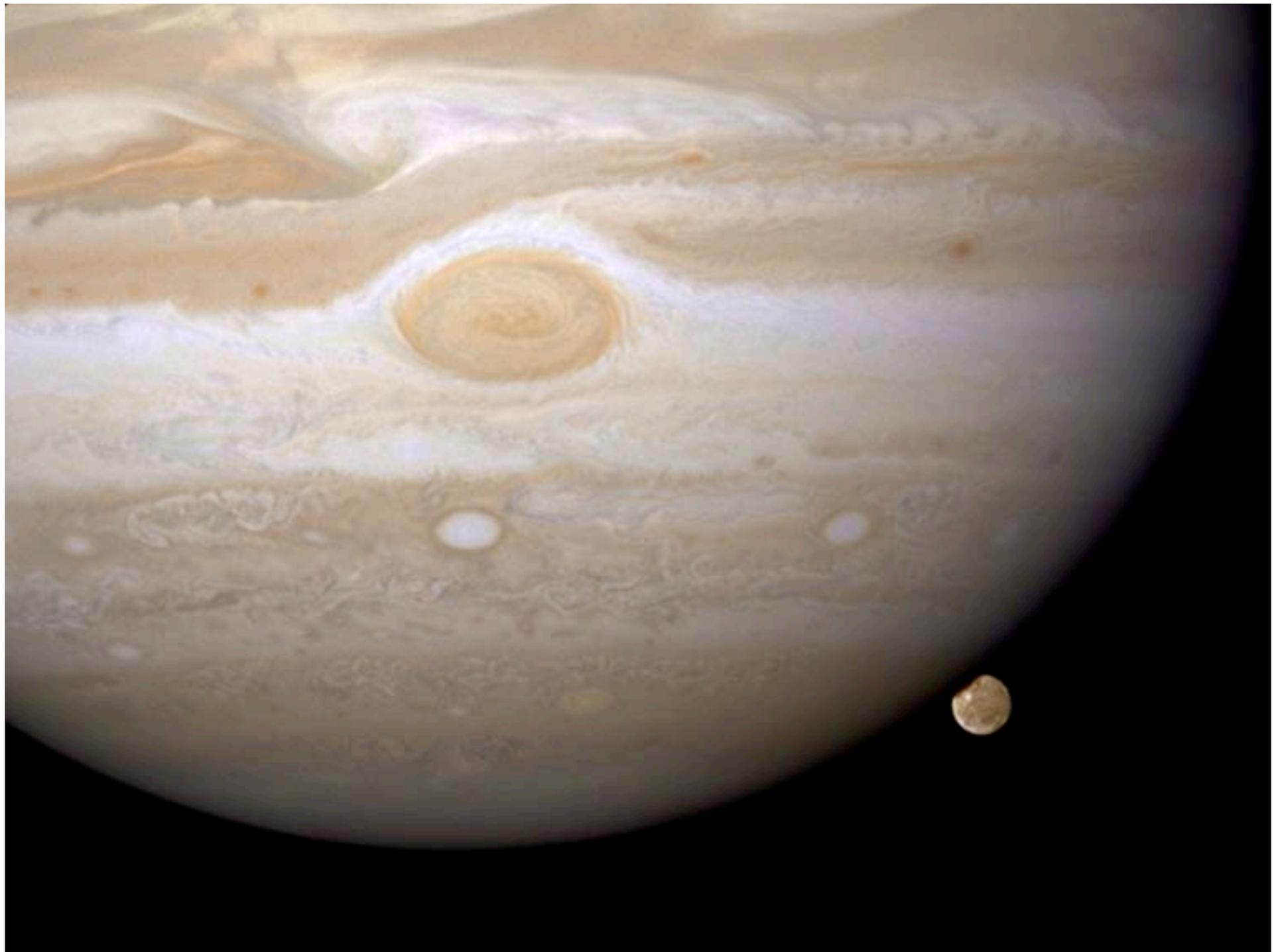






Fomalhaut b Planet

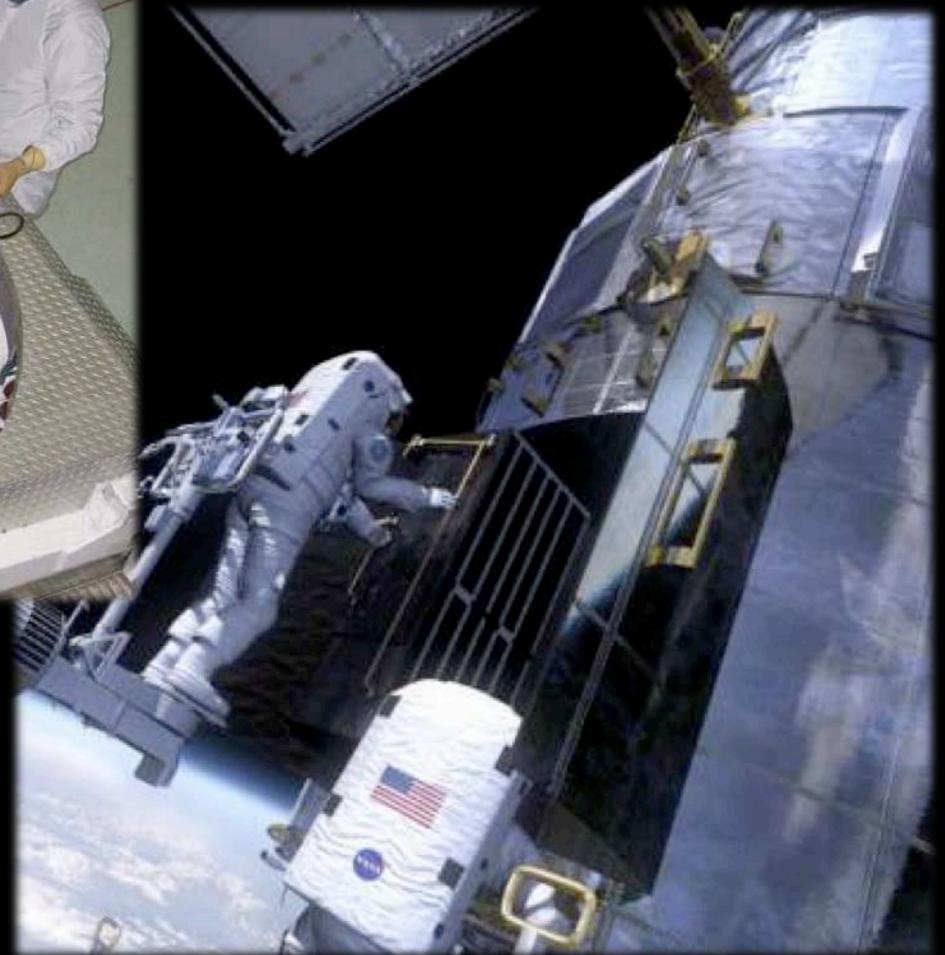
2004
2006



SM4 Highlights: Two New Science Instruments



Wide Field Camera 3



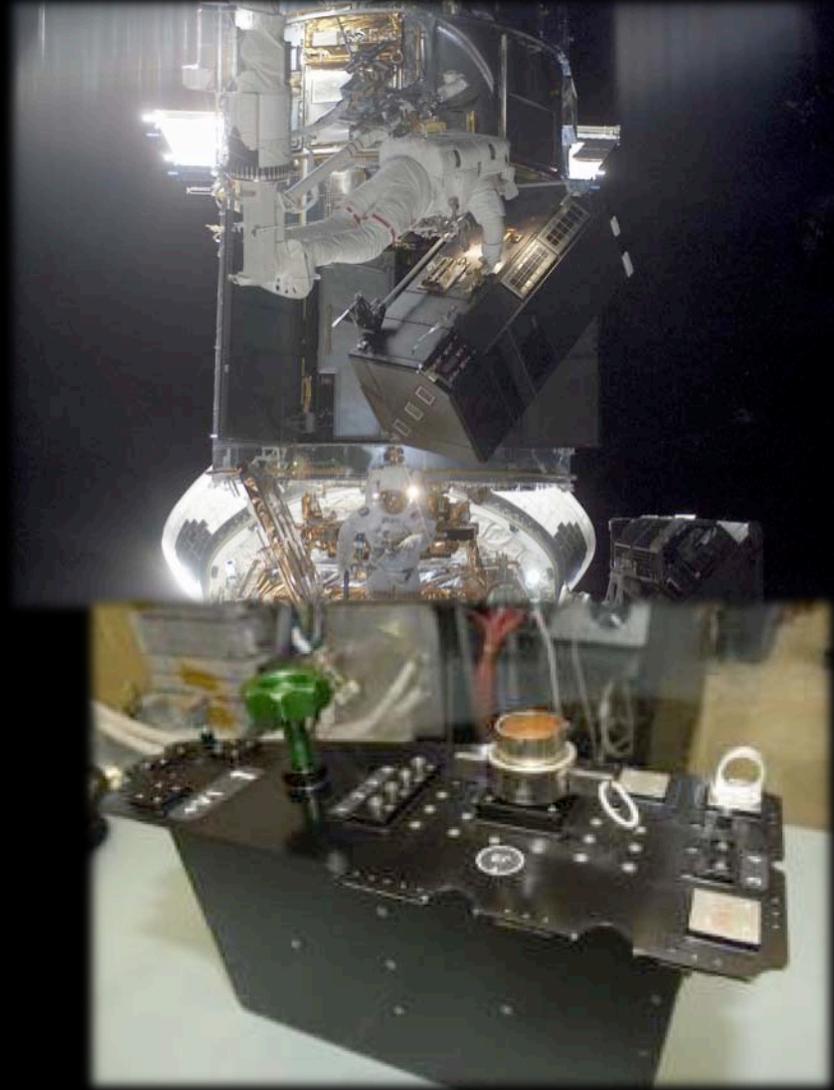
Cosmic Origins Spectrograph

SM4 Highlights: Complex Instrument Repair



Space Telescope Imaging Spectrograph

Advanced Camera for Surveys



SM4 Highlights: Telescope Tune-up



Replace Science Instrument
Command & Data Handling Unit



New Gyroscopes



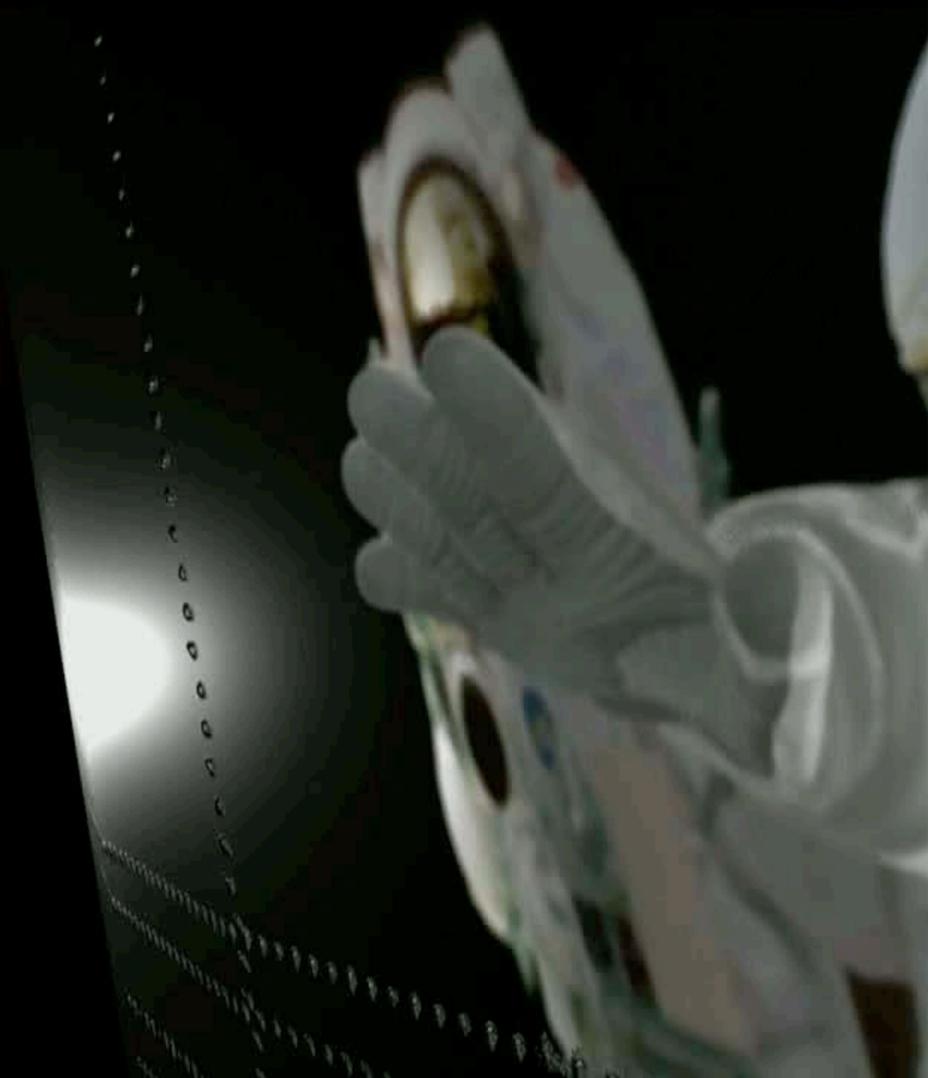
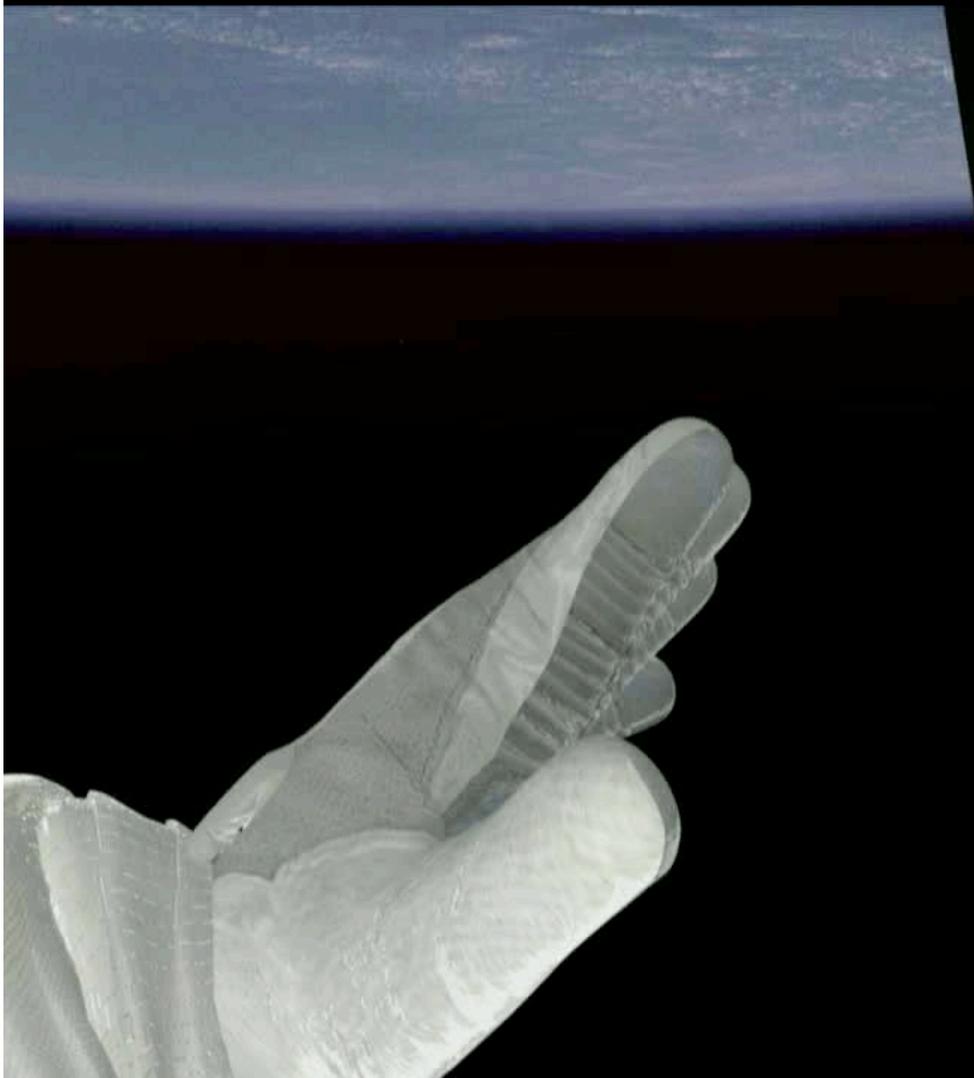
Fine Guidance Sensor



New Batteries



New Outer Blanket Layers



National Aeronautics and Space Administration



DREW FEUSTEL | **MEGAN McARTHUR** | **GREG JOHNSON** | **SCOTT ALTMAN** | **MIKE MASSIMINO** | **MIKE GOOD** | **JOHN MACE GRUNSFELD**

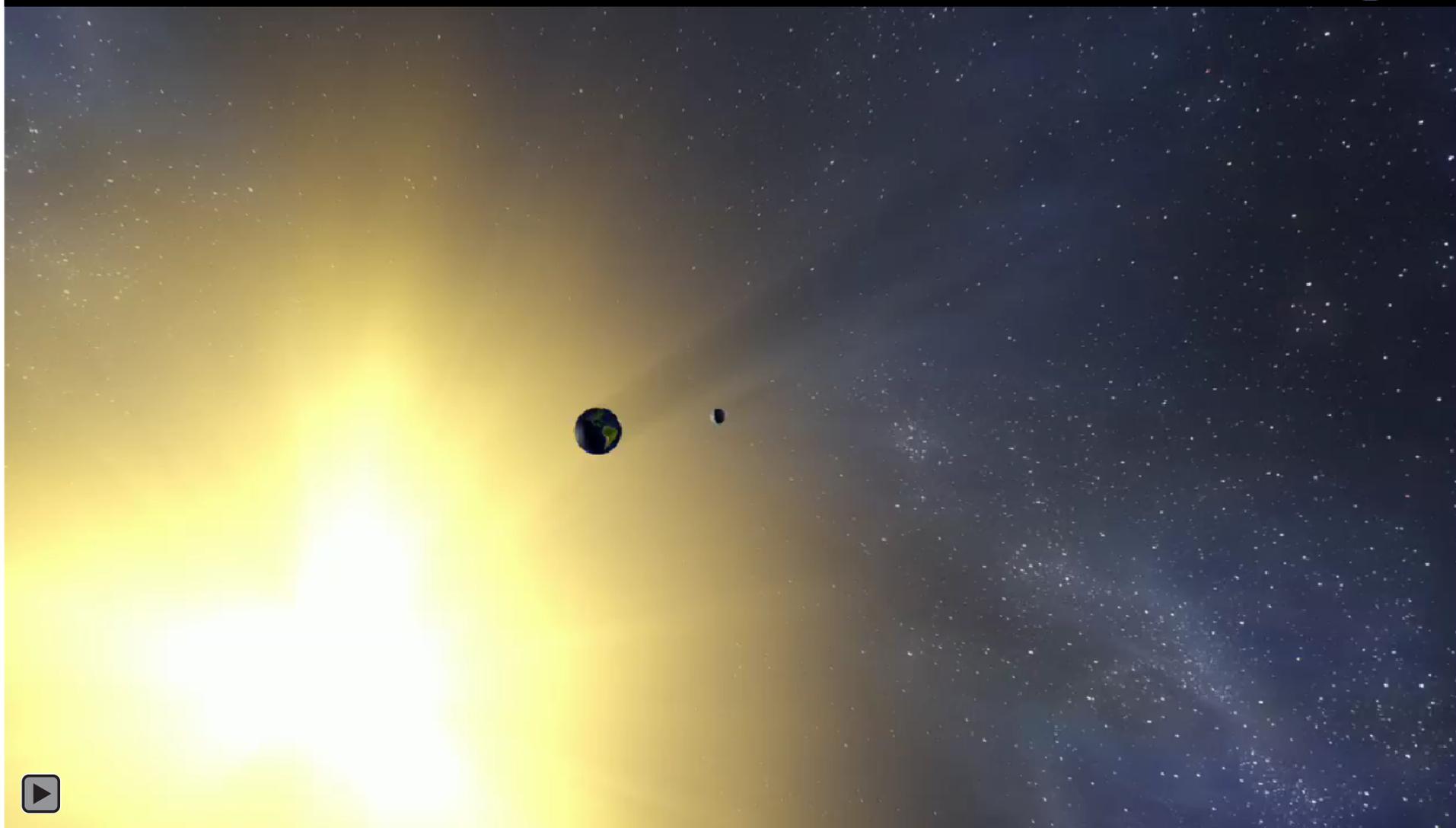
ATLANTIS 125



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NW-2008-003A-JSC



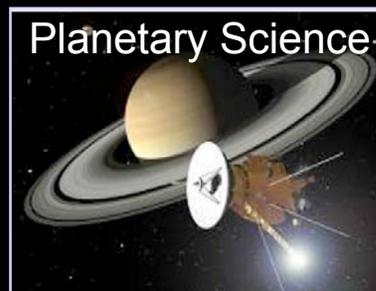
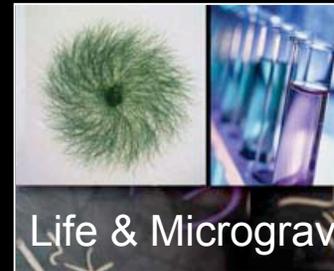
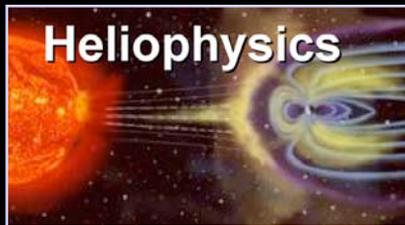




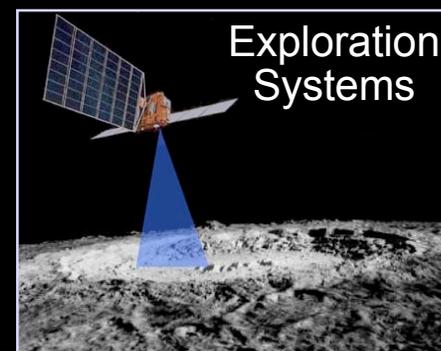


A Partnership of Mutual Benefit

Science



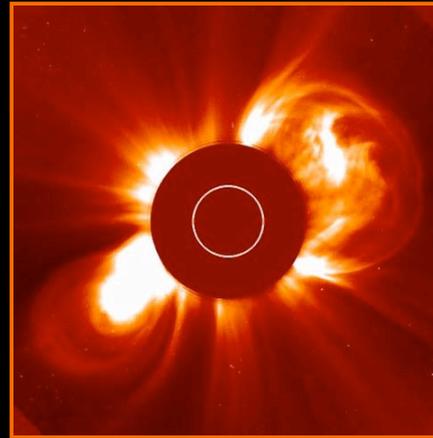
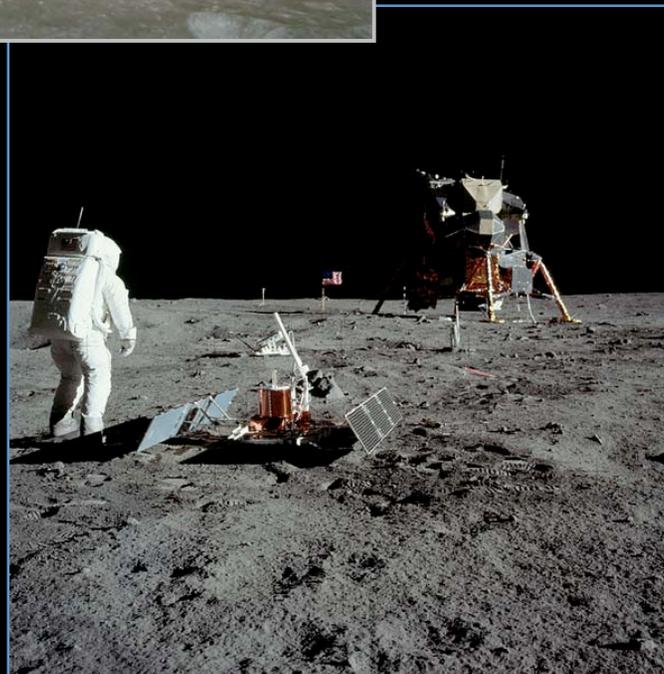
Human Exploration



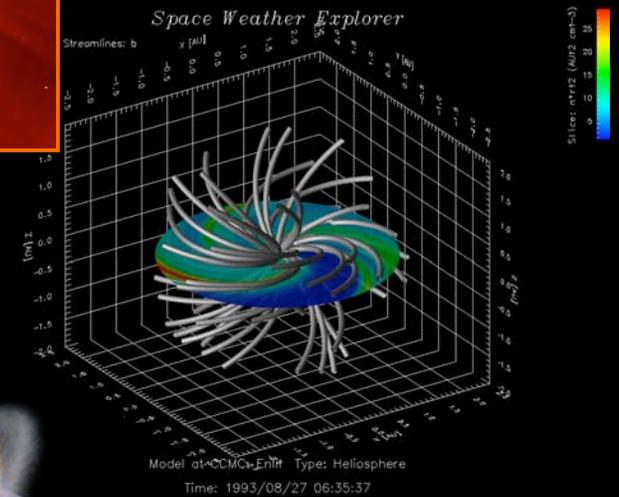


Examples of Connection from Other Science Areas

Apollo 8 – The beginning of the modern environmental movement

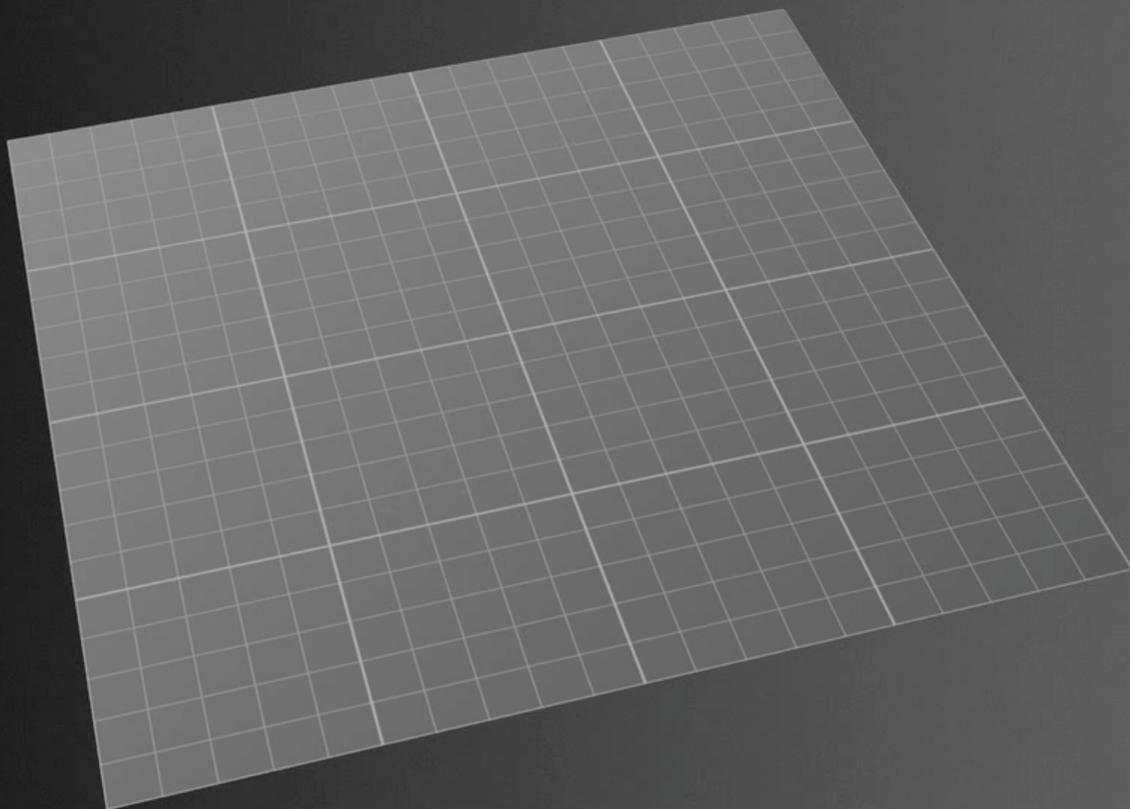


Safeguarding the journey:
Understanding and predicting the radiation environment



Revolutionary ideas on the origin and evolution of the Moon





Crew Launch Vehicle

**Communications
Infrastructure**

Cargo Launch Vehicle

ISS

**In-Space
Transportation**

**What is the
primary reason
for building all
of this?**

**Lunar
Remote Sensing**

**Crewed
Lander**

To Do This!

Surface Mobility

Surface Power

In-Situ Resource Utilization

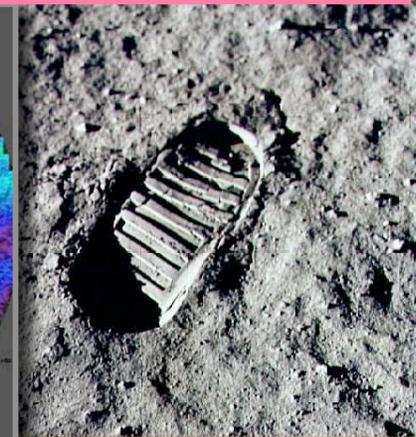
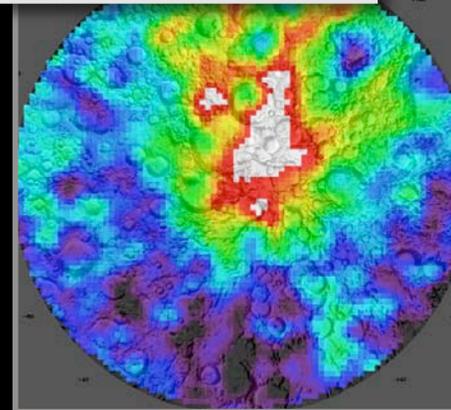
EVA Systems

Habitation & Logistics Systems

The Moon Presents Compelling Science Opportunities



- **Bombardment** of the Earth-Moon system: Consequences for the emergence of life
- Lunar **surface and interior processes** and history
- Scientific treasure in the **permanently shadowed polar environment**
- Regolith as a recorder of the **Sun's history**
- The origin and evolution of the **lunar exosphere**
- The Moon as a Science Platform: **Astronomy, Earth and Solar Activity Observations**
- Testing **Planetary Protection** protocols



And Mars Beckons...

