



# CHANDRA X-RAY OBSERVATORY





CHANDRA X-RAY OBSERVATORY

# SCIENCE IN MOTION

CHANDRA'S 6-YEAR SYMPOSIUM  
November 2-4, 2005

April Hobart, Animator  
Chandra X-ray Center



# PROCESS: Static Data to Animated Story

- Chandra Image/Scientist's Paper
- Storyboard
- Drafts to Final Animation
- Release

# CHANDRA X-RAY OBSERVATORY



**NGC 6240**  
*Merging Black Holes*





# CHANDRA X-RAY OBSERVATORY

X-ray &  
Visible Data



X-ray and Visible Data  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/BH\\_Merger/datanovie.npg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/BH_Merger/datanovie.npg)

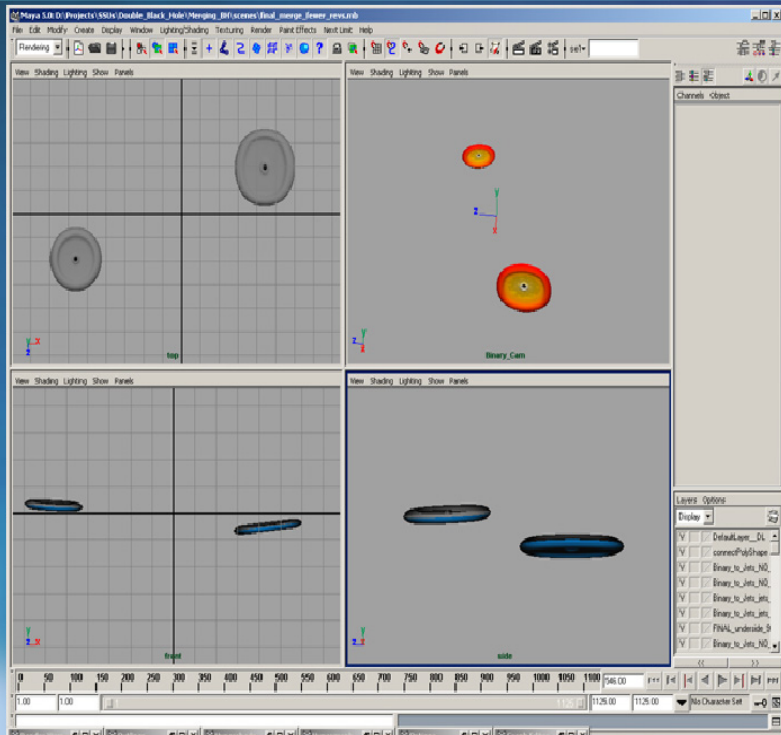
**NGC 6240**  
*Merging Black Holes*

Credit: X-ray: NASA/CXC/MPE/S.Komossa et al.;  
Optical: NASA/STScI/R.P.van der Marel & J.Gerssen



# CHANDRA X-RAY OBSERVATORY

Challenge:  
Merging Disks



**NGC 6240**  
*Merging Black Holes*

# CHANDRA X-RAY OBSERVATORY

Challenge:  
Basing Animation  
on Actual  
Simulation Data



LISA Gravitational Waves Simulation  
Full movie:  
[http://hea-www.harvard.edu/~cxcmedia/science\\_in\\_motion/EH\\_Merger/lisa2.avi](http://hea-www.harvard.edu/~cxcmedia/science_in_motion/EH_Merger/lisa2.avi)

**NGC 6240**  
*Merging Black Holes*

LISA Simulation data

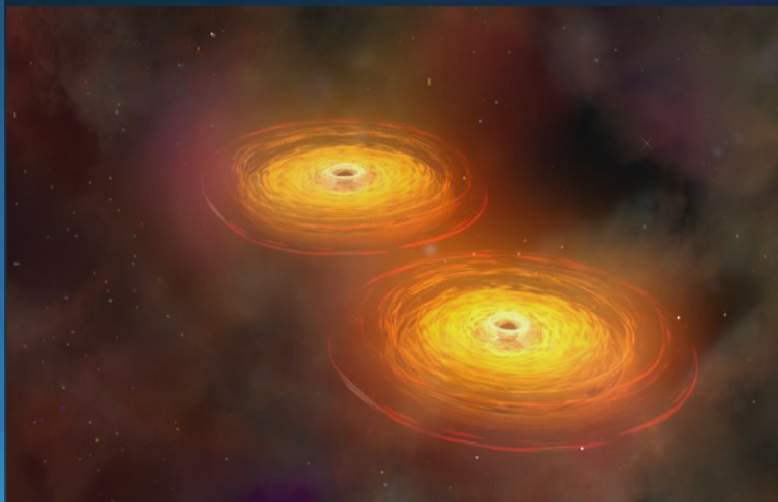


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# CHANDRA X-RAY OBSERVATORY

Final Animation



Final Merger Movie

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/EH\\_Merger/final\\_anim.xpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/EH_Merger/final_anim.xpg)

**NGC 6240**  
*Merging Black Holes*

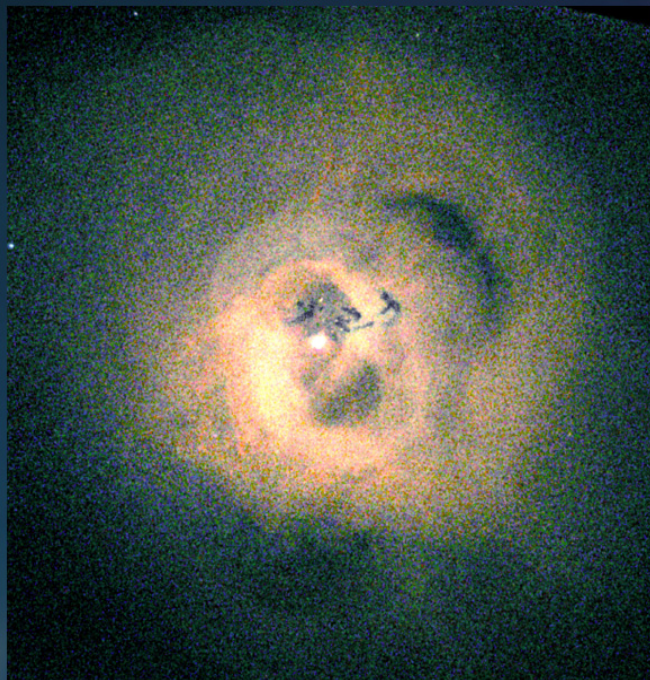
Simulation credit: Josh Barnes (U of Hawaii)/John Hibbard (NRAO)



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# CHANDRA X-RAY OBSERVATORY



*Perseus*  
*Soundwaves in*  
*Outerspace*

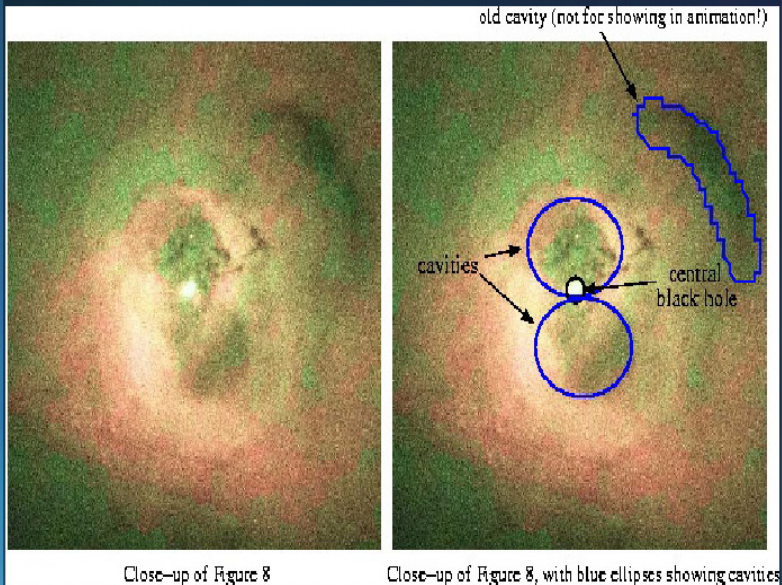




# CHANDRA X-RAY OBSERVATORY

Challenge:  
Scientist/Artist  
Communication

*Perseus*  
Soundwaves in  
Outerspace

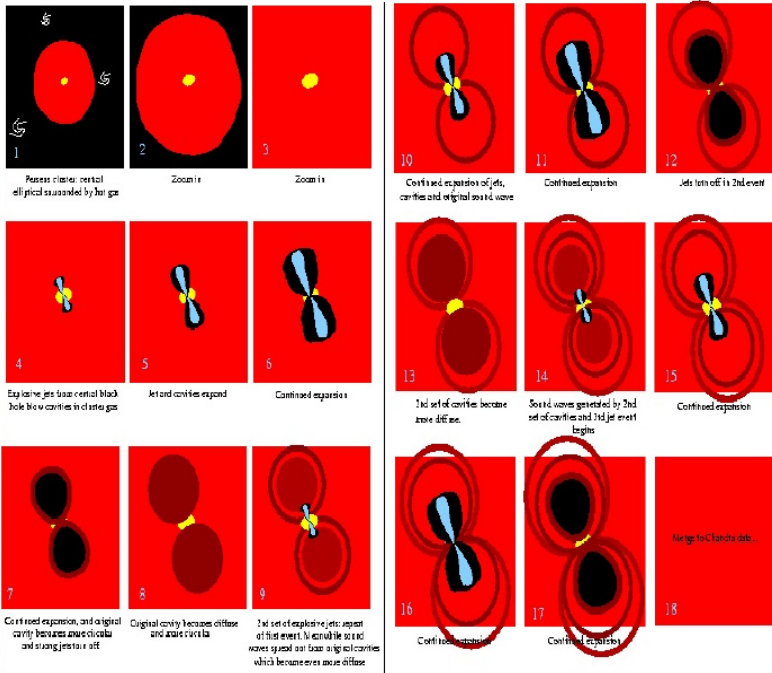


# CHANDRA X-RAY OBSERVATORY

## Challenge: Scientist/Artist Communication

## Perseus Soundwaves in Outerspace

### Perseus Storyboard

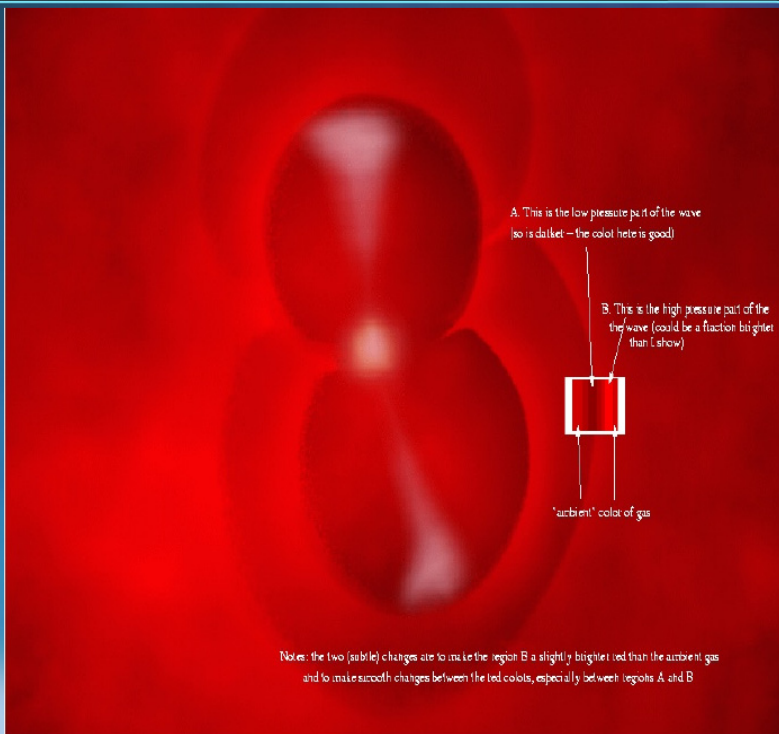


Approximate timing: panels 1-3 (4s), 4-6 (2s), 7-8 (3s), 9-11 (2s), 12-13 (3s), 14-16 (2s), 17-18 (4s)

# CHANDRA X-RAY OBSERVATORY

Challenge:  
Scientist/Artist  
Communication

*Perseus*  
*Soundwaves in*  
*Outerspace*

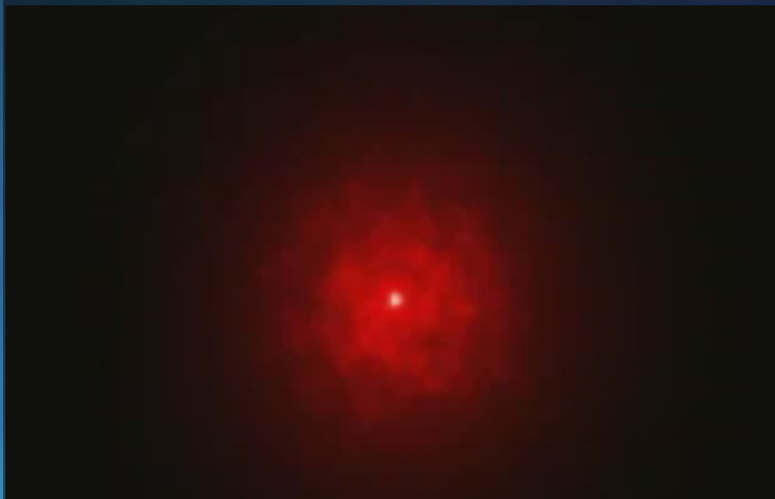




# CHANDRA X-RAY OBSERVATORY

Challenge:  
Accuracy vs.  
Coolness Factor

*Perseus*  
*Soundwaves in*  
*Outerspace*



Perseus: Early Version of Animation  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Perseus/Perseus\\_test1.mov](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Perseus/Perseus_test1.mov)



# CHANDRA X-RAY OBSERVATORY

Final Animation

*Perseus*  
Soundwaves in  
Outerspace



Perseus: Early Version of Animation  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Perseus/Perseus\\_test1.mov](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Perseus/Perseus_test1.mov)



# CHANDRA X-RAY OBSERVATORY

News Story



Perseus: News Story

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Perseus/perseus\\_news\\_starwars\\_short.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Perseus/perseus_news_starwars_short.mpg)

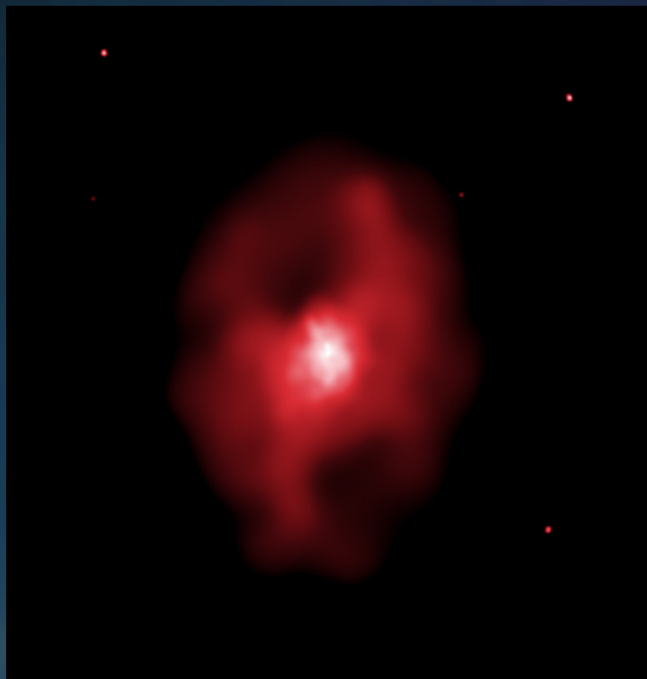
*Perseus*  
Soundwaves in  
Outerspace



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# CHANDRA X-RAY OBSERVATORY

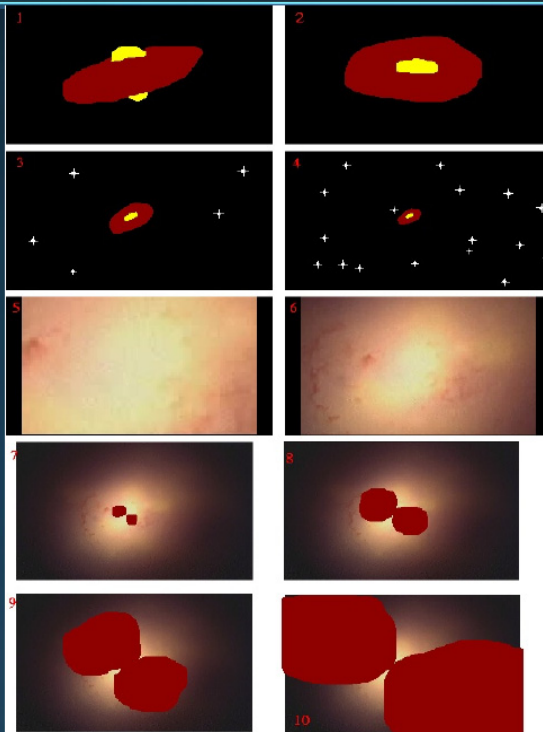


**MS 0735+561**  
*Supergiant Cavities*



# CHANDRA X-RAY OBSERVATORY

Challenge:  
A New Look

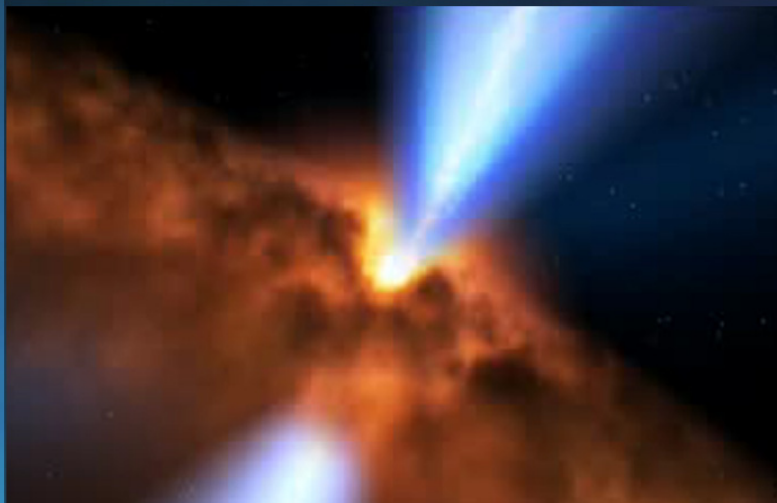


**MS 0735+561**  
*Supergiant Cavities*



# CHANDRA X-RAY OBSERVATORY

Challenge:  
A New Look  
-Dusty Disk



Dusty Disk Inspiration

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/supergiant\\_cavities/esa\\_lchristensen.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/supergiant_cavities/esa_lchristensen.mpg)

**MS 0735+561**  
*Supergiant Cavities*

Animation: ESA & Hubble ESA Information Centre  
(M. Kornmesser & L. L. Christensen)

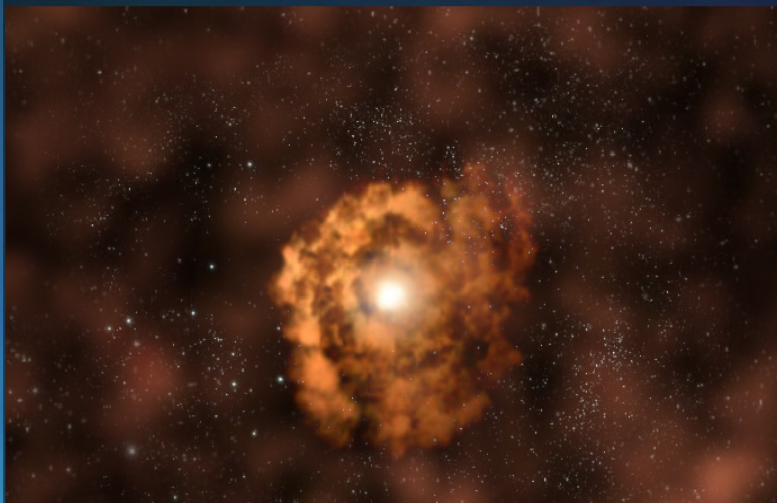


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# CHANDRA X-RAY OBSERVATORY

Challenge:  
A New Look  
-Dusty Disk  
-Better Angle



Supergiant Cavities: Early Version of Animation  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Supergiant\\_Cavities/early\\_angle.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Supergiant_Cavities/early_angle.mpg)

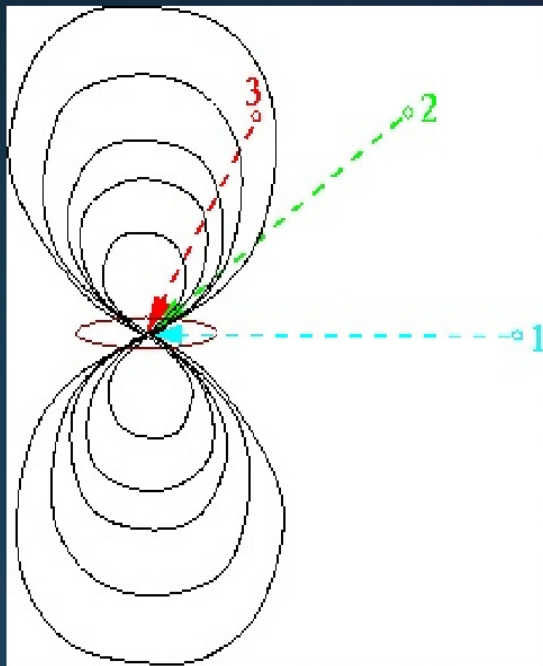
**MS 0735+561**  
*Supergiant Cavities*





# CHANDRA X-RAY OBSERVATORY

Challenge:  
A New Look  
-Dusty Disk  
-Better Angle



**MS 0735+561**  
*Supergiant Cavities*





# CHANDRA X-RAY OBSERVATORY

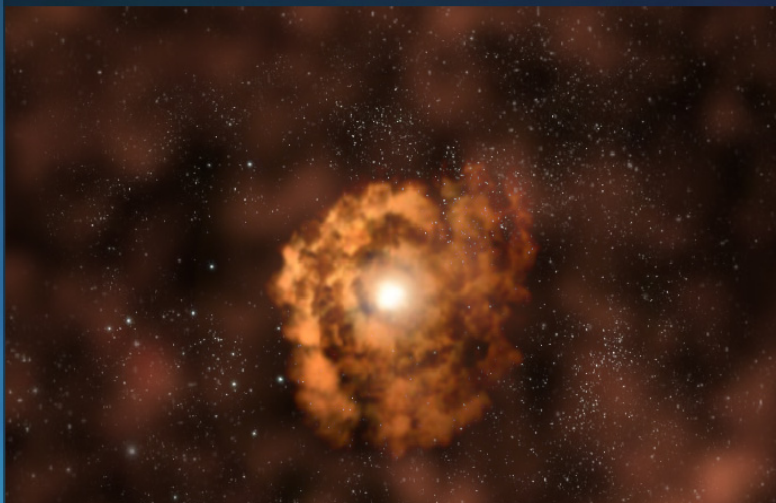
Challenge:

A New Look

-Dusty Disk

-Better Angle

-Improved Cavities



Supergiant Cavities: Final Animation

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Supergiant\\_Cavities/final\\_anim.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Supergiant_Cavities/final_anim.mpg)

**MS 0735+561**

*Supergiant Cavities*

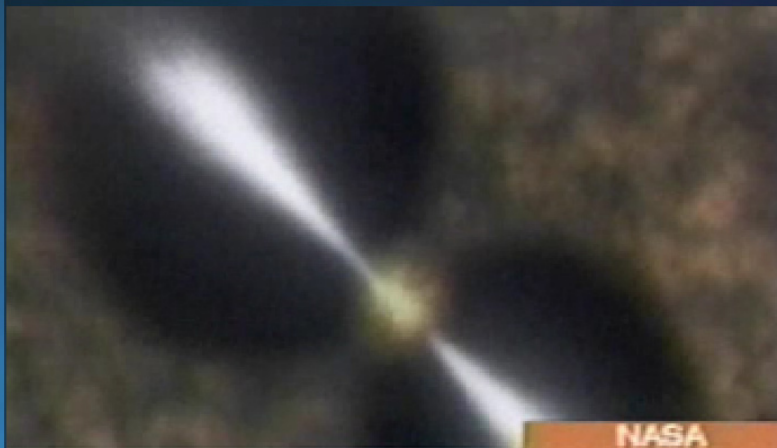


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# CHANDRA X-RAY OBSERVATORY

News Story



NASA

▶ Chandra X-Ray Observatory

KXAN 36  
NEWS 36

Supergiant Cavities: News Story

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Supergiant\\_Cavities/cavities\\_news.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Supergiant_Cavities/cavities_news.mpg)

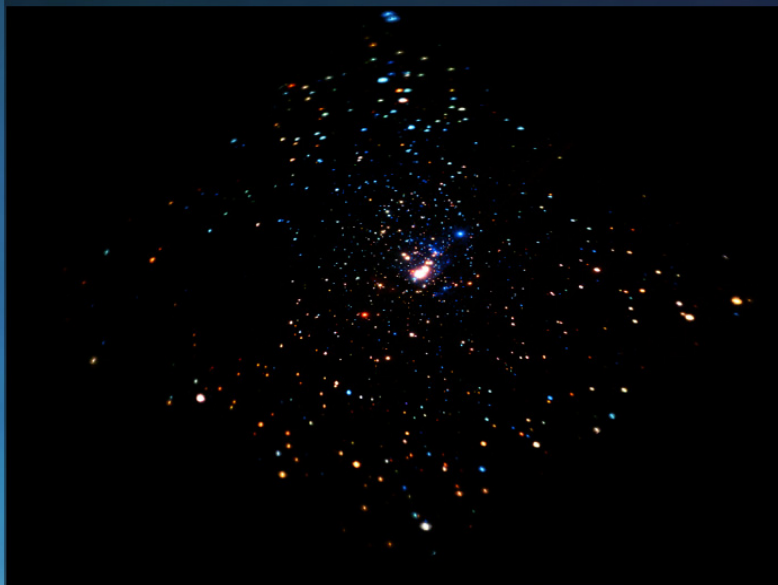
**MS 0735+561**  
*Supergiant Cavities*



SCIENCE IN MOTION



# CHANDRA X-RAY OBSERVATORY



*Orion*  
*Superflares*



# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources



Flares in Orion: X-ray Data Timelapse  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/data\\_timelapse.xpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/data_timelapse.xpg)

*Orion*  
Superflares

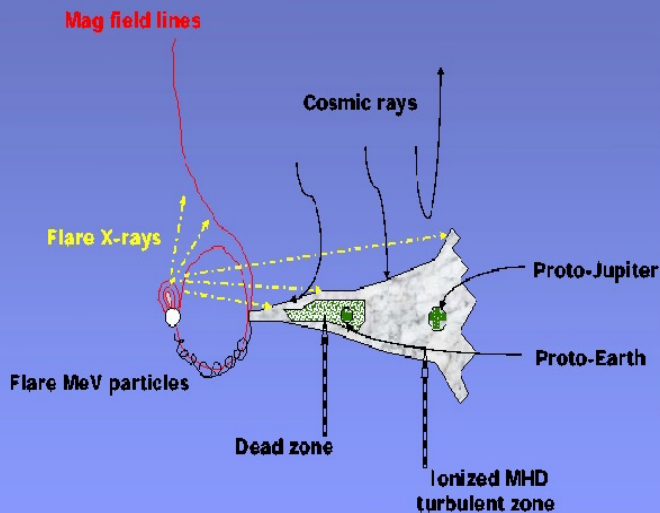


# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

## High energy processes & protoplanetary disks



*Orion*  
Superflares

Feigelson 2003, 2005a, 2005b

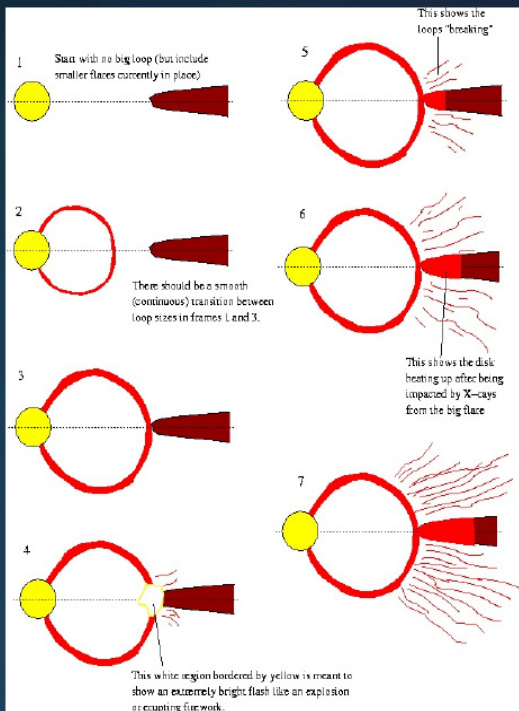


# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

Orion  
Superflares





# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources



More Dusty Disk Inspiration

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/hurt\\_dusty\\_disk.mp3](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/hurt_dusty_disk.mp3)

*Orion*  
Superflares

Animation credit: Robert Hurt (Spitzer)

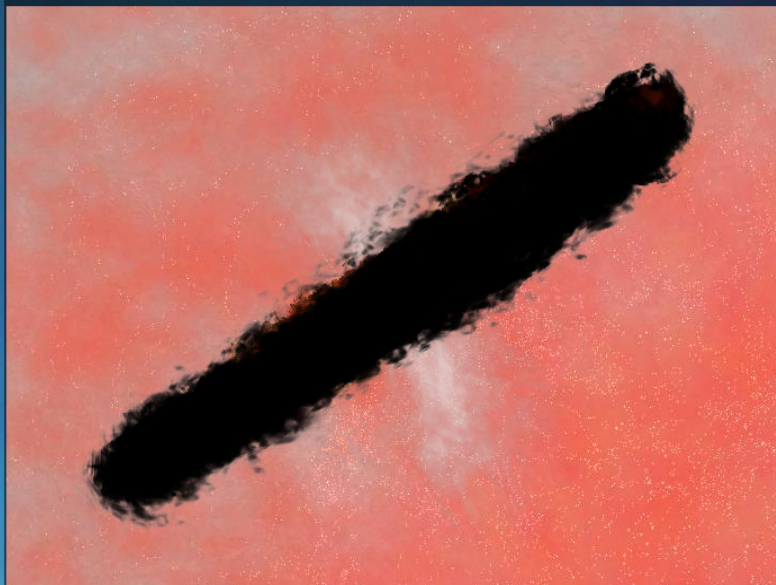


# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

*Orion*  
*Superflares*



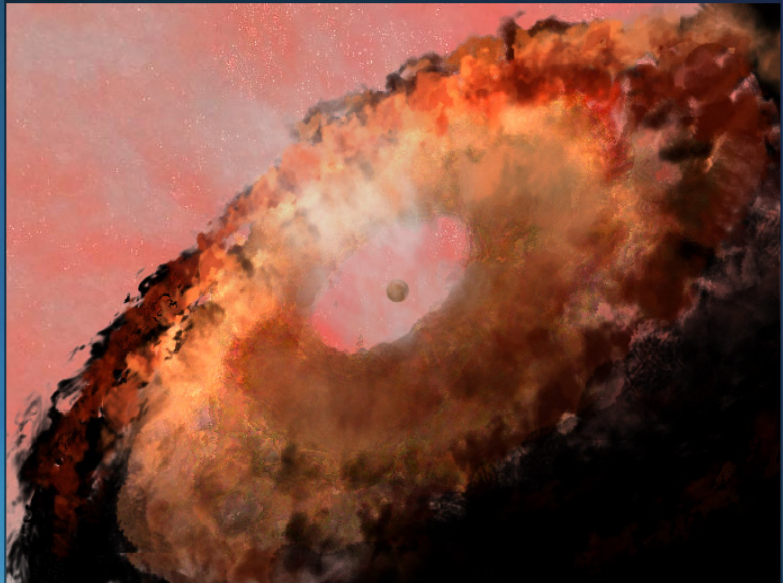


# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

*Orion*  
*Superflares*

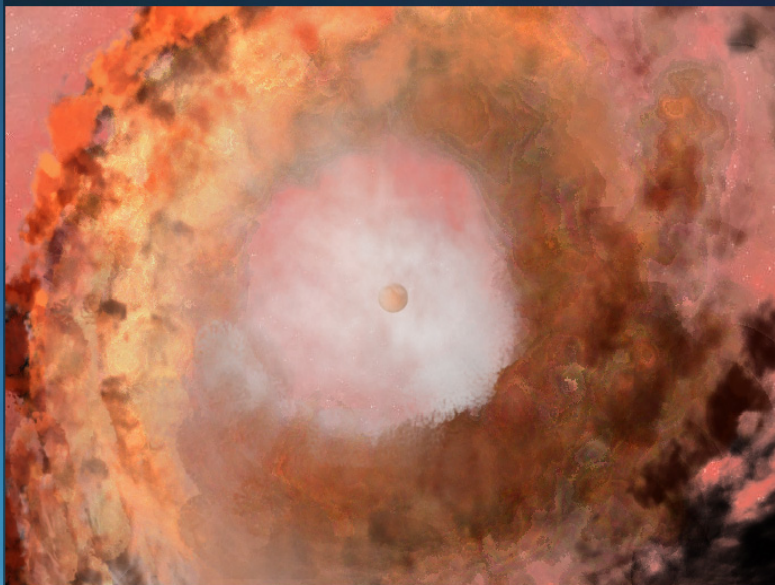


# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

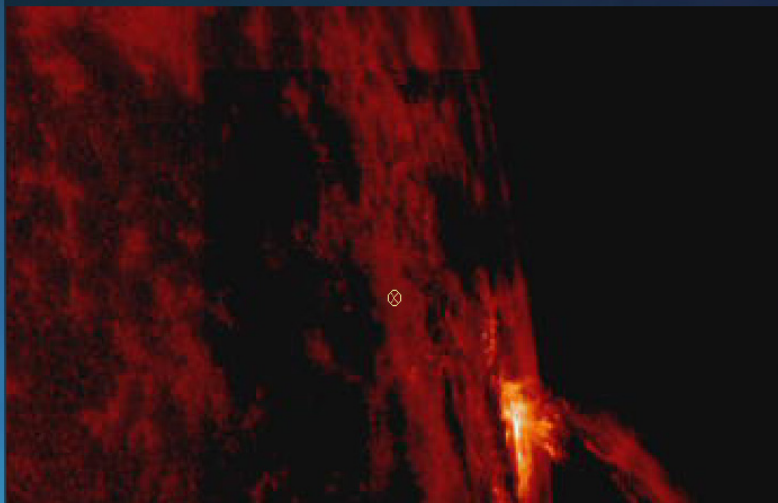
*Orion*  
*Superflares*



# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources



Real Flare Footage

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/flare\\_example1.mov](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/flare_example1.mov)

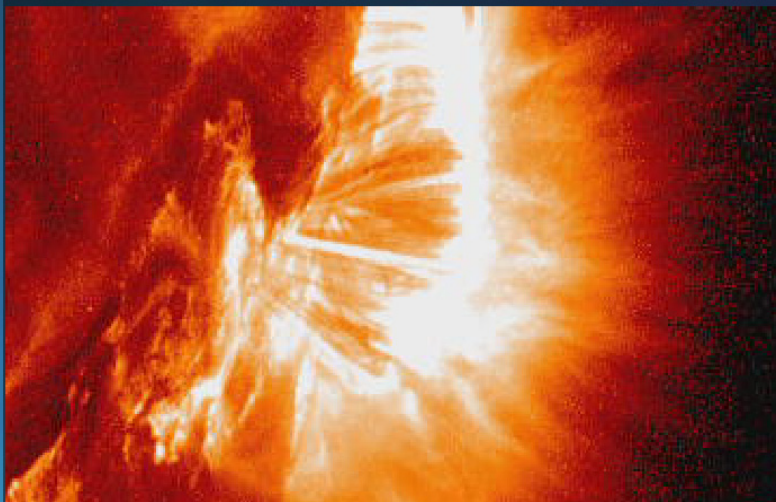
*Orion*  
Superflares



# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources



Real Flare Footage

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/flare\\_example2.mov](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/flare_example2.mov)

*Orion*  
Superflares



# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

*Orion*  
Superflares



Early Flare Test  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/early\\_flare.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/early_flare.mpg)



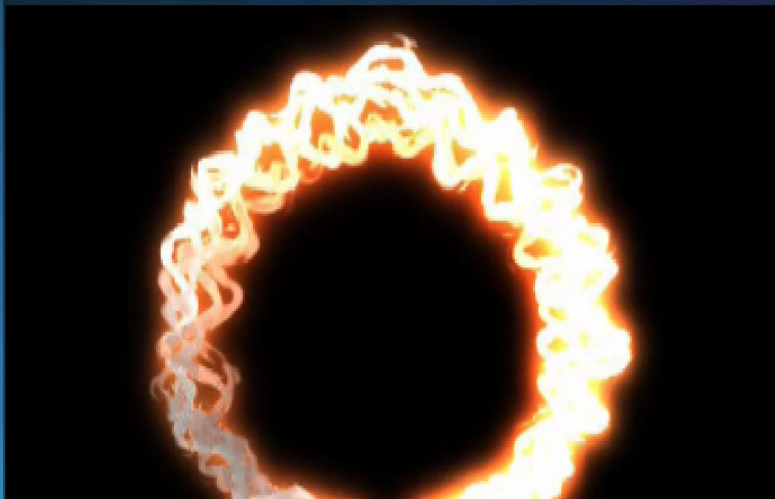


# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

*Orion*  
Superflares



Late Flare Test  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/final\\_flare.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/final_flare.mpg)



# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources



Flares in Orion: Early Version of Animation  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/early\\_flaretiming.upg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/early_flaretiming.upg)

*Orion*  
*Superflares*

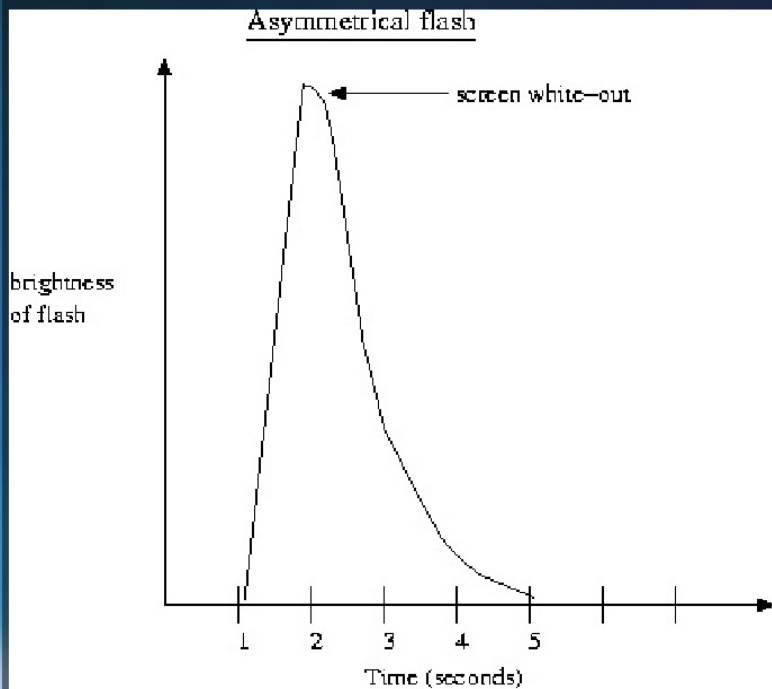


# CHANDRA X-RAY OBSERVATORY

Challenge:  
Many Renditions

Support:  
Many Resources

*Orion*  
Superflares





# CHANDRA X-RAY OBSERVATORY

Final Animation



Flares in Orion: Final Animation

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Orion/final\\_anim.tpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Orion/final_anim.tpg)

*Orion*  
*Superflares*



SCIENCE IN MOTION



# CHANDRA X-RAY OBSERVATORY

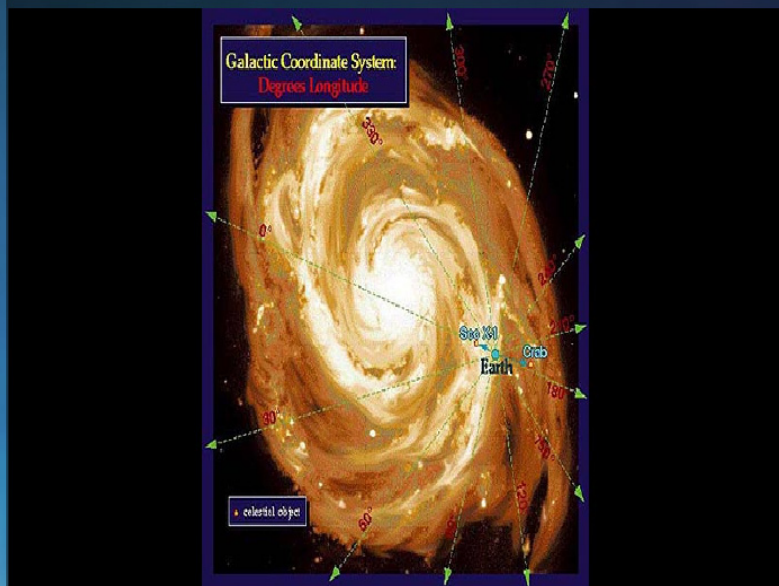
*Where is  
Chandra?  
Tour of the Milky  
Way in Perspective*



# CHANDRA X-RAY OBSERVATORY

Challenge:  
Where are we  
anyway?

*Where is  
Chandra?  
Tour of the Milky  
Way in Perspective*



# CHANDRA X-RAY OBSERVATORY

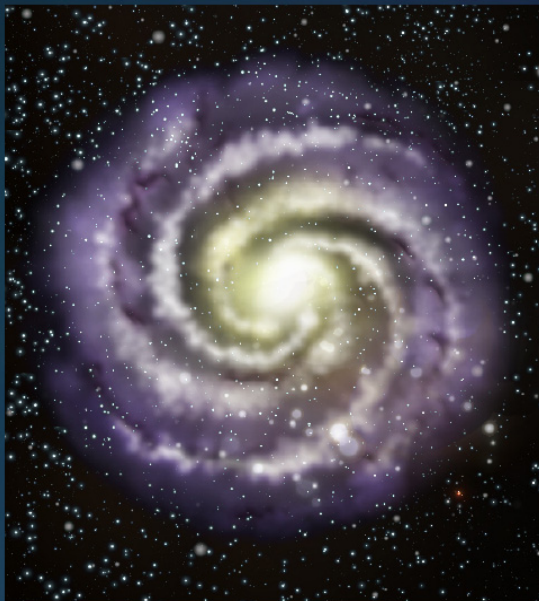
Challenge:  
Where are we  
anyway?

*Where is  
Chandra?  
Tour of the Milky  
Way in Perspective*



# CHANDRA X-RAY OBSERVATORY

Challenge:  
2D to 3D Galaxy

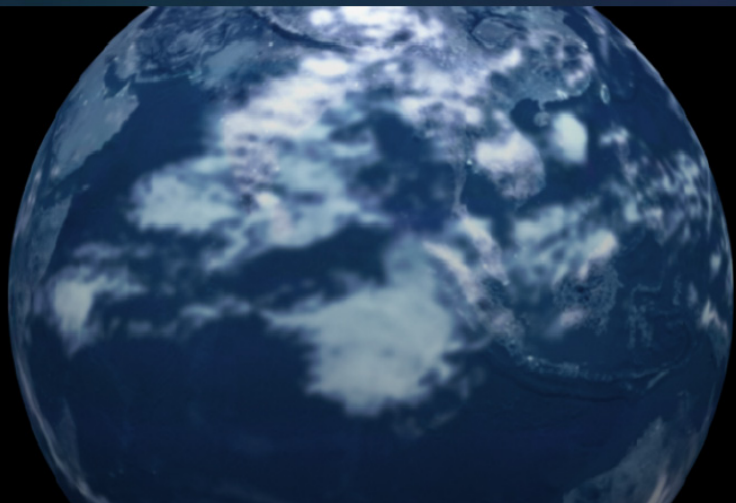


*Where is  
Chandra?  
Tour of the Milky  
Way in Perspective*



# CHANDRA X-RAY OBSERVATORY

Final Animation



*Where is  
Chandra?  
Tour of the Milky  
Way in Perspective*

Virtual Voyage of the Milky Way: Earth to Local Group of Galaxies

Full movie:

[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Milky\\_Way/earth2localgroup\\_lg\\_web.mpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Milky_Way/earth2localgroup_lg_web.mpg)



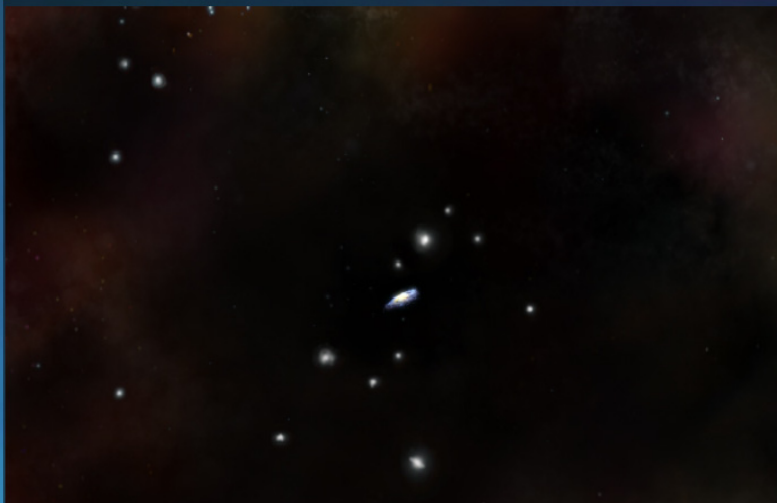
SCIENCE IN MOTION





# CHANDRA X-RAY OBSERVATORY

Final Animation



Virtual Voyage of the Milky Way: Local Group of Galaxies to Milky Way Center  
Full movie:  
[http://hea-www.harvard.edu/~cxcmmedia/science\\_in\\_motion/Milky\\_Way/localgroup2gctr\\_lg\\_web.tpg](http://hea-www.harvard.edu/~cxcmmedia/science_in_motion/Milky_Way/localgroup2gctr_lg_web.tpg)

*Where is  
Chandra?  
Tour of the Milky  
Way in Perspective*



SCIENCE IN MOTION

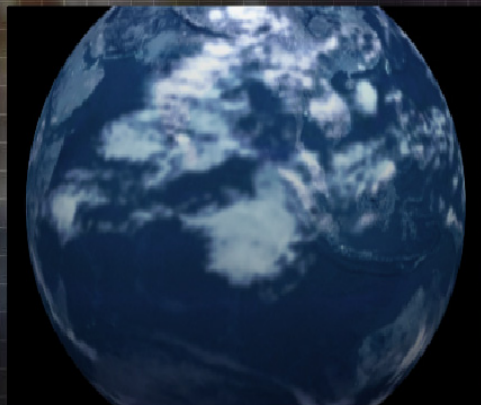


# CHANDRA X-RAY OBSERVATORY

Final Animation

*Where is  
Chandra?  
Tour of the Milky  
Way in Perspective*

## VIRTUAL TOUR OF THE MILKY WAY



Take a virtual voyage from Earth through the Milky Way galaxy to the outer reaches of the Local Group of galaxies.

MORE INFO

ENTIRE JOURNEY TO EARTH

ENTIRE JOURNEY FROM EARTH

?

CLOSE

# CHANDRA X-RAY OBSERVATORY



*Thank you!*

