http://chandra.harvard.edu

Chandra X-ray Observatory

Superb Observatory

Operating Smoothly

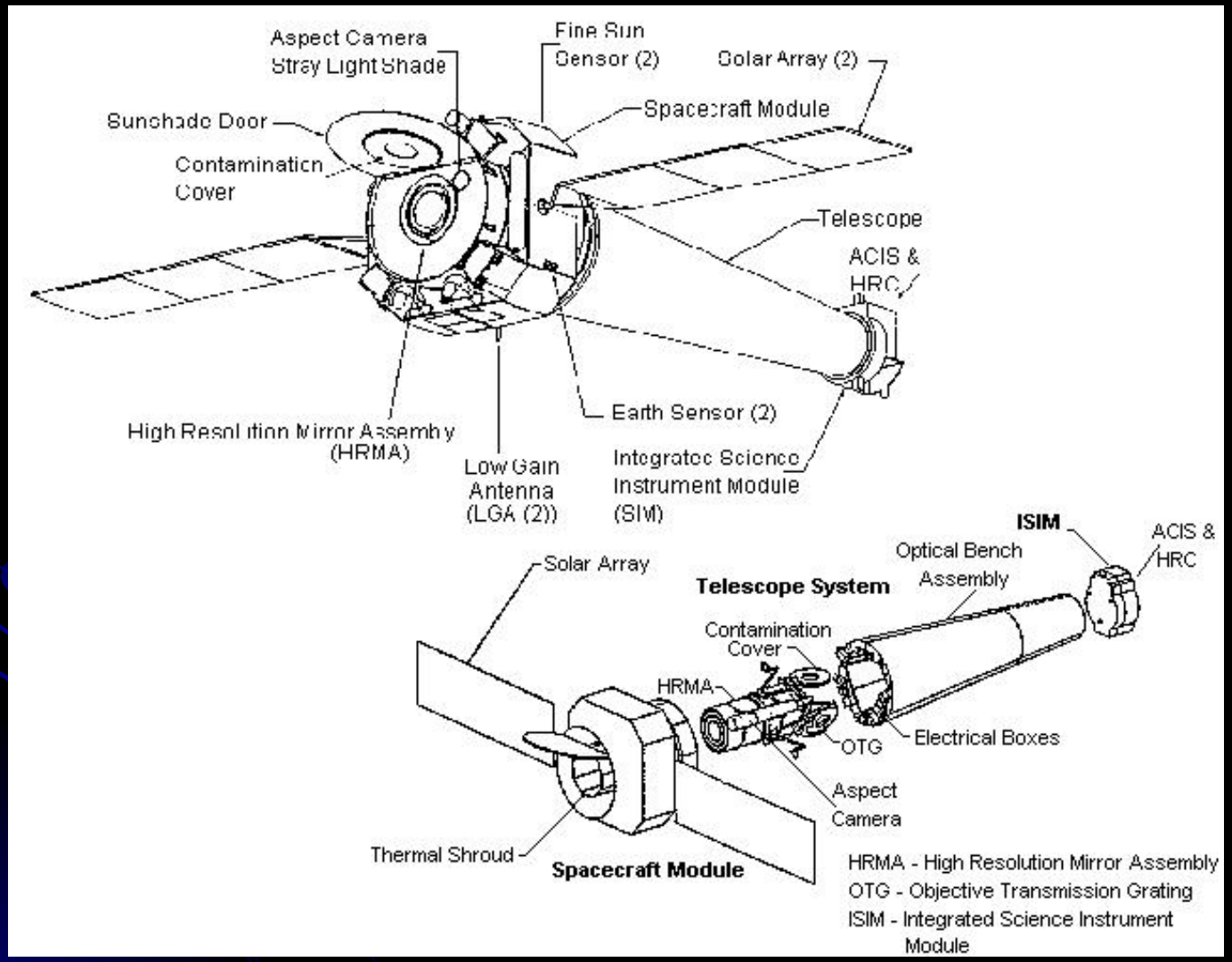
Science is Exciting & Outstanding!

August 5, 2003

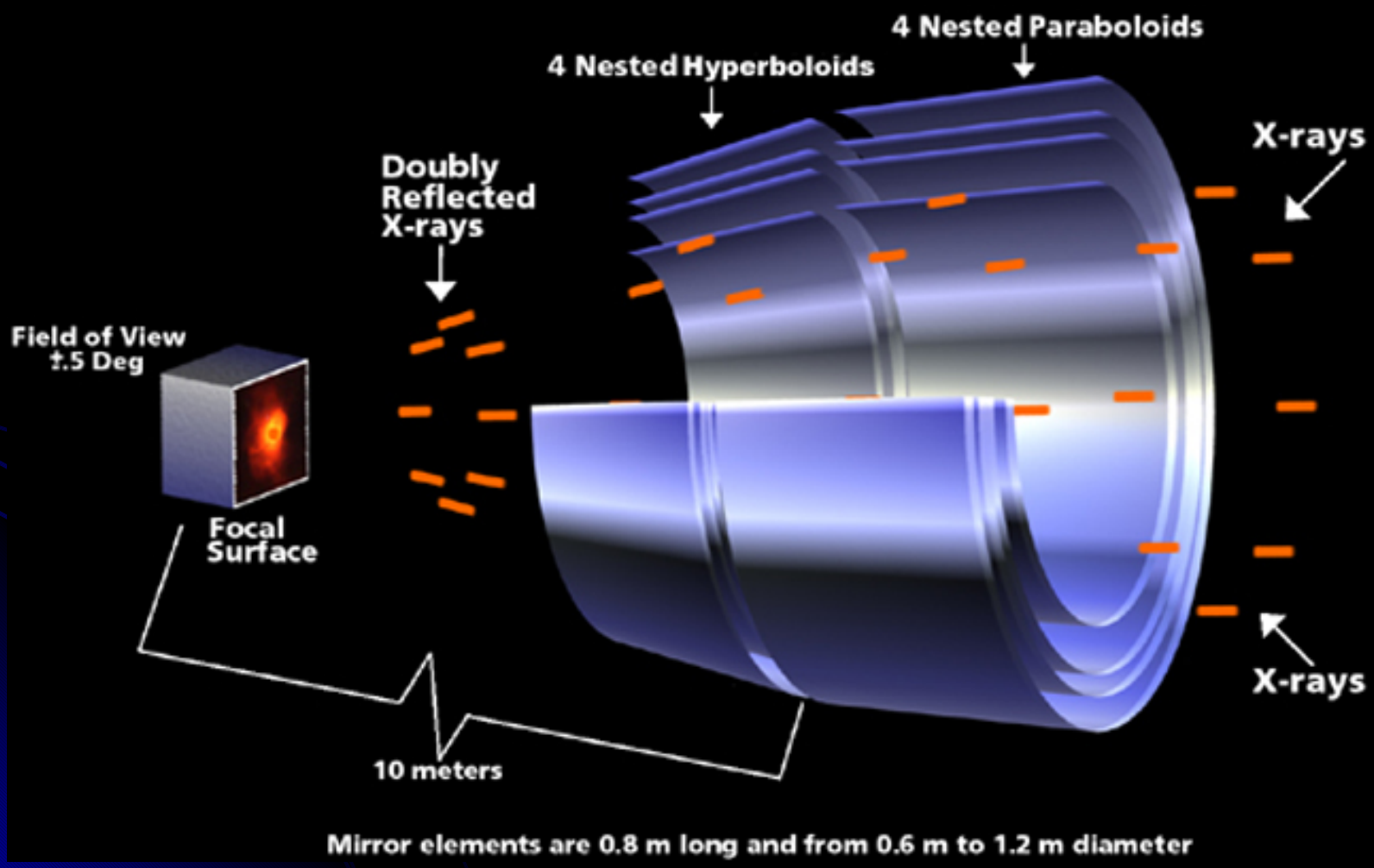
Martin C. Weisskopf

Launch
July 23, 1999

The Observatory

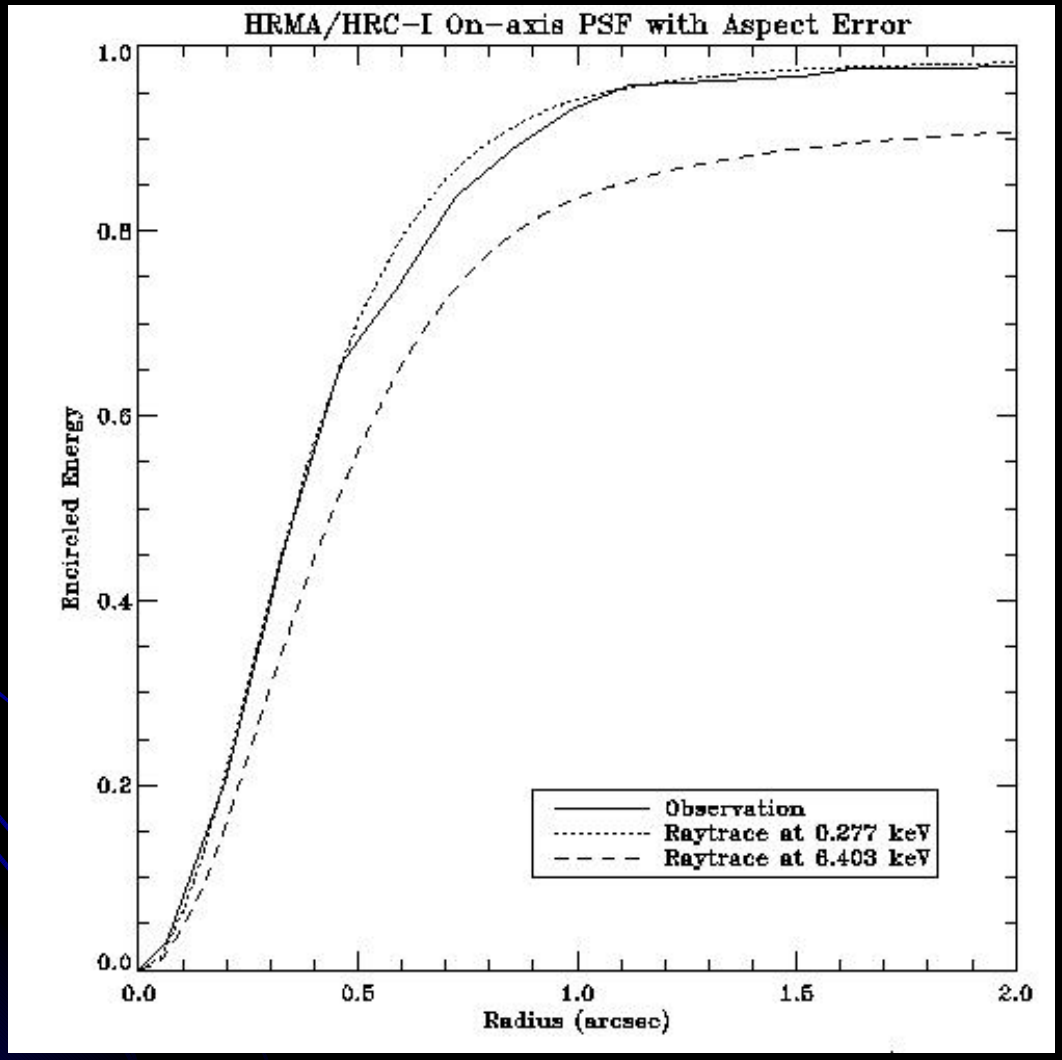


Grazing Incidence



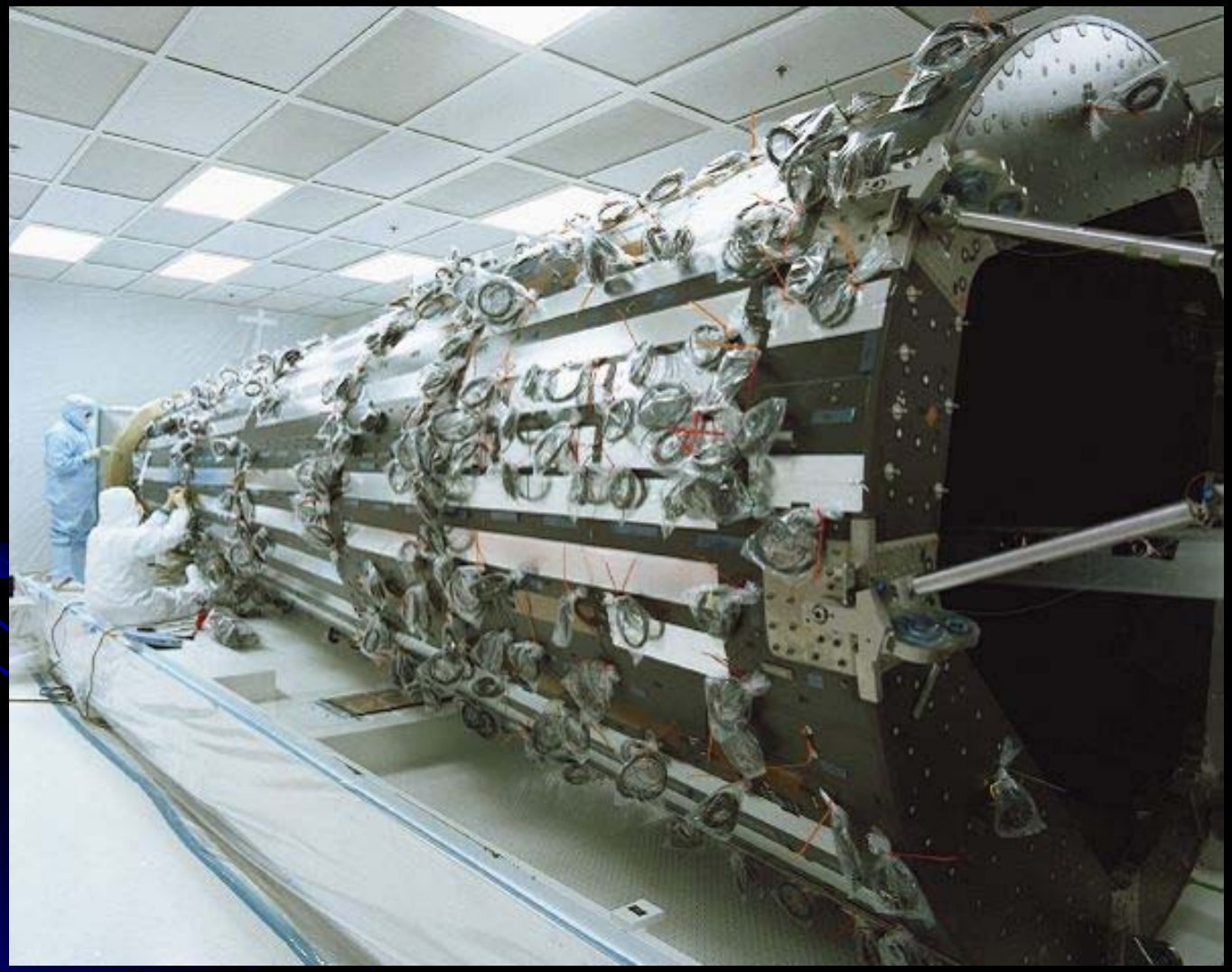
Optics

Chandra Encircled Energy

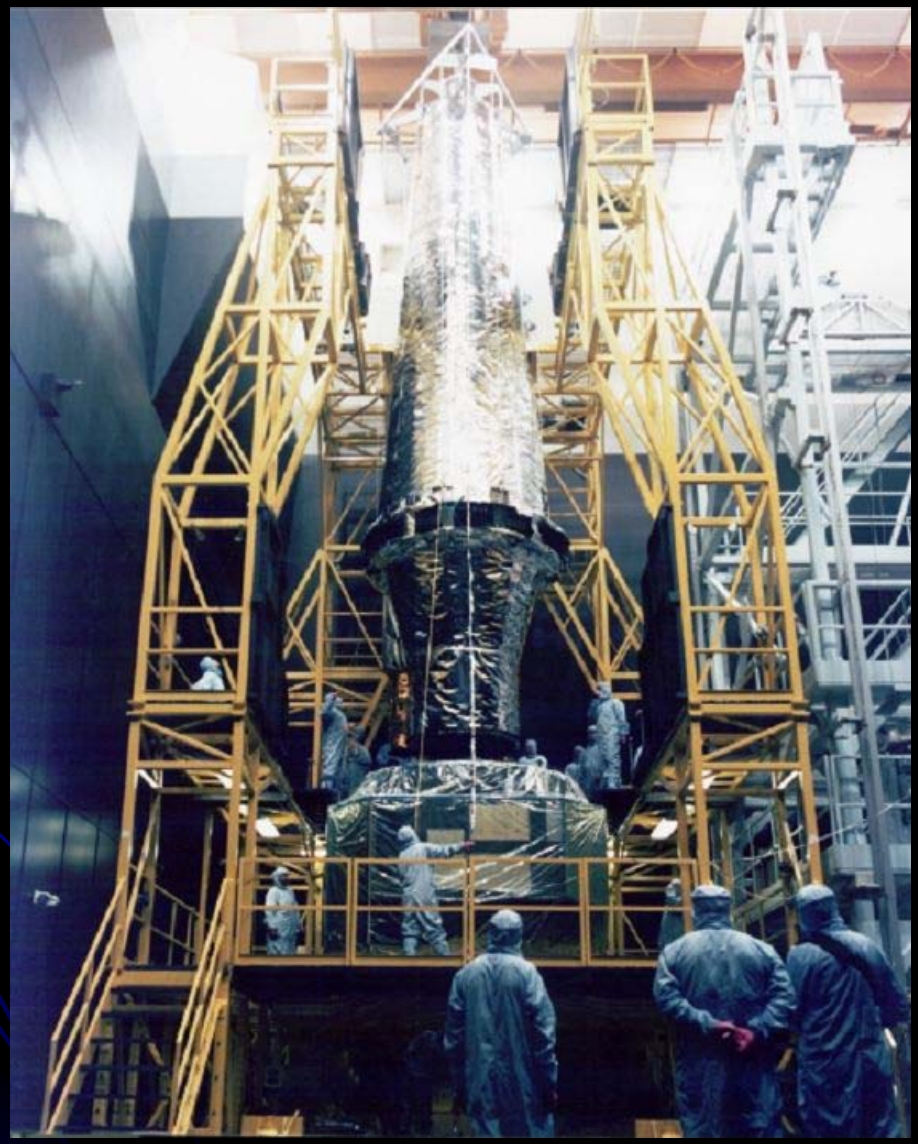


Optical Bench

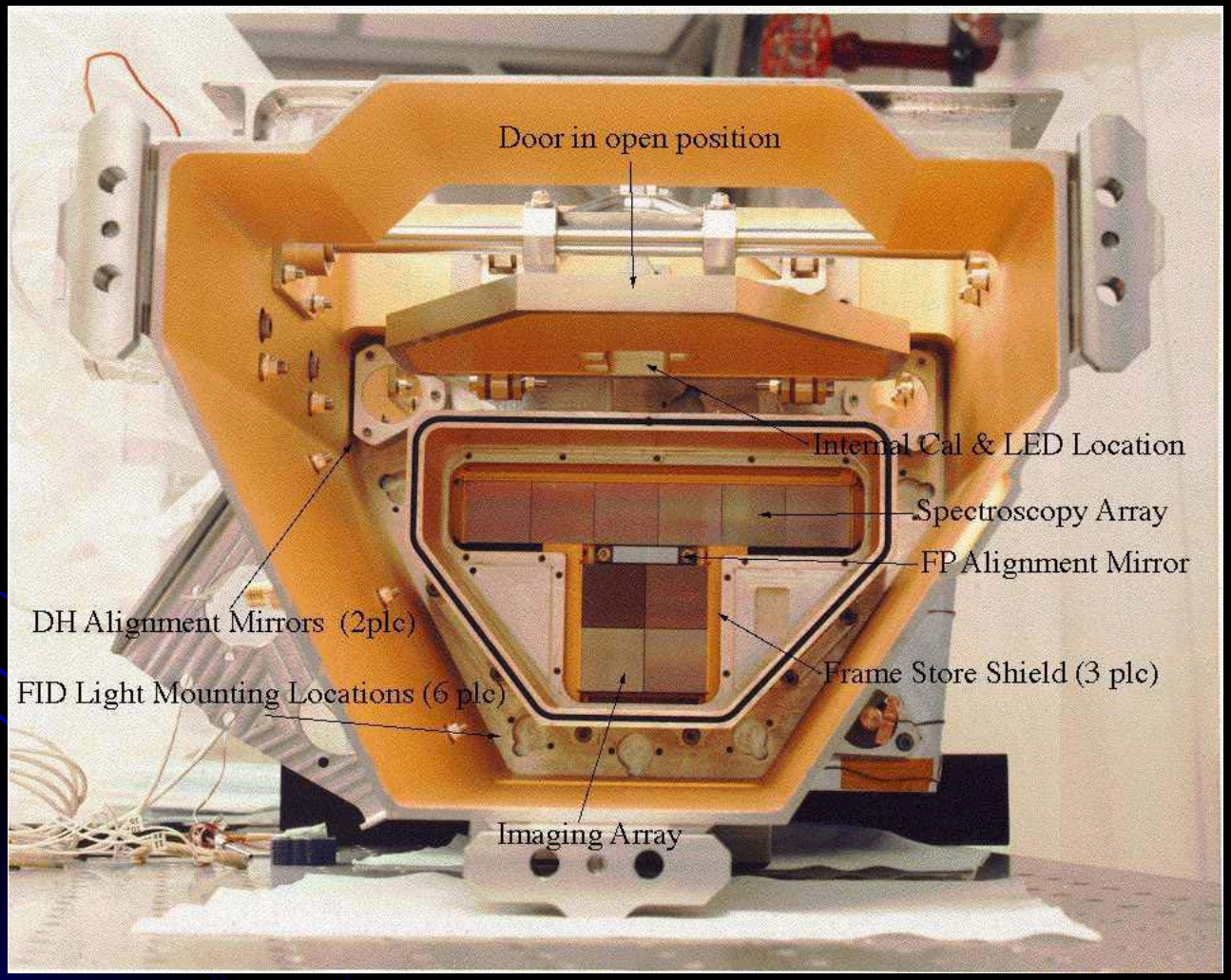
Optical Bench



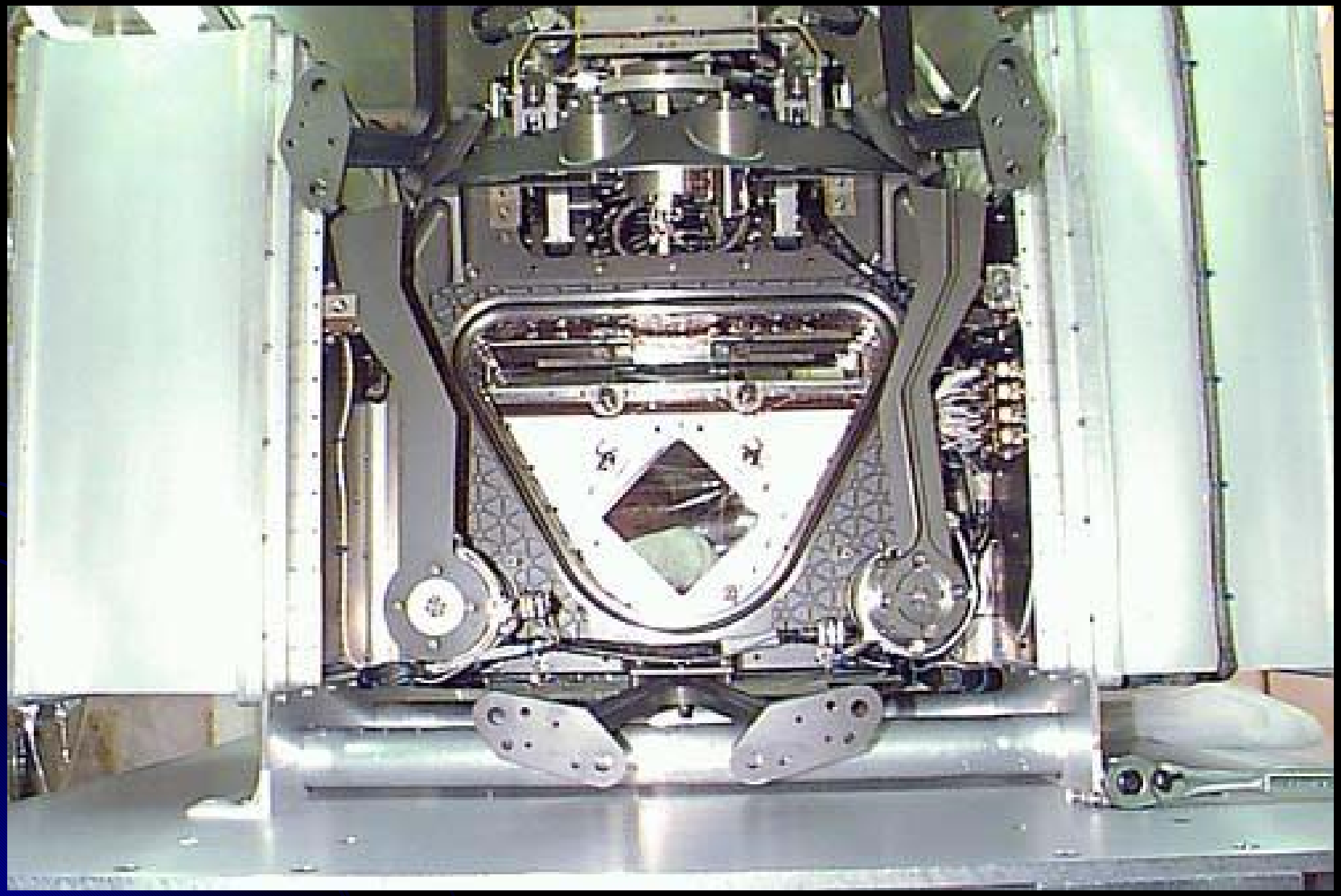
Integration with the S/C



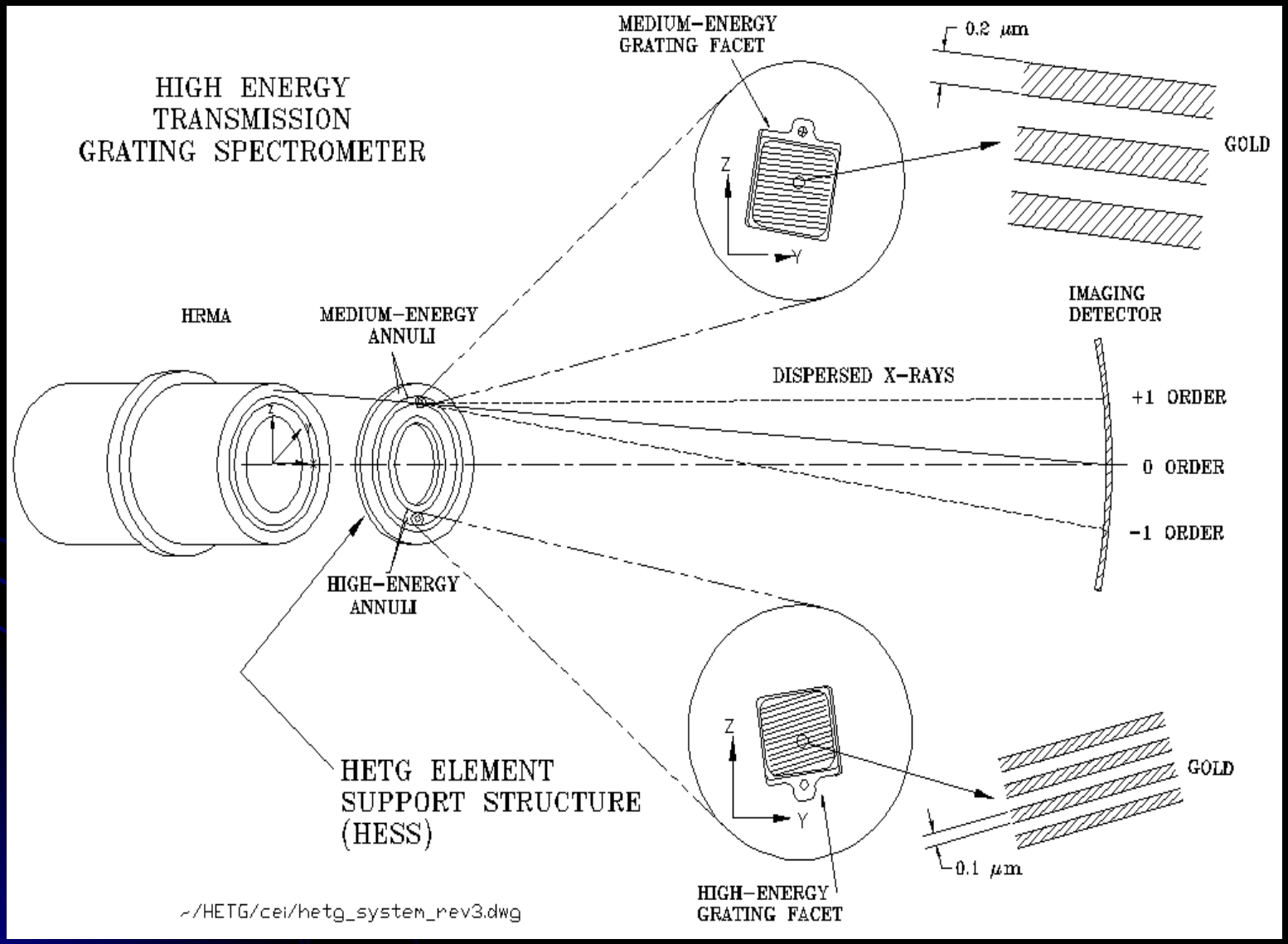
Focal Plane Instruments ACIS



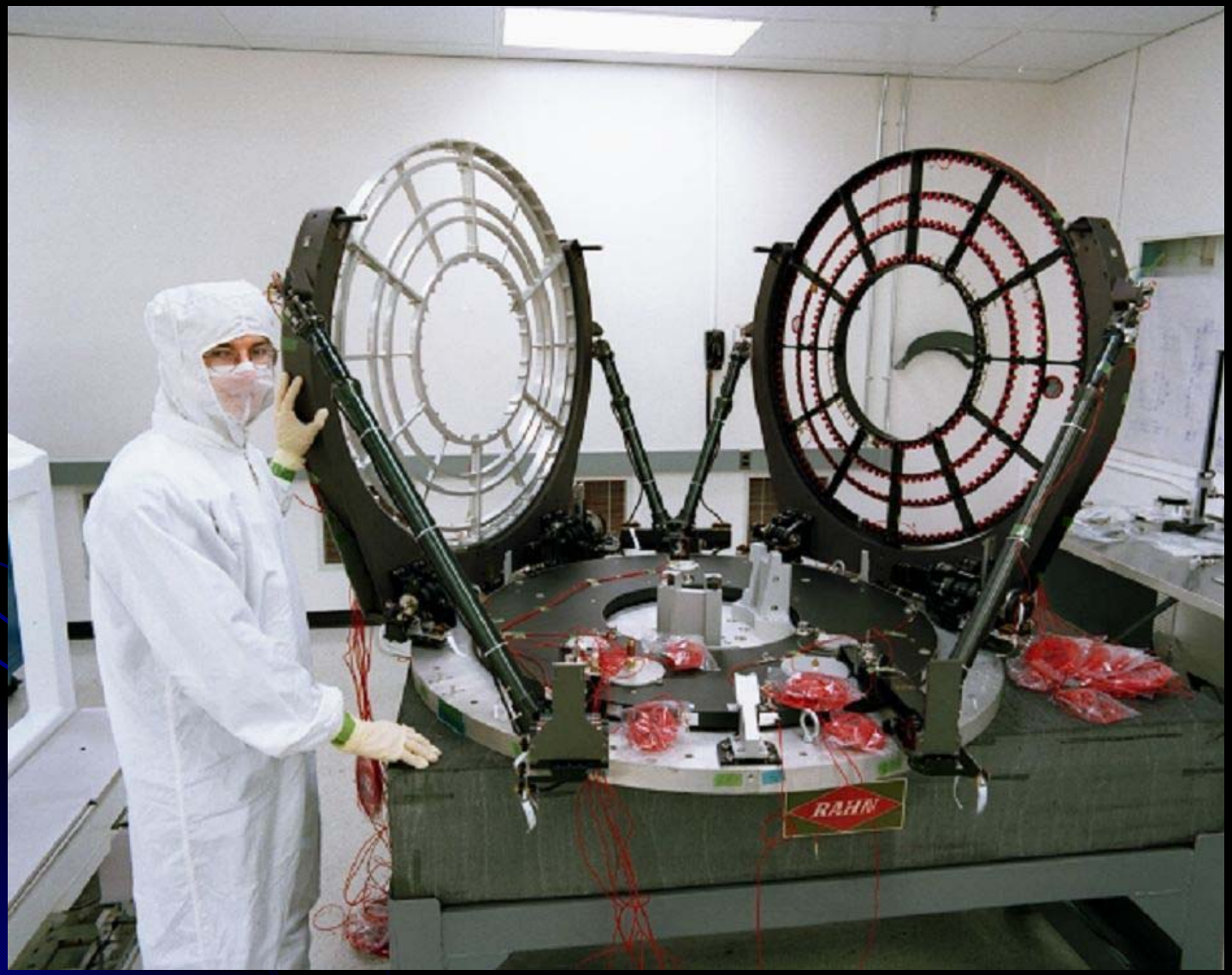
Focal Plane Instruments
HRC



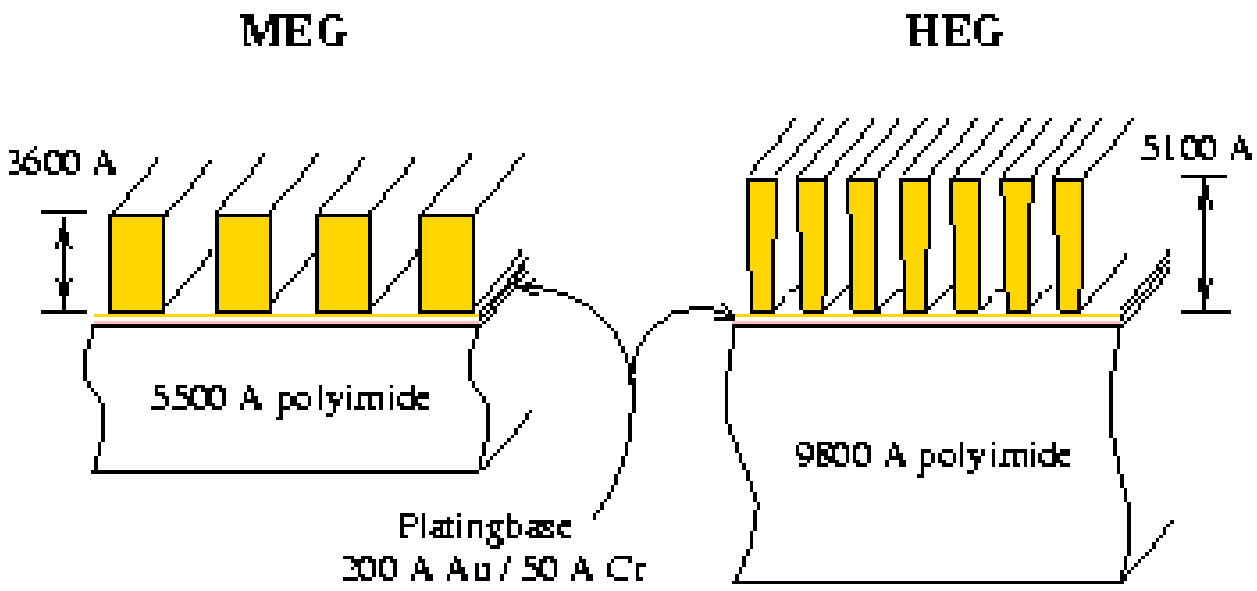
The Gratings



Grating Mounts



Gratings - Continued



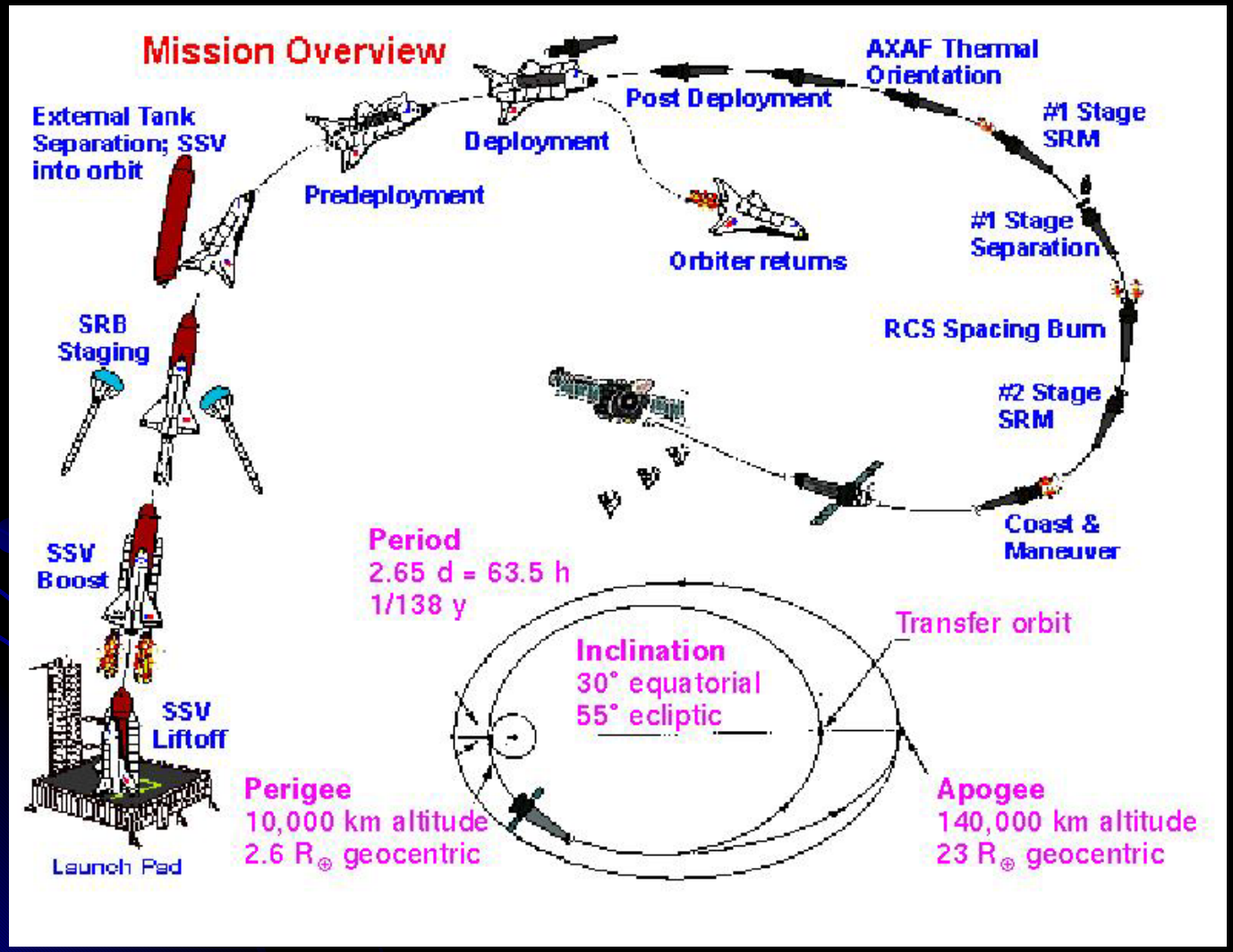
Instrument Status

- Things seem to have settled down
- All instruments operational
- Survived proton damage of FI CCDs
- Noisy Gyro
  - Switched to backup
- Contamination buildup on ACIS filters

Chandra Lifetime

- Fuel: >40 years
- Orbit: 30-50 years
- Funding: NASA committed to 10 year mission

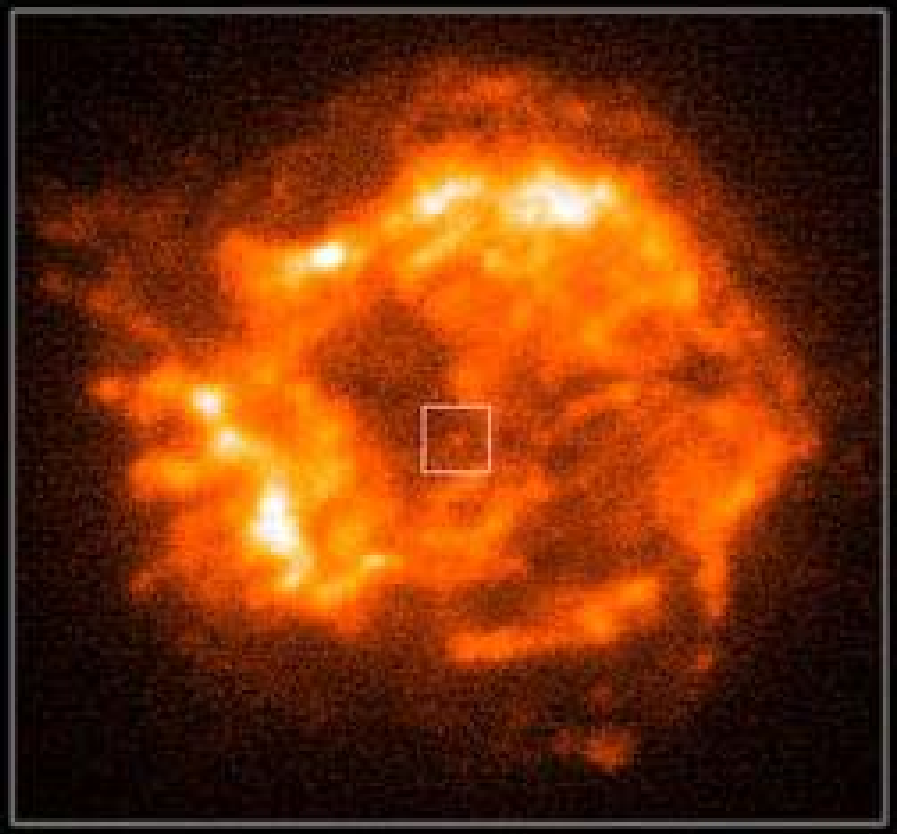
The Orbit


Mission Overview
External Tank Separation; SSV into orbit
Predeployment
Deployment
Post Deployment
AXAF Thermal Orientation
#1 Stage SRM
#1 Stage Separation
Orbiter returns
RCS Spacing Burn
#2 Stage SRM
Coast & Maneuver
SRB Staging
SSV Boost
SSV Liftoff
Launch Pad
Period
2.65 d = 63.5 h
1/138 y
Inclination
30° equatorial
55° ecliptic
Transfer orbit
Perigee
10,000 km altitude
2.6 R⊕ geocentric
Apogee
140,000 km altitude
23 R⊕ geocentric

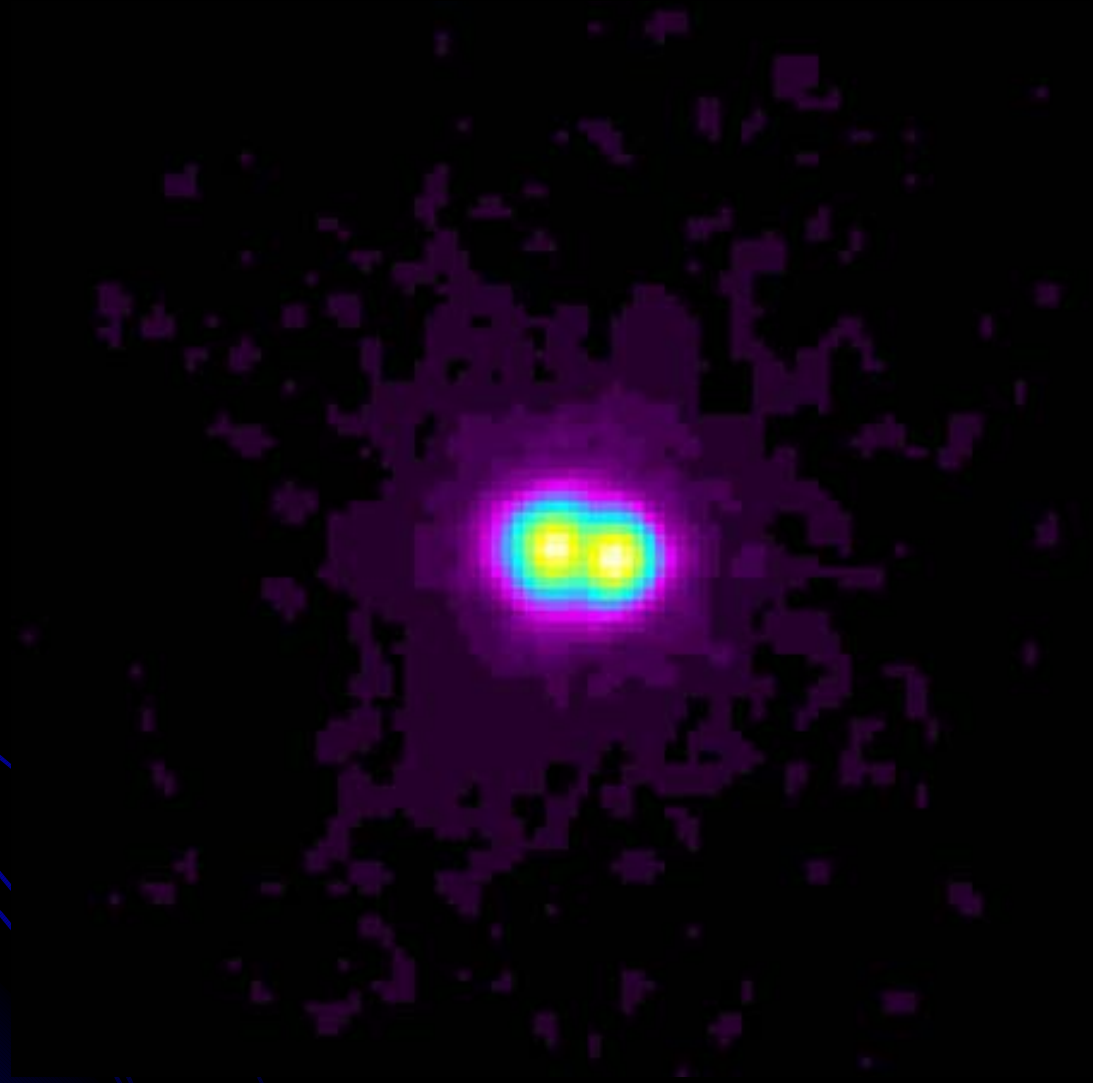
In Cargo bay

First Deployment

First Light

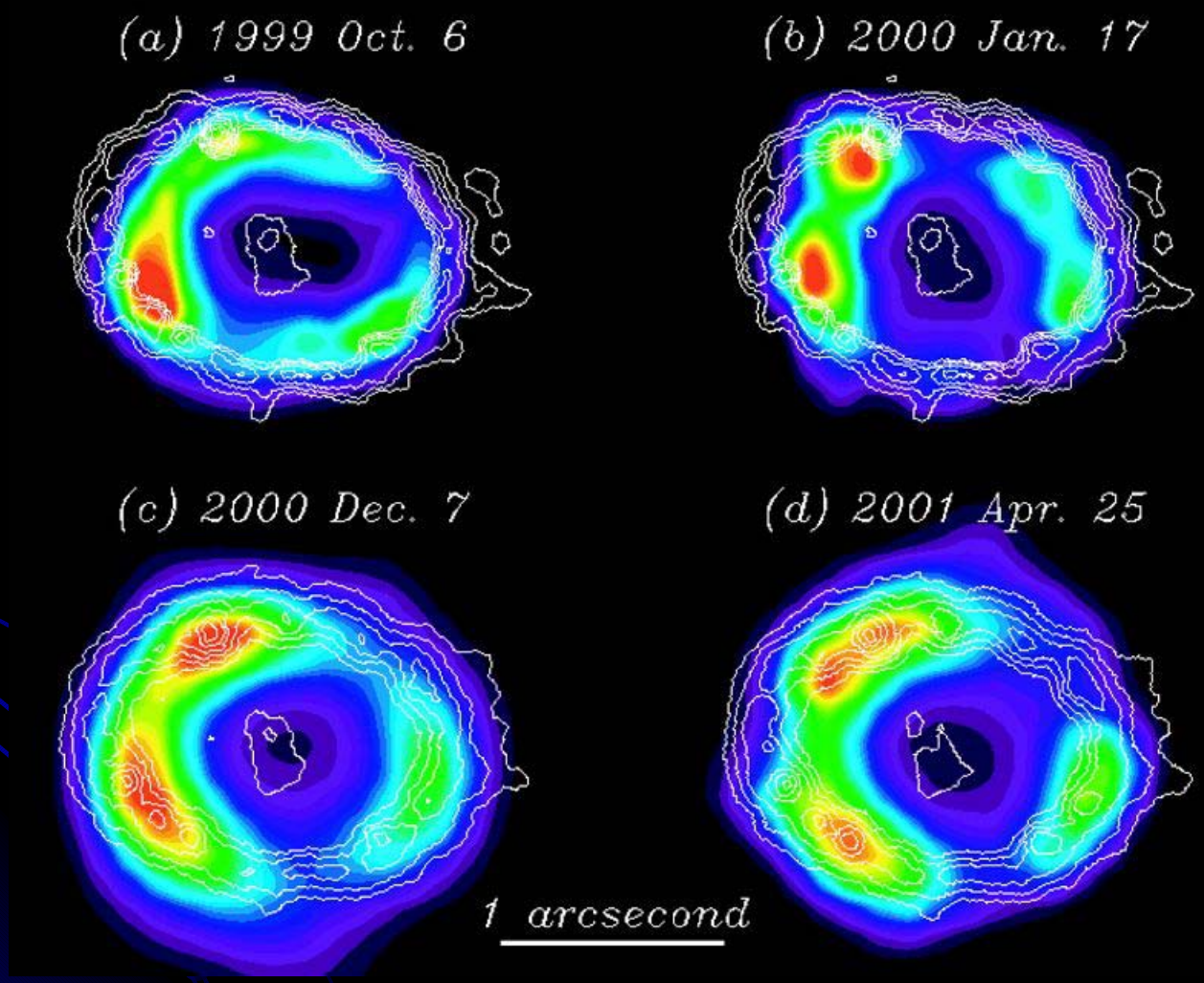


M15



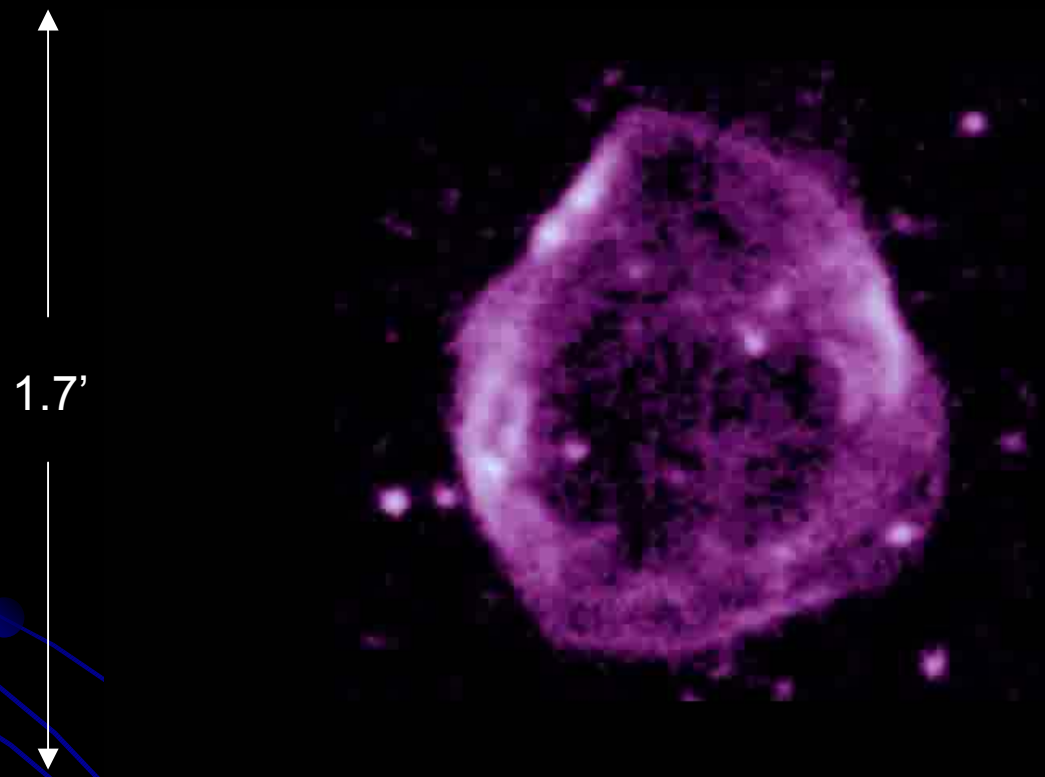
White and Angelini

SNR 1987a



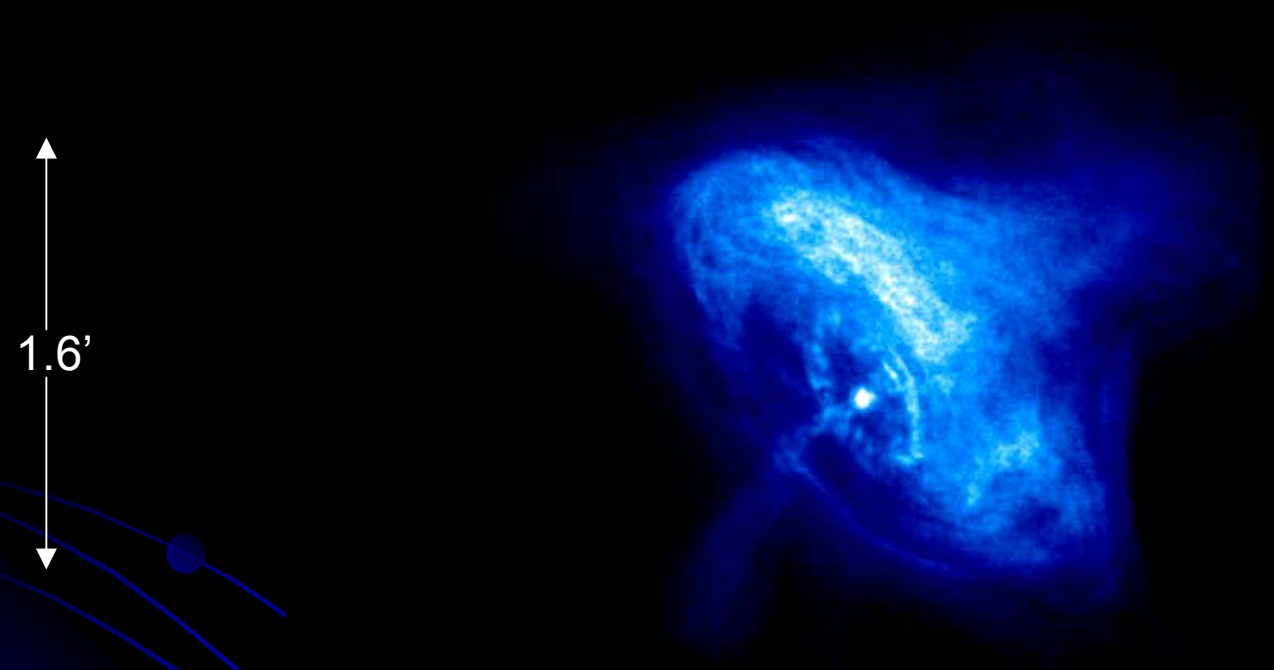
Park et al. 2002

SNR DEM L71



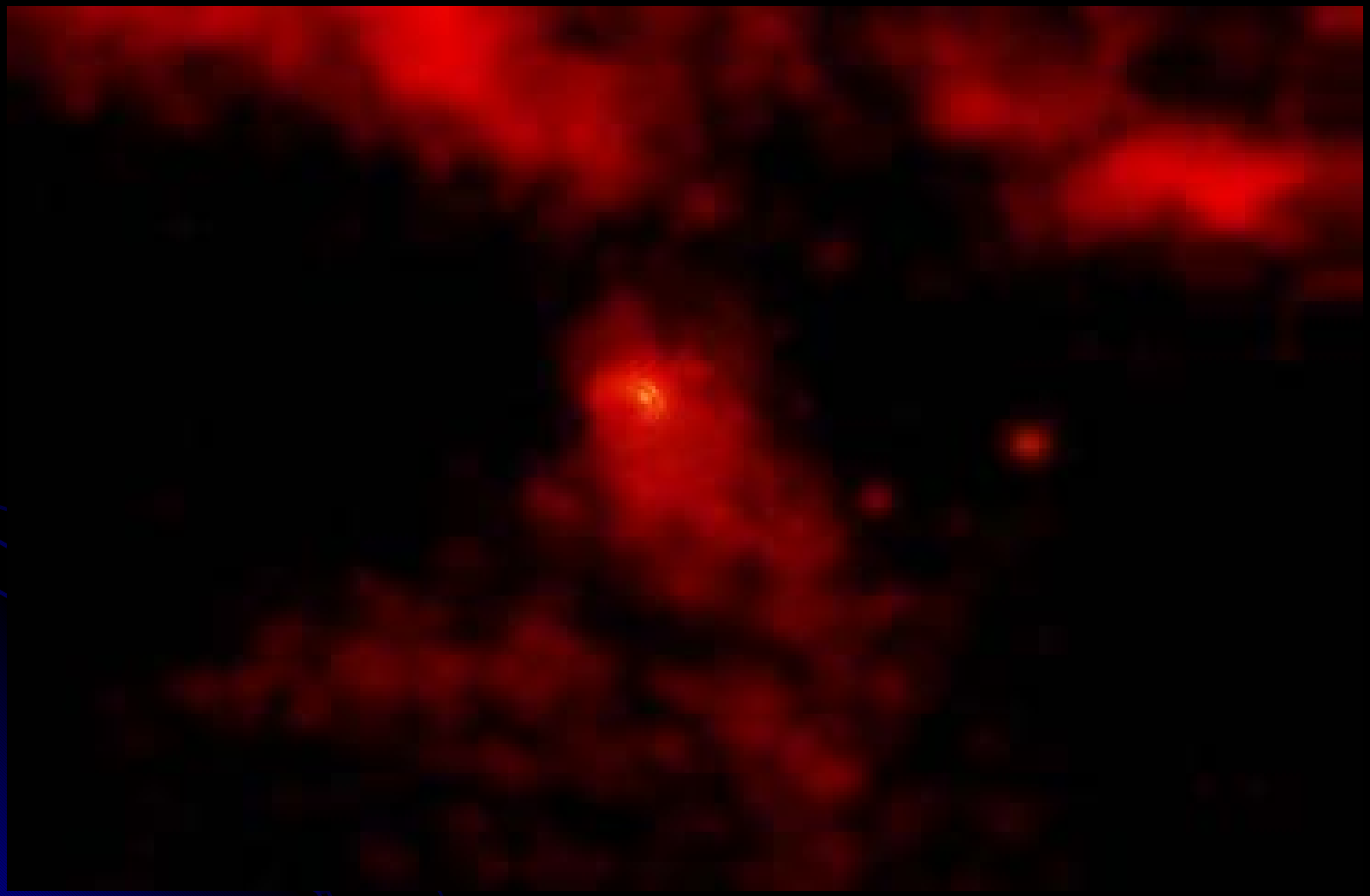
Hughes et al. 2003

Crab Nebula and Pulsar



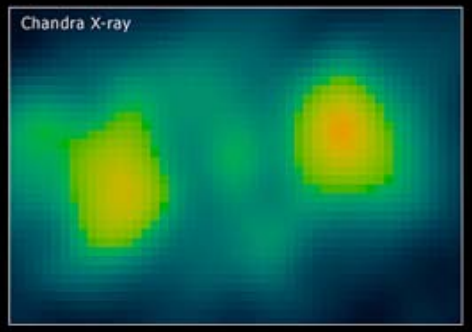
Weisskopf et al. 2000; Hester et al. 2002

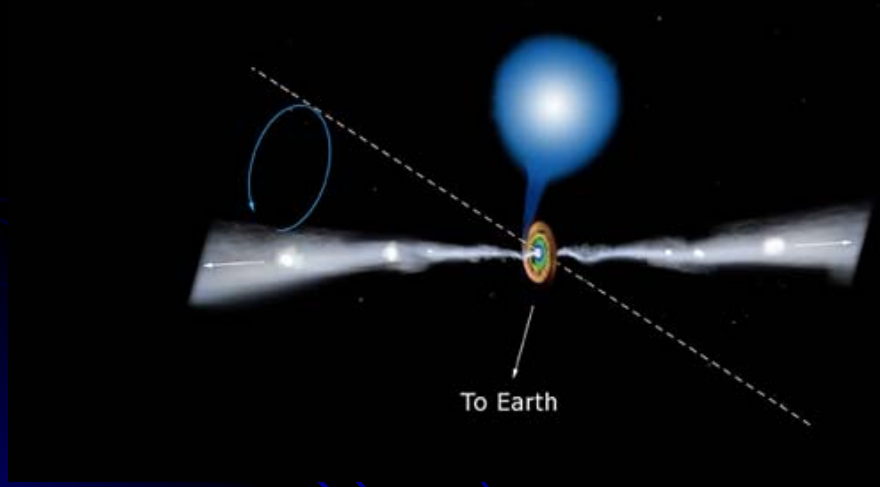
Vela Pulsar

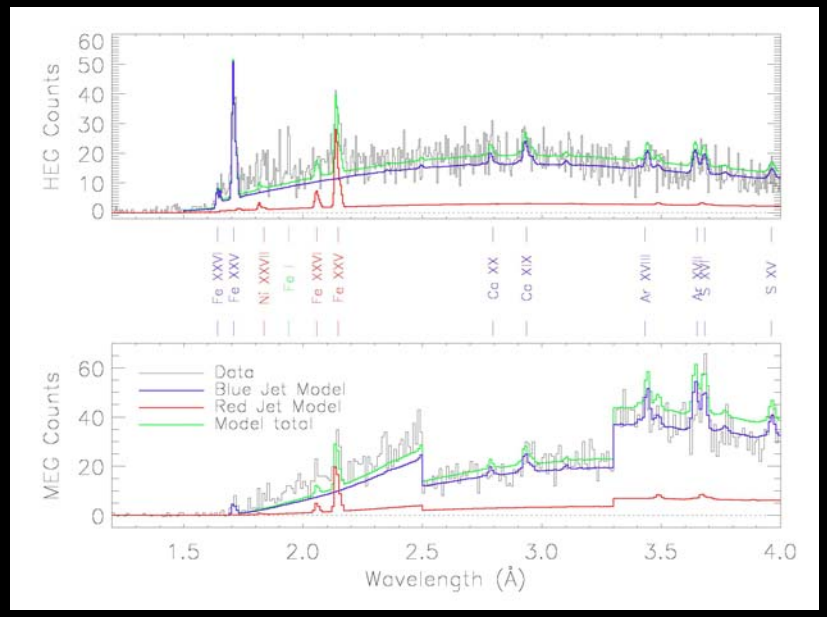


Pavlov et al. 2003

Jets - SS 433





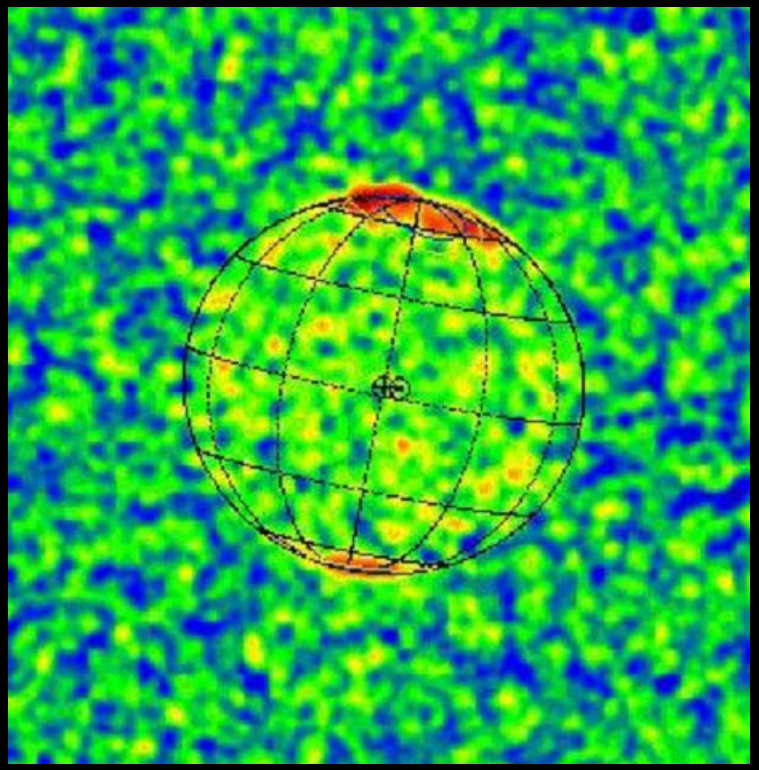


Marshall, Canizares, and Schulz (2002); Migliari et al 2003

Planets

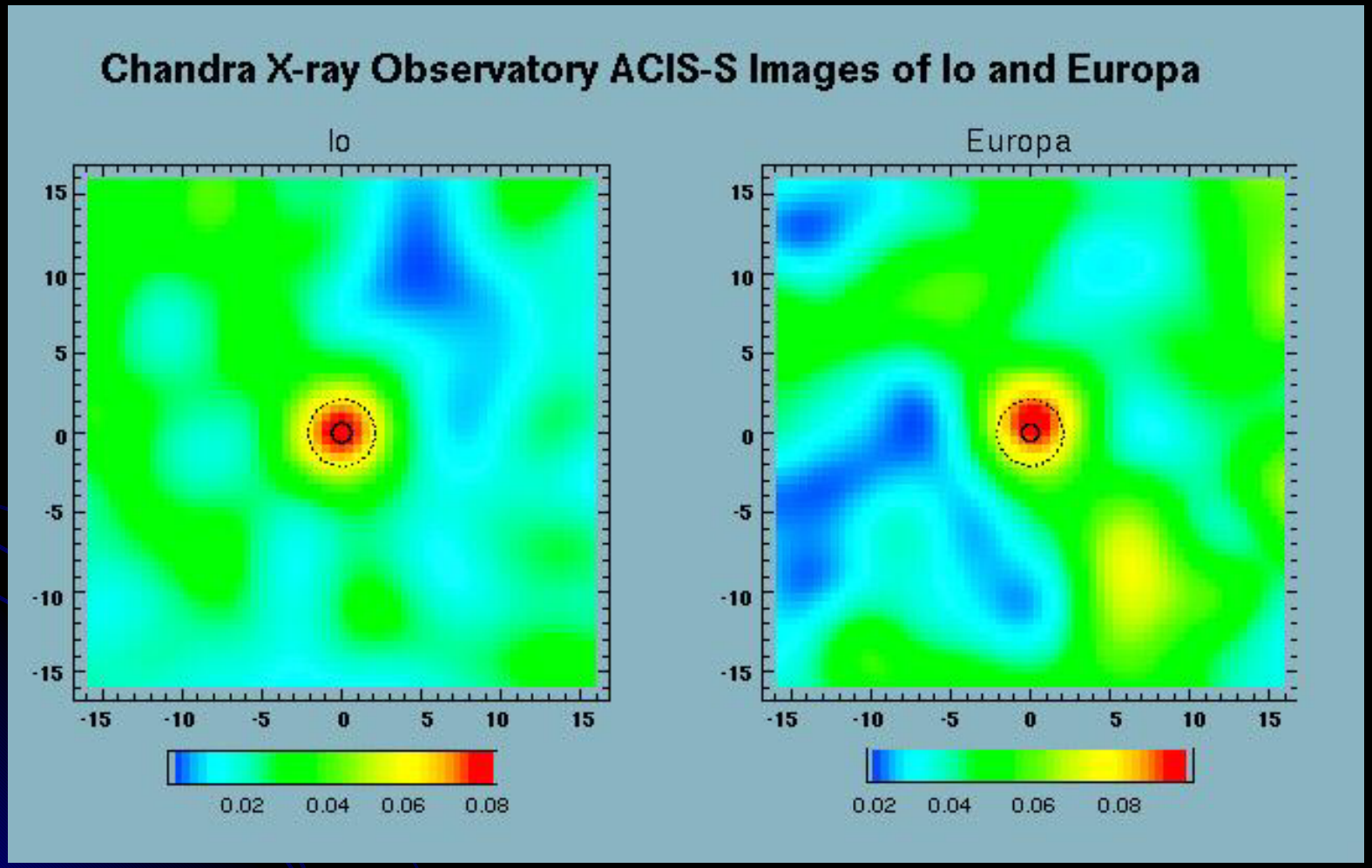
Jupiter

- Hot spots at high latitudes
  - *Big surprise*
- Sometimes pulsates (45 minute period)



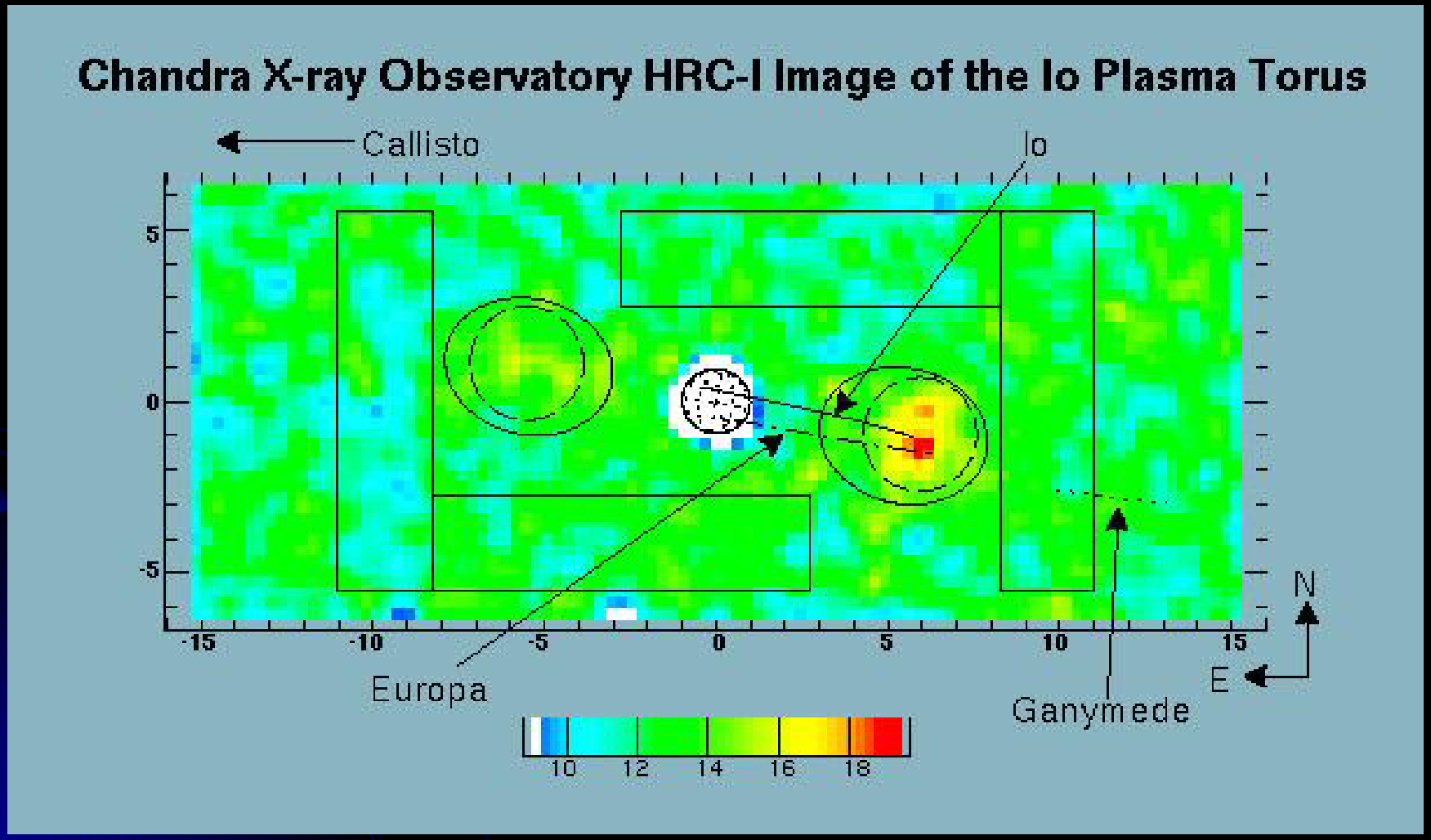
Gladstone et al. 2002

Planets

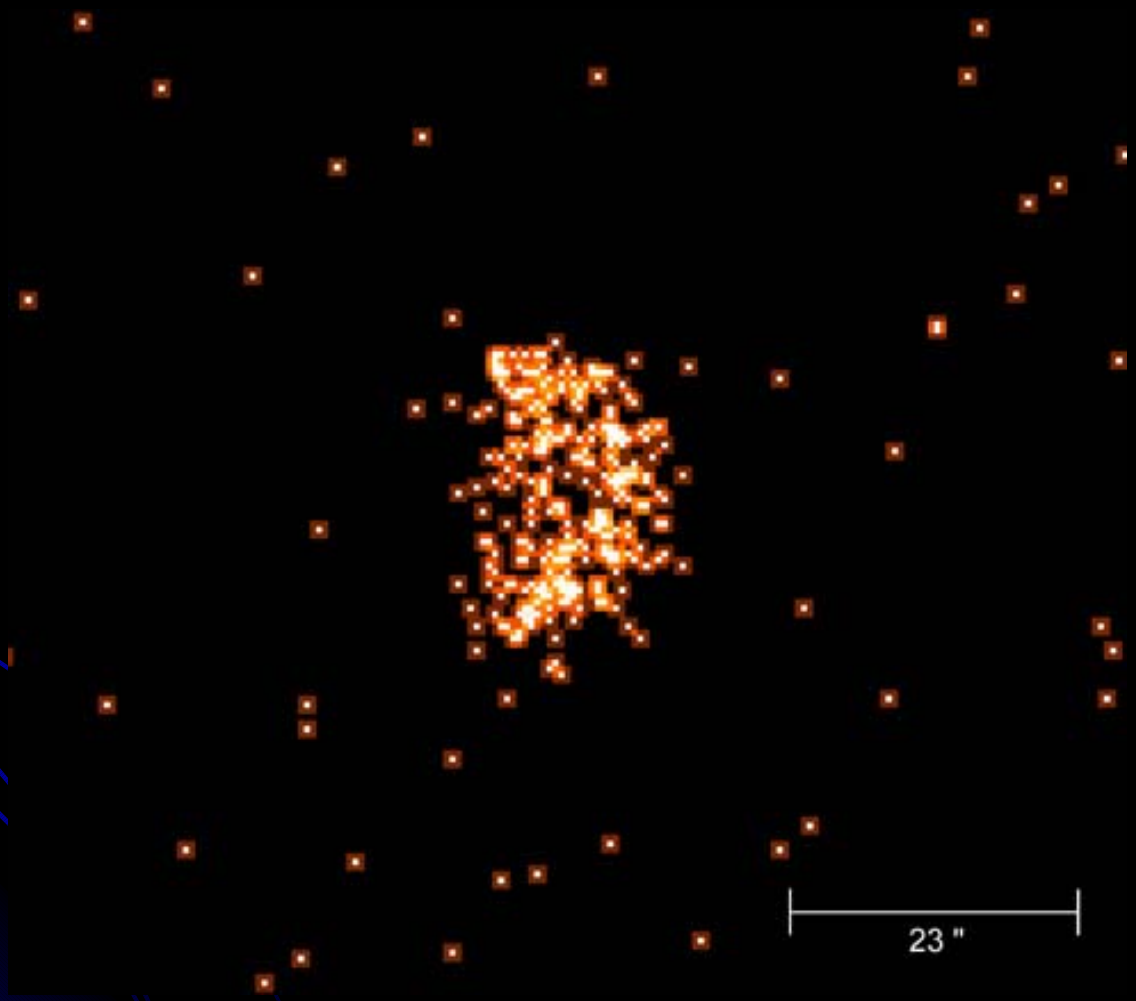


Elsner et al. 2002

Io plasma torus



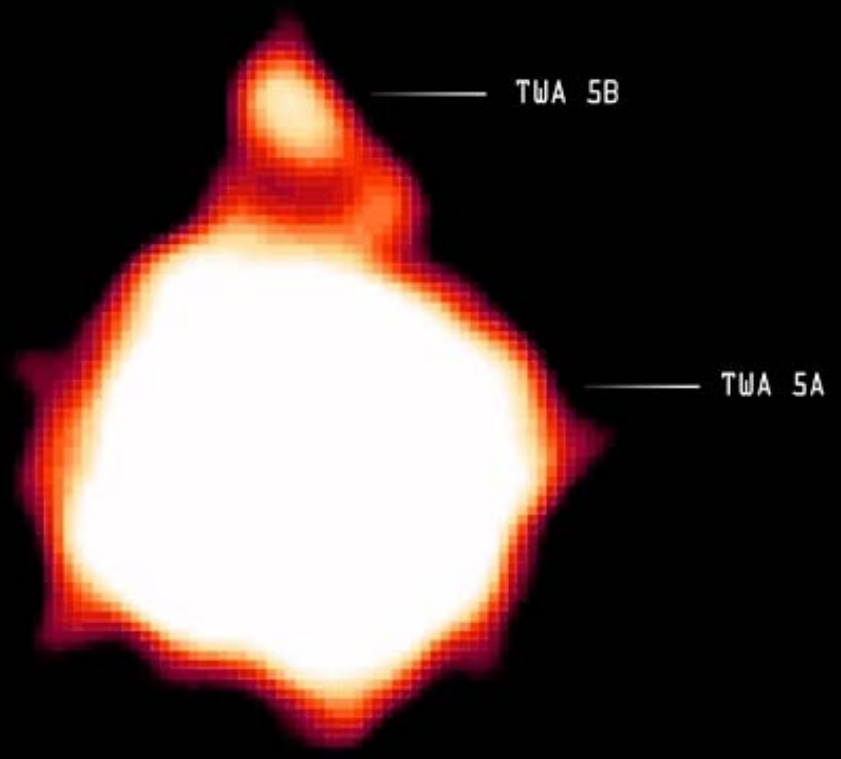
Planets
Venus



Dennerl et al

Brown Dwarf (TWA58)

6’’



Tsuboi et al. 2003

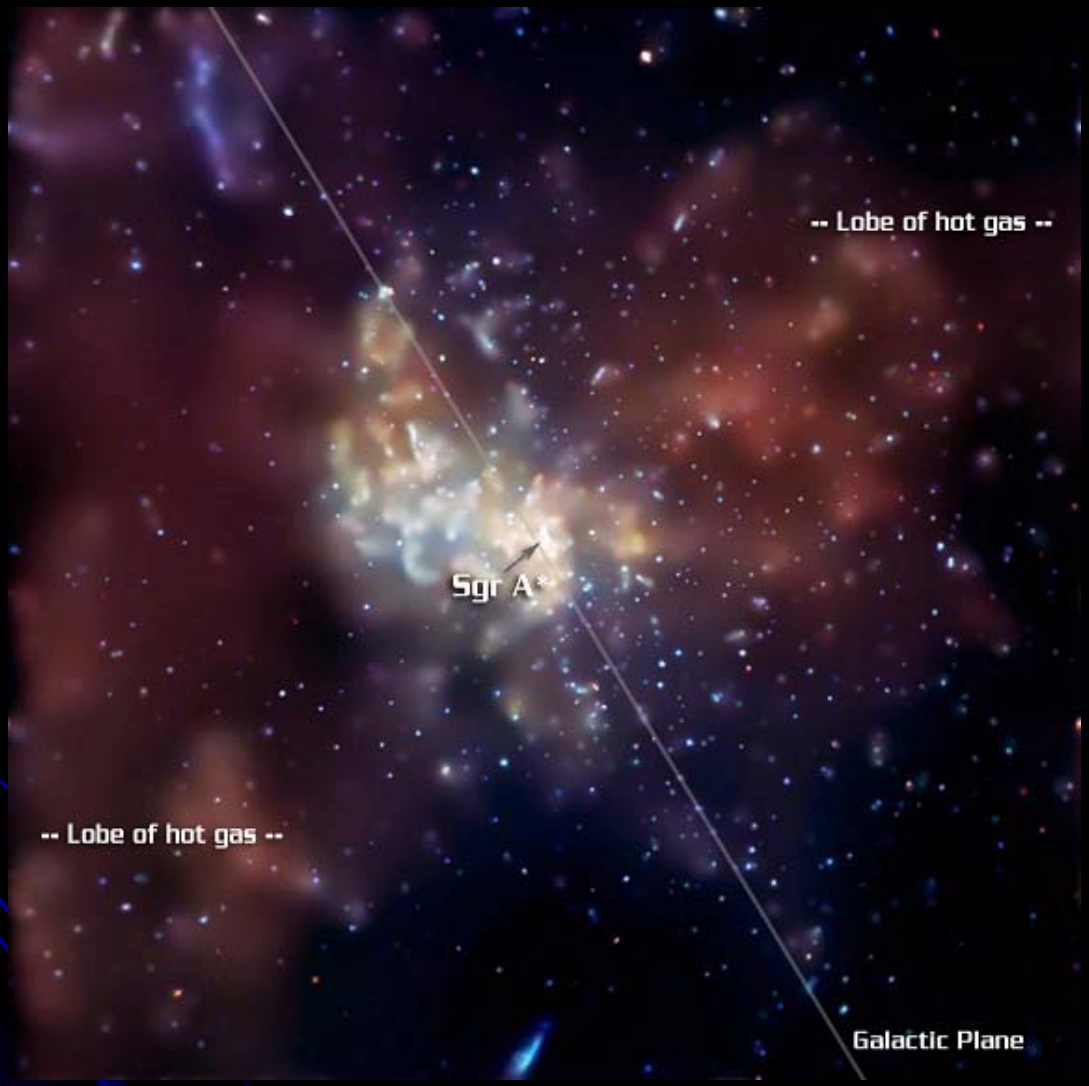
Galactic Center

48’

Wang et al. 2002

Galactic Center

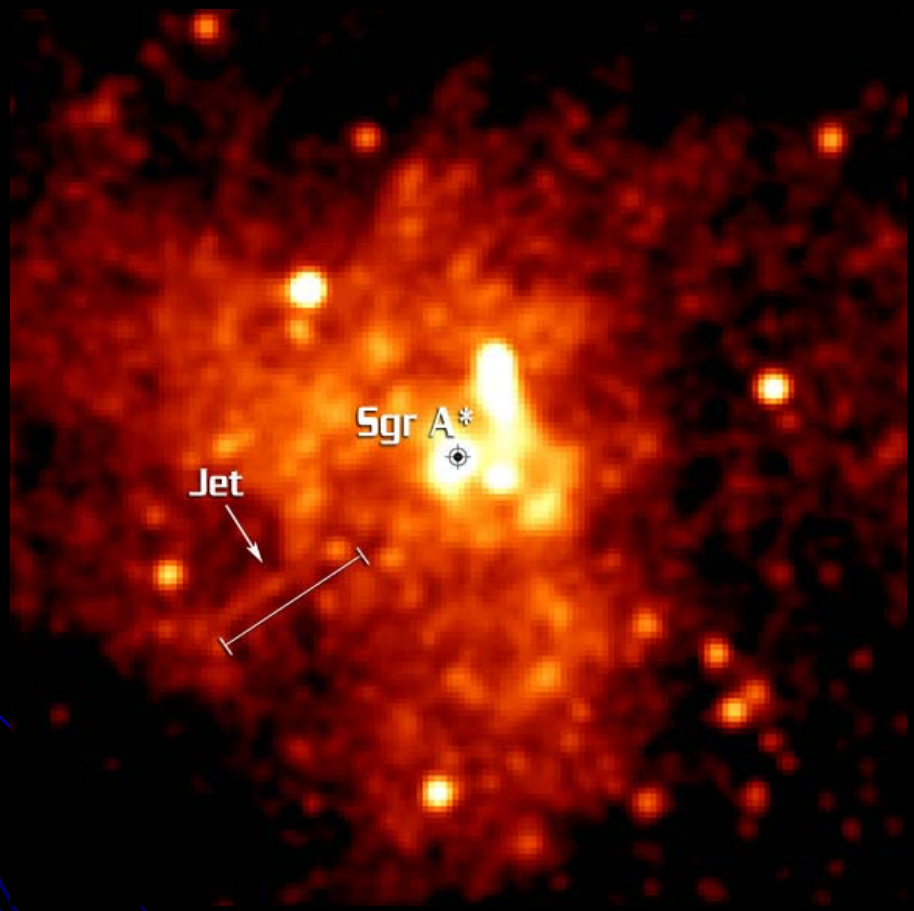
8.4’



Baganoff et al. 2003

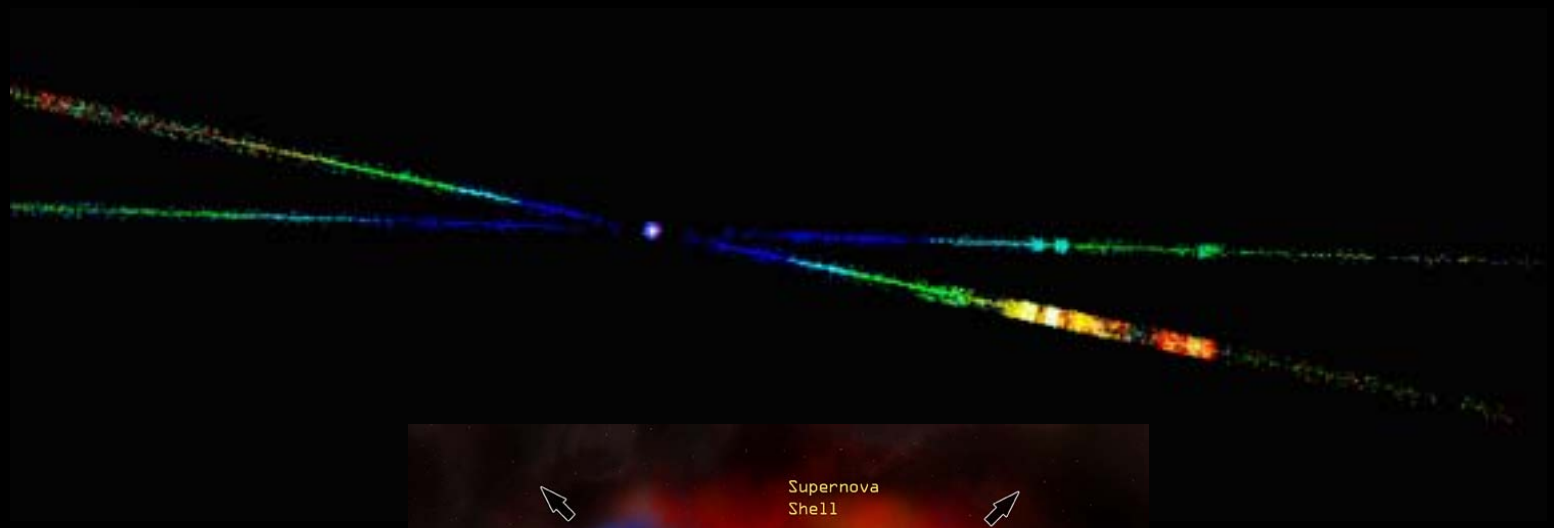
Galactic Center

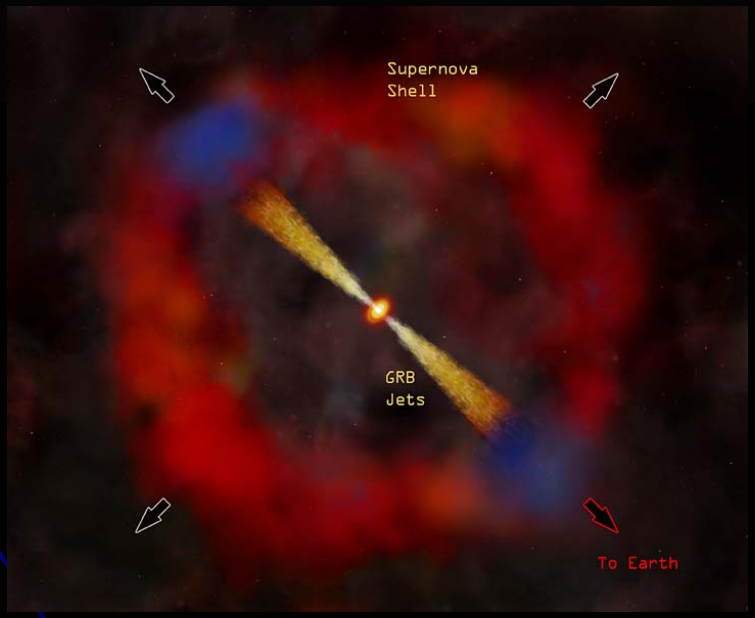
1.23’



Baganoff et al. 2003

GRB 020813

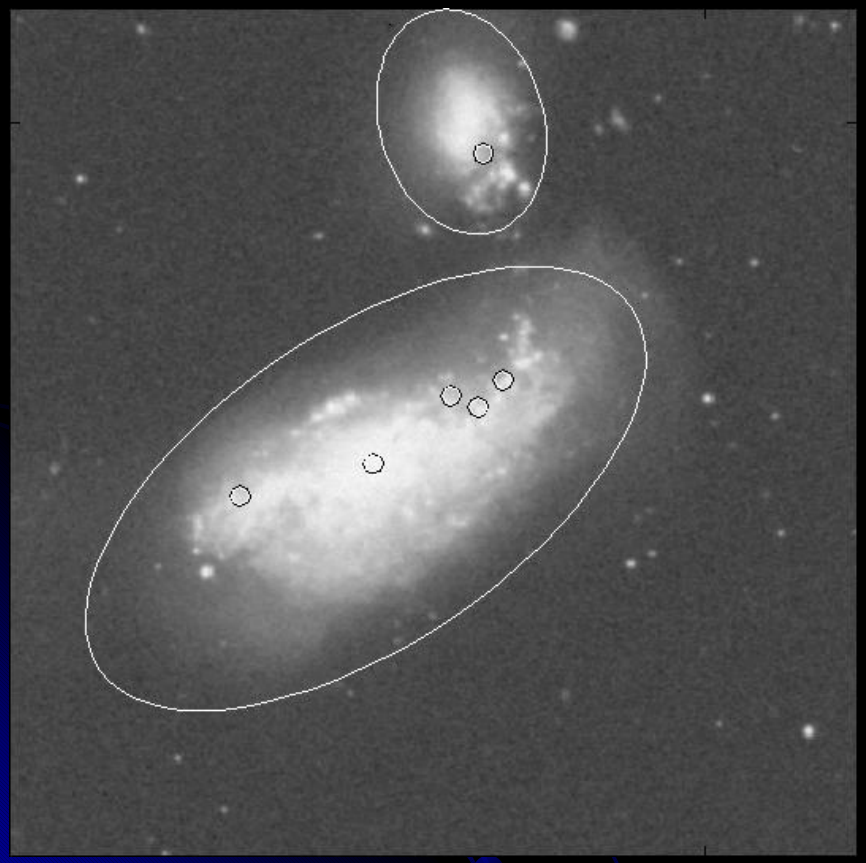


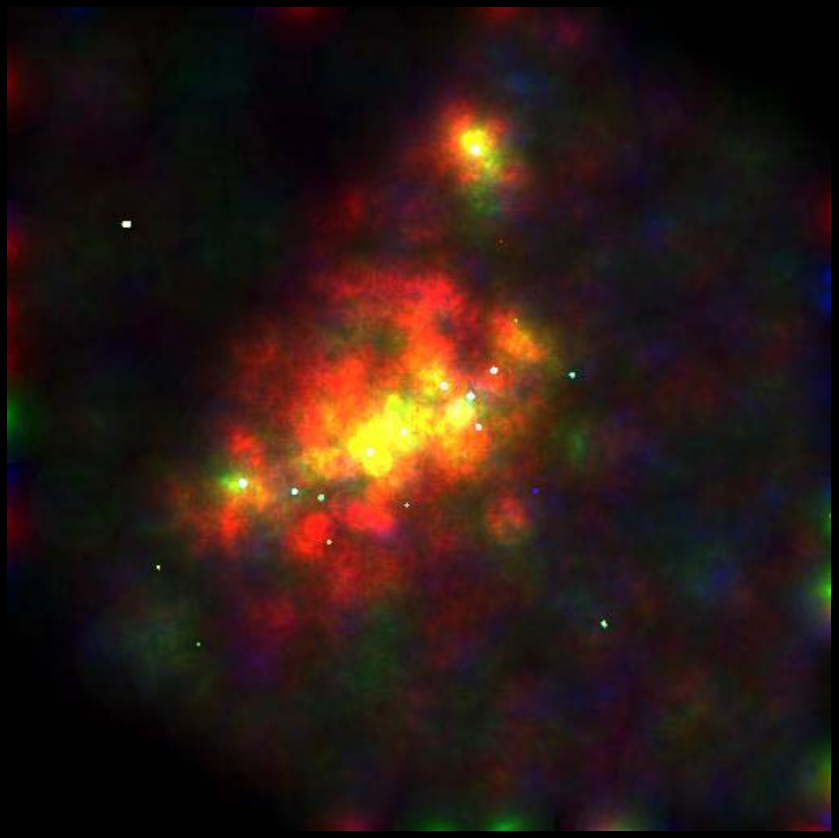


Butler et al. 2003

NGC 4490 & 4485 ULX

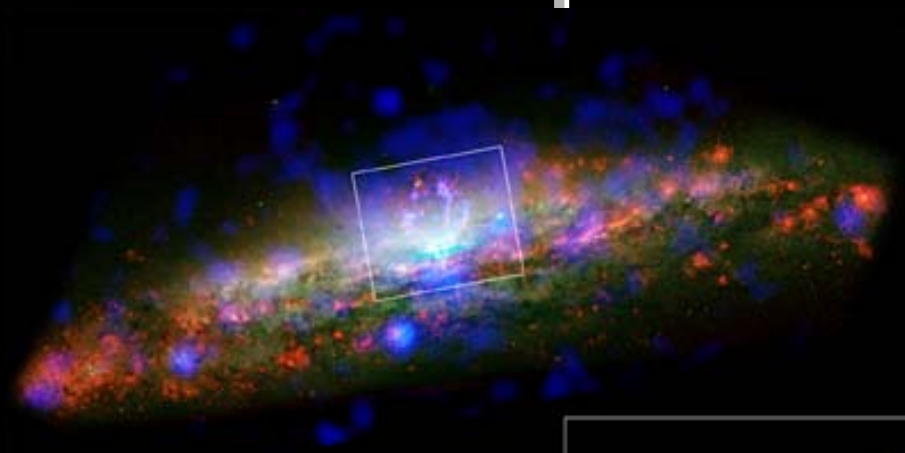
8’

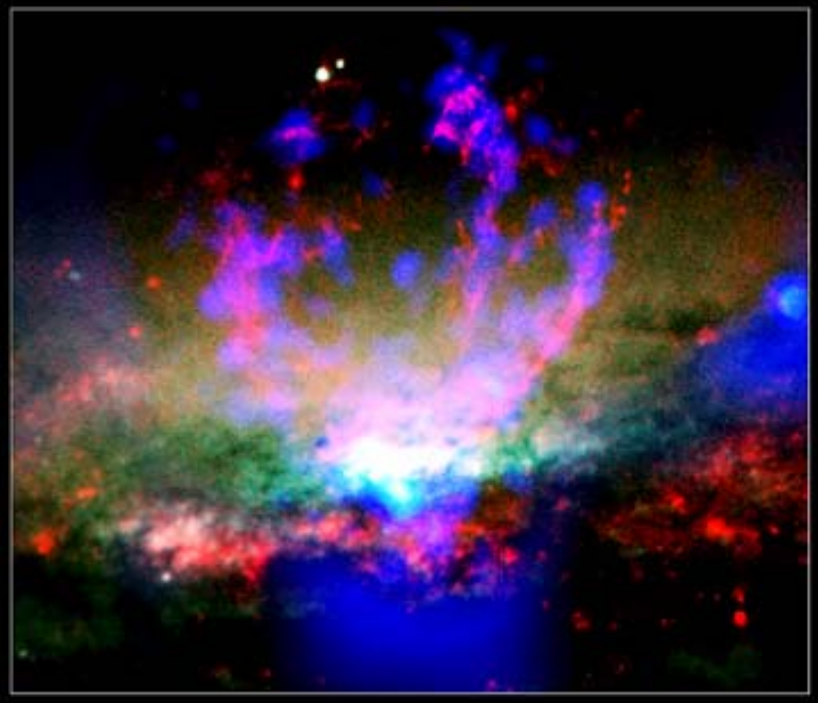




Swartz et al. 2003

NGC 3079 Superwinds

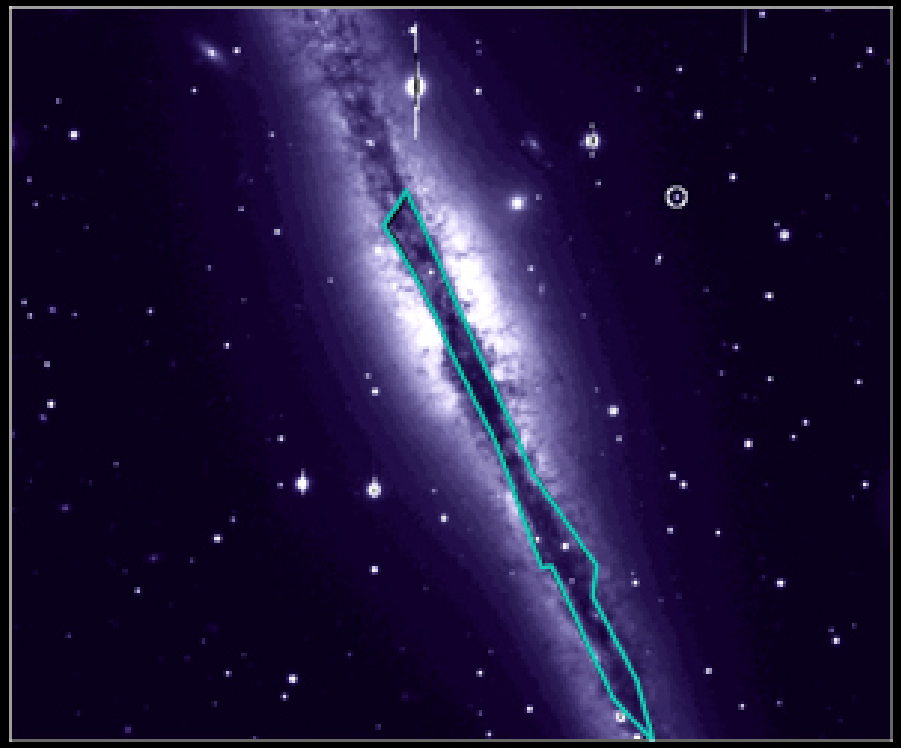




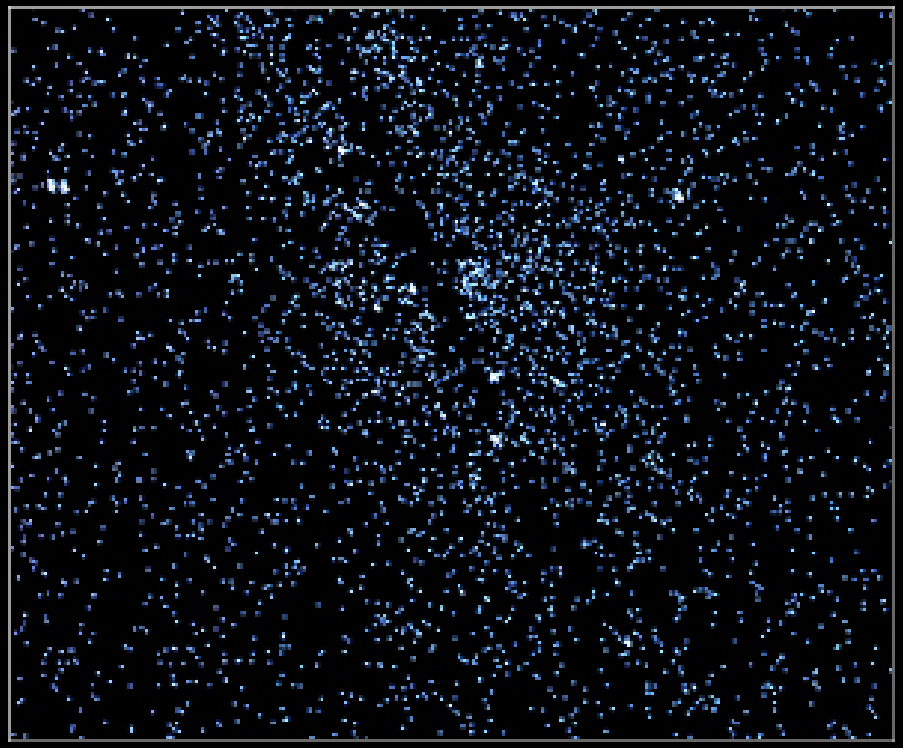
30’’

Cecil et al. 2003

WHIM – NGC 891



Optical with X-ray Contour



Chandra X-ray

Bregman & Irwin 2002

NGC 6240
Double AGN

20”

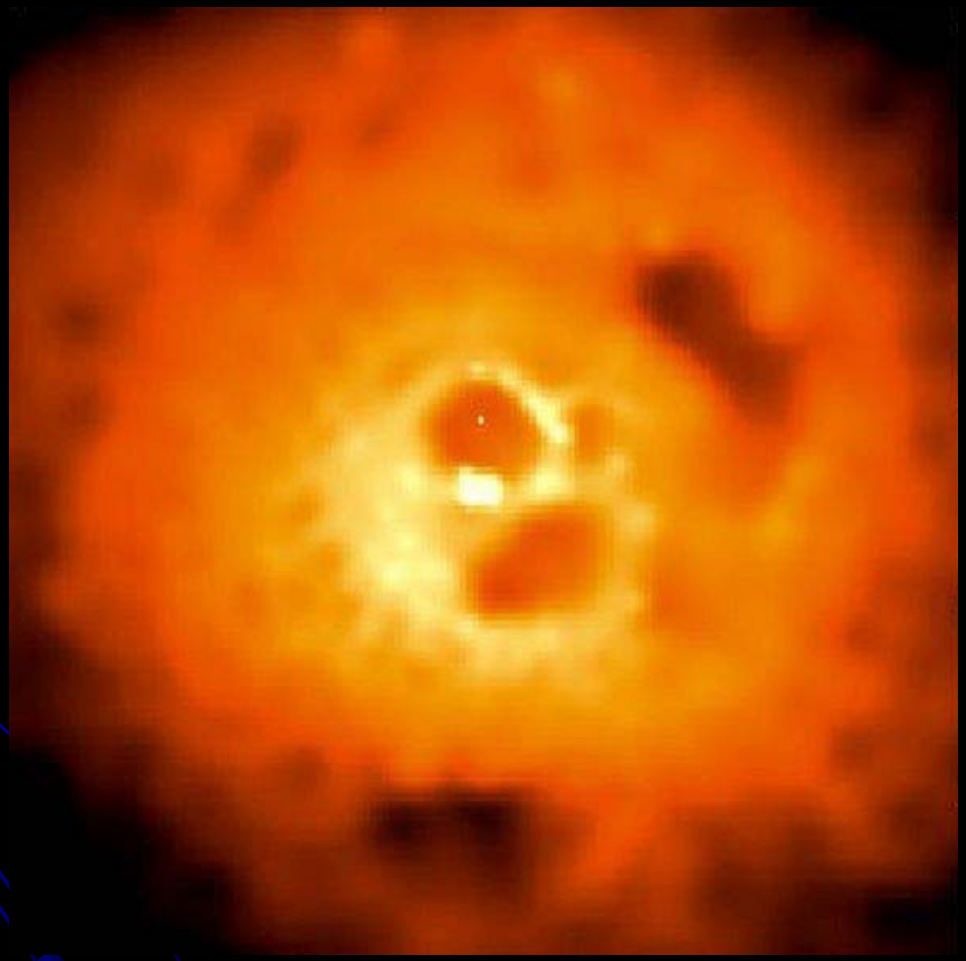
Komossa et al 2003; van der Marel & Gerssen

Abell 2029
Dark Matter Probe

Lewis, Buote, & Stocke 2003

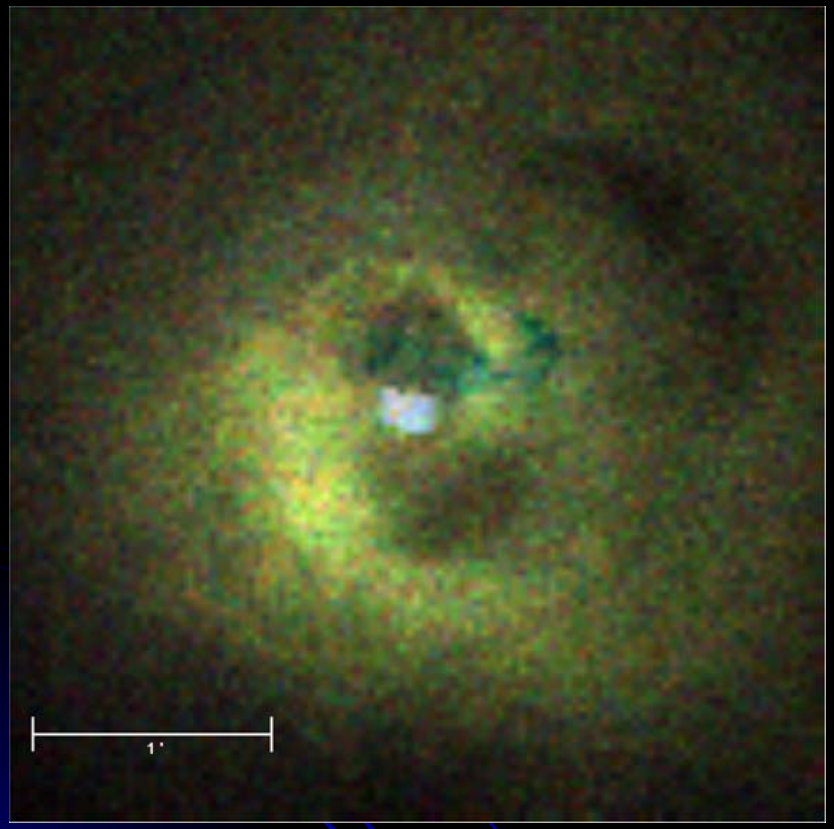
Perseus Cluster

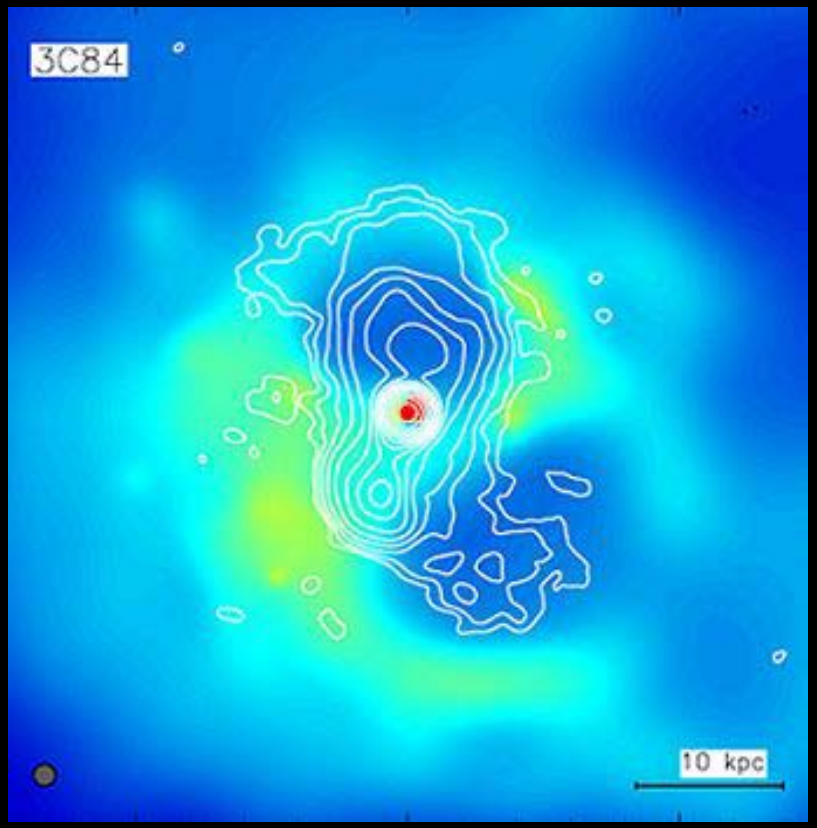
6’



Fabian et al. 2002

Perseus Cluster

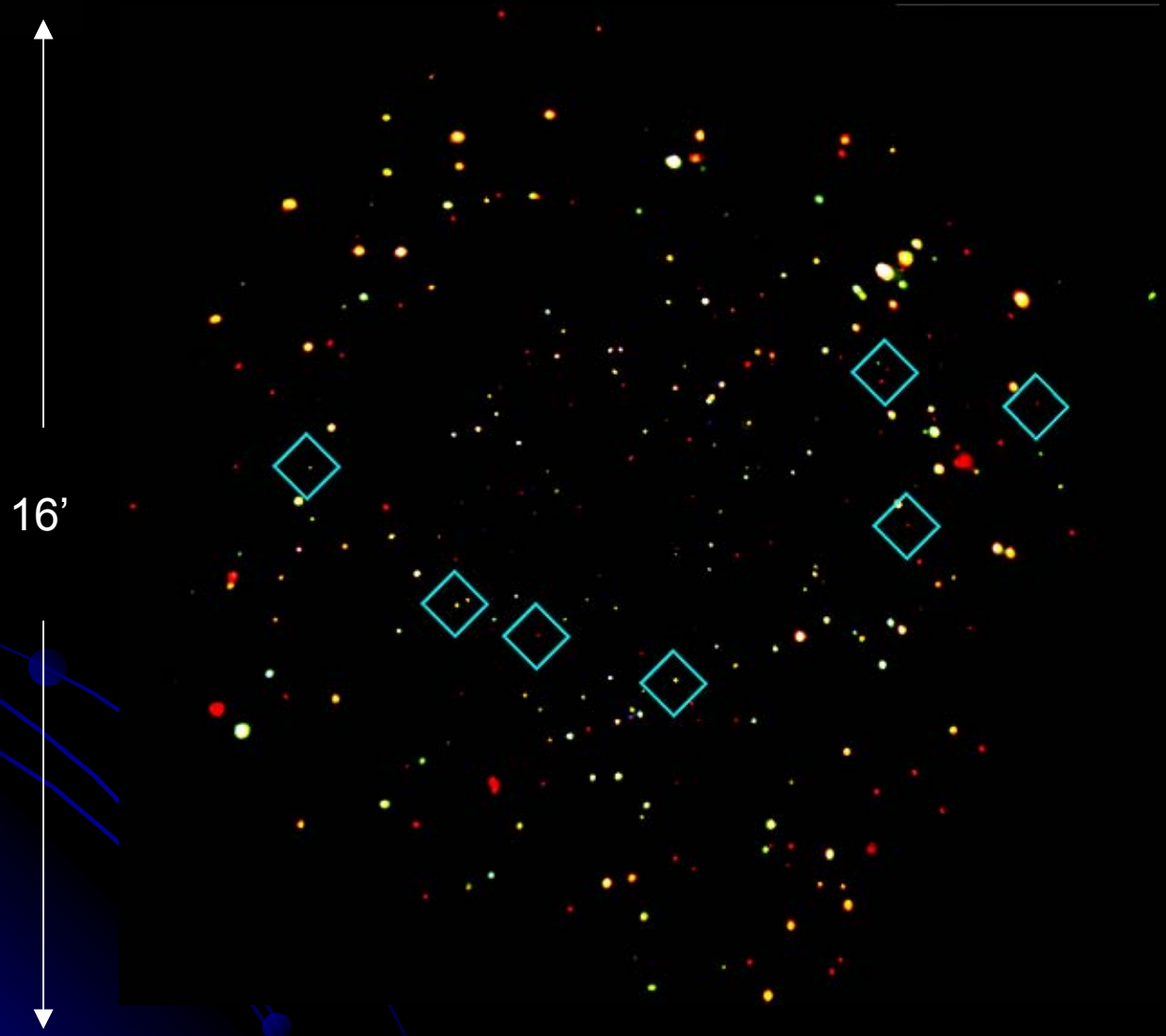




The Deep Surveys

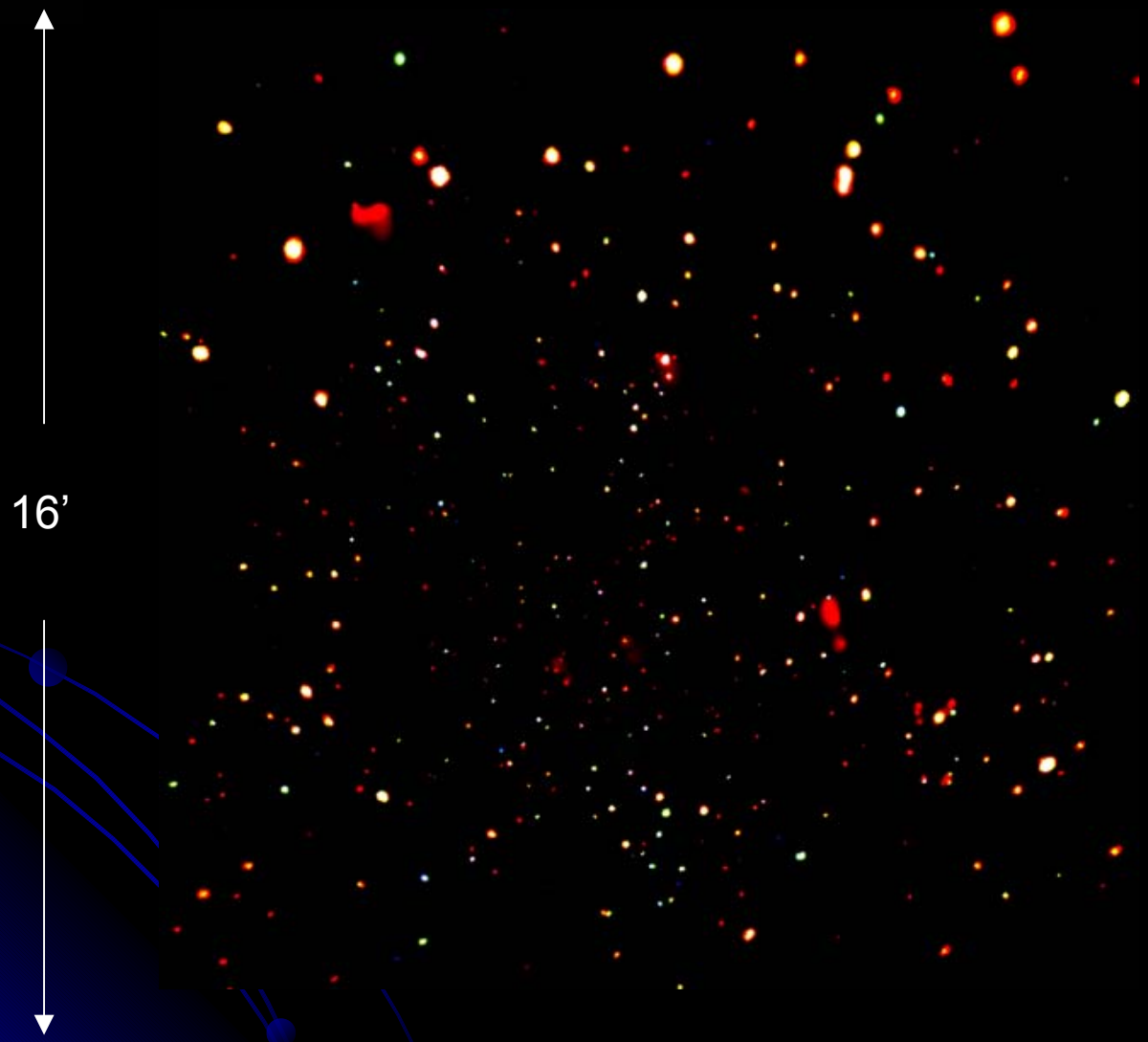
- 1Ms on CDF-S and 2 Ms on CDF-N
  - *Probe is 80 times deeper at soft energies*
  - *800 times deeper at hard energies*
  - *All data publicly available*
- CDF-N detects about 600 point sources and 6 extended sources
- Resolved essentially all the background
  - *Limiting factor is the knowledge of the background itself!*

Chandra Deep Field South



CDF-S Team – R. Giacconi PI

Chandra Deep Field North



CDF-N Team – N. Brandt PI

The Deep Surveys

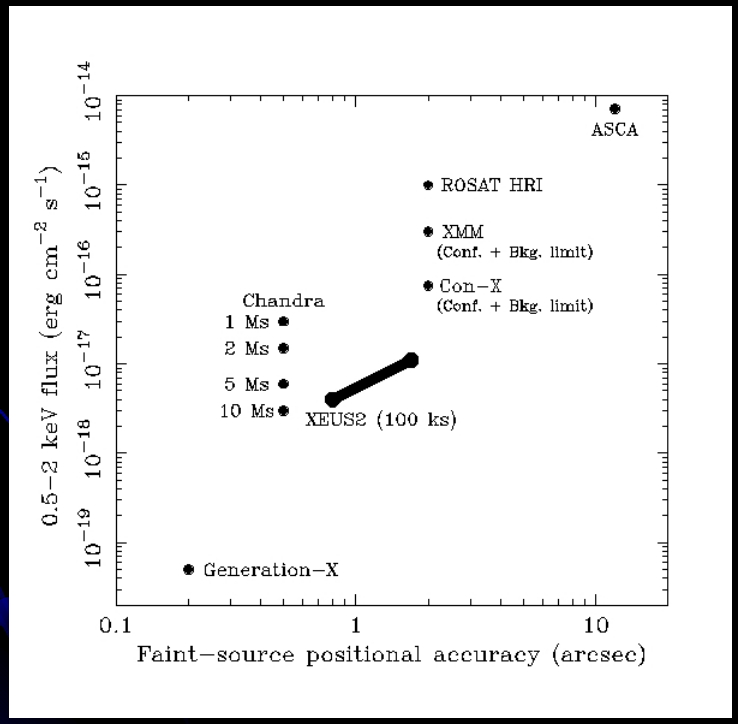
- Resolved the “spectral paradox”
- Redshifts range from 0.07-5.18 (284 sources CDF-N)
  - *Number with Z<1.3 surprising (high)*
  - *Two with Z>4 in survey*
- At faint end detecting many non-agn including starburst and normal galaxies

The Deep Surveys

- Stacking analyses being used to determine spectral properties of galaxies
  - *Changes in x-ray properties with star formation rate*
    - Normal galaxies at z = 0.5-1.2 appear 2-3 times as luminous as local counterparts
    - Lyman-break galaxies at z = 2-4 resemble most luminous local starburst galaxies
  - *Can use x rays to probe star formation*

The Deep Surveys

- Chandra Best x-ray tool for probing the "dawn of the early universe" for now and for the foreseeable future



Brandt et al. 2002

Summary

- Operations are running smoothly
- Mission success because of:
  - Design of the Observatory
  - Excellent and committed staff
  - Team effort involving NASA HQ, MSFC, CXC, TRW, IPIs, IDSs and GOs
- Exciting and fundamental scientific results
  - Papers at a rate of ~10 per week

Education and Outreach

http://chandra.harvard.edu