CHANDRA'S EARLY YEARS (1963-1989/91)

Celebrating 20 Years of Chandra

Special Session: Riccardo Giacconi and X-ray Astronomy

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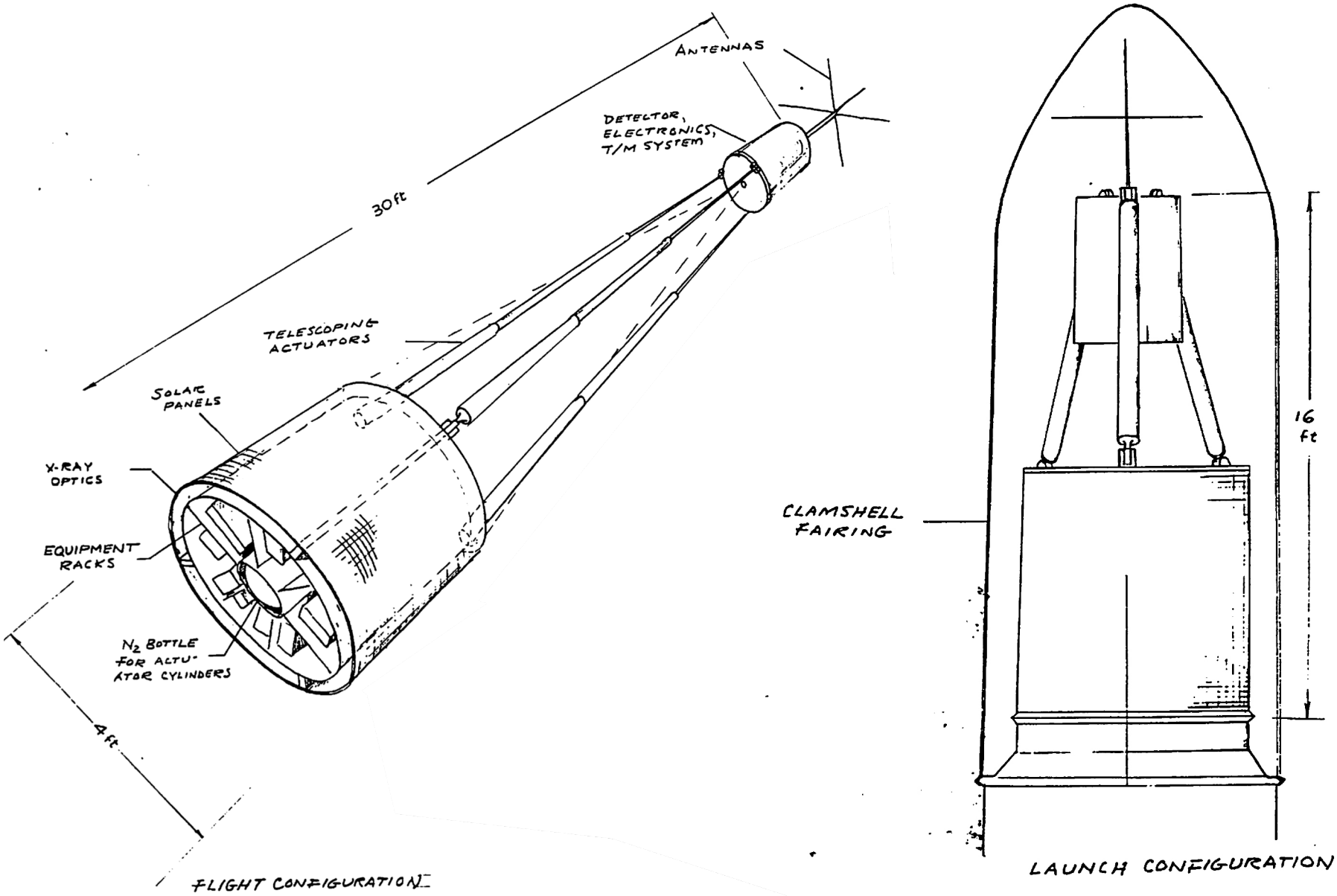
1963 White Paper/Proposal

- Unsolicited proposal from Riccardo and Herb Gursky to NASA
- Submitted 25 Sept 1963 - ~15 months after first discoveries
- Laid out vision for development of field as 7-Phase program
- Culminating with an X-ray Telescope launched in mid-1968
  - Based on a few discrete sources and all-sky background
  - Grazing incidence reflection with nested shells (Giacconi & Rossi)
  - Mirror diameter 4ft, focal length 30ft, angular resolution a few arcsec

Proposed 30ft Orbiting Telescope



The 1976 SAO Proposal led by Riccardo and Harvey

- Unsolicited (again) proposal: Long-lived - 10-year life w servicing
- Telescope: 1.2m OD, ~9m FL, ~0.5" ang res, ~1000cm^2 EA @ 1 keV
- Why 1976?
  - LOXT downsized to HEAO-B in 1973 with 1-year nominal life
  - NASA did not agree to add magnetic torquers to extend mission
- Noel Hinners – NASA AA for Space Science – approved technology and mission studies
- MSFC selected, MW hired as Project Scientist, and RG chaired initial SWG
- SAO and MSFC teamed – for 42 years and still counting!

Some Observations about Riccardo

- Amazing vision for long-term development of X-ray Astronomy
- Laid out key steps in 1963 – took a bit longer than anticipated
- Riccardo did not wait to be "asked" – took the lead with NASA and science community
- Riccardo did not always win – at least not on first attempt
- Patience not his strength – could not have waited until 1999 for Chandra launch
- With foresight, he accepted an offer to become Director of STScI in 1981

1980 Decadal Survey – Field Report

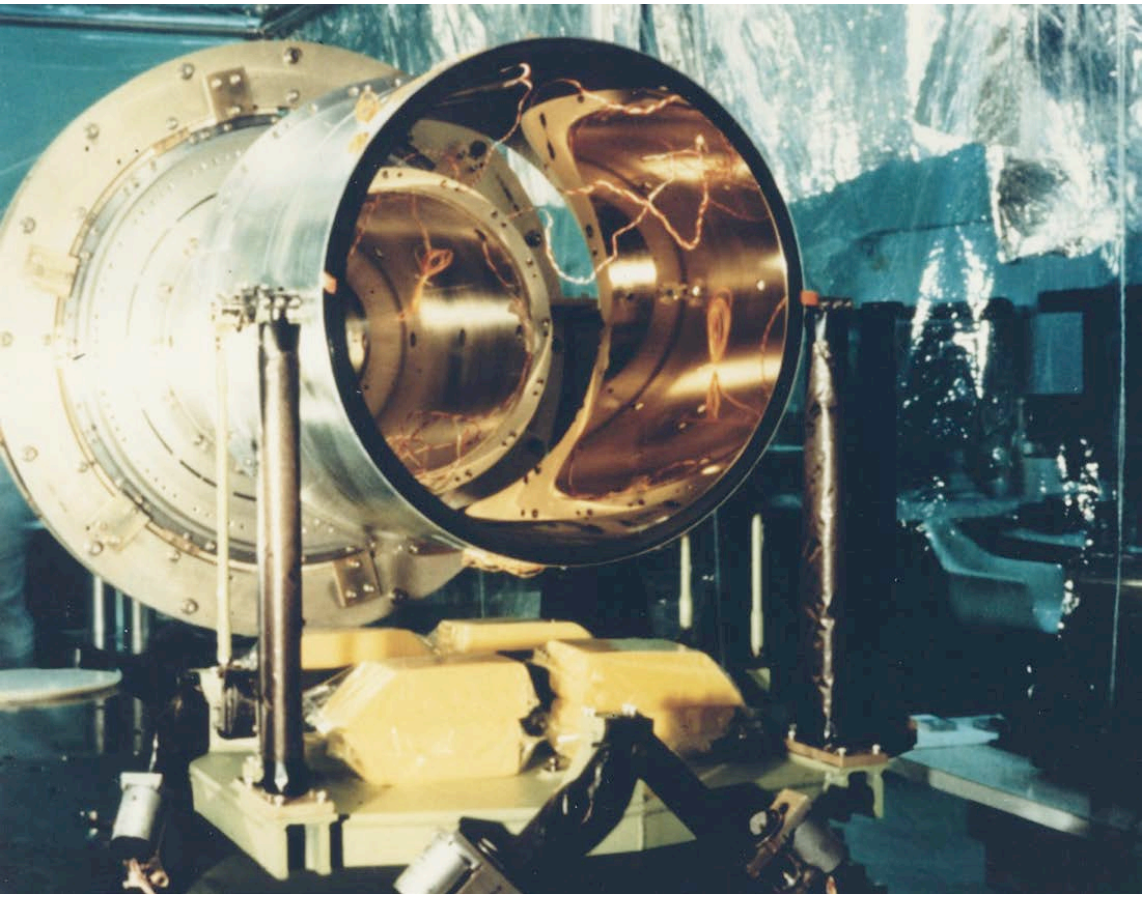
- Einstein launched and showed that all types of astronomical objects from stars to quasars are X-ray sources
- Provided strong basis for AXAF mission
- Survey recommended AXAF as highest priority major new program

  - Seen as a "permanent" national observatory in space – RG's dream

  -"AXAF will profoundly influence and enhance the development of nearly all areas of …. Astronomy"

  - Recommended institutional arrangements similar to STScI to manage science operations and facilitate participation of science community

Technology Mirror Assembly

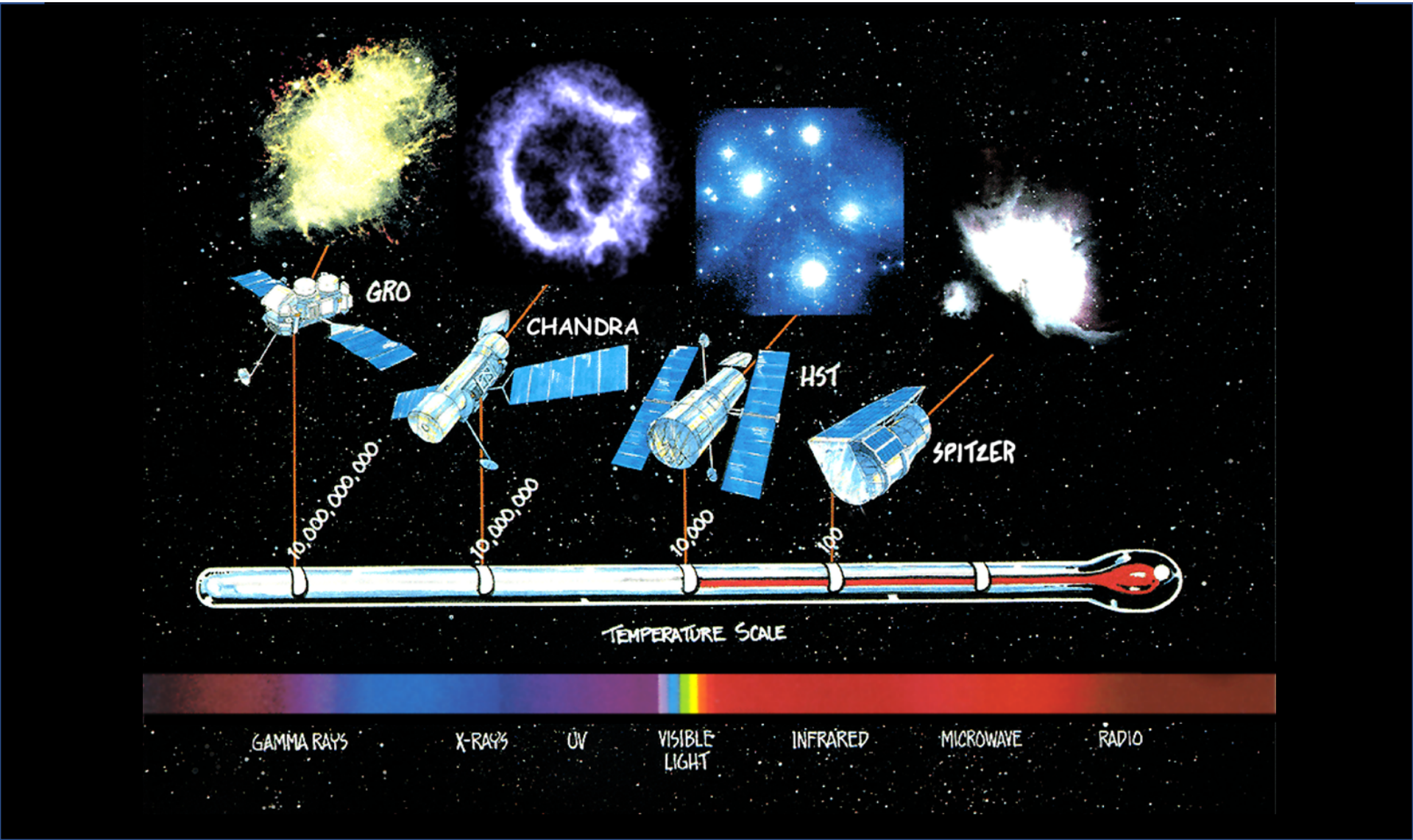


- 2/3 version of smallest Chandra shells
- Sized to fit into XRCF at MSFC
- Metrology for mid-frequency errors esp challenging
- PE delivered TMA with 90% EE within 1” radius
- Met AXAF requirements

Challenges within Astrophysics Division

- HST and GRO underway and SIRTF becomes a free flyer
- Should SIRTF be moved ahead of AXAF?
- George Field reconfirms priority of AXAF based on 1980 Survey
- Charlie Pellerin proceeds with AXAF as mission most ready to start Phase B
- Pellerin invites Martin Harwit to lead meeting of senior astronomers, creating Great Observatories concept

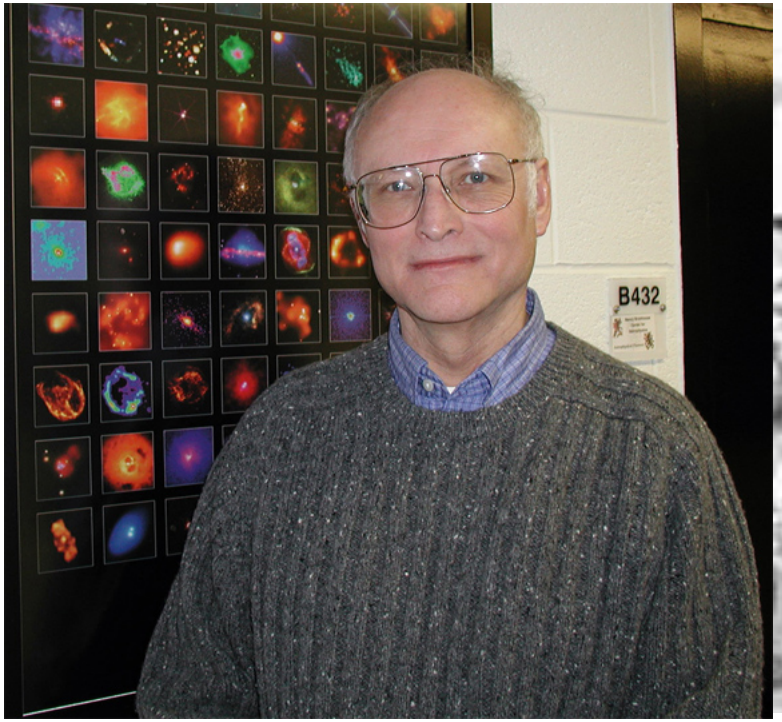
Great Observatories Cover the E-M Spectrum



Meanwhile back at the ranch

- AO in 1983 for instruments/PIs, TS, IDS's - 2nd SWG formed in 1985 with Martin Weisskopf as Chair
- Two Phase B studies led by Lockheed and by TRW
- RFP for flight prime contractor in 1988 with PE designated to provide finished optical elements to selected team
- TRW team including EK and Ball selected in 1989
- SAO-led team competitively selected for Science Center in 1991

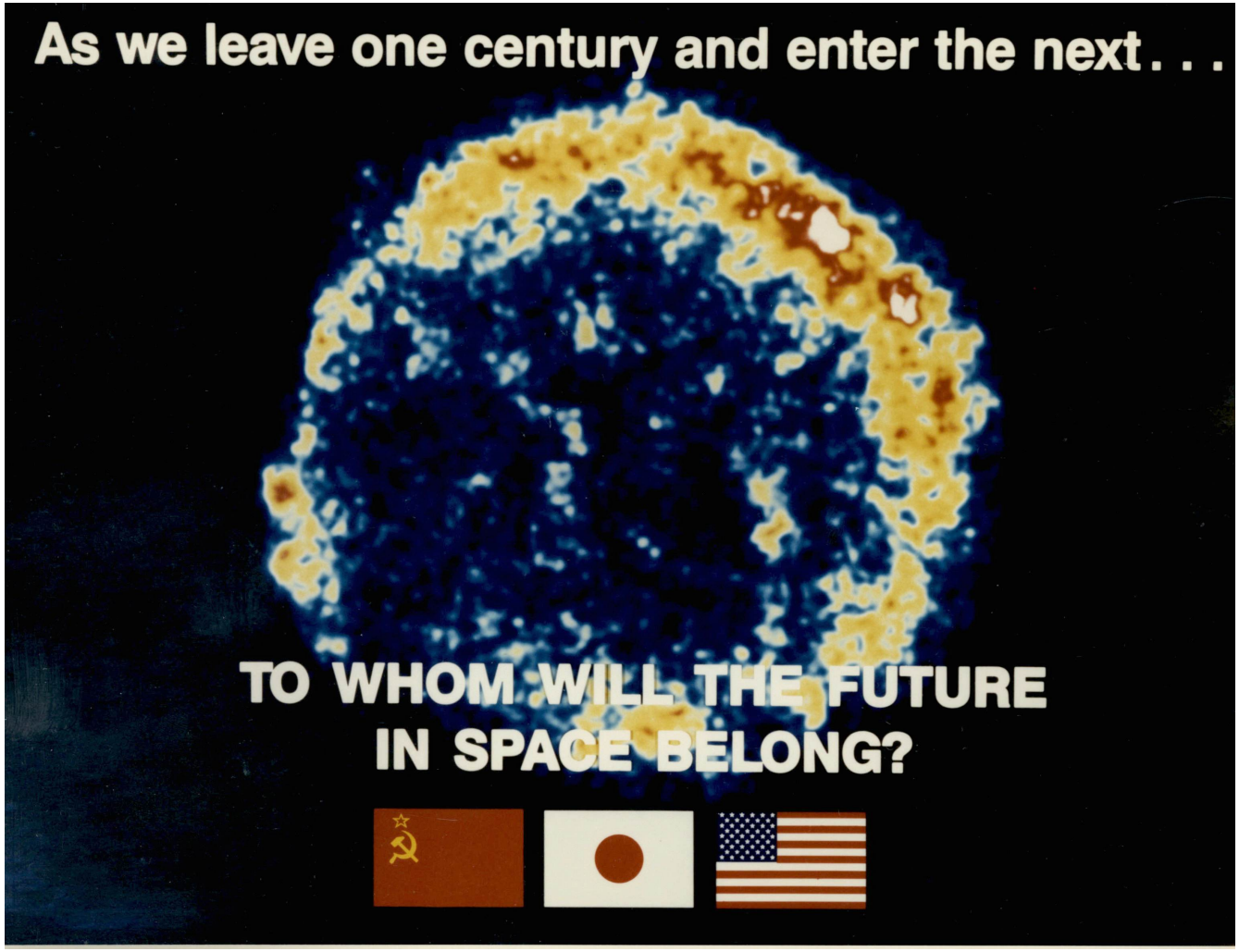
Leon Van Speybroeck and Steve Murray



Challenges within OSSA

- Tops in astrophysics (1980) necessary but not sufficient
    - OSSA encompassed Helio, Planetary, and Earth Science
    - typically, 1 new major start per year
- Hubble delays and popularity of other fields blocked AXAF
- Dramatic change when Len Fisk became AA (1987)
    - Josh G and Harvey T met with Fisk at UNH
    - AXAF different science from HST – cluster images
    - Less complicated with photon counting and queue scheduling
    - TMA demonstrated mirror performance
- AXAF recommended for FY89 new start, but then sidelined by OMB

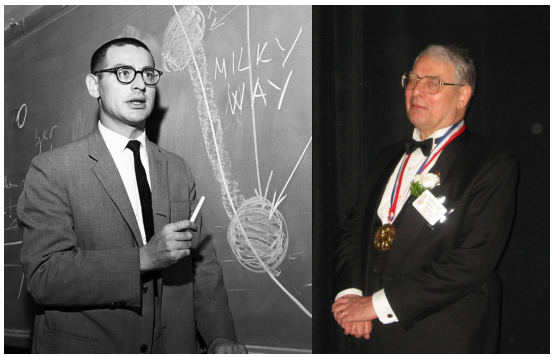
Chart for President Ronald Reagan



Congress and the Mirror Challenge

- New start request in FY89 budget
- Dick Malow clerk for House Appropriations Subcommittee
    - Concerned by ongoing difficulties with Hubble
    - Questioned ability to build mirrors even with TMA
- Compromise offered by Malow to NASA and AXAF team
    - 3 years to build largest optics pair and demonstrate X-ray performance (0.5 arcsec FWHM)
    - Funding or cancellation for AXAF depended on meeting that challenge

Paraphrased from Riccardo's Own Words



- While analyzing Uhuru data, I came to love discovery for its own sake (p143)
- I felt my greatest contribution to the field could be to build great instruments available to the entire astronomical community and to operate them in such a way as to maximize the scientific returns (p143)
- As a young man of 28, I had invented the X-ray telescope; at 31, I had discovered the first X-ray star and the XRB. The nature of the X-ray binaries had become clear with Uhuru which also discovered the intergalactic plasmas in clusters. Einstein made X-ray astronomy relevant to all astronomers. Thanks to Chandra, the nature of the XRB has almost been solved by 2002. It seemed as if my scientific career has come full circle (p367)