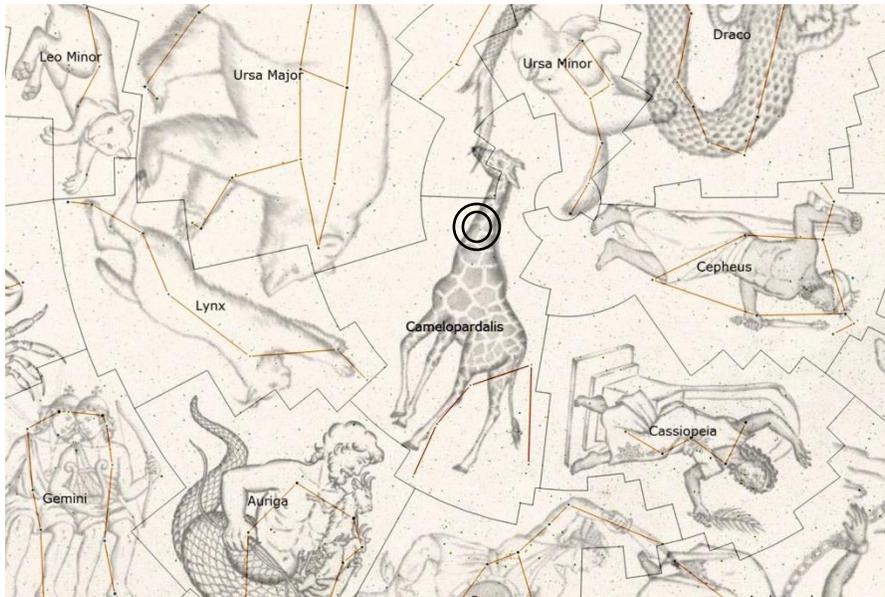


A Brand New Meteor Shower!

On May 24, 2014, the Earth will travel through debris ejected from comet 209P/LINEAR in the 18th, 19th, and 20th centuries. If the comet was actively producing a lot of dust during that time, the Earth may be treated to a new meteor shower, tentatively named the May Camelopardalids.



The May Camelopardalid radiant is in the constellation Camelopardalis, which translates to “camel leopard” or giraffe. Credit: NASA/MEO/D. Moser using Starry Night Pro.

Models, Timing, and Visibility – oh my!

This is a new shower, so scientists aren’t quite sure what, if anything, observers will see on May 24. NASA scientists at Marshall Space Flight Center expect the shower to be active between 02:30 and 11:00 UTC on May 24 (that’s 9:30 pm on May 23 to 6:00 am on May 24 CDT), and to peak between 06:00 and 08:00 UTC on May 24 (1:00 am to 3:00 am CDT).

Modeling has been done by several meteor shower experts, with similar results.

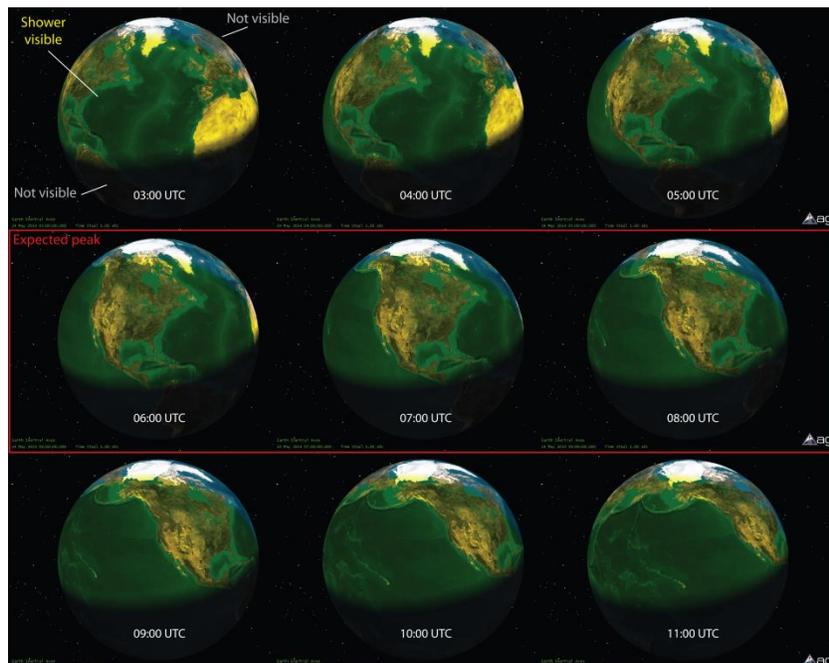
Model (stream ejection year)	Time on May 24 (UTC)	ZHR (# meteors/hr)
Lyytinen & Jenniskens (1929)	3:19	
Lyytinen & Jenniskens (1979)	6:04	
Moser & Cooke (multiple, max)	6:11	200
Ye & Wiegert (multiple, max)	6:29	200 storm unlikely
Lyytinen & Jenniskens (1818, 1853)	6:33	
Moser & Cooke (multiple, curvefit)	6:43	
Moser & Cooke (multiple, peak 2)	6:56	
Lyytinen & Jenniskens (1903, max)	6:59	

Lyytinen & Jenniskens (1909)	7:15	
Maslov (1898-1919; 1903)	7:18	200-300
Maslov (max)	7:21	100
Vaubailion (multiple)	7:40	100-400
Lyytinen & Jenniskens (1914)	7:49	
Maslov (1763-1783)	7:55	50-150
MSFC (multiple, peak 3)	8:10	

Each model points to a potential shower peaking between 1 and 3 am CDT on May 24. Nobody can quite agree on how many meteors are expected, but a rate of 200 meteors per hour during the peak may be possible.

There are a lot of modeling difficulties at play here. This shower hasn't been seen before, so models can't be calibrated. We don't know how well the model describes the shower timing, or critically, the rate. And despite model "post-predictions" of activity in the past, few historical observations matching this shower have been found. Add to this uncertainties about how active the comet was in the past, and you come up with a lot of question marks. The good news is that we are reasonably sure of the timing; if there is going to be a meteor shower or outburst, it will occur in the early hours of May 24, before sunrise.

North America is well placed for observing the May Camelopardalids. Due to the position of the radiant, observations are best from the northwestern United States and southern Canada. Check out the map below to see if you can see the May Camelopardalids from your location. The graphic is a time sequence, starting at 03:00 UTC on May 24 and ending at 11:00 on May 24. Yellow shading indicates where the shower is visible at each particular time. The red box denotes when the shower is expected to peak.



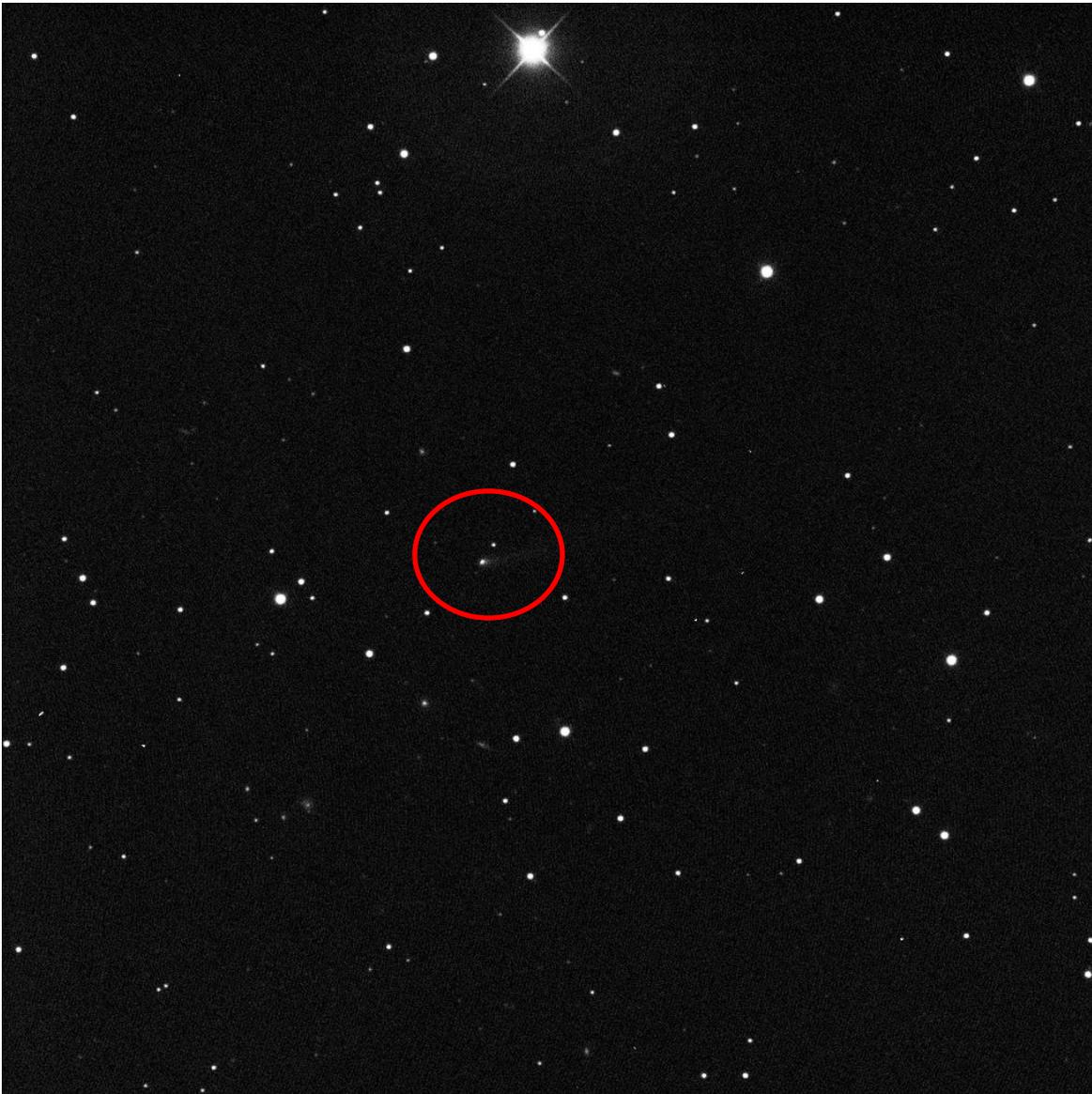
Visibility map for the May Camelopardalids from 03:00 UTC to 11:00 UTC on May 24. Yellow shading indicates places that will be able to see the meteor shower. The red box calls out the geometry during the expected shower peak between 06:00 and 08:00 UTC on May 24. NASA/MEO/D. Moser using STK.

Here's the Comet 4-11

Comet 209P/LINEAR is a Jupiter-family comet discovered by the Lincoln Laboratory Near-Earth Asteroid Research (LINEAR) project in 2004. While orbiting, the closest it comes to the Sun is 0.9 AU (84 million miles) and the farthest it gets from the Sun is about 5 AU (465 million miles), close to Jupiter's orbit. This year, 209P will have a close approach to Earth on May 29. It will come within a distance of 0.04 AU of our planet. That's about 3.7 million miles – a pretty close shave in cosmic terms. But no worries, there's no chance it will hit us.

Recent data shows that 209P is not very active, meaning it's not releasing much gas or dust. But there is no data that can tell us how active 209P was in the 18th and 19th centuries, when we think the up-coming intersecting debris trails were created. If the comet wasn't very active back then, we may not even have a meteor shower on May 24. But if it was, we could be in for a treat.

Any data we collect about the May Camelopardalids this year will shed some light on how much dust 209P produced in the past. So even no data is good data, as they say.



Comet 209P/LINEAR on May 15, 2014. Even though the comet will travel close to Earth, you won't be able to see it with the naked eye. NASA/MEO/A. Kingery

What do I need to know?

Along with the cheat sheet below, here are some “take aways”.

- On May 24, 2014 Earth will encounter multiple streams of debris ejected from comet 209P/LINEAR.
- This will likely produce a new meteor shower, never before seen.
- Rates are predicted to be from zero to hundreds of meteors per hour between 1 and 3 am CDT, so we are dealing with a meteor outburst. A peak rate of ~200 meteors per hour is the current best estimate.
- It’s difficult to calibrate meteor shower models of the May Camelopardalids due to lack of past observations of the shower and comet. Comet activity is low now, but past activity is unknown.

	<i>May Camelopardalid Cheat Sheet</i>
○	Tentative shower name: May Camelopardalids Parent comet: 209P/LINEAR Predicted activity: May 24, 02:30 – 11:00 UTC (May 23 9:30 pm – May 24 6:00 am CDT) Predicted peak: May 24, 06:00 – 08:00 UTC (May 24, 1:00 am – 3:00 am CDT) Predicted peak rate: 200 meteors/hr (under ideal conditions) Predicted radiant: $\alpha = 125^\circ$, $\delta = +79^\circ$ (near Lynx, Ursa Major, Camelopardalis) Predicted speed: $V_{\text{geo}} = 16 \text{ km/s}$ ($V_{\text{geo}} = 36,000 \text{ mph}$) Particle sizes: dust grains to mm-sized
○	Particles ejected from parent: During comet orbits in the 1700s-1900s Observable: North America, best from N.W. United States and S. Canada

How can I enjoy the show?

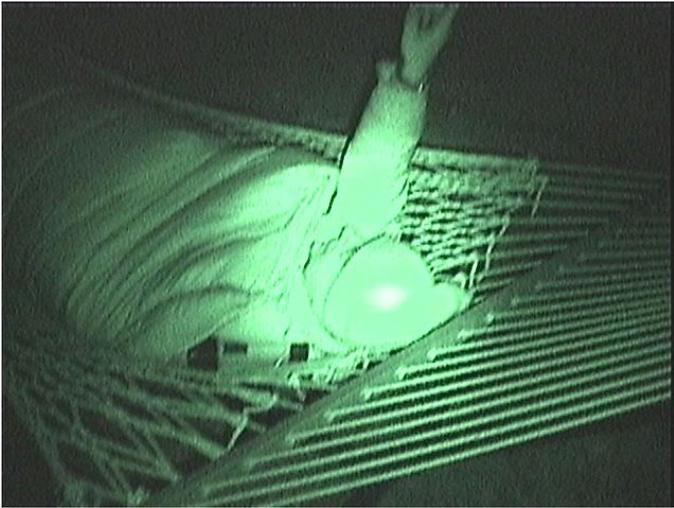
North America has a pretty good seat for this cosmic event. First, check the visibility map to make sure it’s visible from your location. Then check the weather – if you are expecting clouds, then Mother Nature has just rained on your parade, you won’t be able to see any meteors. If the weather gods are smiling down upon you, find a safe, dark location and lay out beneath the stars. You don’t need to look in any particular direction, just straight up. Meteors can appear all over the sky. Add a lawn chair or sleeping bag and snacks and you should be set!

If you’re stuck with bad weather, check out this page

<http://www.nasa.gov/topics/solarsystem/features/watchtheskies/may-camelopardalids.html>

NASA will be live streaming the meteor shower from Huntsville, Ala. the night of the peak. Meteor expert Dr. Bill Cooke will be on hand to answer your May Camelopardalid questions between 10 pm and 2 am CDT, May 23-24.

NASA also posts images and videos of meteors each day at <http://fireballs.ndc.nasa.gov>. These meteors are observed by the NASA All Sky Fireball Network and analyzed by Dr. Cooke and his team.



Meteor shower observing from a hammock.

What's NASA's interest in this?

Meteor scientists all over the world are mobilizing to gather data on the May Camelopardalids. NASA will be observing this meteor shower very carefully using multiple techniques, including making observations with various meteor cameras and meteor radar. Observations will help calibrate meteor shower forecasts used by satellite operators and the data will also tell us something about how active comet 209P was in the past.

Gettin' Schooled -- Meteor Astronomy Terms

Meteor astronomy is often filled with confusing terms. Here are a few you'll want to know.

METEOROID: Small chunks of rock and ice out in space left behind by comets and asteroids. Meteoroids are smaller than asteroids.

METEOR: Streaks of light that you see as a meteoroid ablates, or burns up, in the atmosphere. Meteors are commonly called 'shooting stars' or a 'falling stars'.

METEORITES: What is left of the meteoroid if it survives the trip through the atmosphere and hits the ground.

RADIANT: The point in the sky from which the meteors *appear* to originate. All meteors associated with a particular shower have similar orbits, and they all appear to come from the same place in the sky.

METEOR SHOWER: Many meteors with similar orbits and speeds, observed during specific times of year, associated with a particular comet or asteroid. Meteor showers are caused when Earth runs into a stream of debris left behind by a comet or asteroid.

Frequently Asked Questions (Read 'em!)

Q: *How do you pronounce the name of this meteor shower?*

A: Ask a different person and you'll get a different answer! Common pronunciations are camel-oh-PAR-dahl-idz, kah-MEL-oh-PAR-dal-idz, and camel-oh-par-DAL-idz. It it's too much of a tongue twister, you are camelopardon-ed. :-)

Q: Why does this shower have such a funny name?

A: Meteor showers are named after the location of their radiant – or the point in the sky from which the meteors appear to originate. This shower is expected to produce meteors in May with a radiant in the constellation Camelopardalis.

Q: Can I see the May Camelopardalids from my location in _____?

A: Check out the visibility map above. If your location is in the yellow zone, and you have clear dark skies, you should be able to see May Camelopardalids during the expected peak, if it occurs.

Q: When can I see May Camelopardalids?

The expected peak is between 1 and 3 am CDT on May 24.

Q: Where is the May Camelopardalid radiant?

A: The radiant is in the constellation Camelopardalis. It's not a well-known constellation, but you can find the general direction if you look between Ursa Major and Cassiopeia.

Q: Should I look at the radiant to see May Camelopardalids?

A: Nope!

Q: Ok, where should I look then, smarty-pants?

A: If it's not cloudy, get as far away from bright lights as you can, lie on your back, and look up. You should be able to see May Camelopardalids over the whole sky.

Q: How do I know if the meteor I just saw is a May Camelopardalid?

A: If you see a meteor, try to trace it's path backwards. If you end up in the constellation Camelopardalis, there's a good chance you've seen a May Camelopardalid!

Q: My skies are dark and cloud-free but I'm still not seeing any meteors! Why not?!

A: There are a couple of possibilities. (1) The comet wasn't very active 200+ years ago, and therefore didn't produce many meteoroids. So the meteor shower is much weaker than predicted. (2) You need to have patience. You also need to make sure your eyes are adapted to the dark – this takes about 45 minutes. Make sure you don't keep looking at your phone or other sources of light, else your eyes will have to start the dark adaptation process all over again.

Q: Has a satellite ever been hit by a meteoroid?

A: Yes. Here are a few examples: Mariner IV, a NASA planetary exploration spacecraft encountered a meteoroid stream between the orbits of Earth and Mars in Sept 1967. The encounter damaged the thermal shield. Olympus, an ESA communication satellite, was struck by a Perseid near the time of the shower peak in August 1993. It was sent tumbling and exhausted its fuel supply.

Q: How big are May Camelopardalid meteoroids?

A: These meteoroids are expected to be anywhere from dust-grain sized to millimeter sized.

Q: How can a small bit of rock damage a satellite?

A: Meteoroids travel very fast and therefore have a lot of energy. The May Camelopardalids will be traveling slowly, as far as meteors go, but they will still be moving at 36,000 mph! That's about 27 times faster than the Concorde jet!