

NASA's flagship mission for X-ray astronomy.



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JKCS041: Galaxy Cluster Smashes Distance Record



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- The most distant galaxy cluster yet has been discovered using Chandra and optical and infrared telescopes.
- At some 10.2 billion light years away, the galaxy cluster is seen when the Universe was only one quarter of its current age.
- This object, known as JKCS041, may help scientists better understand how the Universe developed at this crucial stage.

This is a composite image of the most distant galaxy cluster yet detected. This image contains X-rays from NASA's Chandra X-ray Observatory, optical data from the Very Large Telescope (VLT) and optical and infrared data from the Digitized Sky Survey. This record-breaking object, known as JKCS041, is observed as it was when the Universe was just one quarter of its [current age](#). X-rays from Chandra are displayed here as the diffuse blue region, while the individual galaxies in the cluster are seen in white in the VLT's optical data, embedded in the X-ray emission.

JKCS041 was originally detected in 2006 with infrared observations from the United Kingdom Infrared Telescope (UKIRT). The distance to the cluster was then determined from optical and infrared observations from UKIRT, the Canada-France-Hawaii telescope in Hawaii and NASA's Spitzer Space Telescope. However, scientists were not sure if it was a true [galaxy cluster](#), rather than one that has been caught in the act of forming. The shape and extent of the X-ray emission in the Chandra data, however, provided the definitive evidence that showed that JKCS041 was, indeed, a galaxy cluster. The Chandra data also allowed scientists to rule out other possible explanations for the data, including a group of galaxies, or a filament of galaxies seen along the line of sight.

Galaxy clusters are the largest gravitationally-bound objects in the Universe. Scientists have calculated when they should start assembling in the early Universe, and JKCS041, at a distance of some 10.2 billion light years, is on the early edge of that epoch. Follow-on observations of JKCS041 will provide scientists with an opportunity to find important information about how the [Universe evolved](#) at this crucial stage.

Fast Facts for JKCS041:	
Credit	X-ray: NASA/CXC/INAF/S.Andreon et al Optical: DSS; ESO/VLT
Release Date	October 22, 2009
Scale	Image is 370 arcsec across
Category	Groups & Clusters of Galaxies
Coordinates (J2000)	RA 02h 26m 44s Dec -04° 41' 45"
Constellation	Cetus
Observation Date	11/23/2007
Observation Time	20 hours and 50 minutes
Obs. ID	9368
Instrument	ACIS
References	S.Andreon, et al., 2009, A&A, accepted
Color Code	X-ray (blue); Optical (Red, Green, Cyan)
<div><div></div><div></div></div>	
Distance Estimate	About 10.2 billion light years
<div></div>	



It looks to me like individual galaxies in the cluster and the cluster as a whole are gravitationally lensing objects farther away making rings around the galaxies and a large ring around the cluster defined by the xray image.

Posted by Richard L Blake on Friday, 11.27.09 @ 23:22pm

Dear Harry,

Thanks for your question. This image contains a mixture of objects: some foreground stars (in our galaxy), some foreground galaxies like the obvious spirals in the lower right part of the image and, of course, objects in the galaxy cluster itself. There also may be objects that are more distant than the galaxy cluster. The X-ray sources are mostly active galactic nuclei, or rapidly growing supermassive black holes.

CXC

Posted by CXC on Tuesday, 11.3.09 @ 11:41am

Dear Mark,

Thanks for your question. Please see:

http://chandra.harvard.edu/xray_sources/galaxy_clusters.html

for an explanation of why the gas in galaxy clusters is so hot and

<http://chandra.harvard.edu/photo/2003/perseus/>

<http://chandra.harvard.edu/photo/2008/m84/>

for an explanation of how the gas stays hot.

CXC

Posted by CXC on Tuesday, 11.3.09 @ 11:38am

Is every object visible in the photograph an individual galaxy, or are there some Milky Way objects that are in the way, between us and the cluster? For example, are the optically visible objects near-field while the x-ray objects, are they galaxies? Some objects appear in both, but most are in one or the other. I'm confused.

Posted by Harry on Thursday, 10.29.09 @ 11:02am

Why is the gas in this and other galaxy clusters so hot? What is the source's for keeping such large amounts of gas at such high temperatures?

Posted by Mark on Wednesday, 10.28.09 @ 14:49pm

Dear Roberto,

Thanks for your question. Dark matter should dominate the mass and gravity of this cluster and would have been a critical factor in the formation of this object.

P. Edmonds, CXC

Posted by P. Edmonds on Wednesday, 10.28.09 @ 08:47am

Thanks Tom - we've fixed this error. It was meant to be 370 arcsec!

P. Edmonds, CXC

Posted by P. Edmonds on Tuesday, 10.27.09 @ 13:37pm

Dear Carl,

There is a good chance there are other planets like Earth in the galaxy cluster, but it's much too far away to travel there.

P. Edmonds, CXC

Posted by P. Edmonds on Tuesday, 10.27.09 @ 13:35pm

Dear Navaneeth,

The redshift -or distance- of the galaxy cluster was estimated using several different methods, including a study of how the observed colors of galaxies depends on the distance to the galaxies. Full details are in the paper at

<http://lanl.arxiv.org/abs/0812.1699> including a discussion of the measurement errors.

P. Edmonds, CXC

Posted by P. Edmonds on Tuesday, 10.27.09 @ 13:28pm

Thanks Elizabeth - we've done that.

P. Edmonds, CXC

Posted by P. Edmonds on Tuesday, 10.27.09 @ 13:25pm

Thanks Alan - we have now posted the redshift of 1.9. Note that the final version of the paper is available at <http://lanl.arxiv.org/abs/0812.1699>

P. Edmonds, CXC

Posted by P. Edmonds on Tuesday, 10.27.09 @ 13:15pm

Thanks Mark for your comment. I don't have any extra information about that possible feature. One's eye can be easily fooled because random distributions of stars or galaxies often produce features that don't look random.

P. Edmonds, CXC

Posted by P. Edmonds on Tuesday, 10.27.09 @ 13:10pm

Chandra did it, every day we know more about the universe, it is enormous. How gravity function on the cluster due to the dark matter?

Posted by Roberto Gonzalez Davisonn on Monday, 10.26.09 @ 16:30pm

Congratulations on an excellent discovery.
I have a question.
Do you have any further information concerning the string a galaxies that seem to be forming a neat curve?
Best wishes

Posted by Mark Ballingotn on Monday, 10.26.09 @ 10:49am

As always, the astronomers at Chandra continue to provide and astonish the community with its discoveries. Providing data to better understand the creation of the universe and all her wonders.
Cheers to all at Chandra
Heidi-Ann Kennedy
Scientific Frontline

Posted by Heidi-Ann Kennedy on Sunday, 10.25.09 @ 11:02am

Sir, my congratulations on this discovery. I hope future observations will reveal more details that will help us in understanding the evolution of the universe. With best wishes

AK Sharma

Posted by AK Sharma on Sunday, 10.25.09 @ 08:55am

Scale 370 arcmin? Isn't that 6 degrees? At 10 billion light years away that would make the image 1 billion light years across. Does that seem right?

Posted by Tom on Sunday, 10.25.09 @ 08:34am

Exquisite use of a most valuable piece of equipment. Thank you for the picture and my appreciation goes out to all the team members that put their time and talents into all the research they are doing.

My fascination of the universe only grows with each and every discovery that you make. Thank you again for helping the apes continue their trek out of the tree.

Regards
Dan Pitney

Posted by Daniel R Pitney on Sunday, 10.25.09 @ 01:07am

It is very very beautiful.

Posted by Valter Rodrigues on Friday, 10.23.09 @ 07:34am

Do you think there is any other planet like earth around there, where we can live in future?

Posted by Carl Vertuin on Friday, 10.23.09 @ 02:05am

Good News. Very interesting to hear this story.
How can we measure the distance of these galaxy clusters? How much accuracy is there?

Posted by Navaneeth Krishnan S on Friday, 10.23.09 @ 00:53am

It would be nice to include the redshift of the cluster.

Posted by Elizabeth P Bozian on Thursday, 10.22.09 @ 20:58pm

Today's technology is astounding the distance of this object and the fact we can see it at all is mind numbing, but extremely exciting as well.

Posted by David Stalker on Thursday, 10.22.09 @ 19:54pm

Very nice. It's mind-boggling to think that the light for this image had already been traveling for 6 billion years before the earth formed.

Posted by David Guidos on Thursday, 10.22.09 @ 18:16pm

Ahh, to be out there somewhere on the Voyager under the command of Captain Janeway. One can only imagine what beauty lies yonder. These fantastic images keep fueling the imagination. Cheers Peter

Posted by Peter on Thursday, 10.22.09 @ 16:14pm

So what's it's redshift? If the story is that it sets a redshift record tell the redshift. That's why to put out a press release so we don't have to phone to get the basics.

P. S. The distance cited is by the look-back time and maybe should be identified as such. This is only one version of the distance of a high-redshift object, though it's the most commonly used.

Posted by Alan MacRobert on Thursday, 10.22.09 @ 12:23pm

The Basics

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In the constellation Cetus (northern hemisphere)

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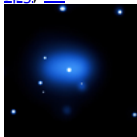
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