

# Oriented Scintillation Spectrometer Experiment (OSSE)





## The OSSE Team



- Naval Research Lab
- Northwestern University, Mel Ulmer (lead)
- Clemson University, Don Clayton (lead)
- Royal Aircraft Establishment (UK), Clive Dyer (lead)
- Ball Aerospace Systems Division

OSSE PI: Jim Kurfess, Naval Research Lab



# Team Meetings



**NRL:** Rob Cameron, Chuck Dermer, Eric Grove, Mike Harris, Craig Jenson, Neil Johnson, Greg Jung, Bob Kinzer, Richard Kroeger, Jim Kurfess, Bernard Phlips, Dan Messina, Kelly McNaron-Brown, Ron Murphy, Patty Sandora, Gerry Share, Mark Strickman

**Northwestern:** David Grabelsky, Steve Matz, Bill Purcell, Mel Ulmer

**Clemson:** Don Clayton, Mark Leising, Lih-Sin The

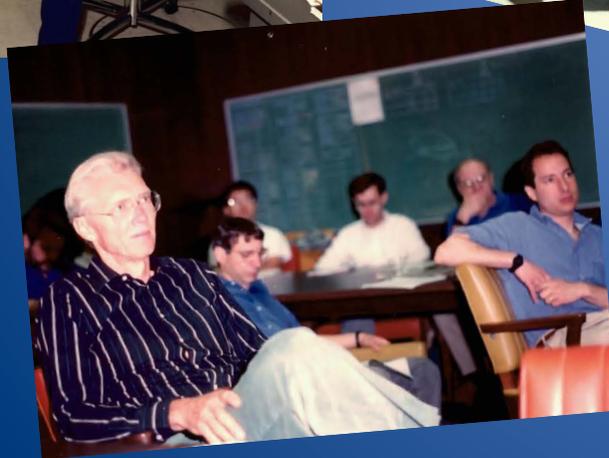
OSSE TEAM MEETING  
at  
NORTHWESTERN UNIVERSITY  
APRIL, 1993



**FRONT ROW:** Mark Strickman, Bernard Phlips, Carlos K. Guérard, Ronald Murphy, J. Eric Grove, Mel Ulmer, Gerry Share  
**SECOND ROW:** Steven Matz, Neil Johnson, Charles Dermer, Lih-Sin The, Kellie McNaron-Brown, David Grabelsky, Bob Kinzer  
**BACK ROW:** Richard A. Kroeger, Donald D. Clayton, James D. Kurfess, Mark Leising, Tom Bridgman, William R. Purcell



# And More Meetings



# OSSE Science Objectives

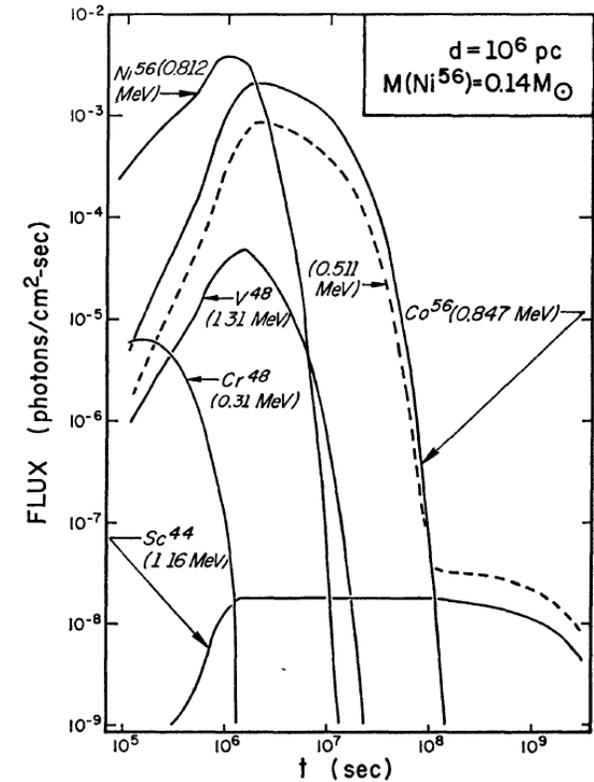
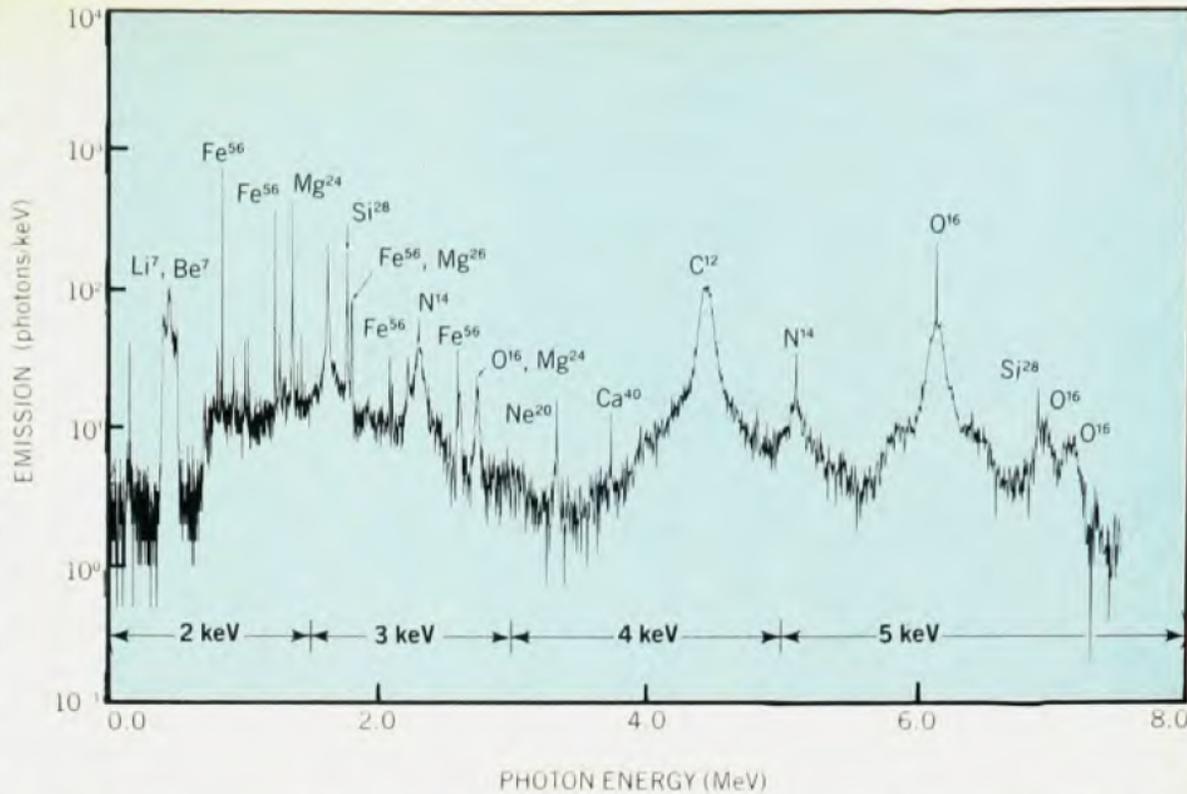
## “A 0.1 to 10 MeV Experiment for GRO”



- Nucleosynthesis in Supernovae
- Novae powered by thermonuclear explosions
- Structure of neutron stars and accretion onto black holes and neutron stars
- Origin of gamma-ray bursts
- Intensity of low-energy cosmic-rays and density of matter throughout the Galaxy
- Nature of solar flares
- Origin of recently discovered high-energy gamma-ray sources
- Pulsars and X-ray bursters
- Energy source in Seyfert galaxies and quasars



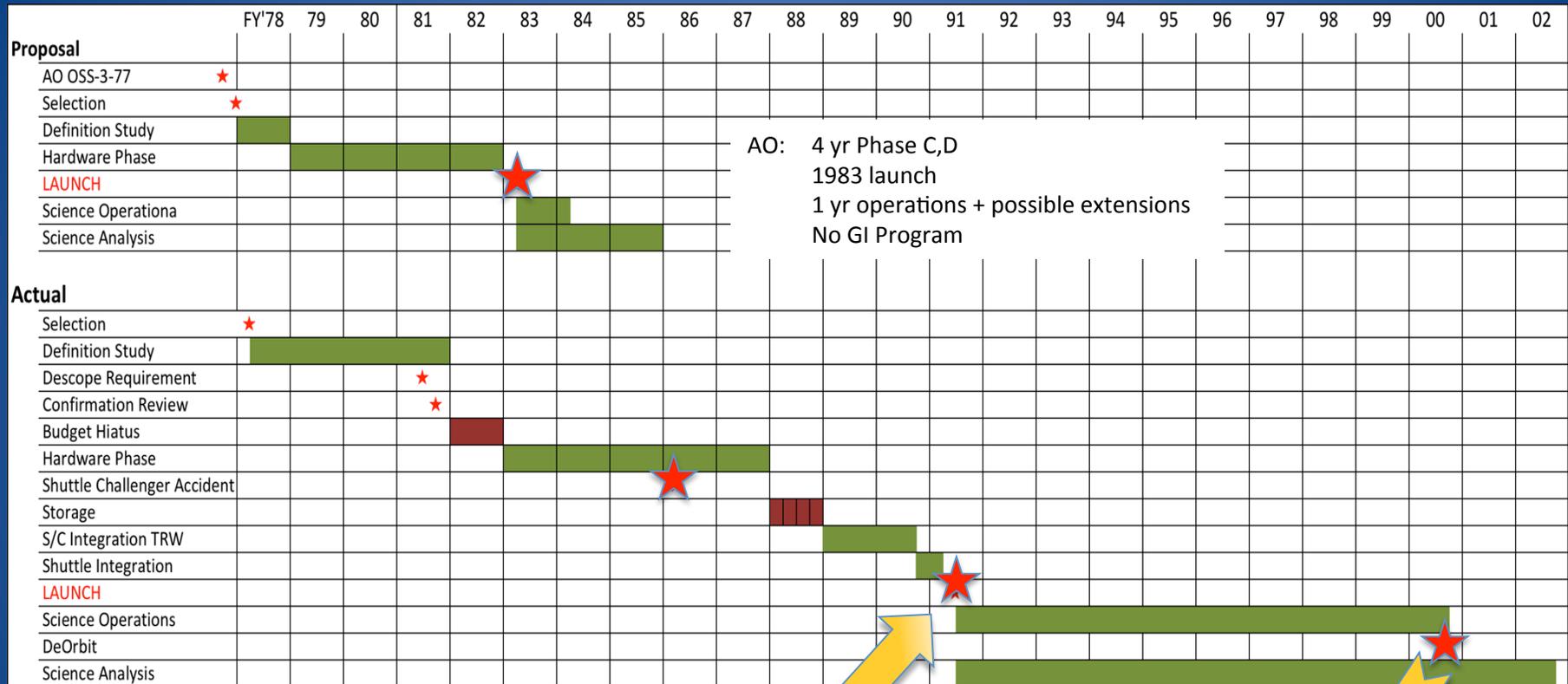
# Gamma Ray Line Astrophysics



Nuclear lines from cosmic ray interactions with the interstellar medium - Lingenfelter & Ramaty, 1978

Type I supernovae  
Nuclear lines vs time – Clayton, Colgate & Fishman, 1969

# GRO Timeline – Bumps in the Road

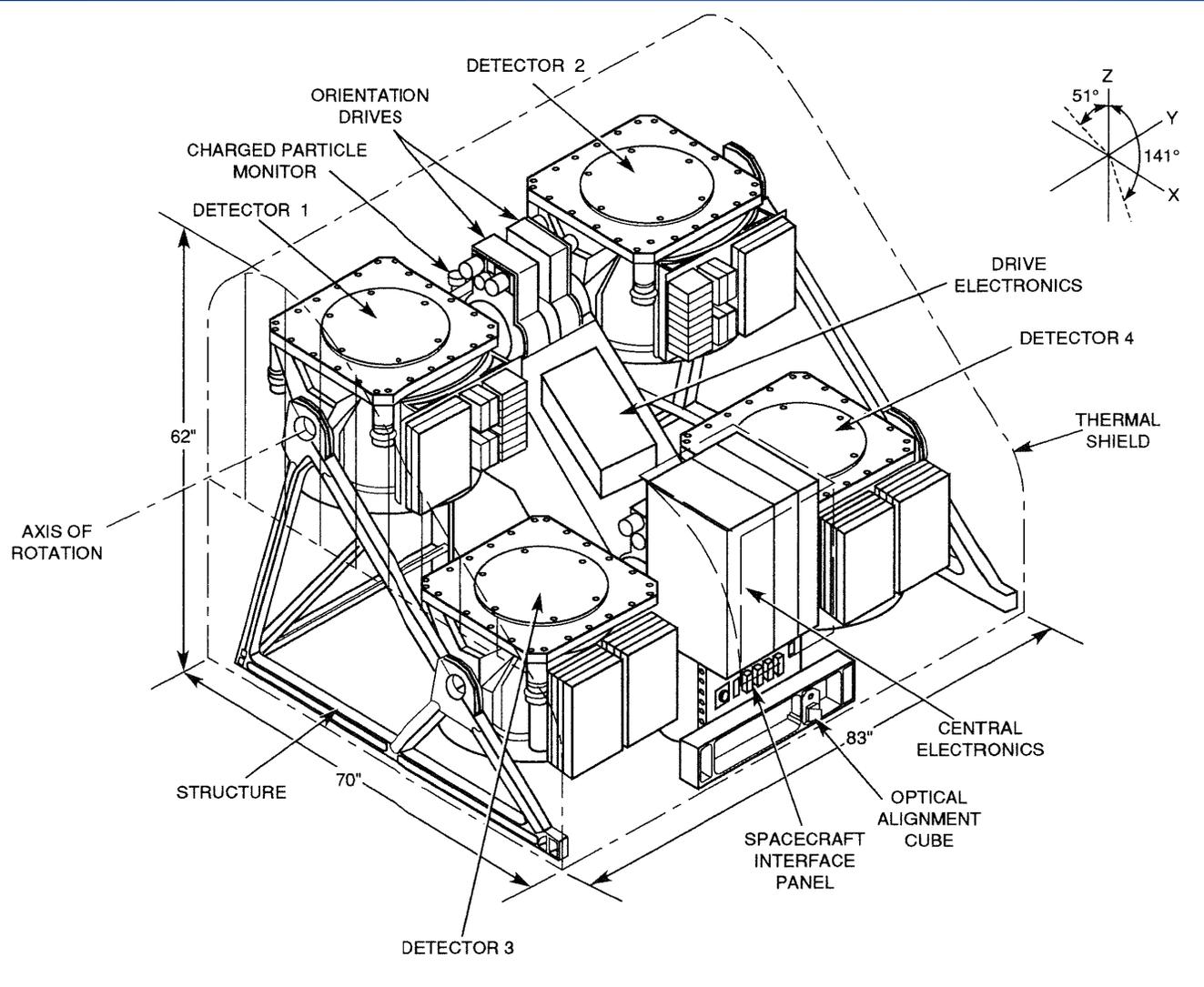


AO: 4 yr Phase C,D  
 1983 launch  
 1 yr operations + possible extensions  
 No GI Program





# 4 Actively Shielded NaI – CsI Phoswich Detectors



192 degrees of articulation

Field of View: 3.8° x 11.4°

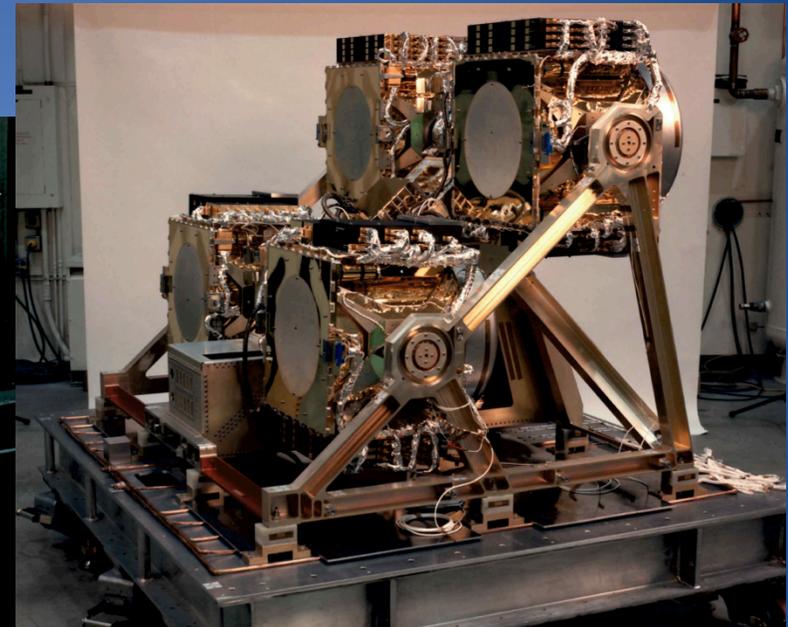
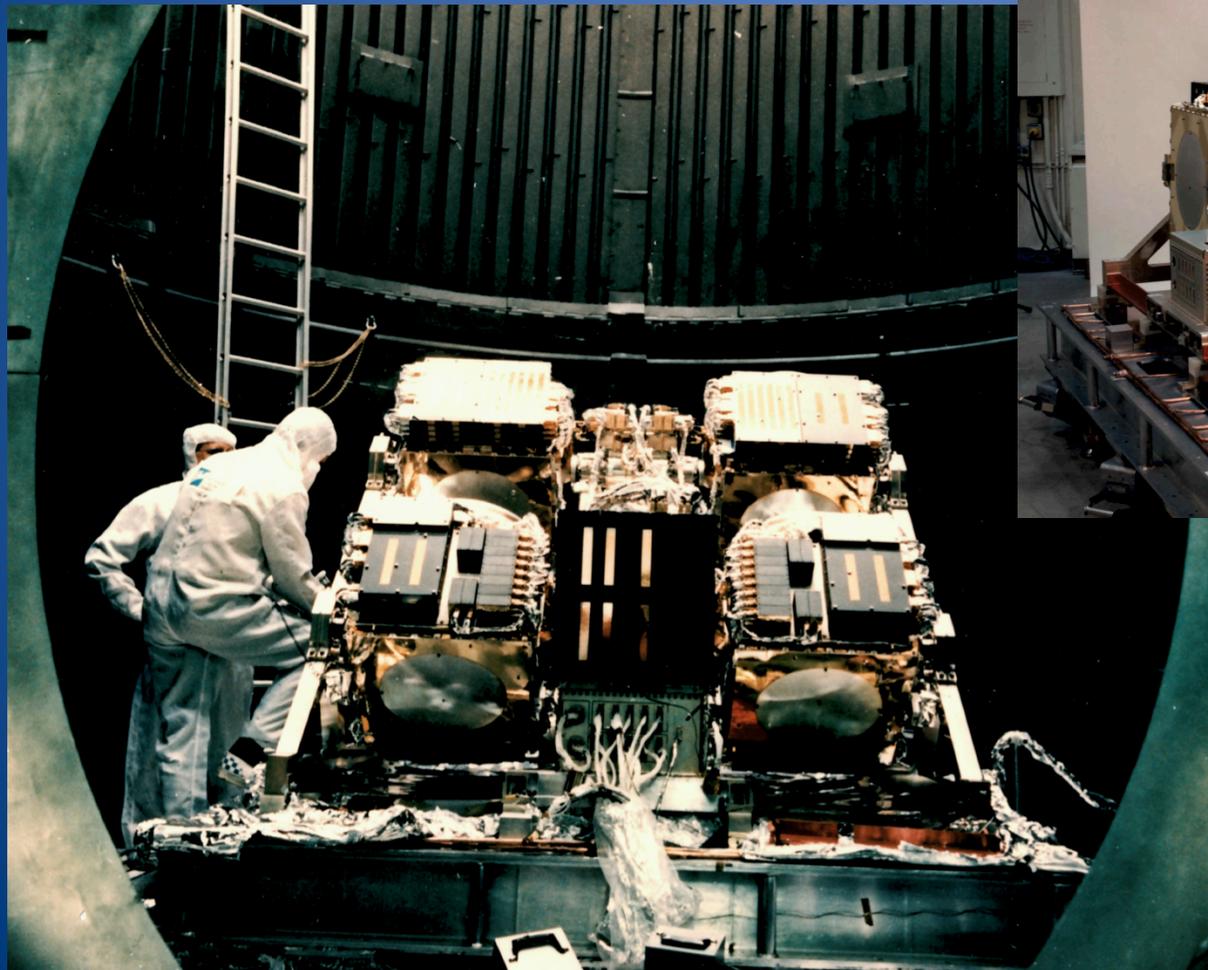
Mass: 1820 kg  
 Power: 192 W  
 Telem: 6492 bps

Effective Area: 2000 cm<sup>2</sup> at 0.511 MeV



# Construction

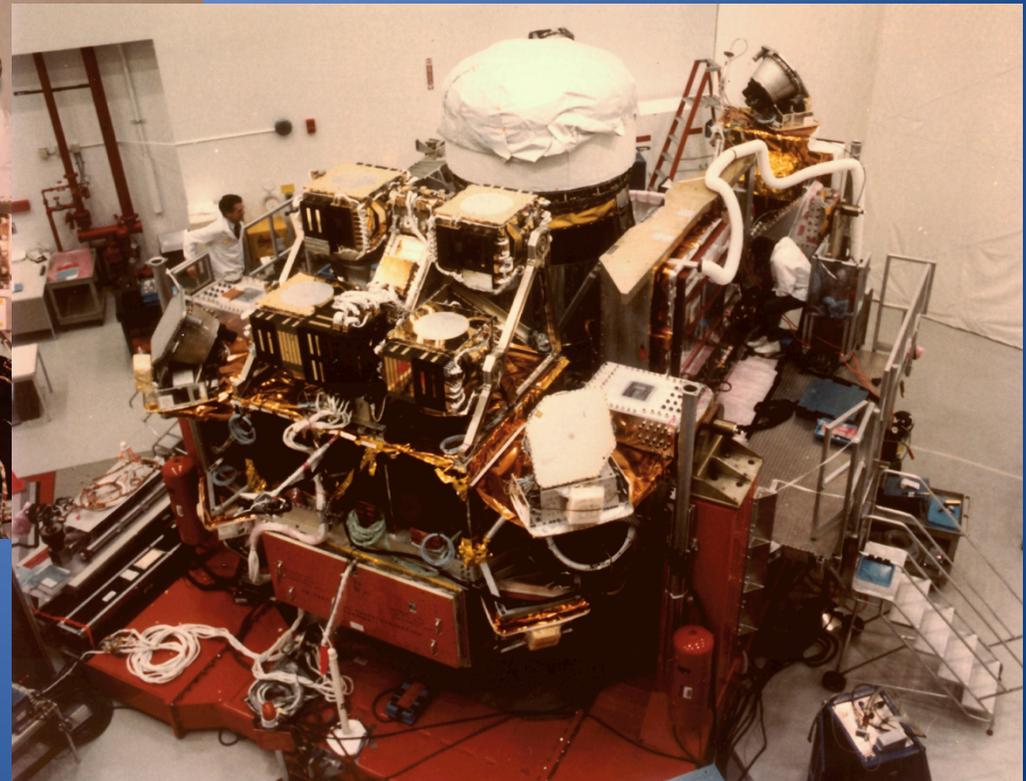
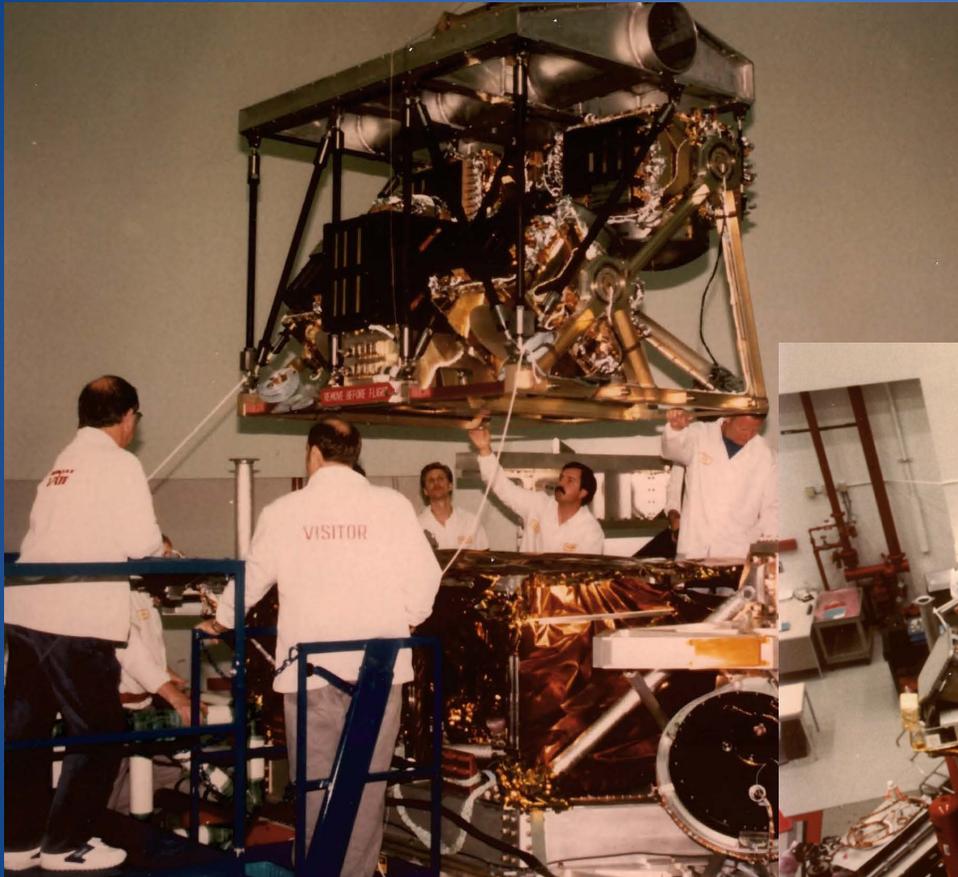
Key Industrial Partner:  
Ball Aerospace Systems Division



Detectors:  
Harshaw, Bicron

PMTs: RCA

# OSSE Integration onto GRO at TRW





# Verification of GRO for TVAC



Operations Working Group meeting at TRW

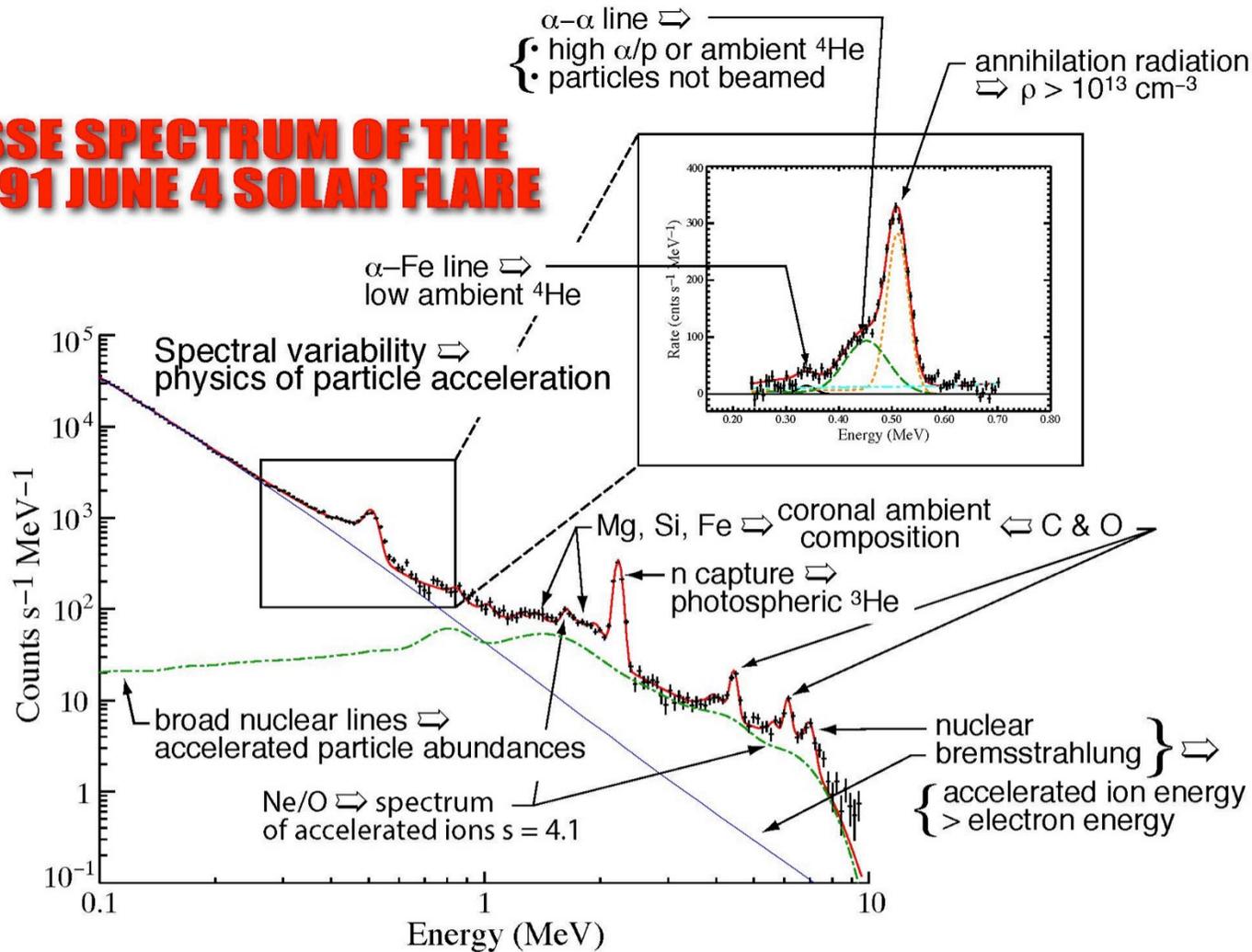
GSFC, TRW, and Instrument teams celebrate the verification of GRO prior to environmental testing



# Start of Science Operations



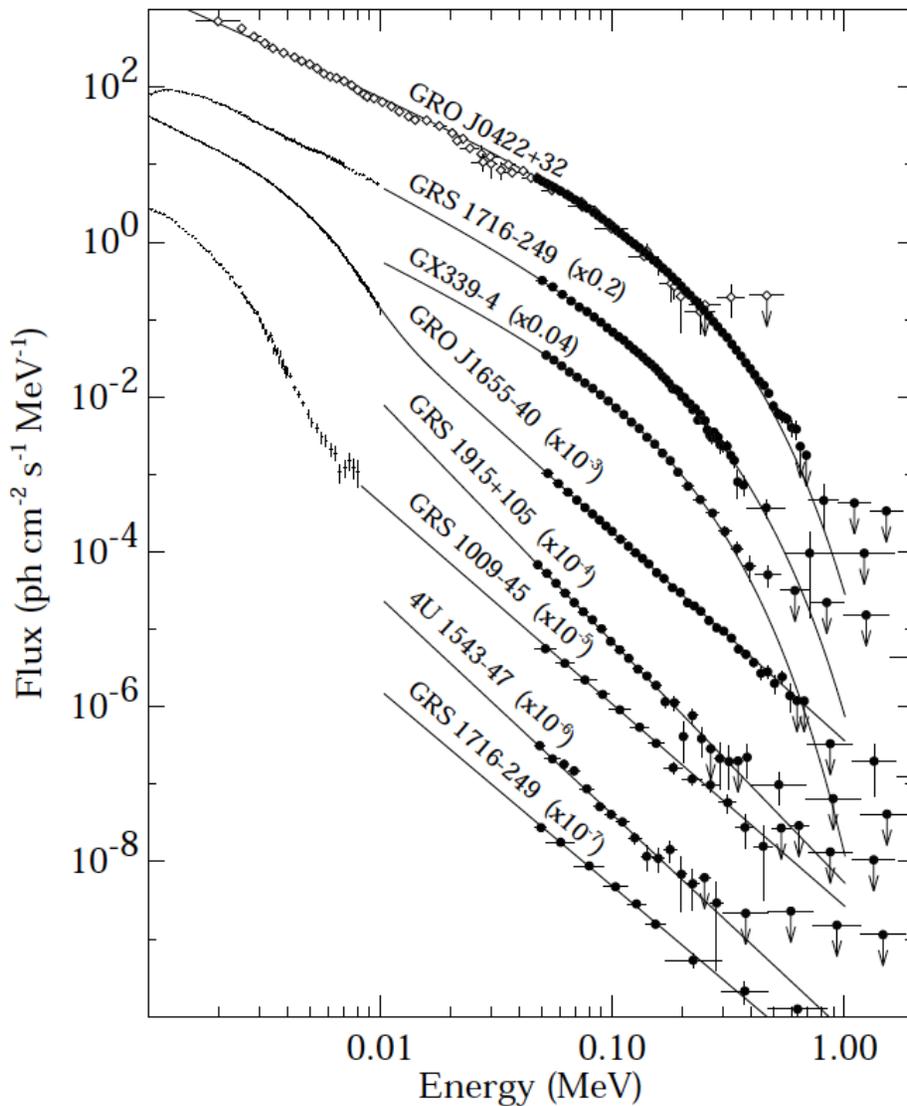
## OSSE SPECTRUM OF THE 1991 JUNE 4 SOLAR FLARE



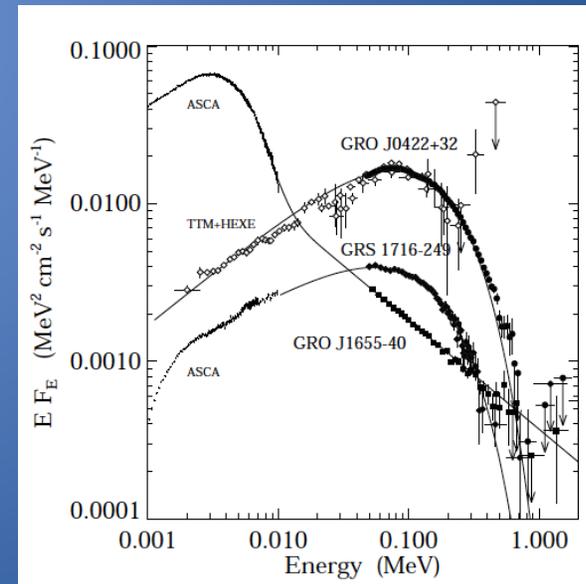
Murphy, Share, et al., ApJ, 1997



# Galactic Black Holes



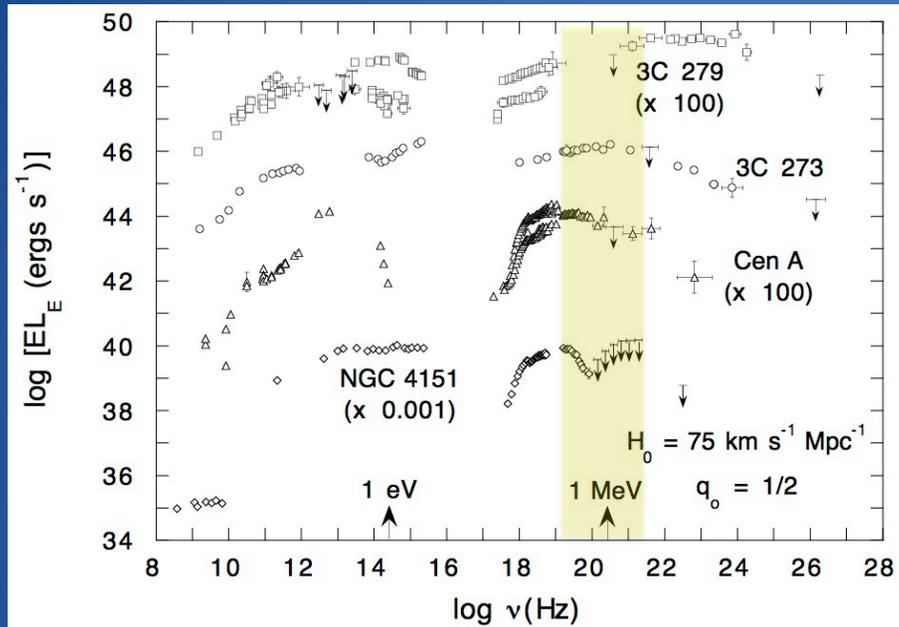
- 7 Black Hole Candidates
- 2  $\gamma$ -ray emission states correlated w/ x-ray emission:
  - Exponential-cutoff PL gammas as extension of x-ray low, hard state
  - Soft PL state as extension of X-ray high, soft state.



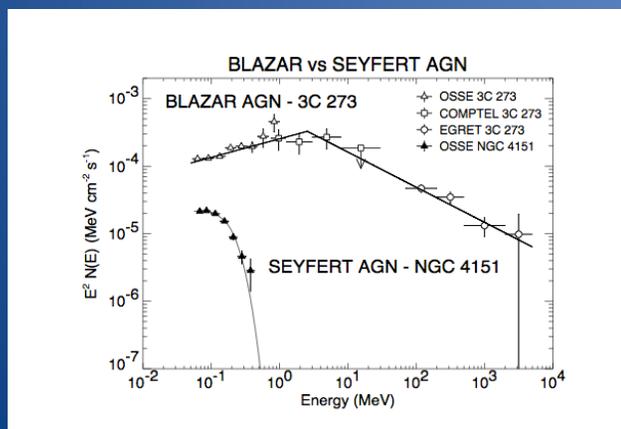
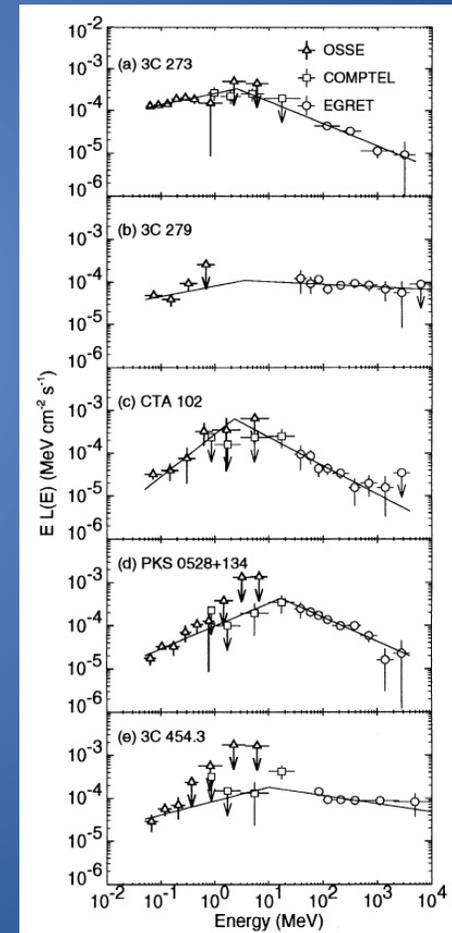
Grove et al., 1998



# Blazars and Seyfert AGN



OSSE observed 17 Blazar AGN and detected 7



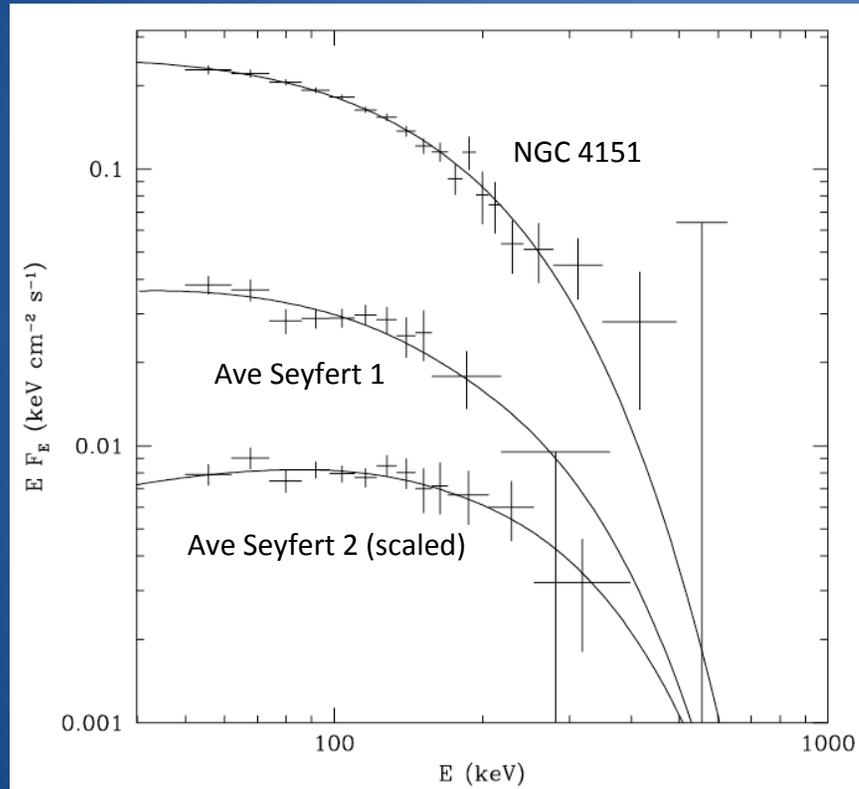
Johnson, et al., 1995

McNaron-Brown, et al., 1995

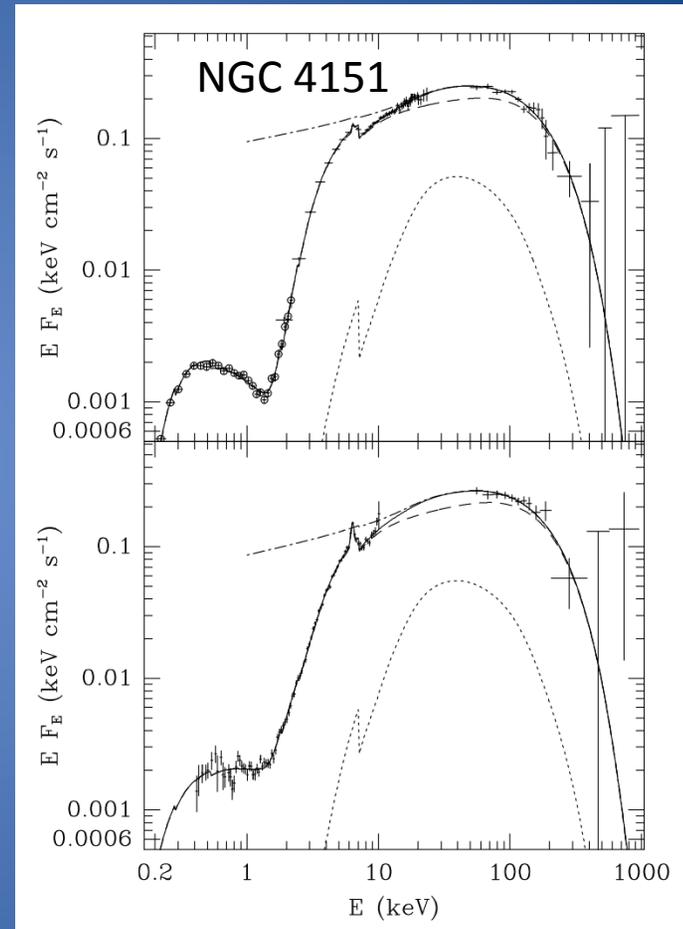


# Seyfert Spectra

Observed 36 Seyferts  
Detected 25 ( $> 3\sigma$ ), 17 ( $> 5\sigma$ )



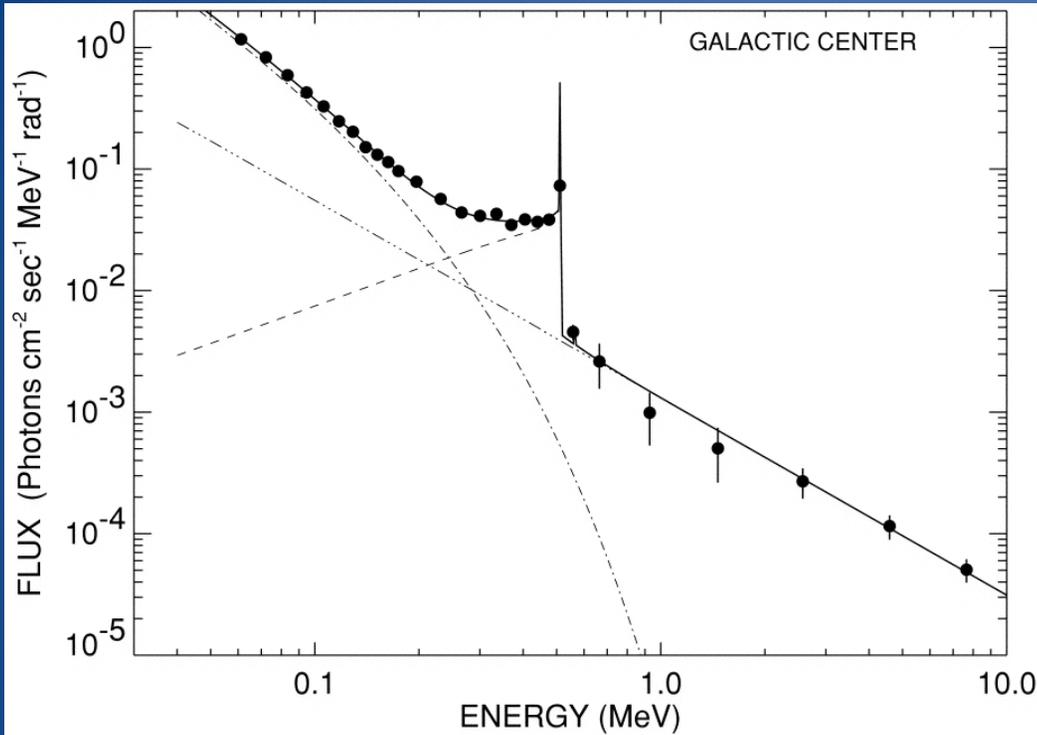
Zdziarski et al, 2000



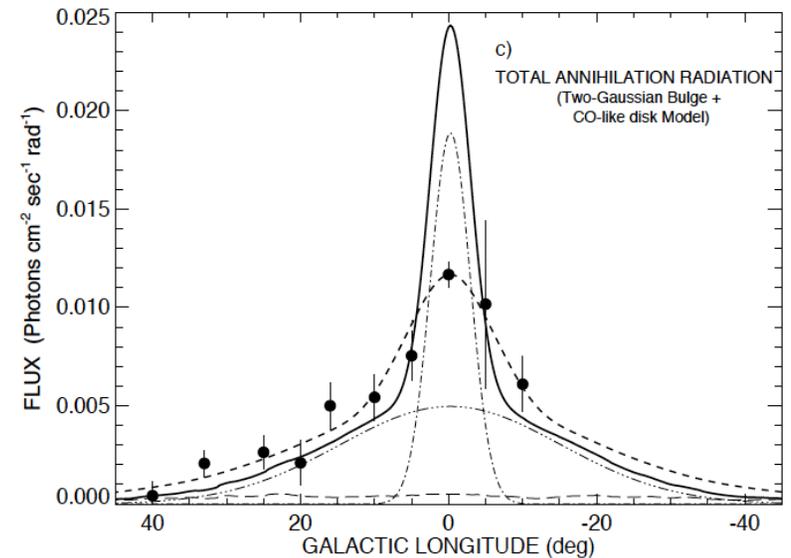
Contemporary X- $\gamma$  measurements:  
OSSE, ROSAT, Ginga, ASCA



# Mapping the Galactic Plane Positrons



Positronium fraction  $0.93 \pm 0.04$



## Longitude Distribution

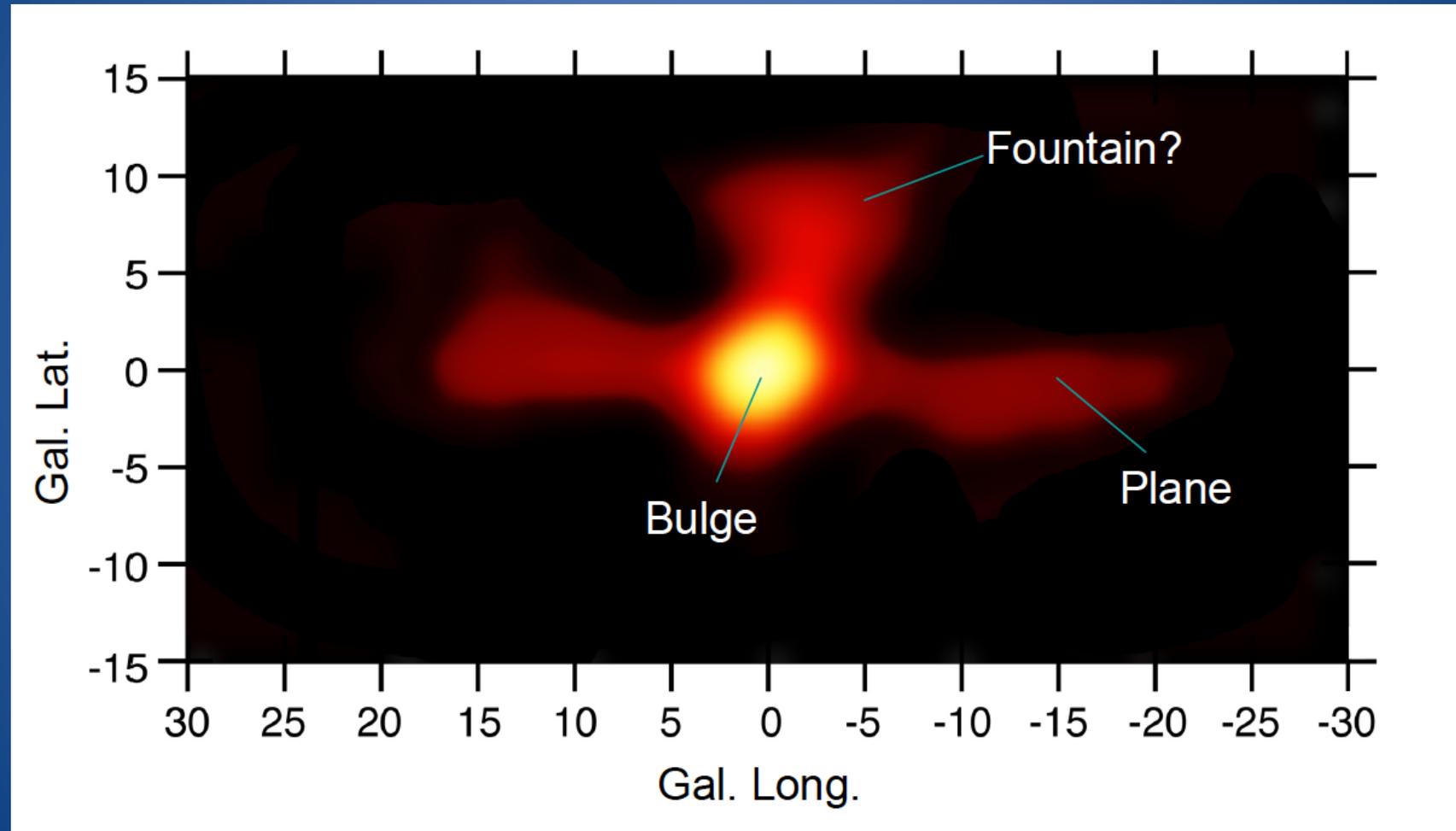
$\sim 6^\circ$  gaussian bulge + CO disk model  
(solid lines – intrinsic model,  
dashed lines – convolved w/ OSSE)

Kinzer et al. ApJ, 2001

# 0.511 MeV in the Galactic Center



60 separate viewings of the Galactic Plane, totaling 67 weeks thru 1997.



Purcell et al. ApJ, 1997



# *Fermi* is to EGRET as ???? is to OSSE, COMPTEL, INTEGRAL

## The “challenging” MeV region

- Past missions show a rich science potential, but how do we probe more deeply?
- Challenges:
  - “Rich” background
  - Three interaction processes (Photoelectric, Compton, Pair)
  - Minimum in interaction cross sections
  - Did I mention background?
- Path Forward:
  - Prioritize your science, polish the science case
  - Optimize the instrument for that science
  - Not likely that one instrument can do all MeV science objectives

**BASEBALL'S OPENING DAY**

Cincinnati hosts Houston at 2 p.m. (WAYK, ESPN).



**LOU PINIELLA:**  
Cincinnati manager.

Other TV games:

■ **2 p.m.:** Chicago White Sox at Baltimore (WGN).

■ **8 p.m.:** Milwaukee at Texas (WAYK, ESPN).

**Complete coverage, 1C, 8C.**

PUBLISHED IN BREVARD COUNTY

**PANEL: CENSURE LIPPMAN**

House committee votes today, 6B.

**EXERCISE**

Know your limitations, 1D.

**PROMOTION**

Manufacturing group touts Brevard, in Business Monday.



**REP. FRED LIPPMAN:**  
Faces charges.

MONDAY, April 8, 1991

**HEADLINES**

TODAY'S NEWS AT A GLANCE

**SPACE:** Next launch is a commercial Delta rocket scheduled for liftoff Friday. It will carry a Contel Corp. communications satellite.

**WEATHER:** Early morning fog, turning partly cloudy with a 40 percent chance of showers or thunderstorms. High in the mid-80s; low in the mid- to upper 60s. Weather, 8A.

**NATION:** Author who skewers Nancy Reagan in a new book as greedy and promiscuous says she is convinced the former first lady ran the U.S. government, 3A.



**BUSH**

President Bush is preparing for another battle with Congress, labor unions and environmentalists — this time over free trade with Mexico, 4A.

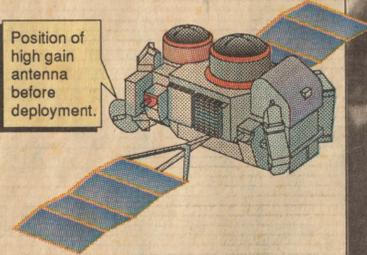
**WORLD:** Three thousand people gather in Moscow for Orthodox Easter services, the first such services in decades, 4A.

**Albanians vote** in runoff elections that either will grant communists unchecked power in parliament or give the opposition an important say in running the poor Balkan nation, 4A.

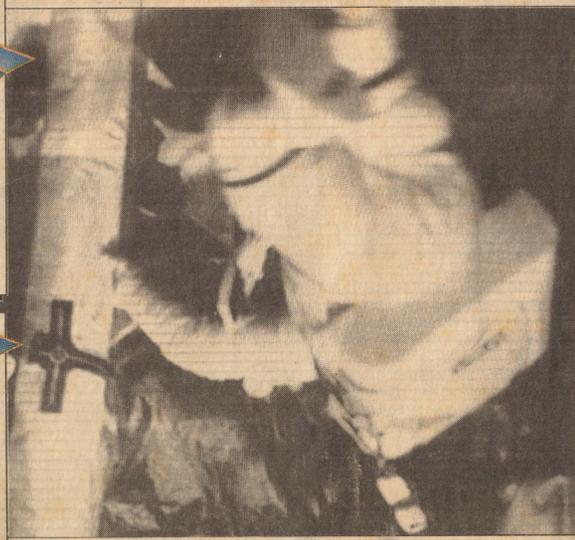
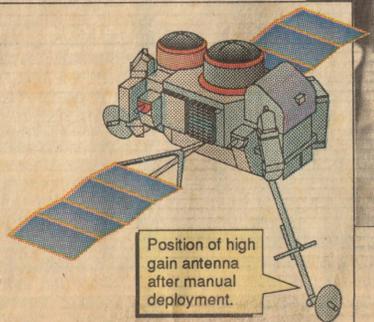
**BREVARD:** Youths accused of slaying Titusville gas station manager have conversation taped while in jail holding cell; lawyers want to keep tape from being used at trial, 1B.

**Gamma Ray is on its way****High-flying repair work****Gamma Ray Observatory**

Position of high gain antenna before deployment.



Position of high gain antenna after manual deployment.



Graphic by Gloria Abood; photo by Craig Bailey from NASA Select TV

**ASTRONAUT JERRY ROSS** performs emergency repairs Sunday to a stuck antenna by pushing its arm and freeing the mechanism on the Gamma Ray Observatory. The antenna, which is used to transmit high volumes of data to Earth, had refused to swing outward from its stowed position. Astronaut Jay Apt joined Ross in the spacewalk.

By I.K. Brown  
FLORIDA TODAY

HOUSTON — U.S. astronauts took an unexpected walk outside their spaceship Sunday — the first time since 1985 — to repair a jammed antenna on the Gamma Ray Observatory.

Shuttle astronaut Jerry Ross freed the antenna on his first try, clearing the way for the successful deployment of the observatory.

"It's free, it's free, I can see it move, it's free!" a jubilant Ross shouted as the antenna swung out into its proper position.

"You saw today the value of manned space flight," said flight director Chuck Shaw at Johnson Space Center. "It was shown to be very effective."

Wearing bulky, protective spacesuits, Ross and fellow spacewalker Jay Apt pushed open Atlantis' airlock at 2:39 p.m. EDT, following nine failed attempts to free the balky antenna.

The two mission specialists were scheduled to make a spacewalk in the Orbiter's open cargo bay today to test equipment for NASA's planned space station. But they had practiced techniques for manually deploying the observatory as well, in case their space-walking repair services were needed.

Tethered to the Shuttle by cables, Ross flipped himself over the right side of Atlantis' payload bay. Dangling 280 miles above Earth, he slowly inched his way,