Zero CTE Glass in the Hubble Space Telescope

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Optics Lead Engineer
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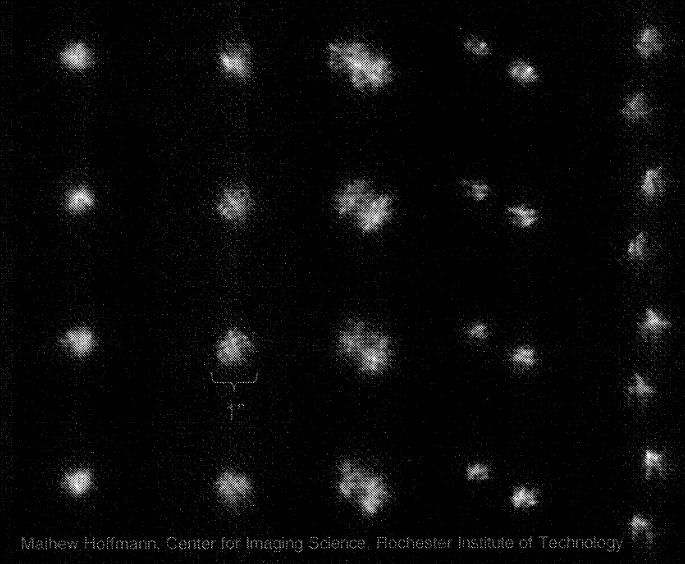
NASA Goddard Space Flight Center

American Physical Society
March 9 – 14, 2008

Atmospheric Point-Spread Function



Full-width Airy Disk, AEOS 3.6-meter telescope is 0.12",
1/10 the width of the seeing disk

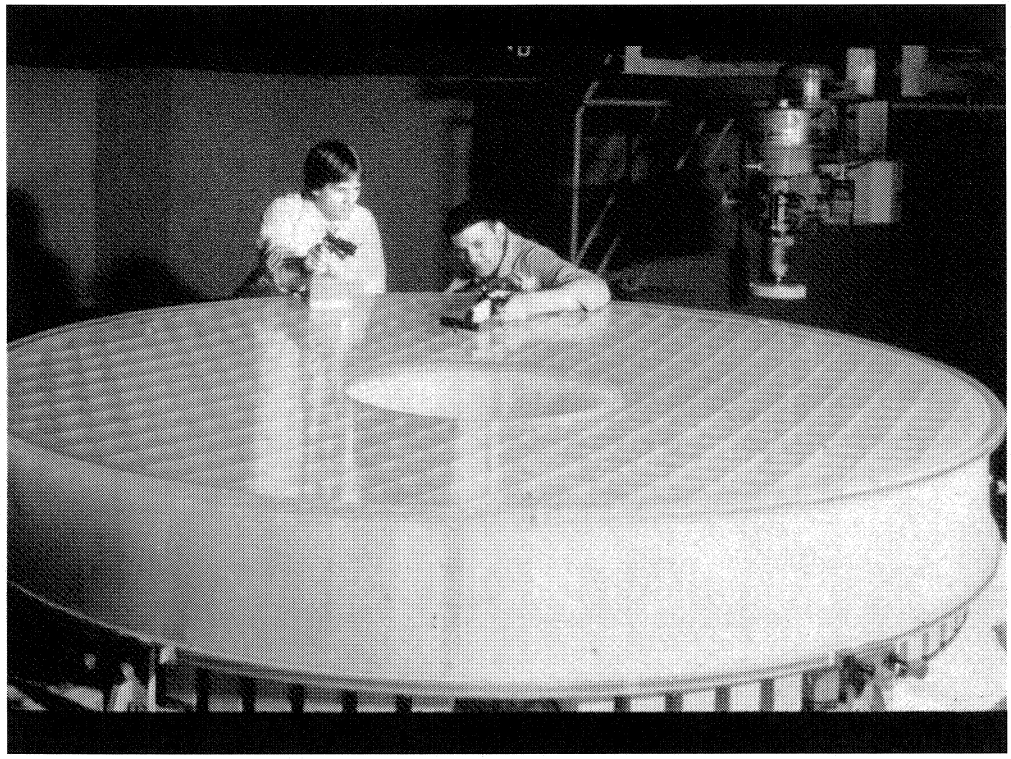
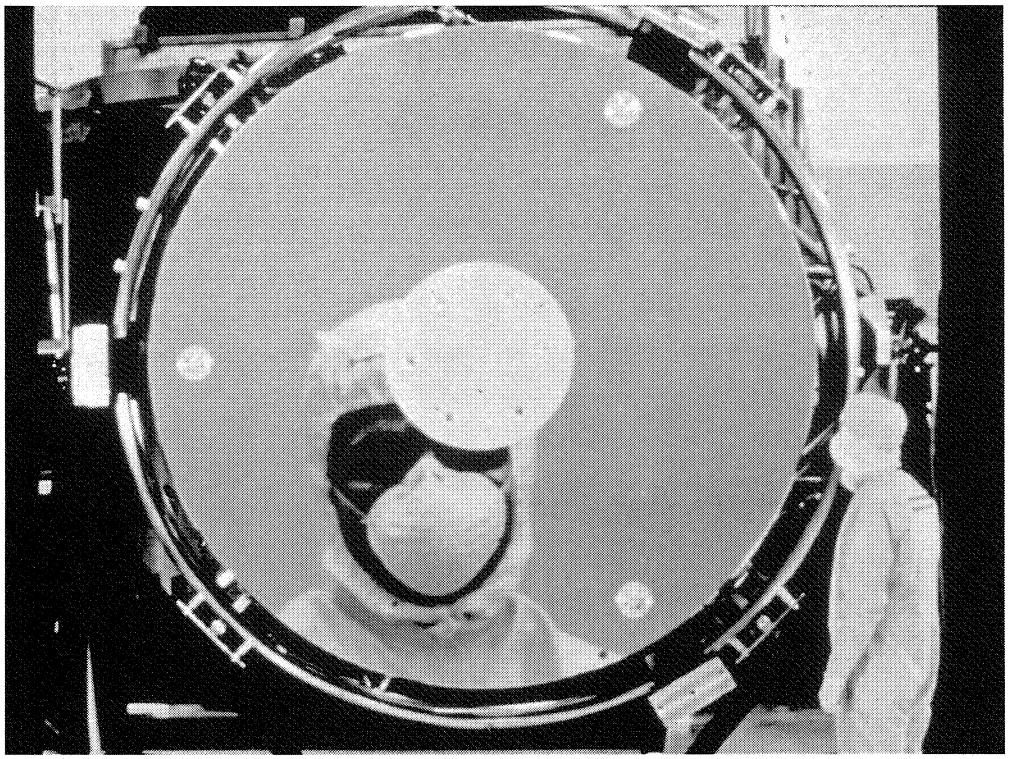


Figure D-1. RNC interferogram of the primary mirror, taken in February 1982.



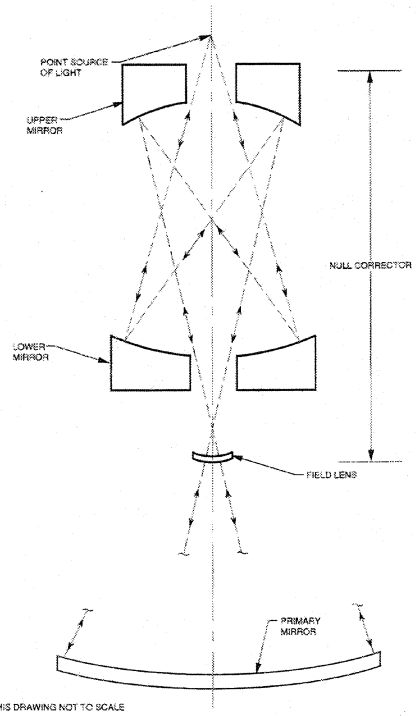
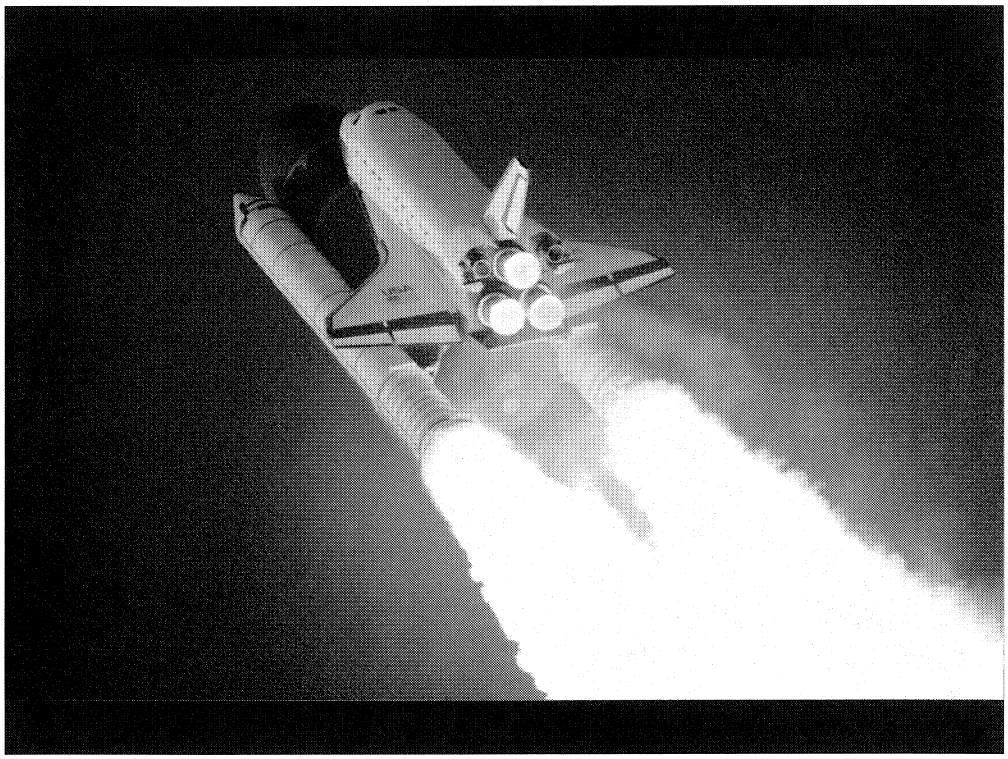
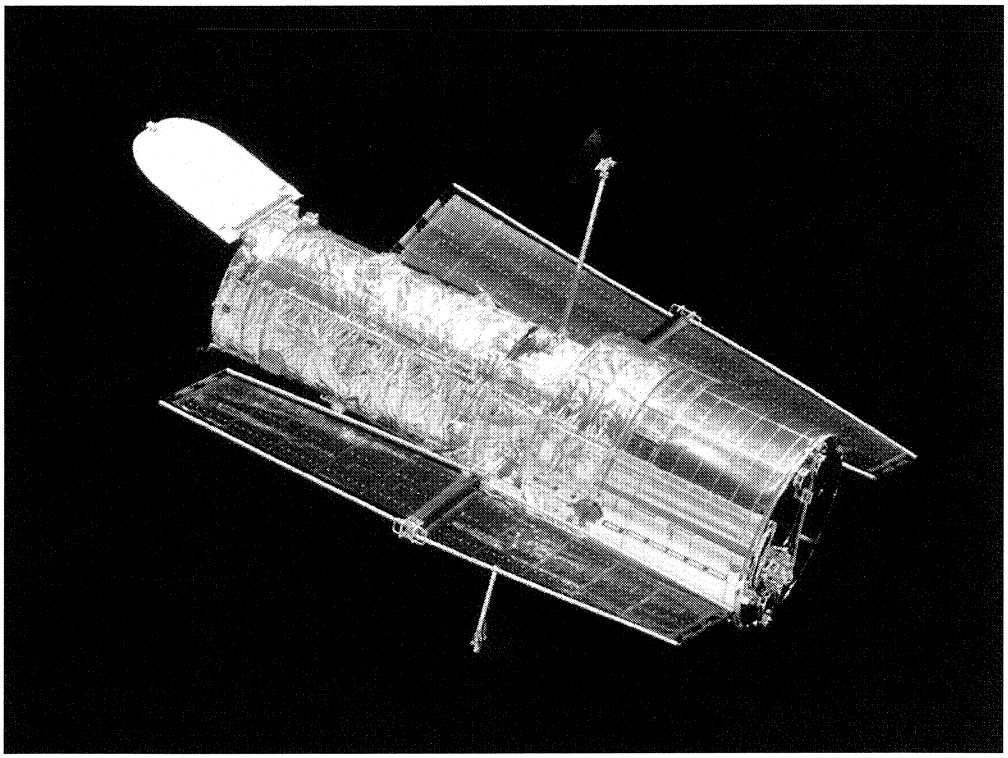
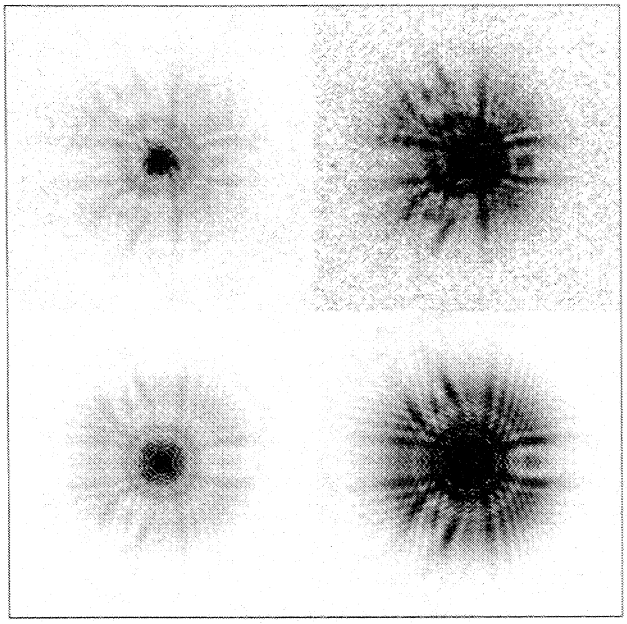


Figure 4-2. Reflective null corrector.







(a) Recorded image of the PC5 star taken on June 14, 1990, with a 0-μm inside focus.

Figure 6-1. Planetary Camera images versus computer simulations. The images in the top frames were taken with the Planetary Camera; those in the bottom frames are computer simulations created using an optical model with 0.5-wave rms wavefront error at 547 nm.

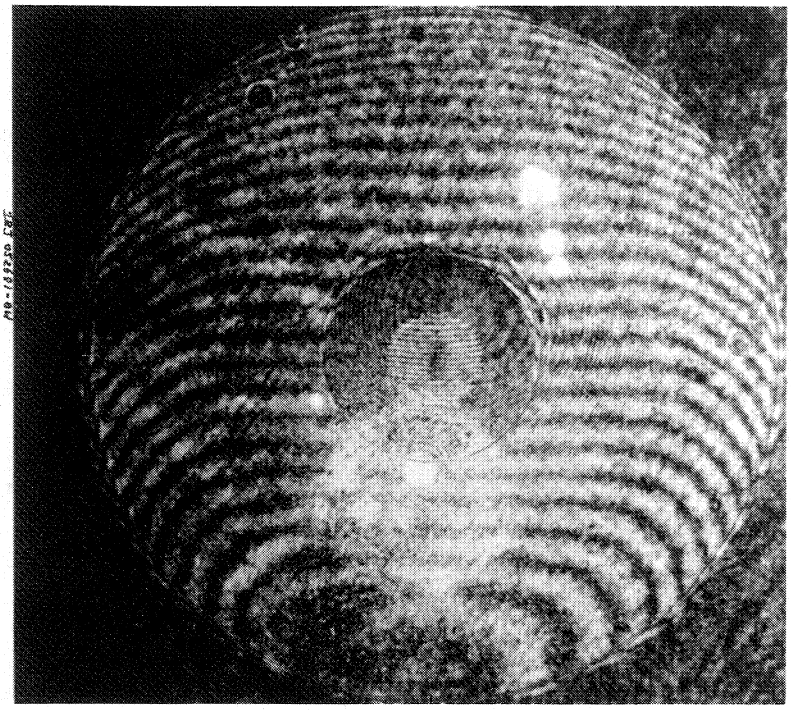


Figure D-2. RvNC interferogram of the primary mirror, taken in May 1981.

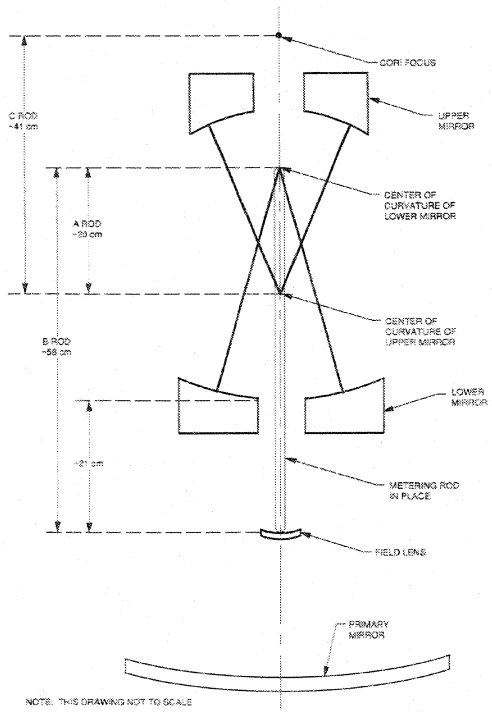


Figure 7-1. Position of metering rods used to space optical elements in the reflective null corrector.

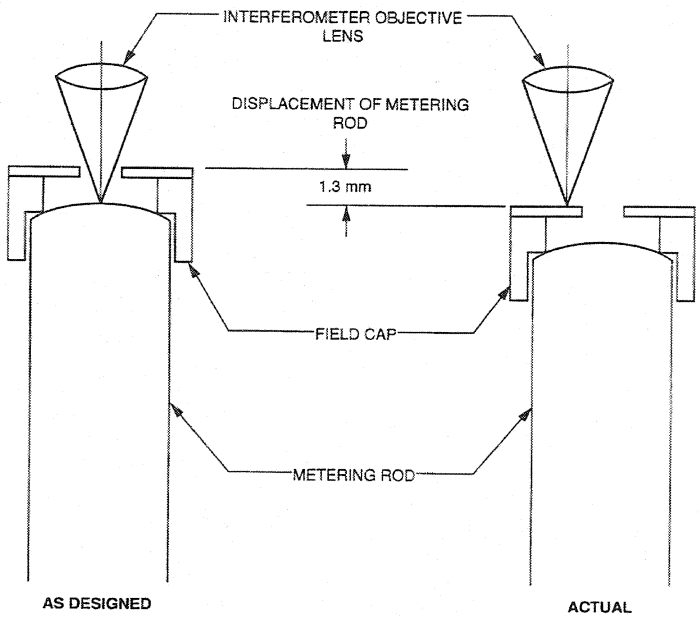


Figure 7-4. Displacement due to the interferometer focusing on the field cap instead of the metering rod.

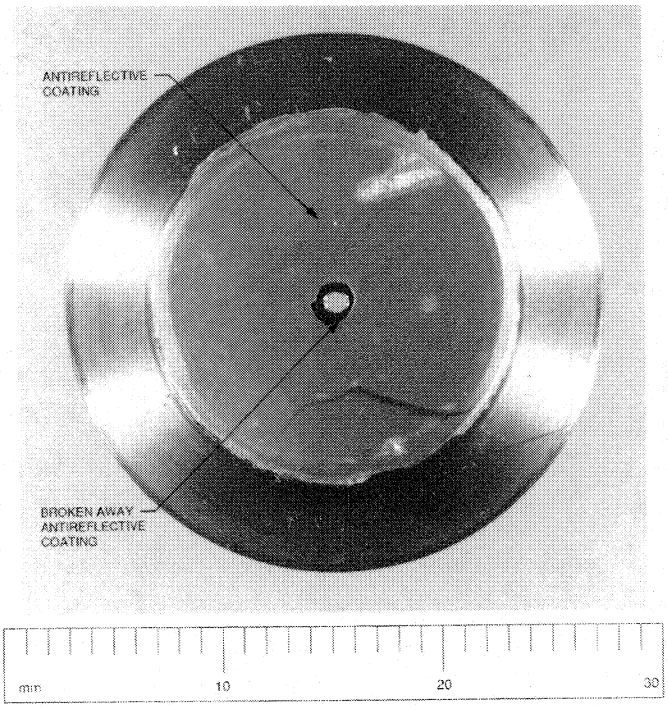
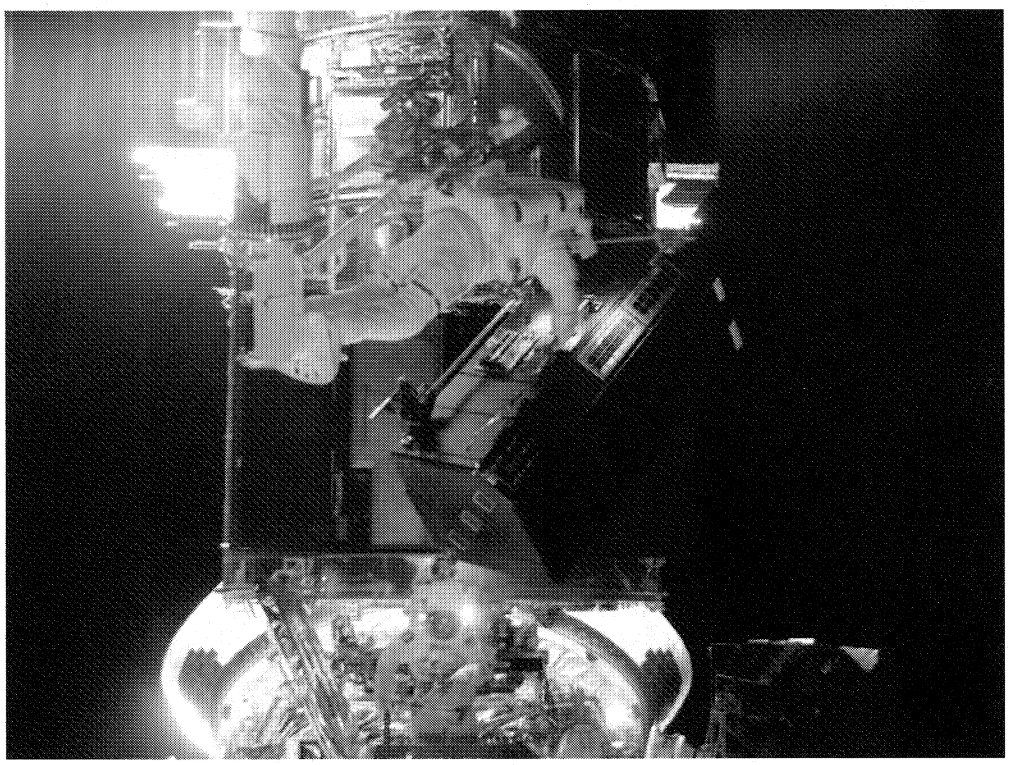


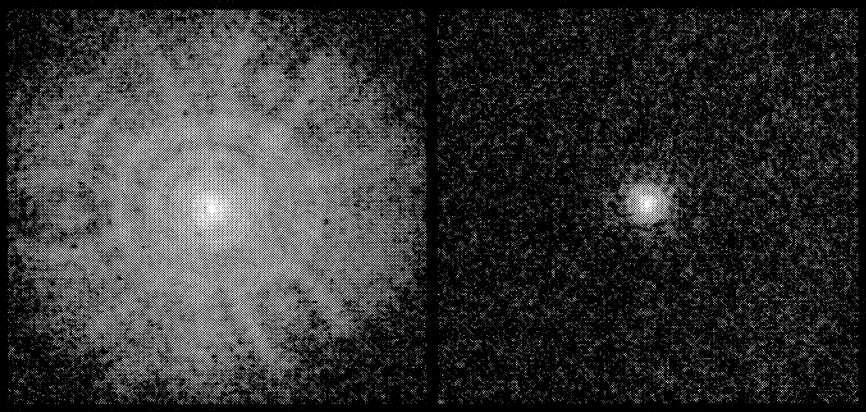
Figure 7-5. Top view of the field cap, showing the aperture and the area where the antireflective coating had broken away.



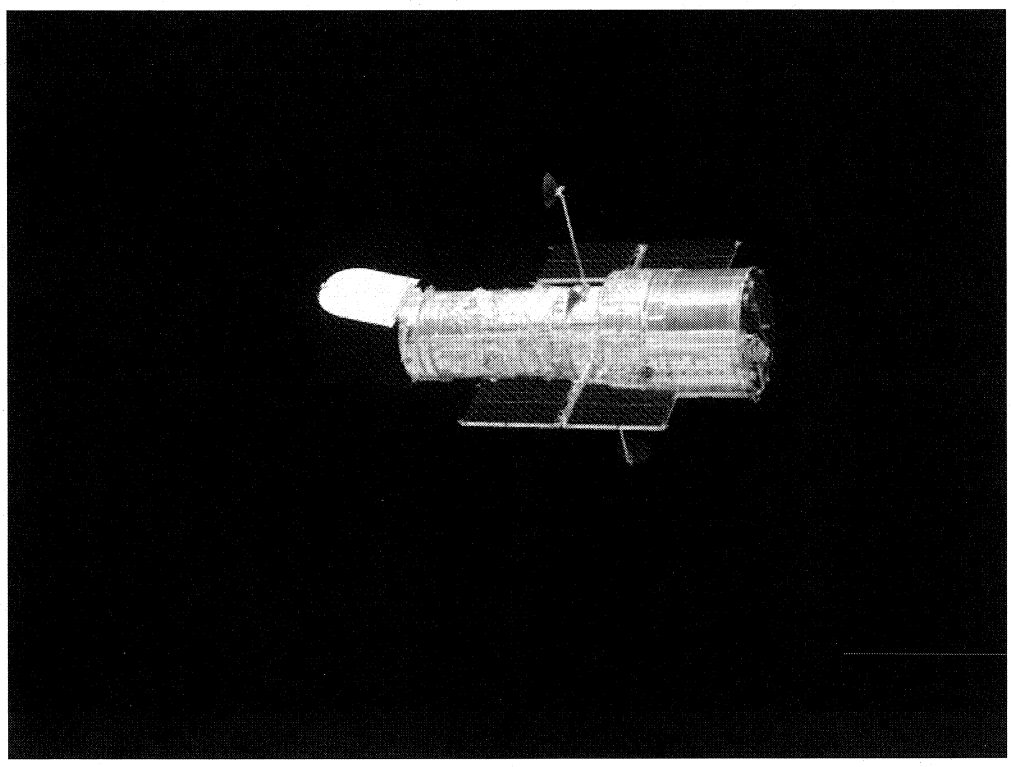
HUBBLE SPACE TELESCOPE

FAINT OBJECT CAMERA

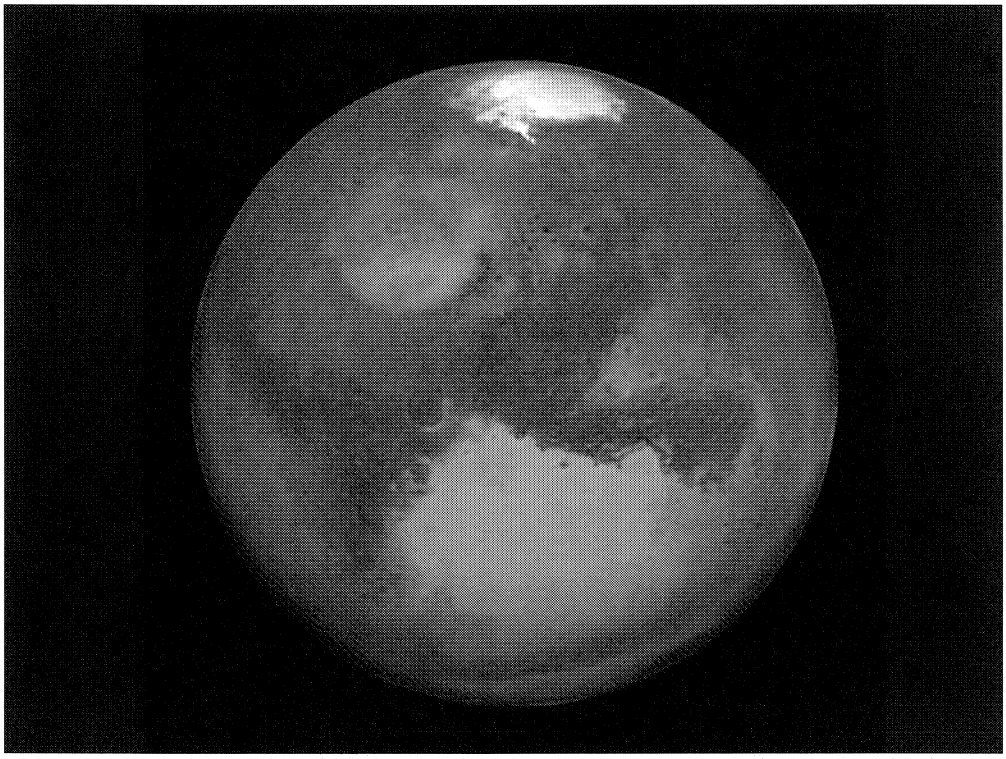
COMPARATIVE VIEWS OF A STAR

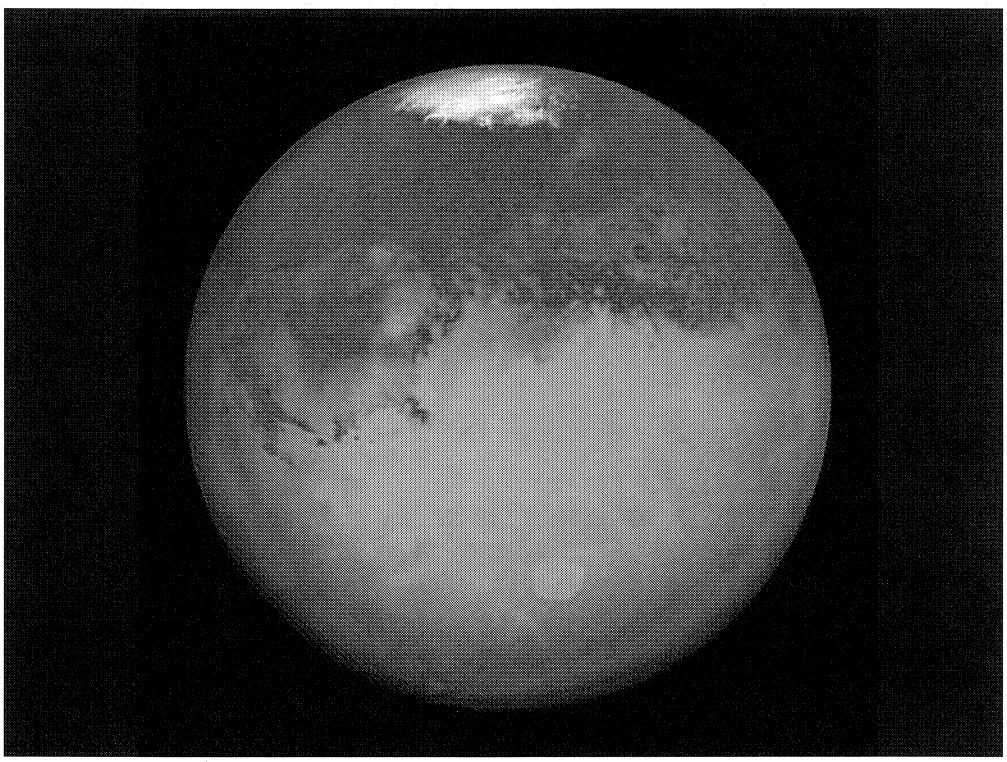


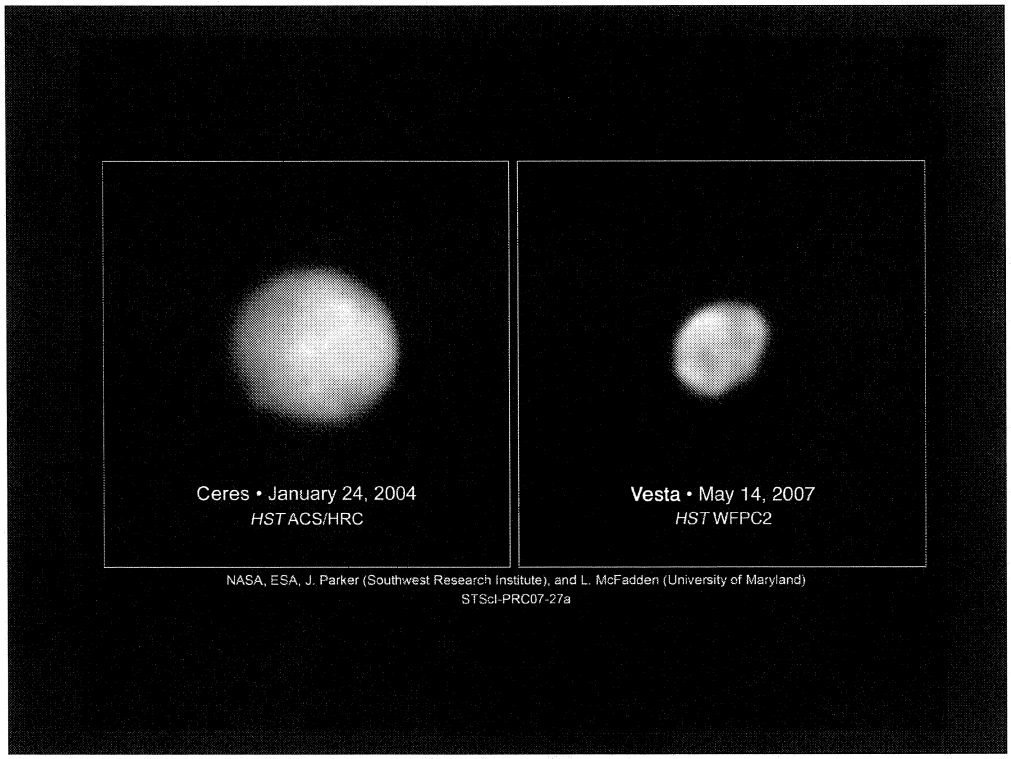
BEFORE COSTAR AFTER COSTAR

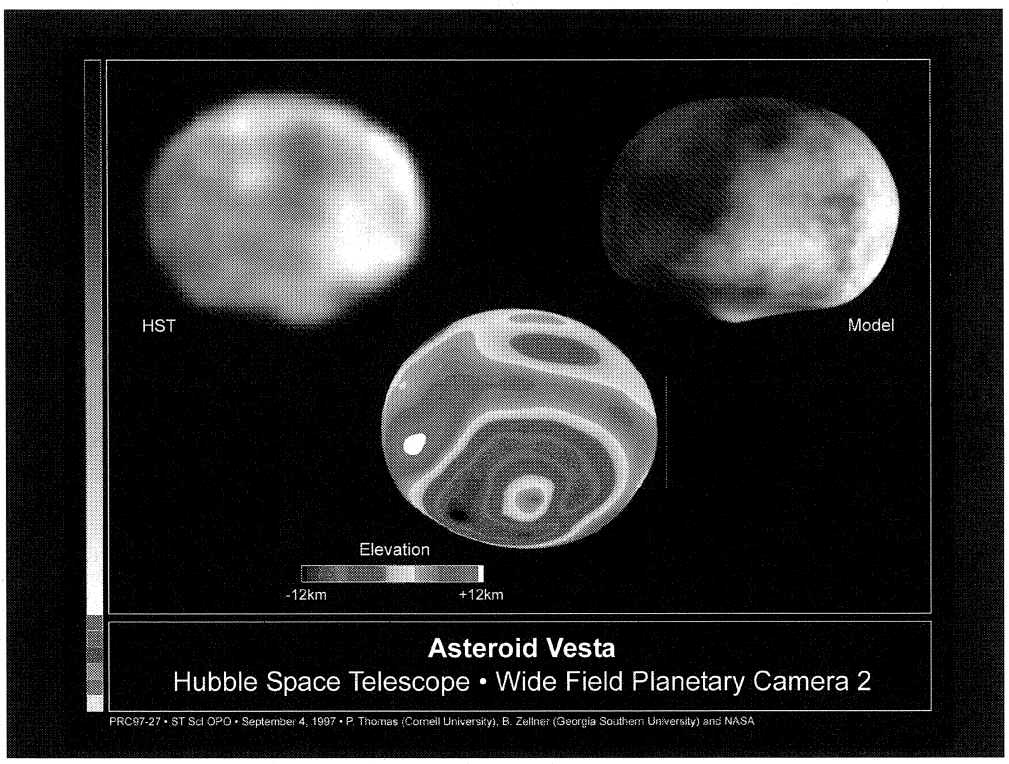


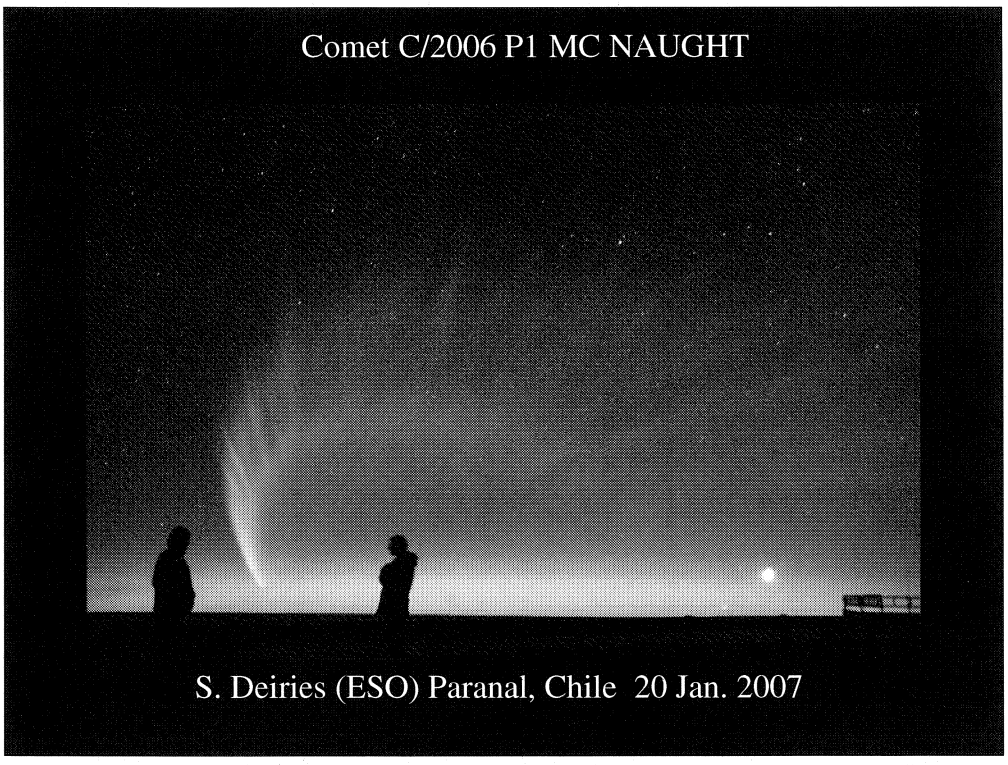
A: PLANETARY SYSTEMS

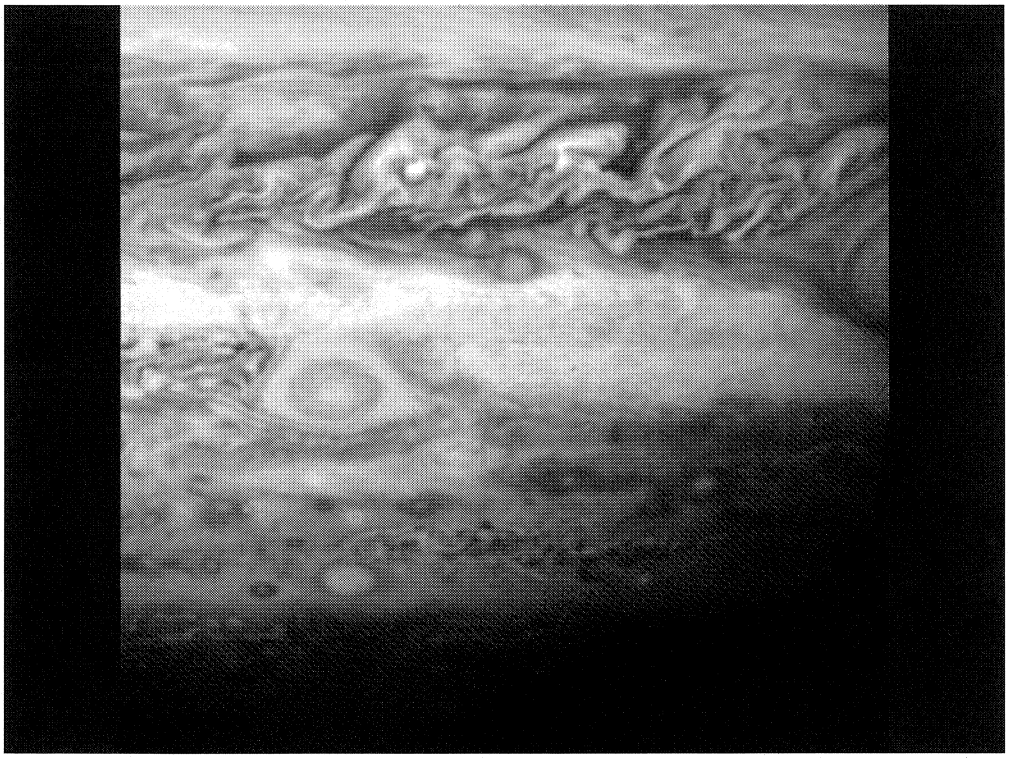




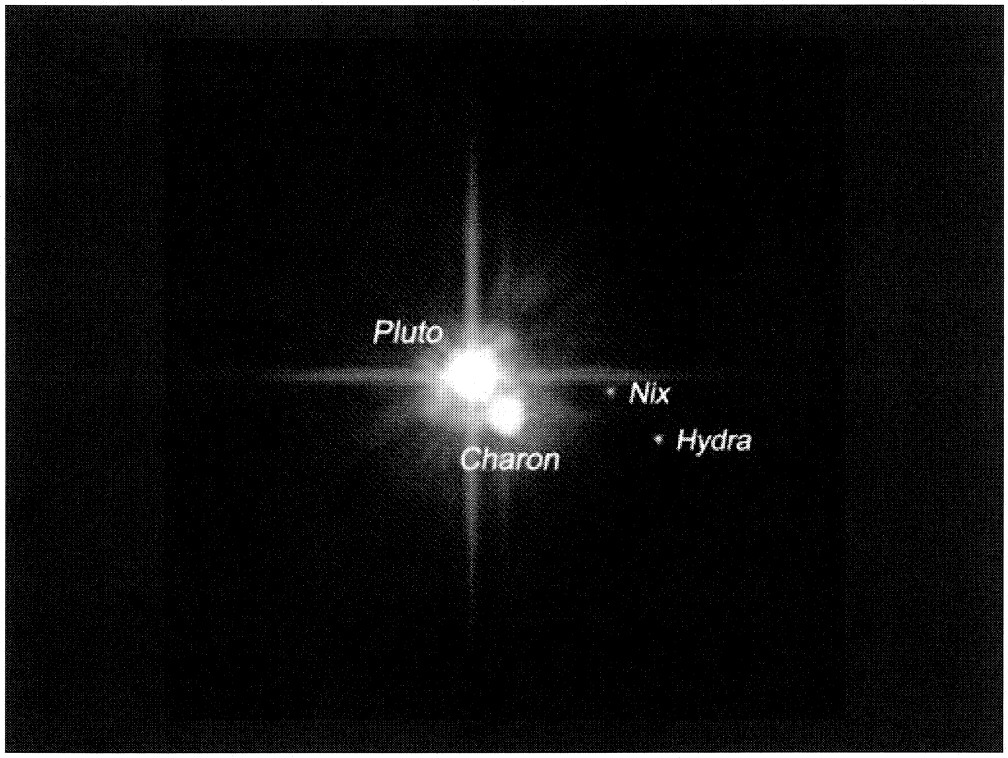

Ceres • January 24, 2004
HST ACS/HRC
Vesta • May 14, 2007
HST WFPC2
NASA, ESA, J. Parker (Southwest Research Institute), and L. McFadden (University of Maryland)
STScI-PRC07-27a

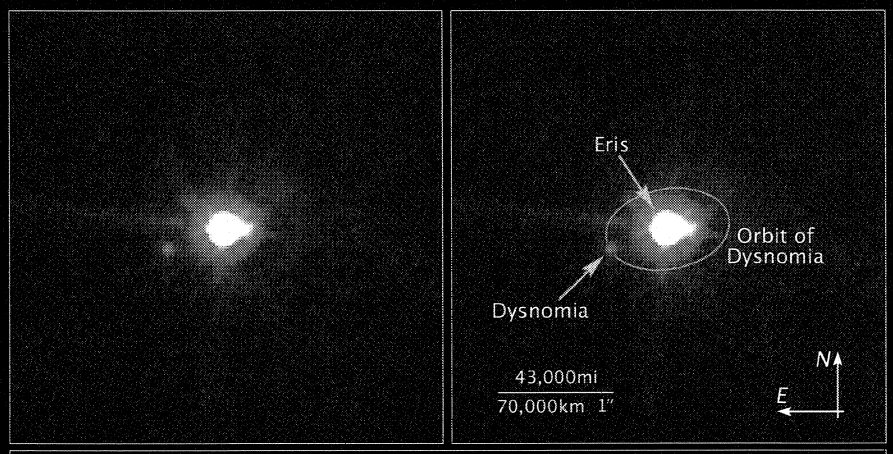

HST
Model
Elevation
-12km
+12km
Asteroid Vesta
Hubble Space Telescope • Wide Field Planetary Camera 2
PRC97-27 • ST ScI OPO • September 4, 1997 • P. Thomas (Cornell University), B. Zellner (Georgia Southern University) and NASA


Comet C/2006 P1 MC NAUGHT
S. Deiries (ESO) Paranal, Chile 20 Jan. 2007



Saturn
Hubble Heritage
NASA and The Hubble Heritage Team (STScI/AURA) • Hubble Space Telescope WFPC2 • STScI-PRC01-15

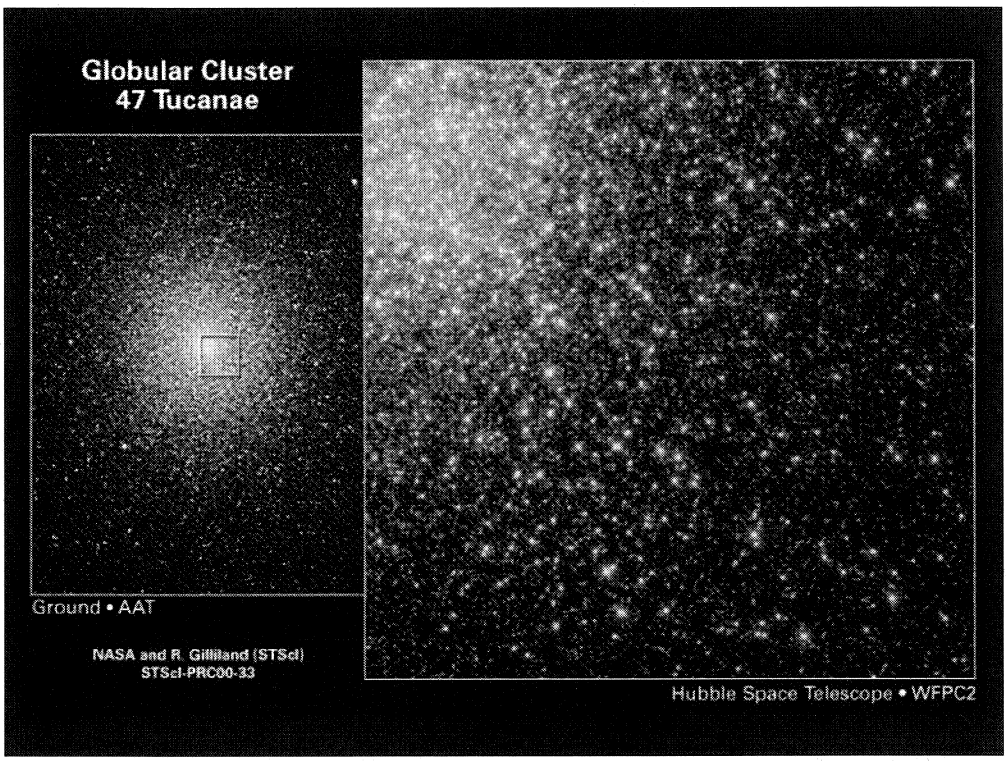

Pluto
Nix
Hydra
Charon

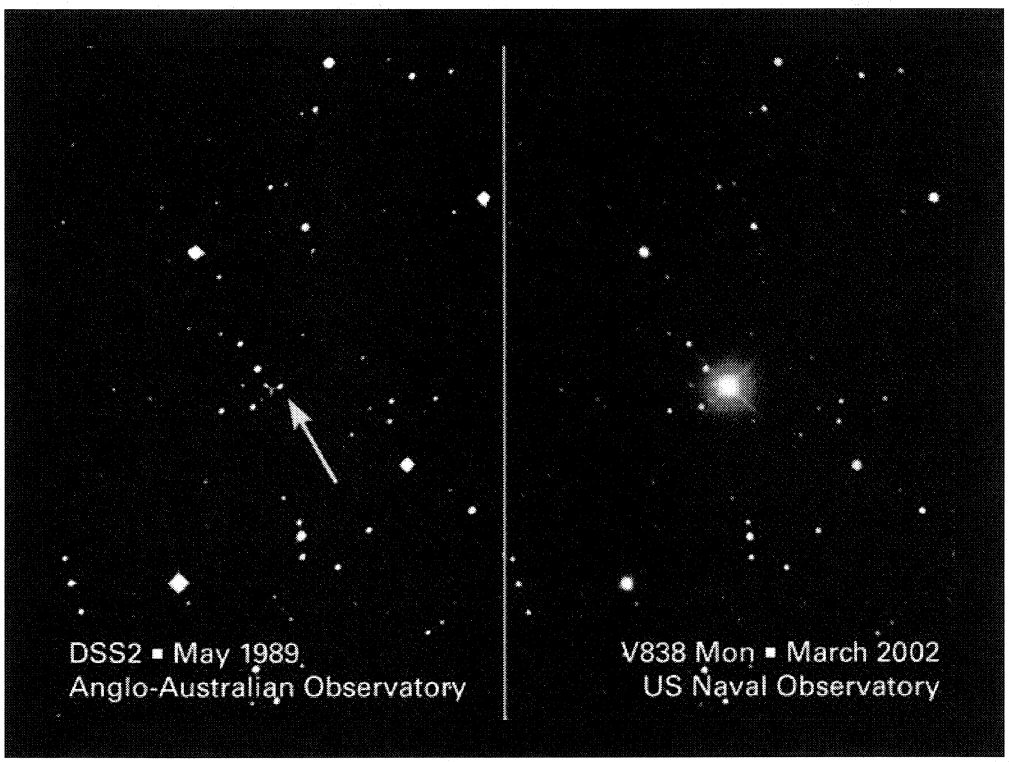


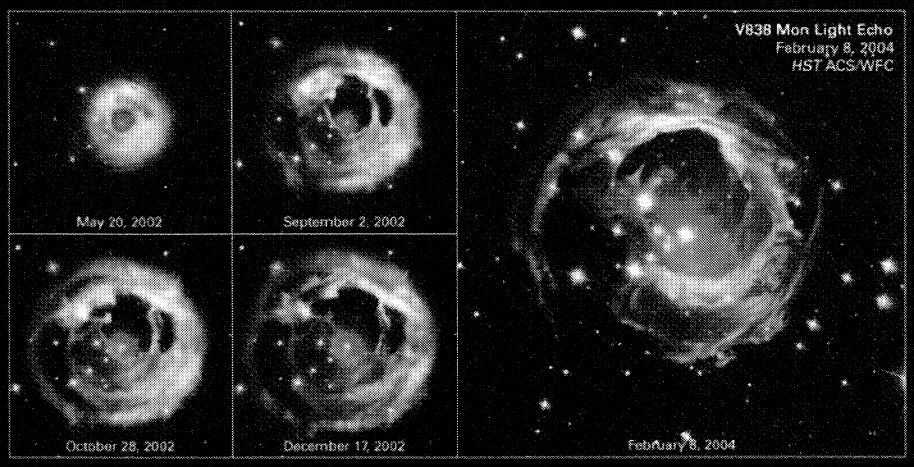
Dwarf Planet Eris and Satellite Dysnomia • August 30, 2006
Hubble Space Telescope • ACS/HRC

NASA, ESA, and M. Brown (California Institute of Technology) STScI-PRC07-24

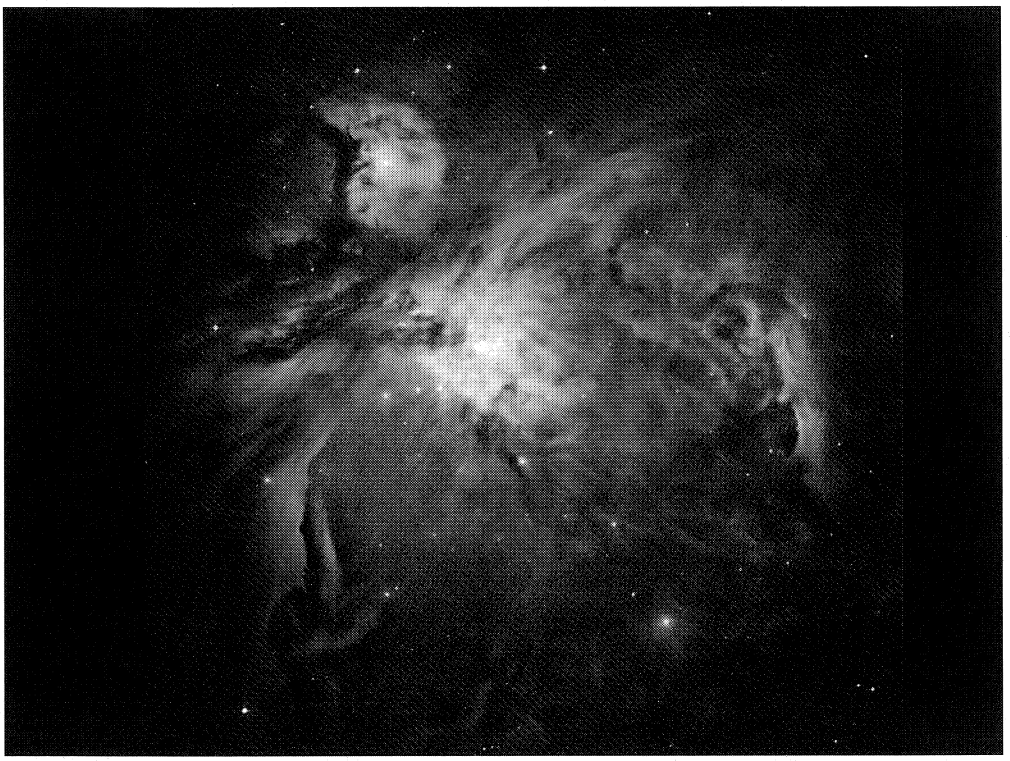
B: STARS

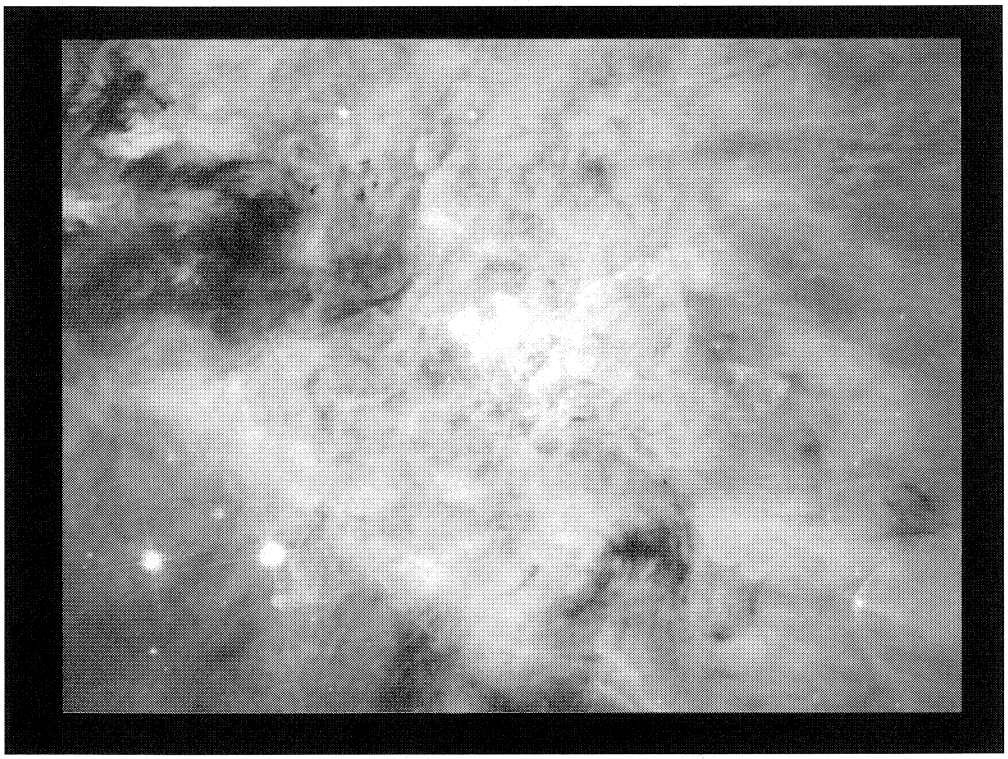

Globular Cluster
47 Tucanae
Ground • AAT
NASA and R. Gilliland (STScI)
STScI-PRC00-33
Hubble Space Telescope • WFPC2

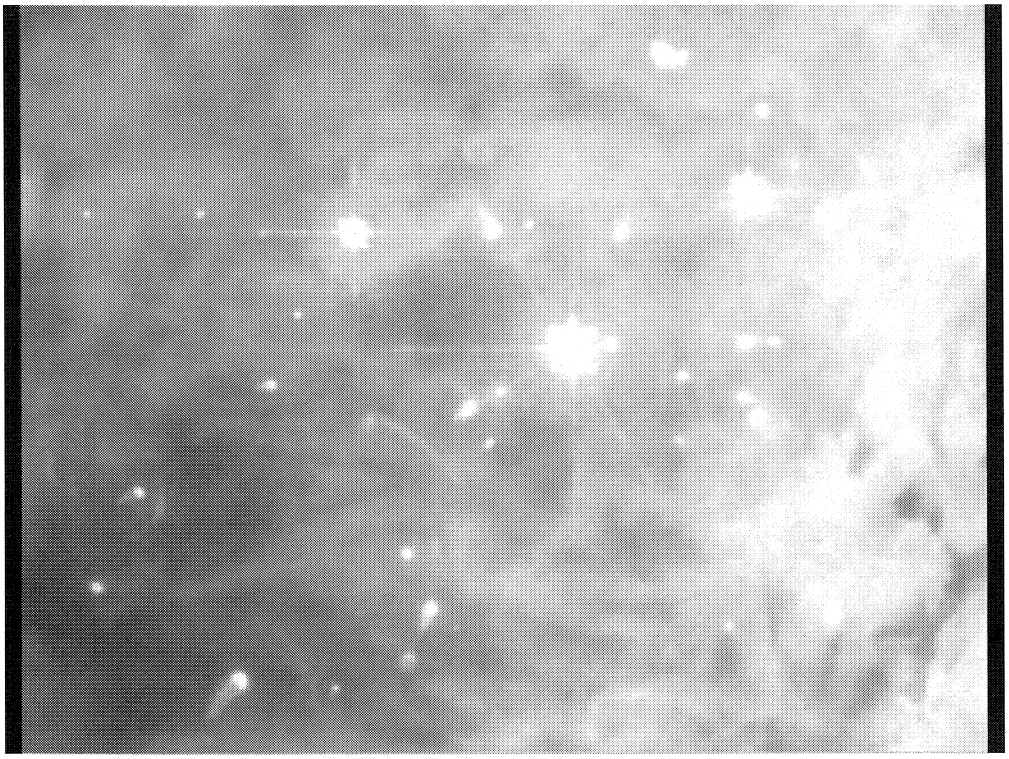

DSS2 ▪ May 1989
Anglo-Australian Observatory
V838 Mon ▪ March 2002
US Naval Observatory

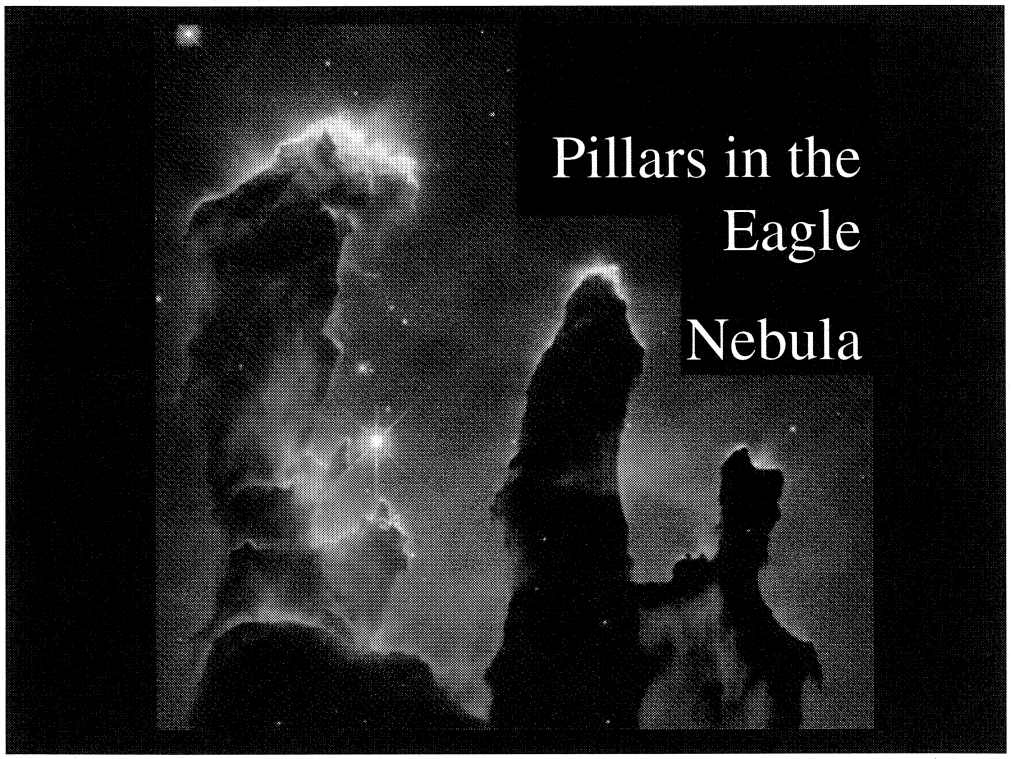

V838 Mon Light Echo
February 8, 2004
HST ACS/WFC
May 20, 2002
September 2, 2002
October 28, 2002
December 12, 2002
February 8, 2004

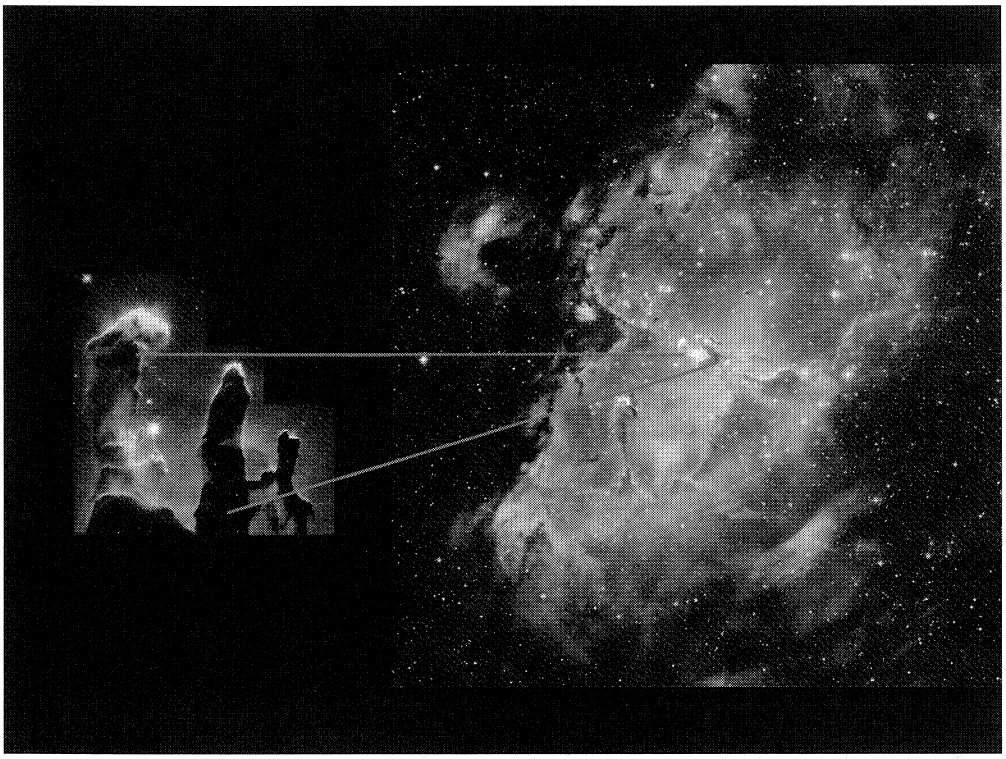
C: NEBULAE

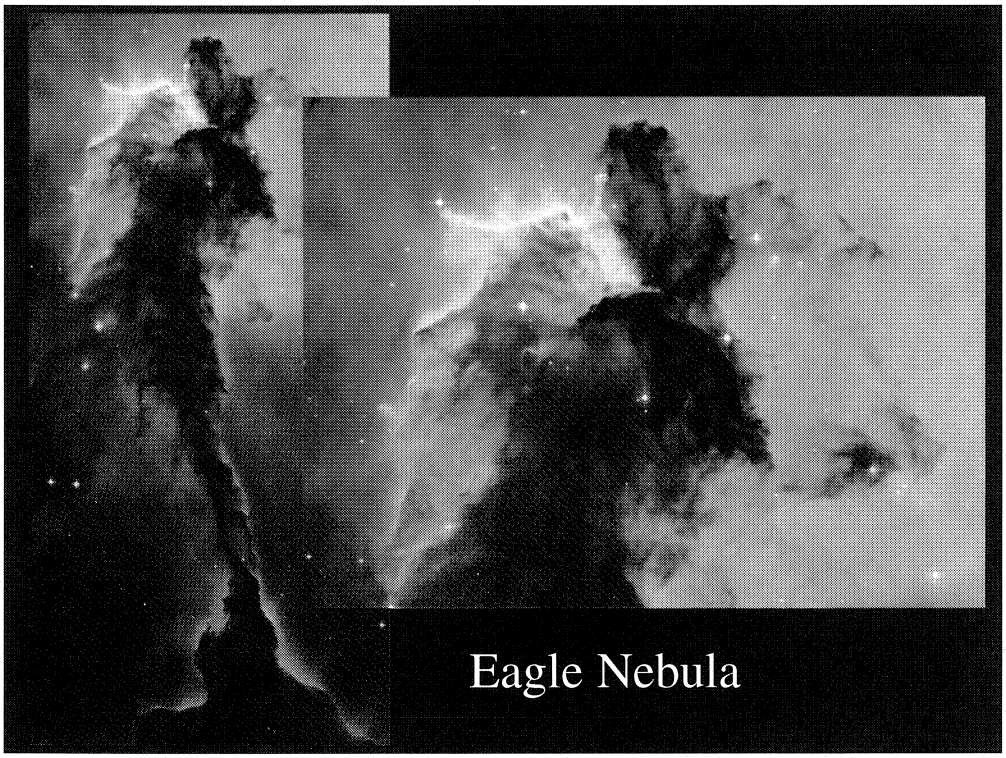




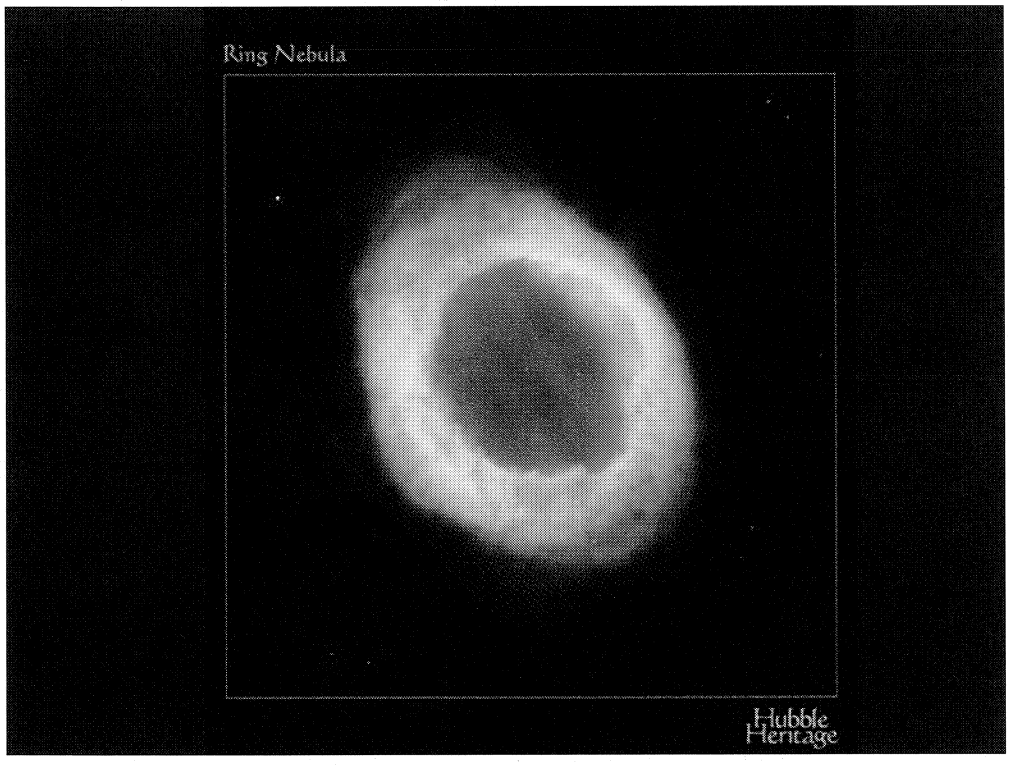


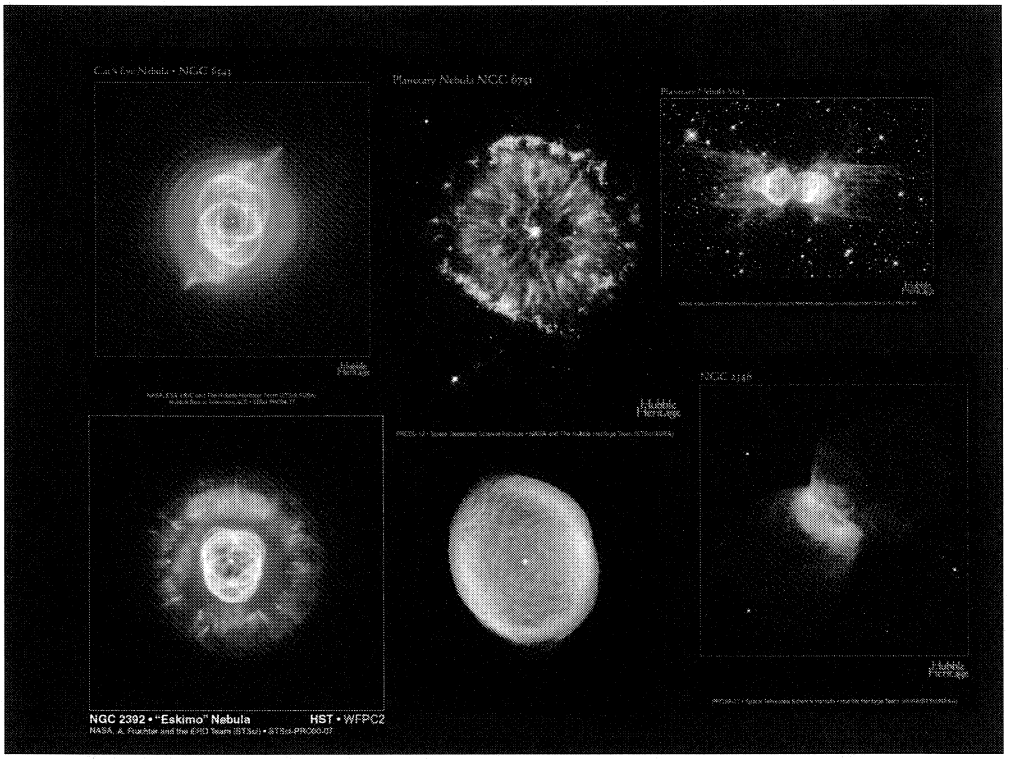

Pillars in the
Eagle
Nebula



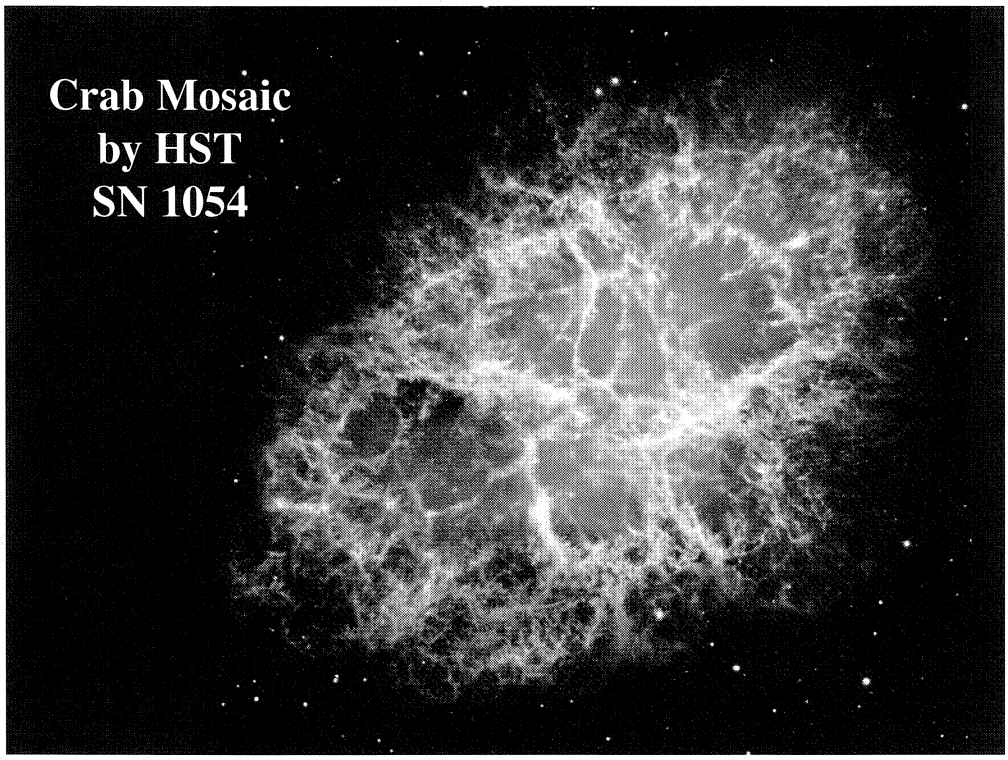

Eagle Nebula

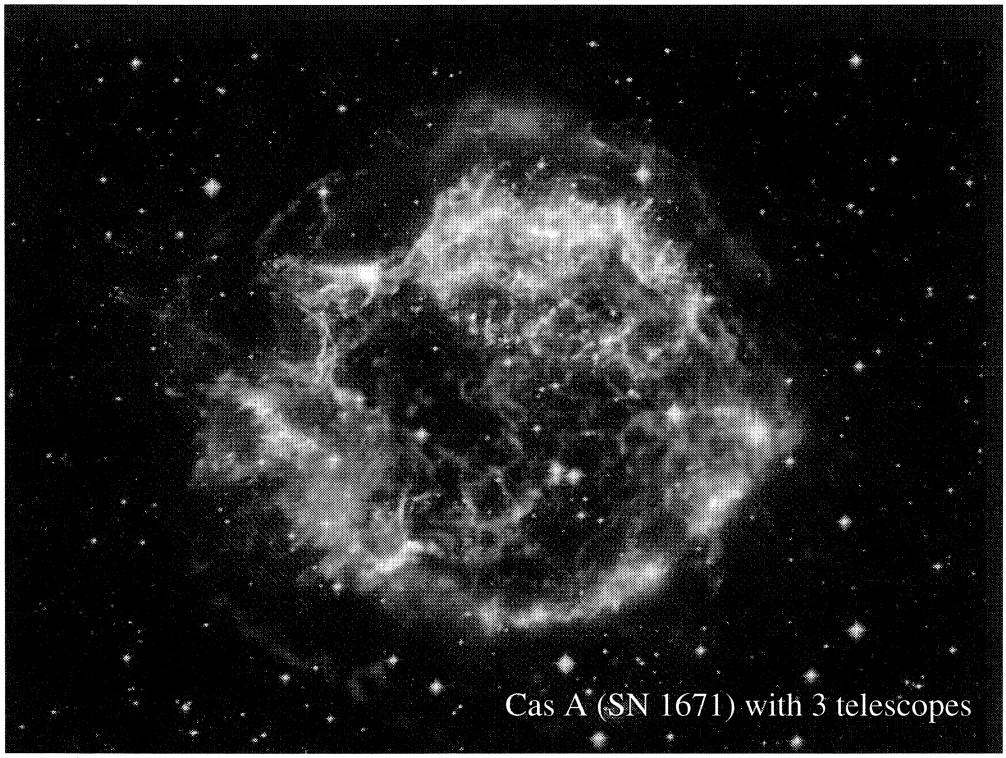
Planetary Nebulae



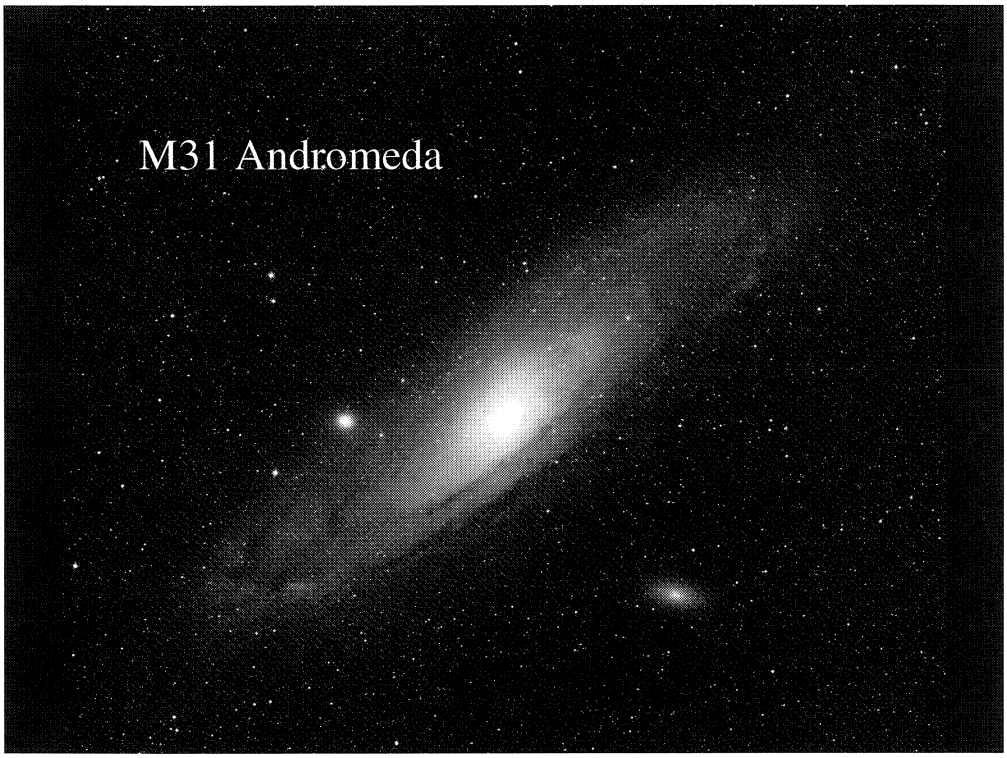


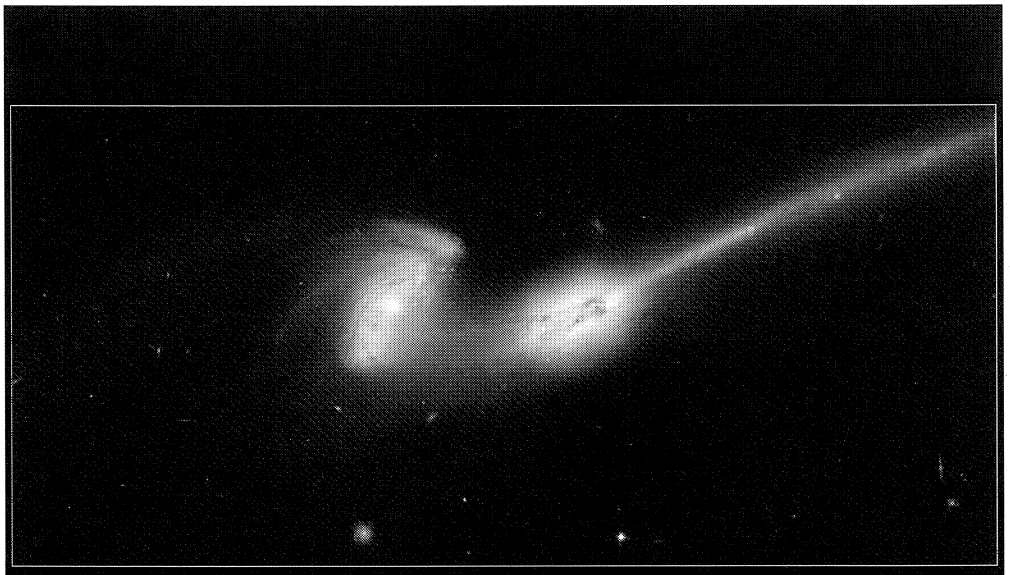
Supernova Remnants


Crab Mosaic
by HST
SN 1054


Cas A (SN 1671) with 3 telescopes

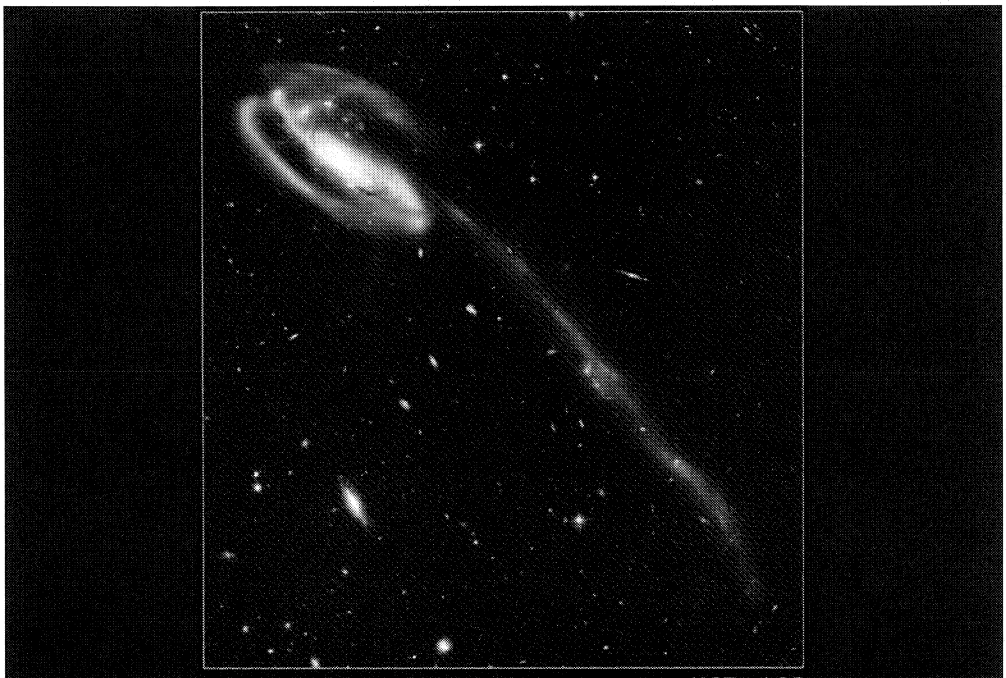
D: GALAXIES


M31 Andromeda



The Mice • Interacting Galaxies NGC 4676 **HST • ACS**

NASA, H. Ford (JHU), G. Illingworth (UCSC/LO), M. Clampin (STScI), G. Hartig (STScI), the ACS Science Team and ESA • STScI-PRC02-11d

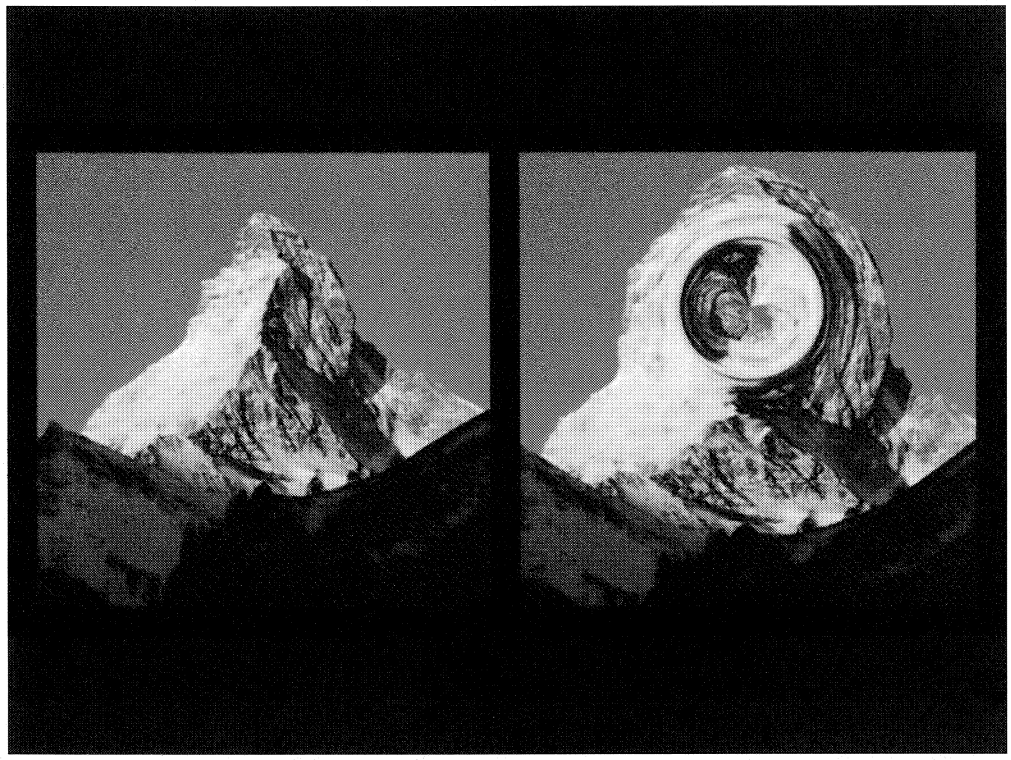


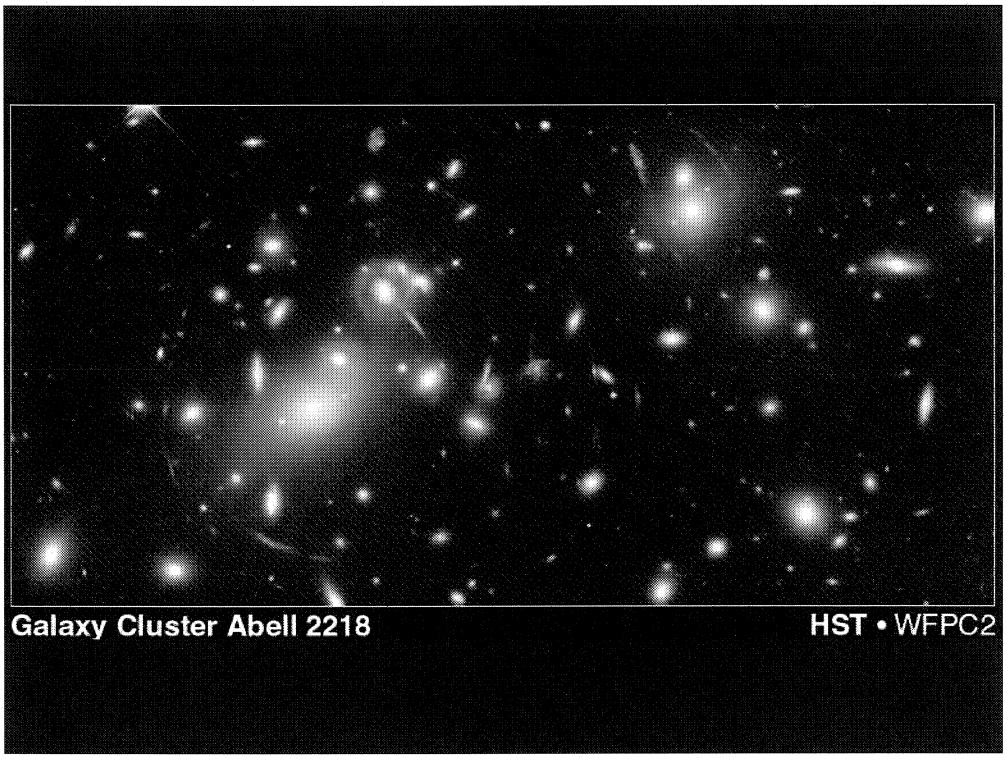
Tadpole Galaxy • UGC 10214 **HST • ACS**

NASA, H. Ford (JHU), G. Illingworth (UCSC/LO), M. Clampin (STScI), G. Hartig (STScI), the ACS Science Team and ESA • STScI-PRC02-11a

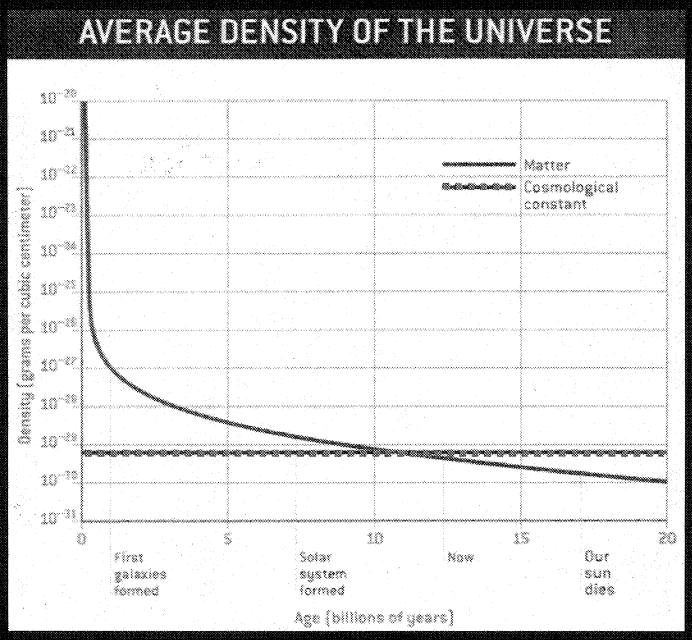
E: THE UNIVERSE

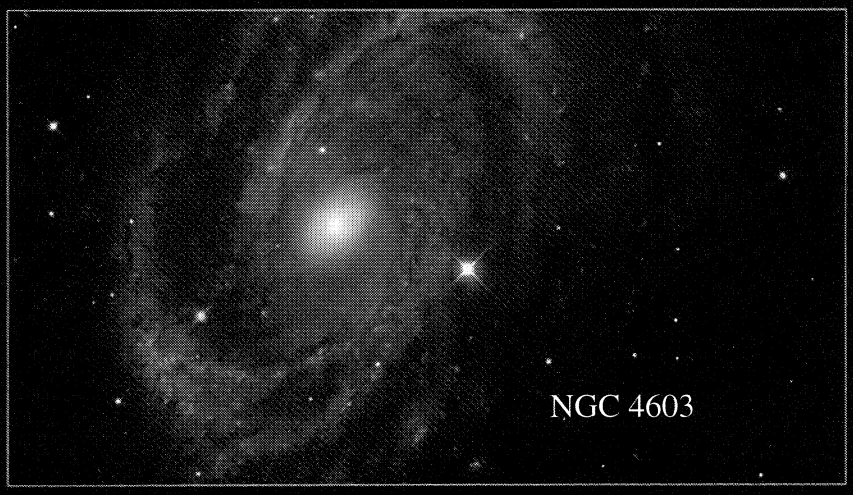
Gravitational Lensing

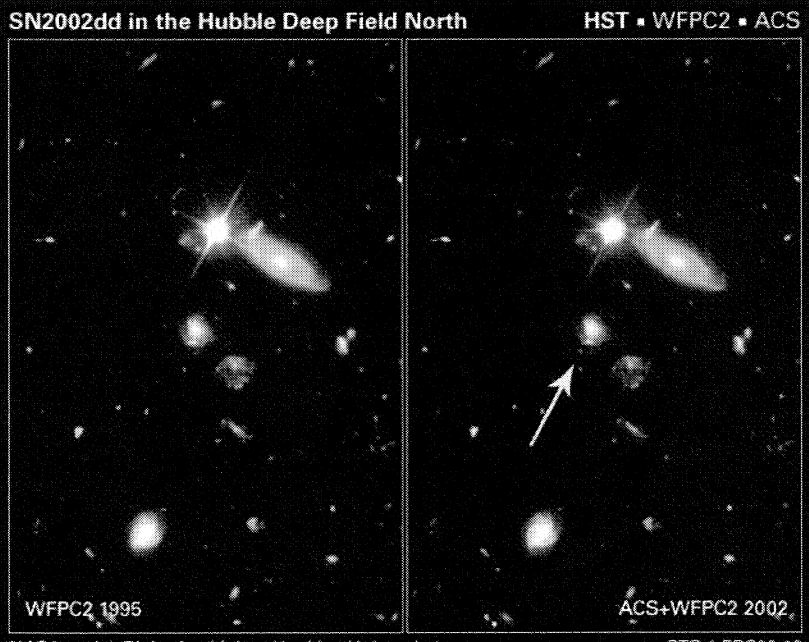


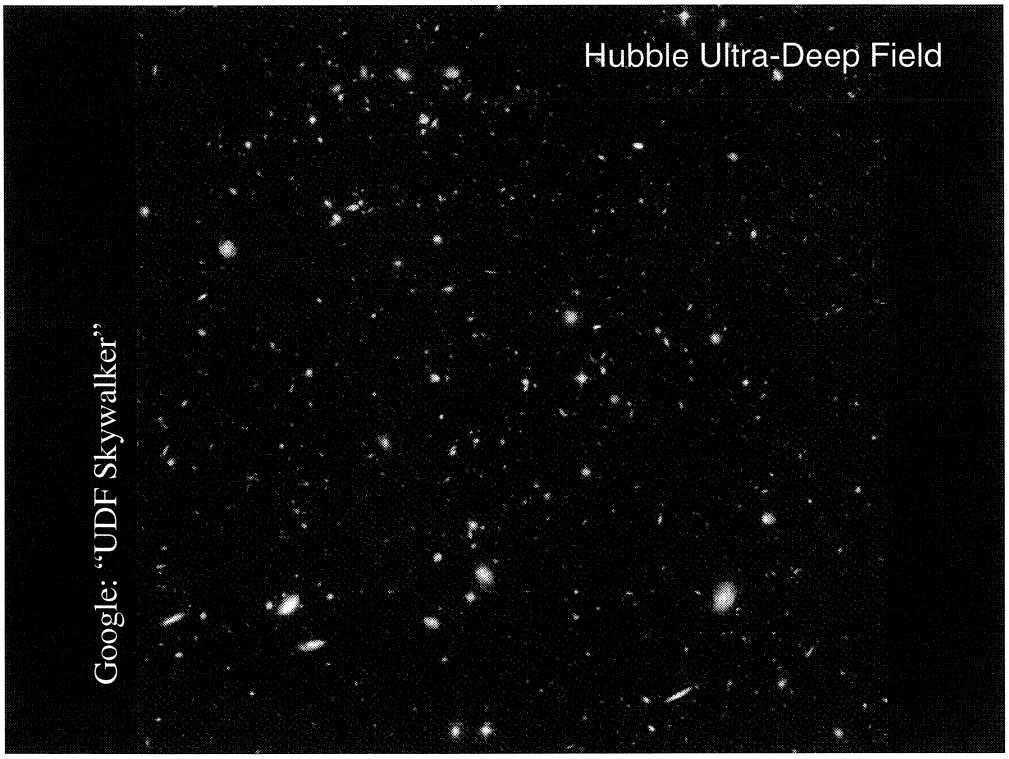

Galaxy Cluster Abell 2218
HST • WFPC2

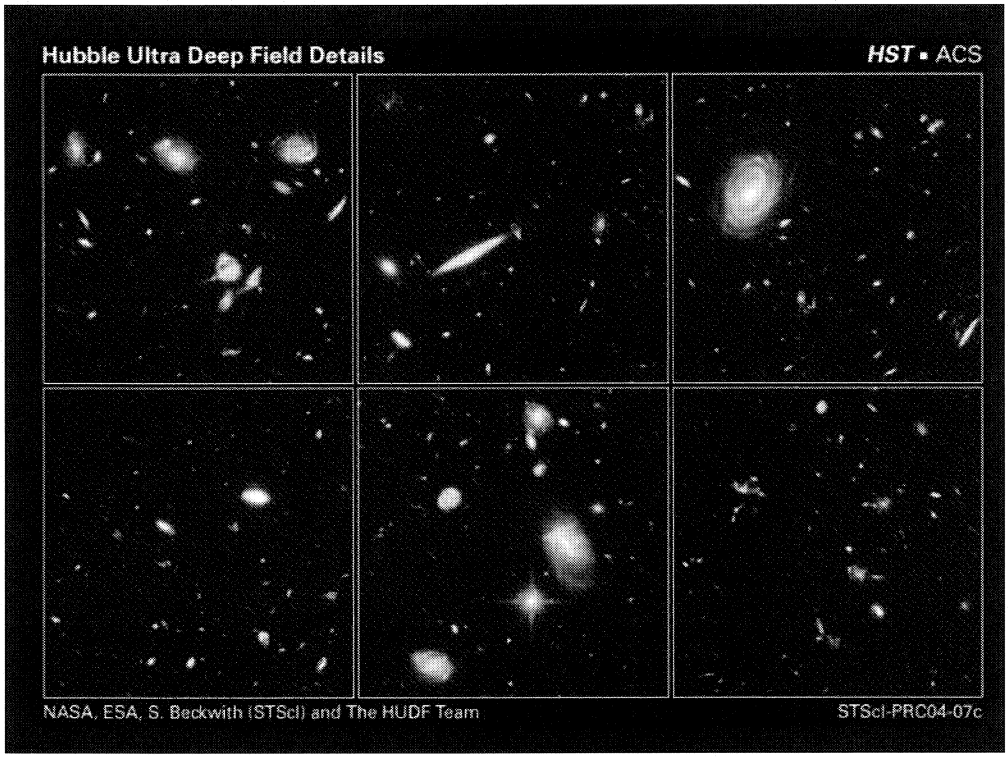
Discovery of Dark Energy

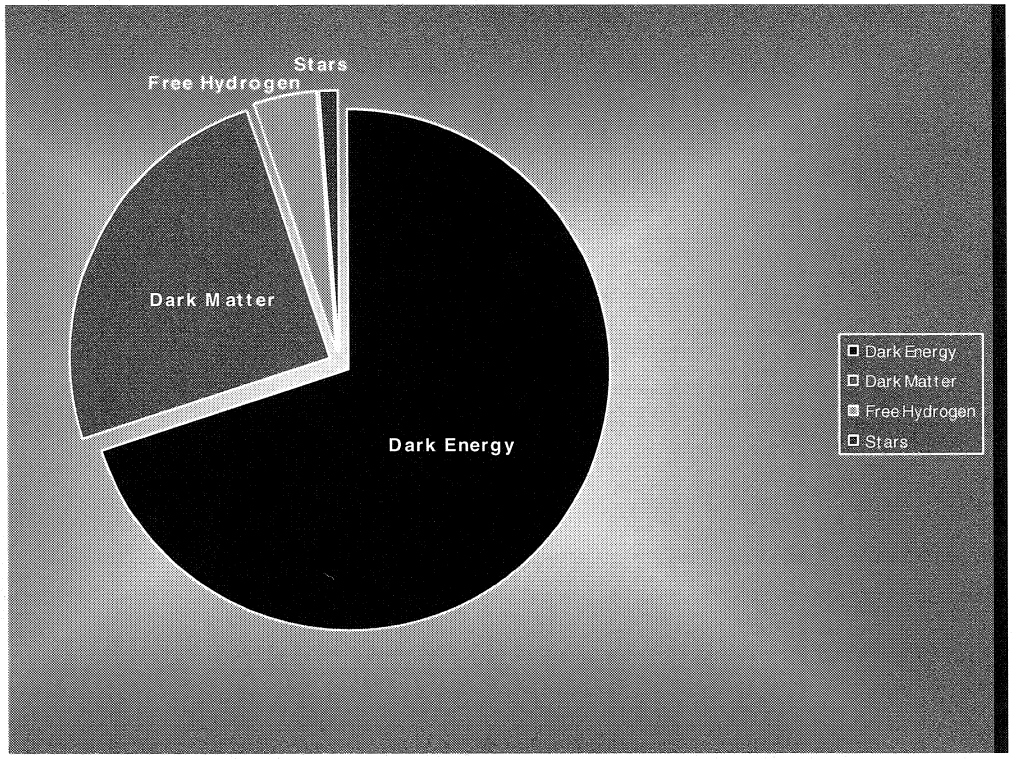
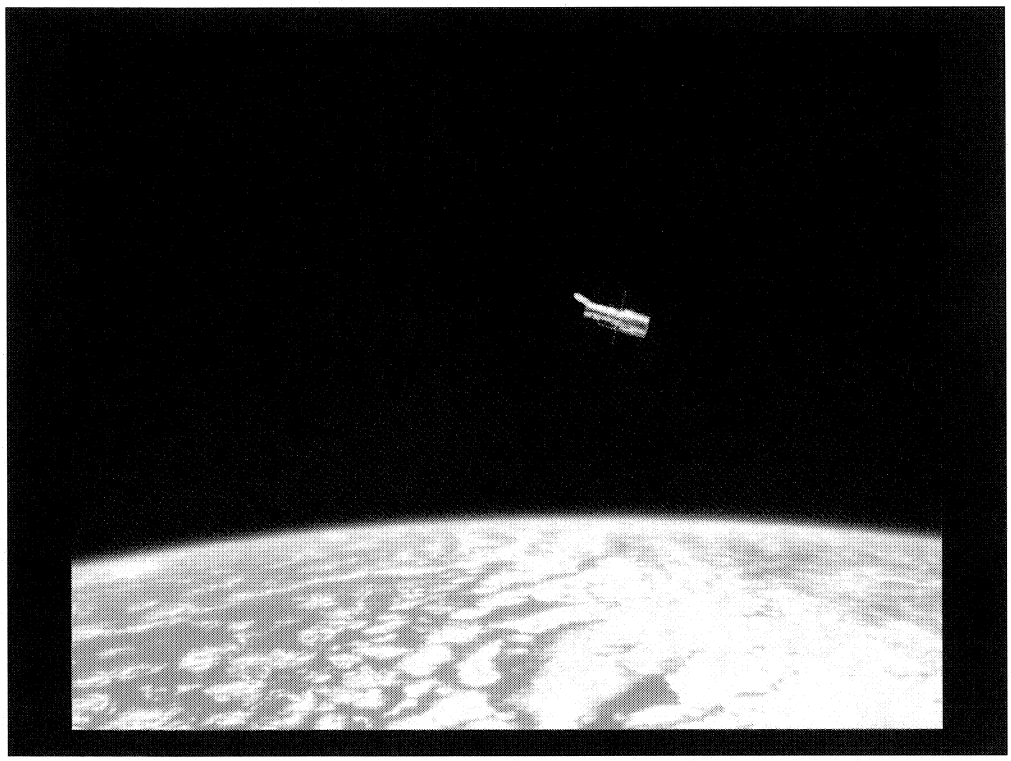
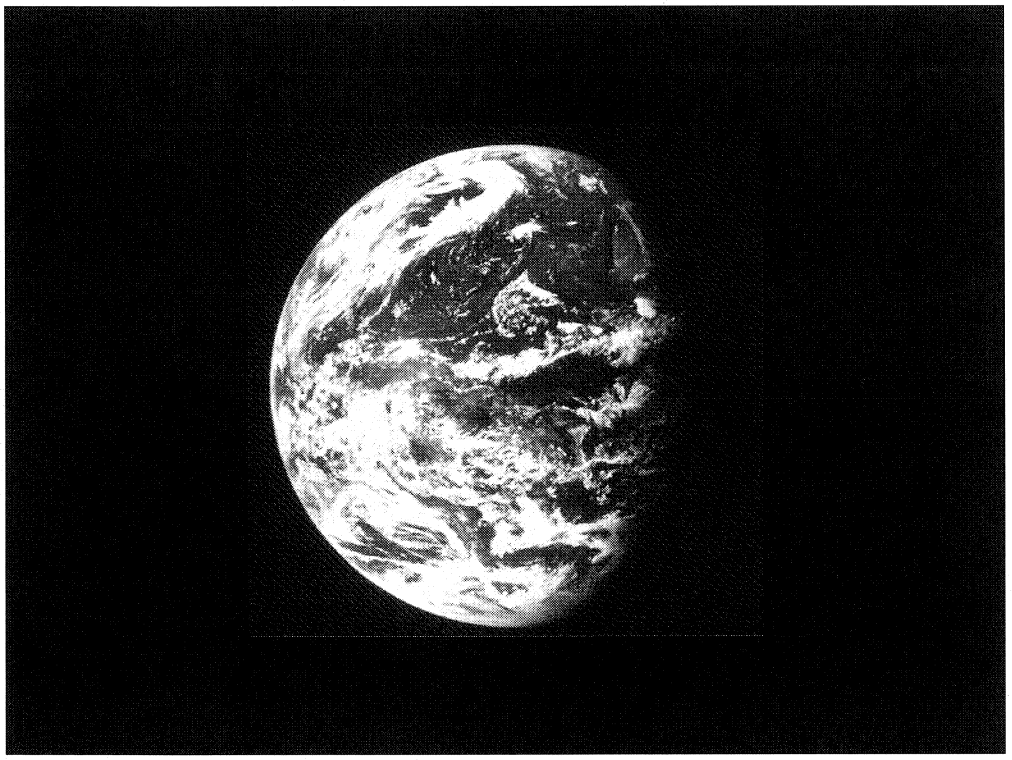



NGC 4603


SN2002dd in the Hubble Deep Field North
HST ▪ WFPC2 ▪ ACS
WFPC2 1995
ACS+WFPC2 2002
NASA and J. Blakeslee (Johns Hopkins University)
STScI-PRC03-12


Hubble Ultra-Deep Field
Google: "UDF Skywalker"


Hubble Ultra Deep Field Details
HST ▪ ACS
NASA, ESA, S. Beckwith (STScI) and The HUDF Team
STScI-PRC04-07c



F: CONCLUSION