

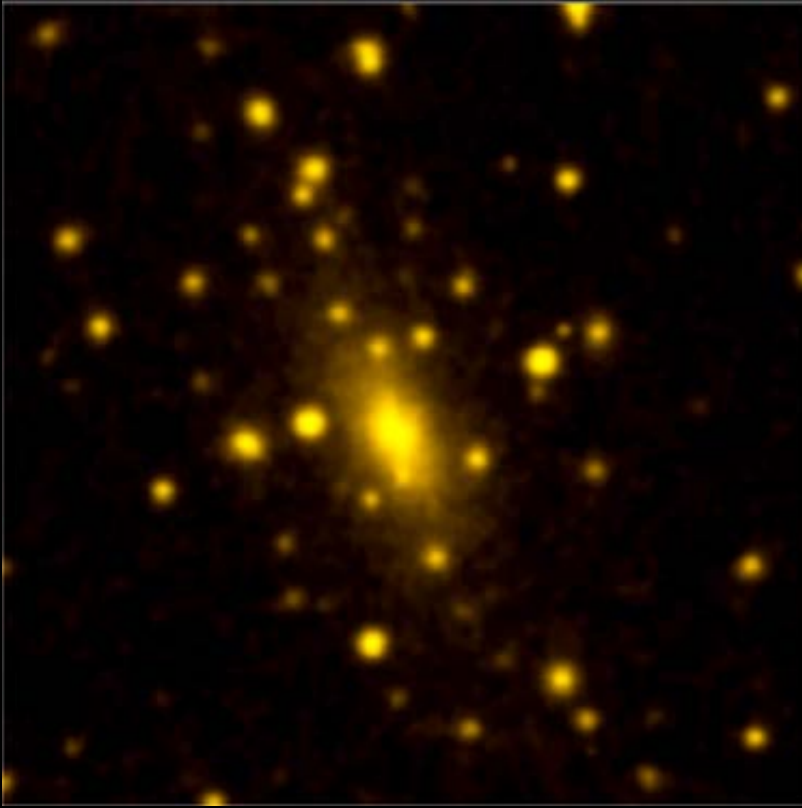
The Chandra X-Ray Observatory: Great Science with a Great Observatory

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Outline

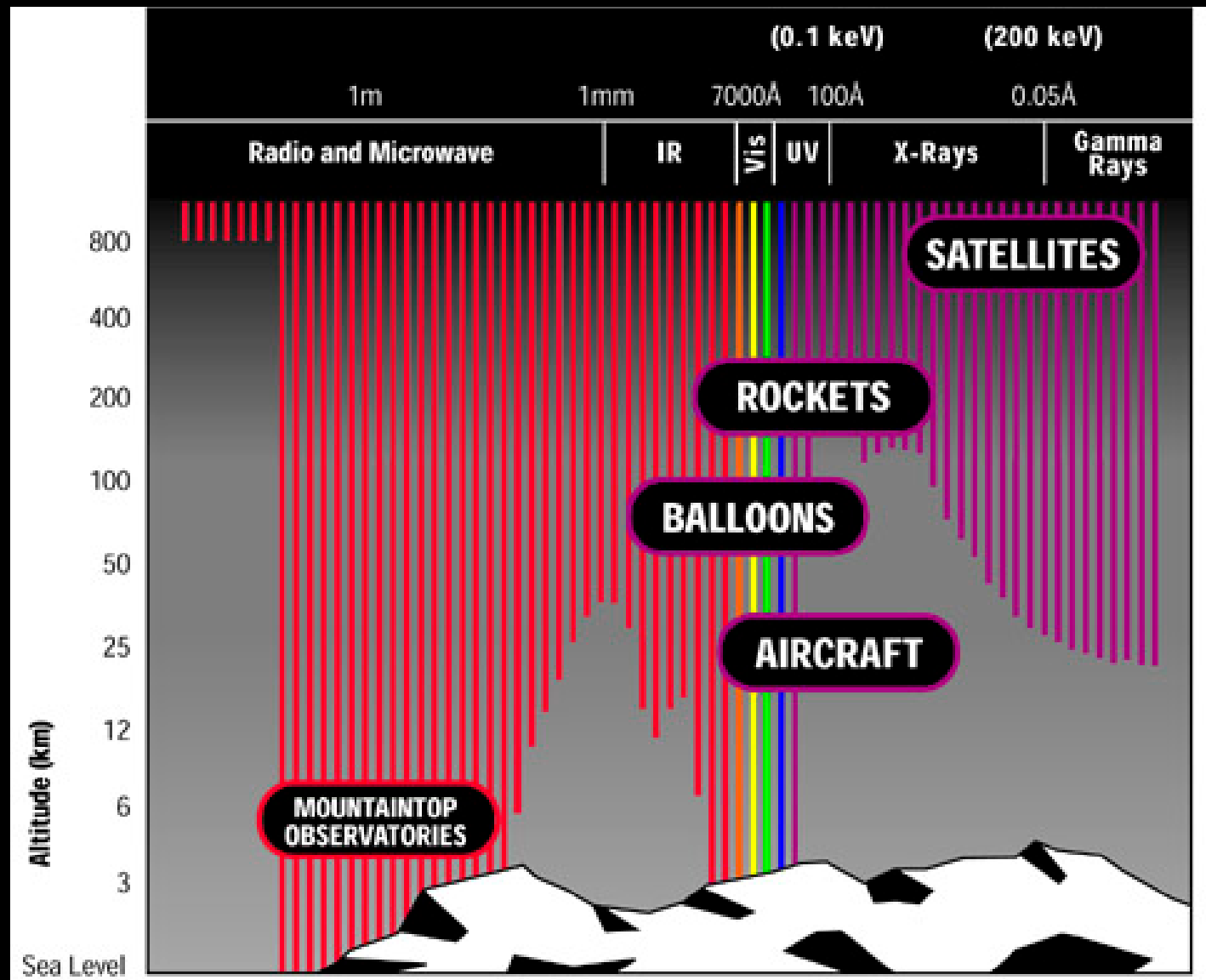
- What are X-rays
- Why X-ray Astronomy is so important
- The building of the Observatory
 - Began in 1976
 - Launched in 1999
 - Designed for 3 years of operation with a goal of 5
- Celebrating the 20-th anniversary
- Launch, deployment, first light!
- Some of the wonderful science

The Importance of X-ray Astronomy



- Most of the matter that we “see” in the universe is via its X-ray emission
- The bulk of this matter is the hot, X-ray-emitting gas in the great galaxy clusters
- Every known class of astronomical object, from comets to quasars, is also an X-ray source

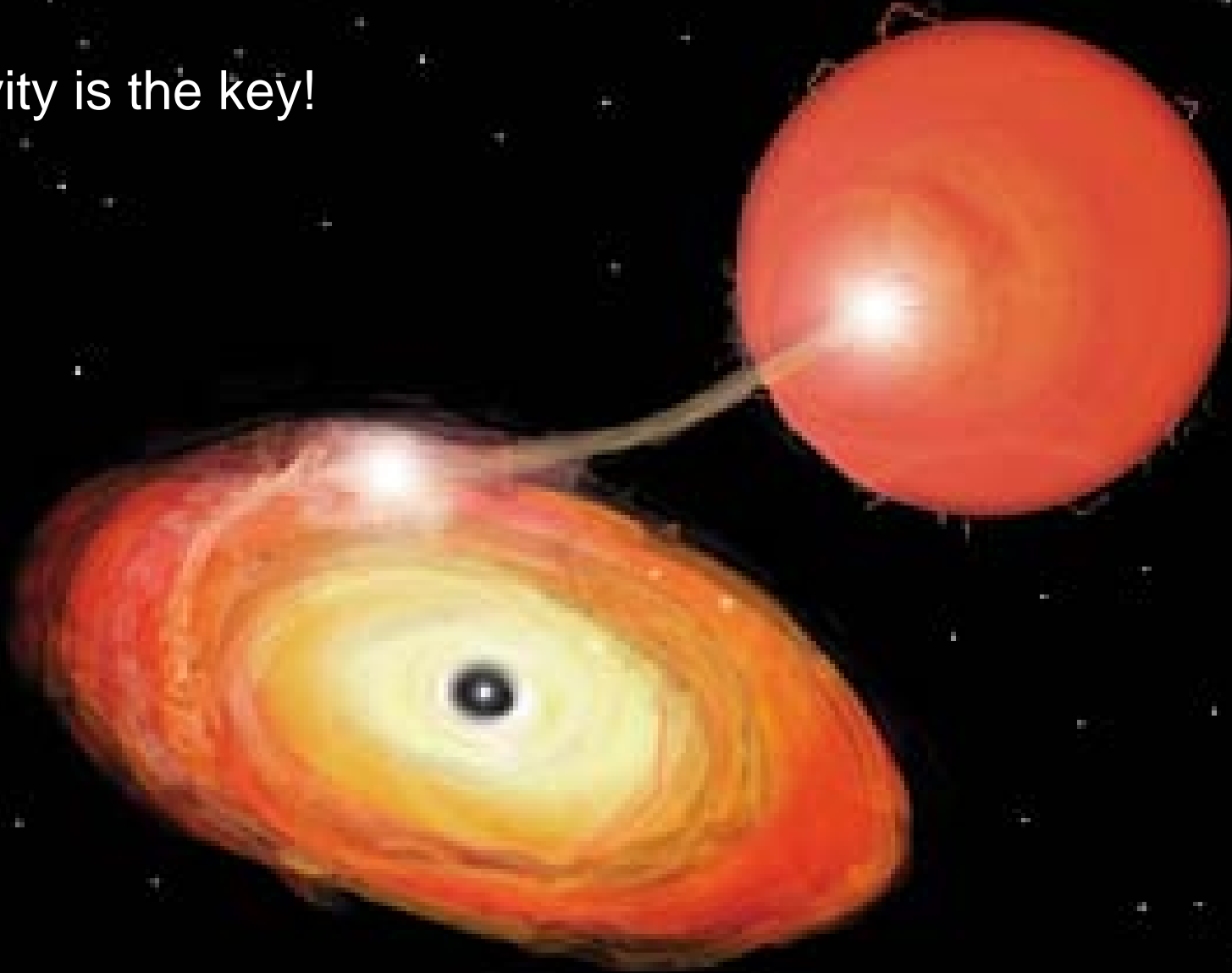
The Atmosphere is a Nuisance



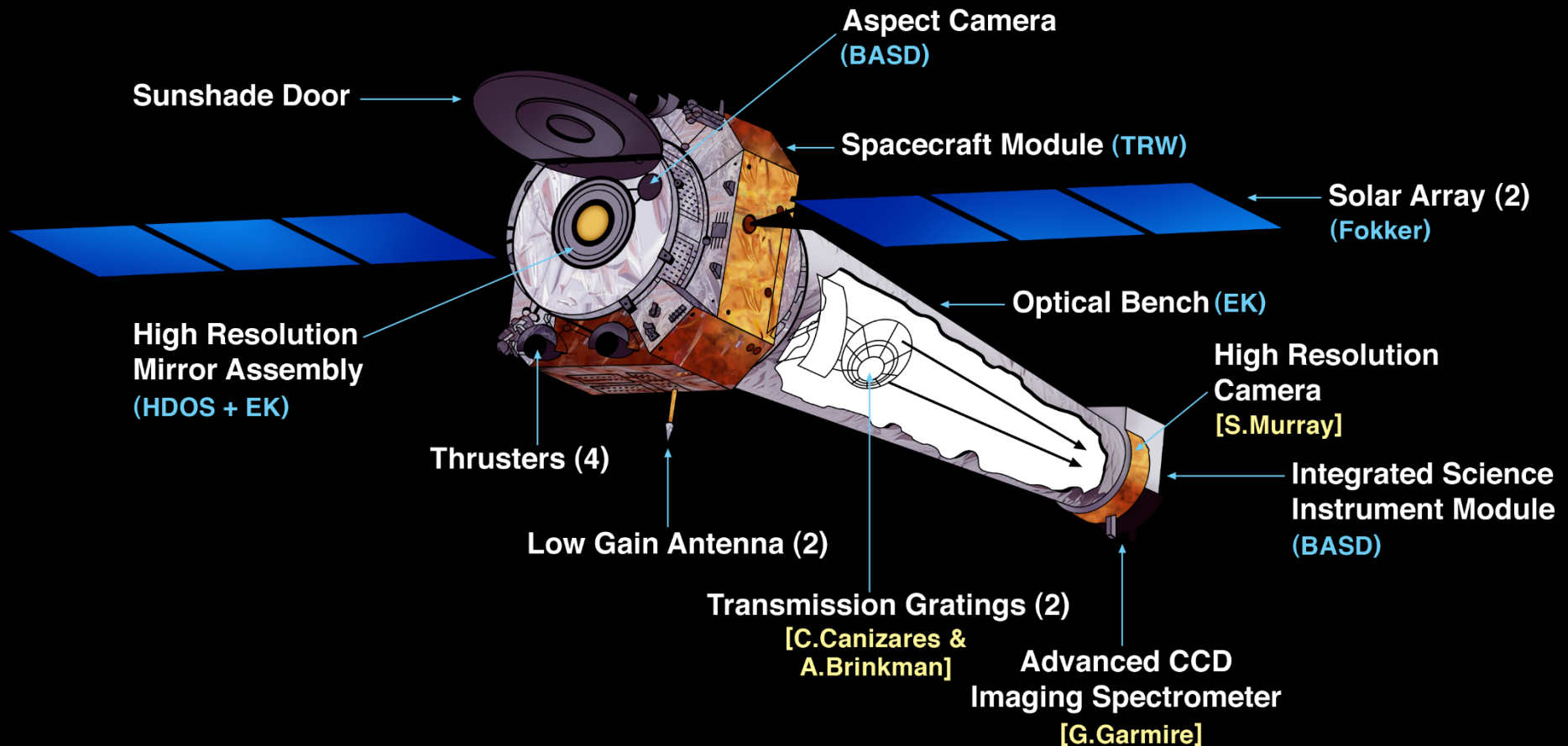
Altitude
(km)

Binaries and Compact Objects

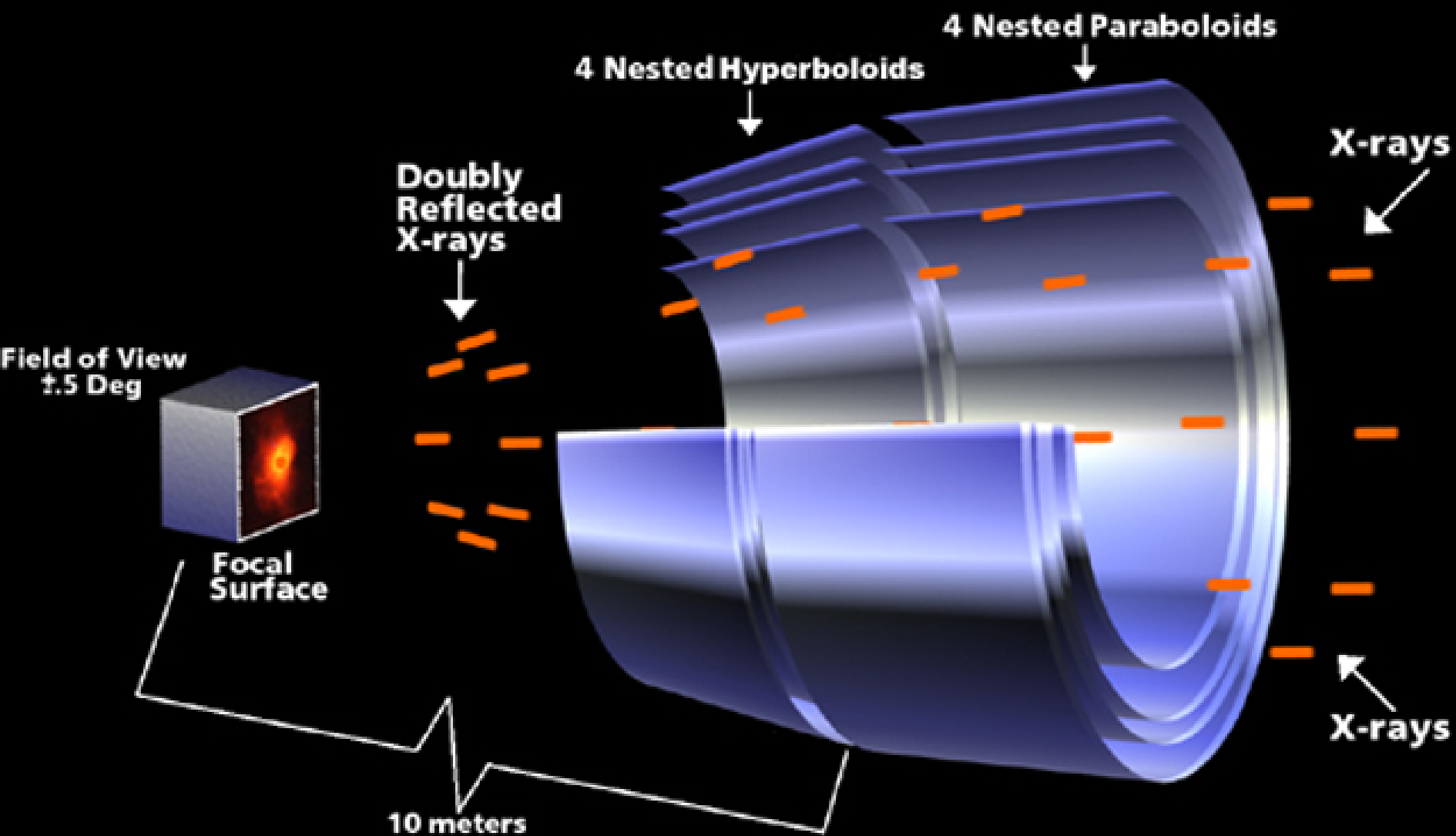
- Gravity is the key!



The Observatory

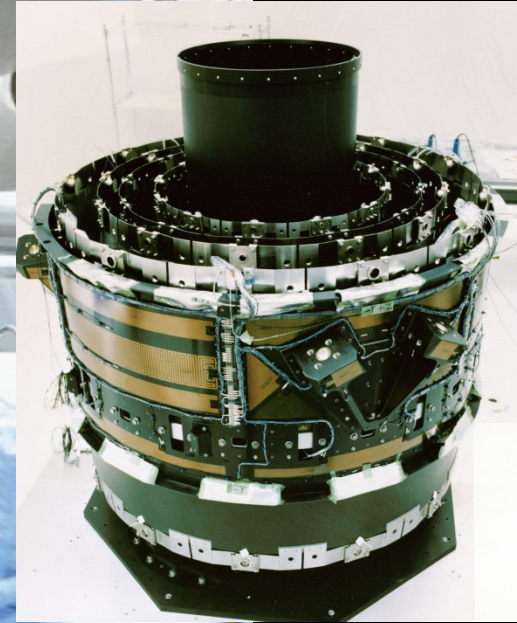
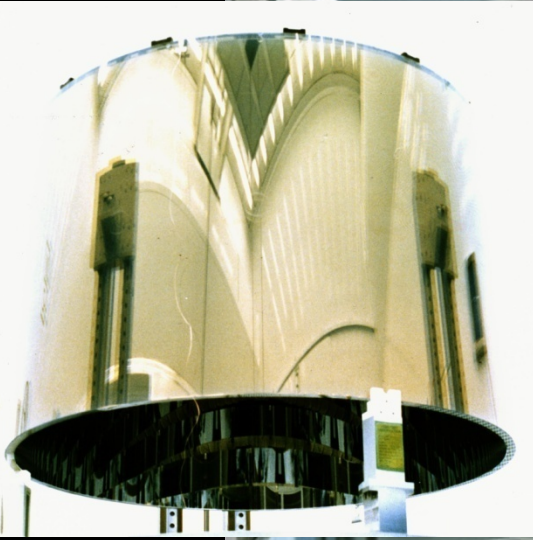
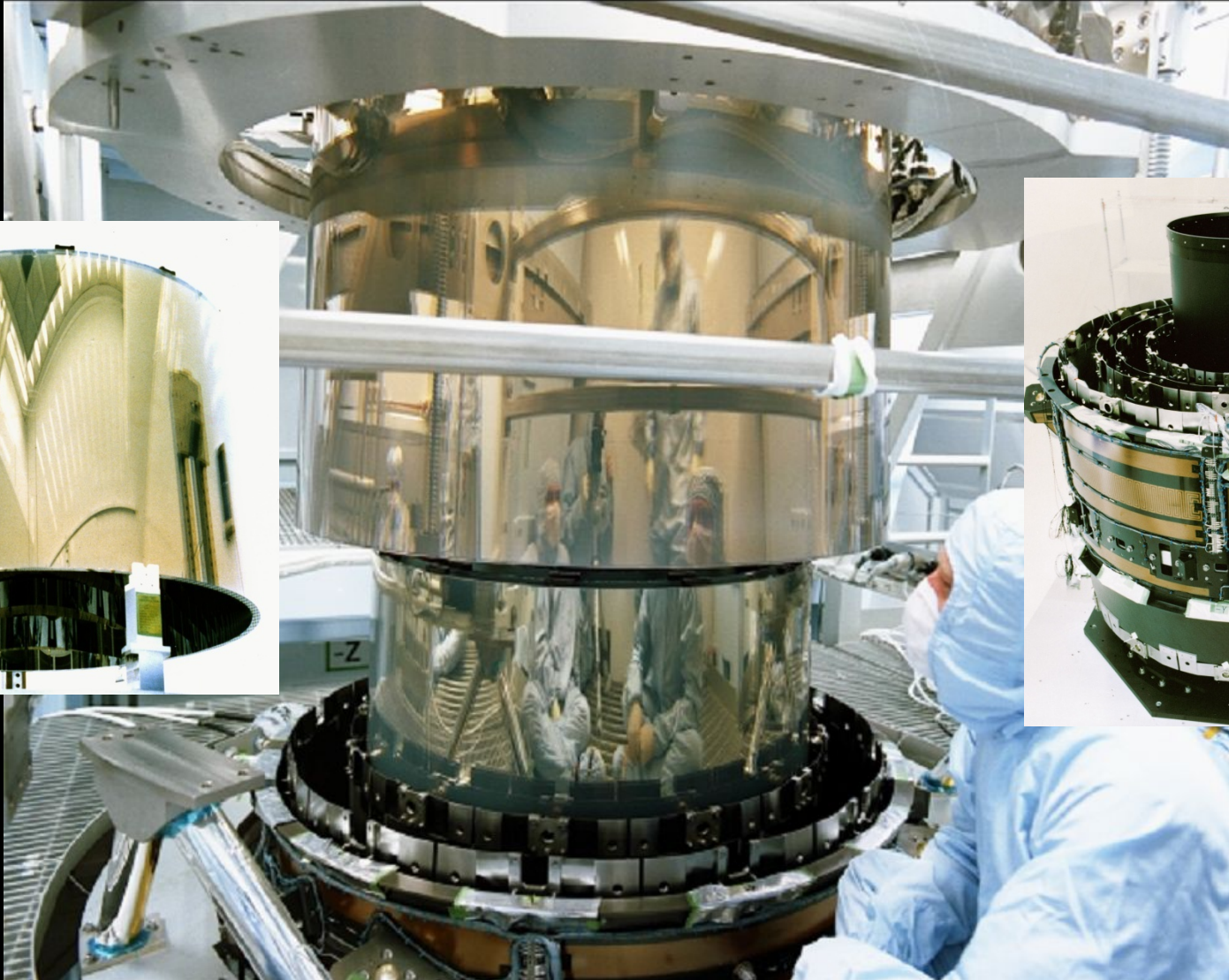


Optics



Mirror elements are 0.8 m long and from 0.6 m to 1.2 m diameter

Optics: Coated, Assembled & Aligned



The X-ray Calibration Facility at MSFC



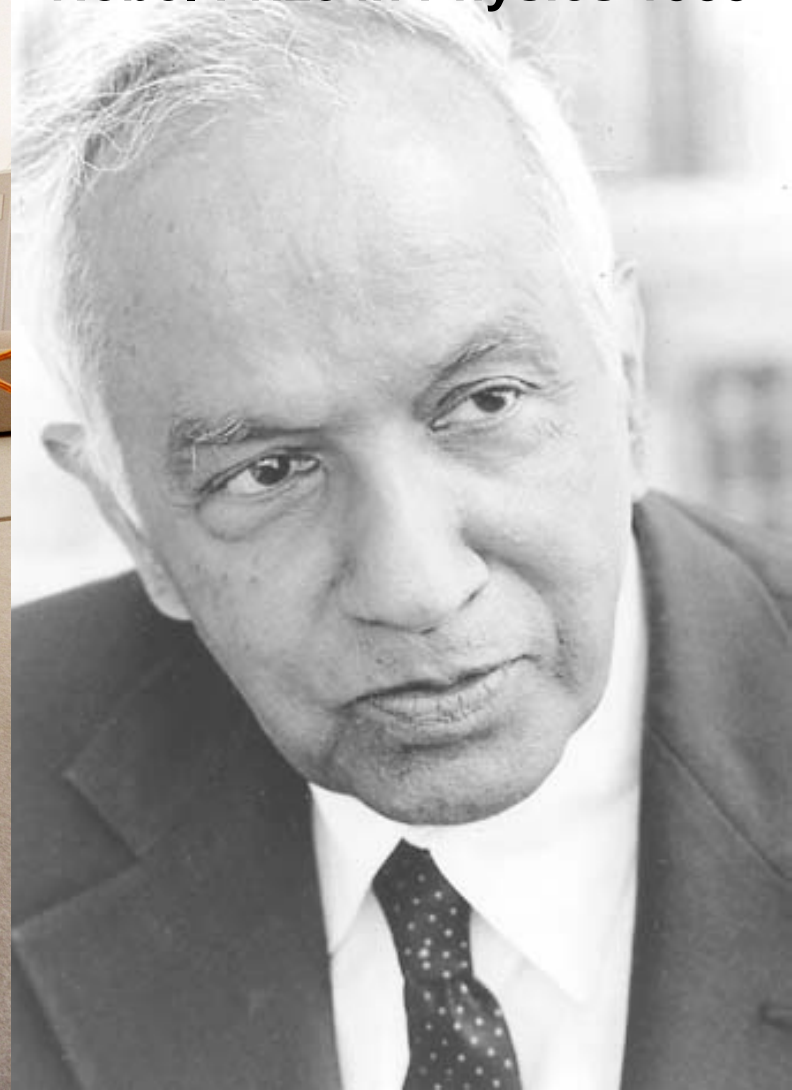
Include the Upper Stage in the Shuttle



The longest and heaviest payload ever launched by the Shuttle



Nobel Prize in Physics 1983



Deployment



Launch – July 23, 1999

Beyond the Sky

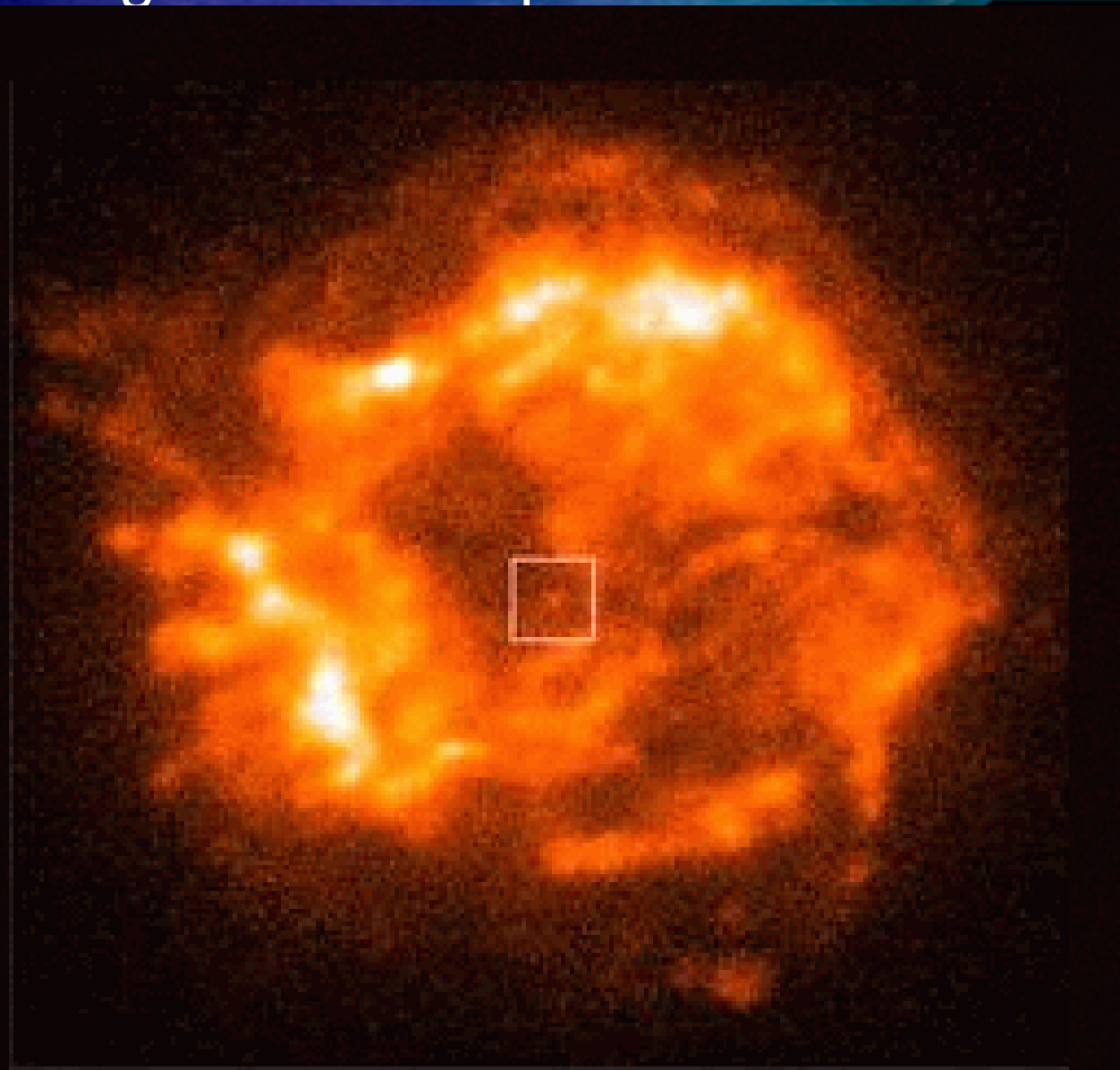
Words and Music by Judy Collins

And we will fly beyond the sky
Beyond the stars beyond the heavens
Beyond the dawn we'll carry on
Until our dreams have all come true
To those who fly - we sing to you



Official First Light — Cassiopeia A

1 arcminute



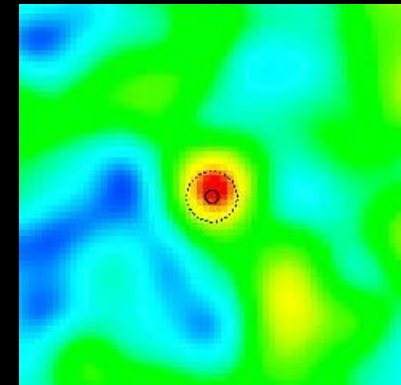
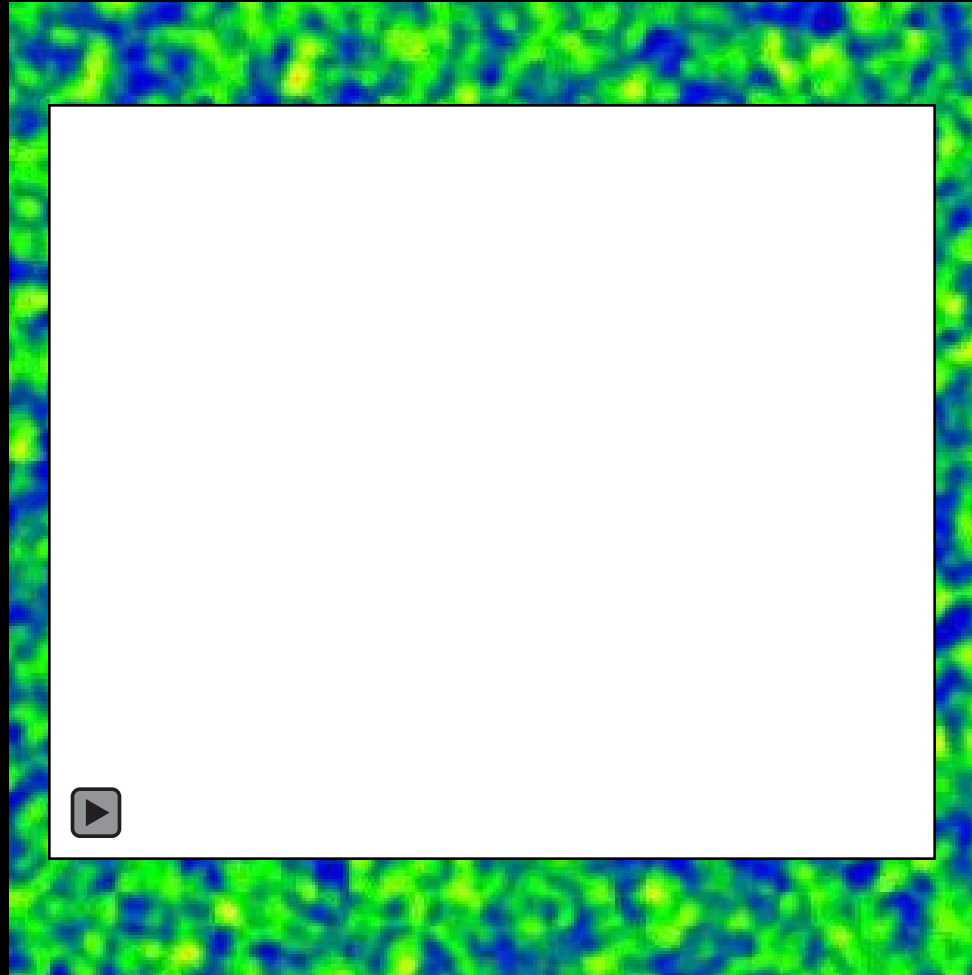
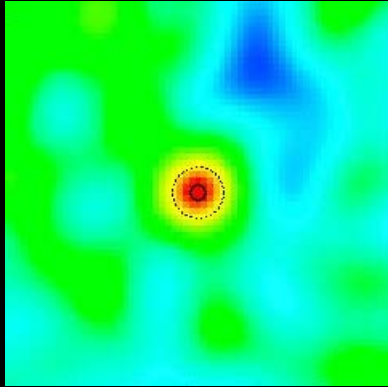
The Crab Nebula and its Pulsar



- A spinning Neutron Star --- the result of a star exploding
 - The size of Huntsville
 - But weighs as much as our sun

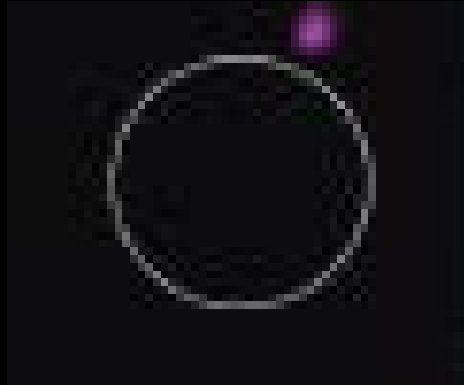
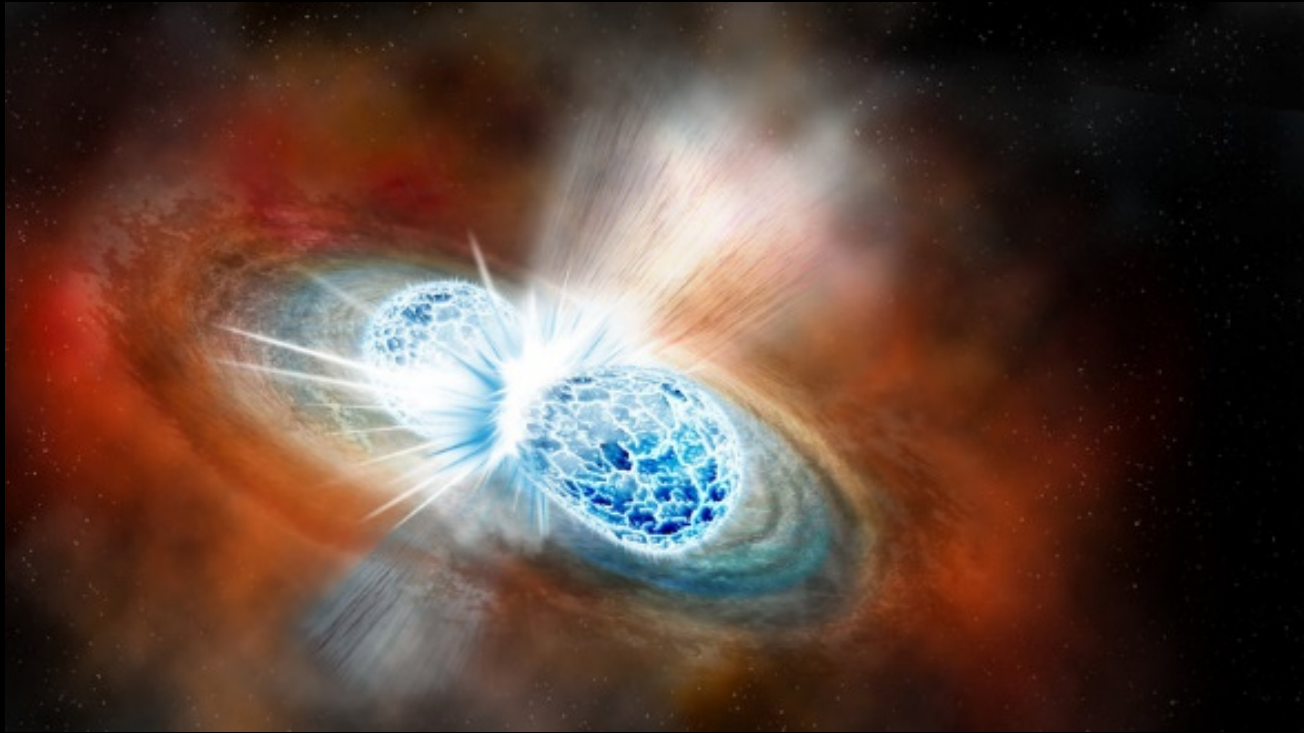
Jupiter and its Moons

Io

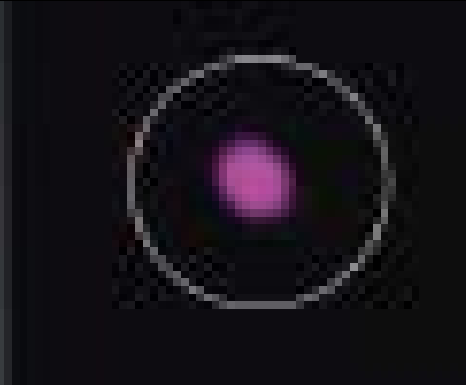


Europa

Two Neutron Stars Collide! (Wow)

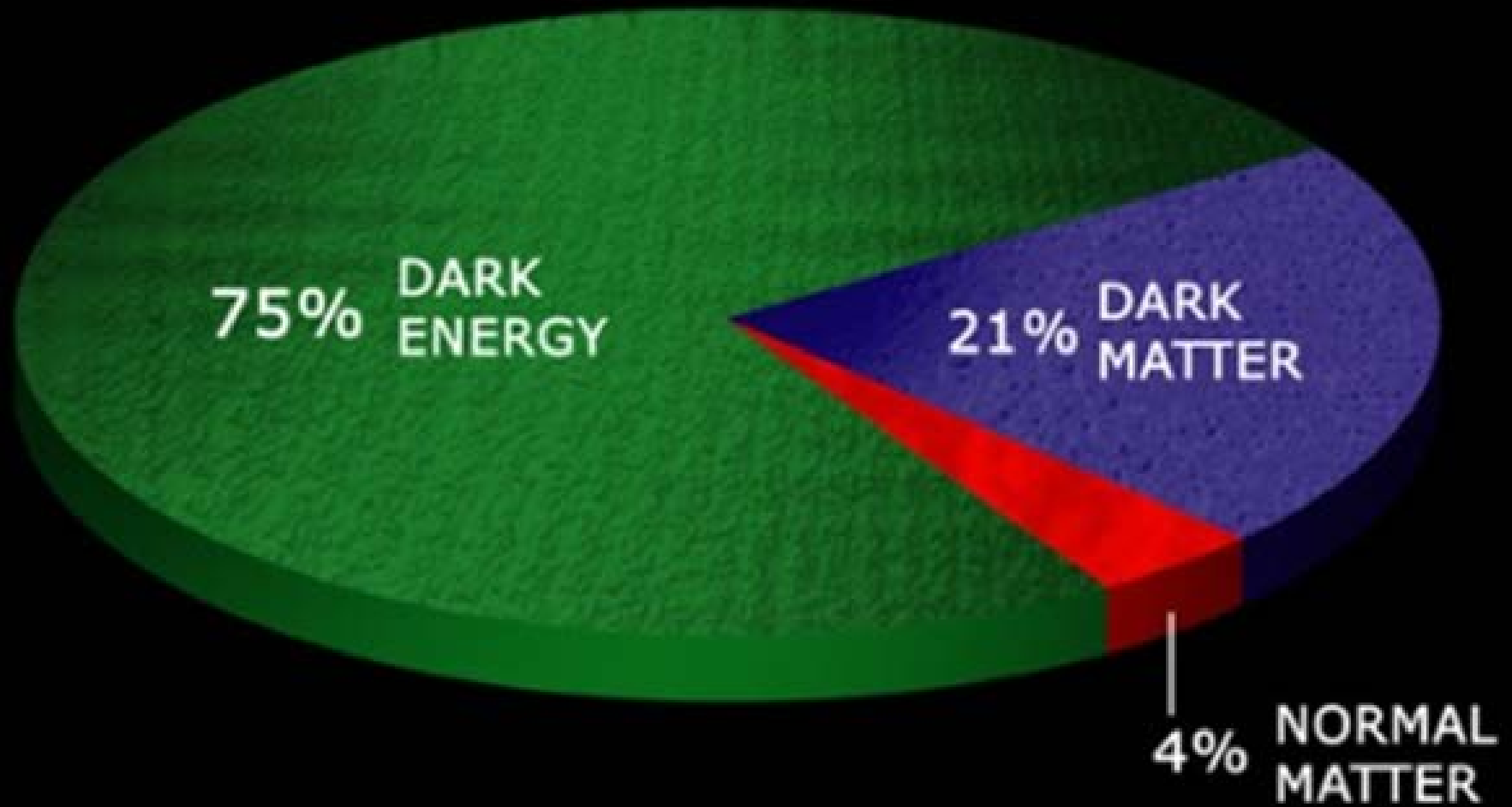


AUG 19

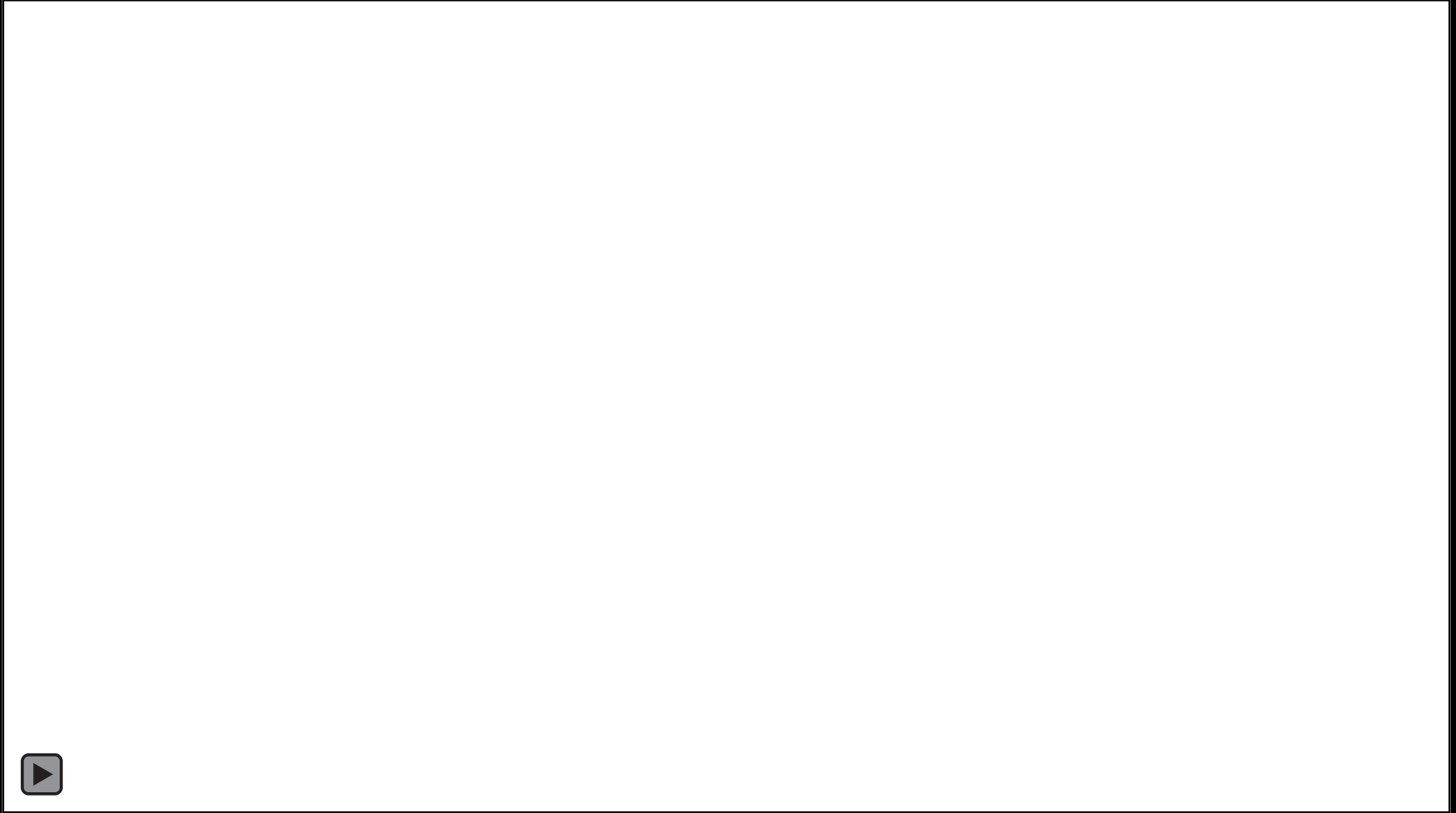


AUG 22

Dark Energy and Dark Matter



Colliding Clusters of Galaxies & Dark Matter



Blue – the location of the dark matter

Pinkish – the normal matter (the X-ray-emitting hot gas)

Learn More



The opportunity for exploration and discovery with Chandra remains as high today as it was at launch