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 - high-current electric discharges in various fusion devices (tokamaks, including the dust deposits in tokamaks; Z-pinches, plasma foci; laser-produced plasmas),
 - **severe weather phenomena (tornado, hailstones, lightning-born long-lived luminous objects),**
 - space (supernova remnants and some galaxies of similar form, “colliding galaxies”, etc.);

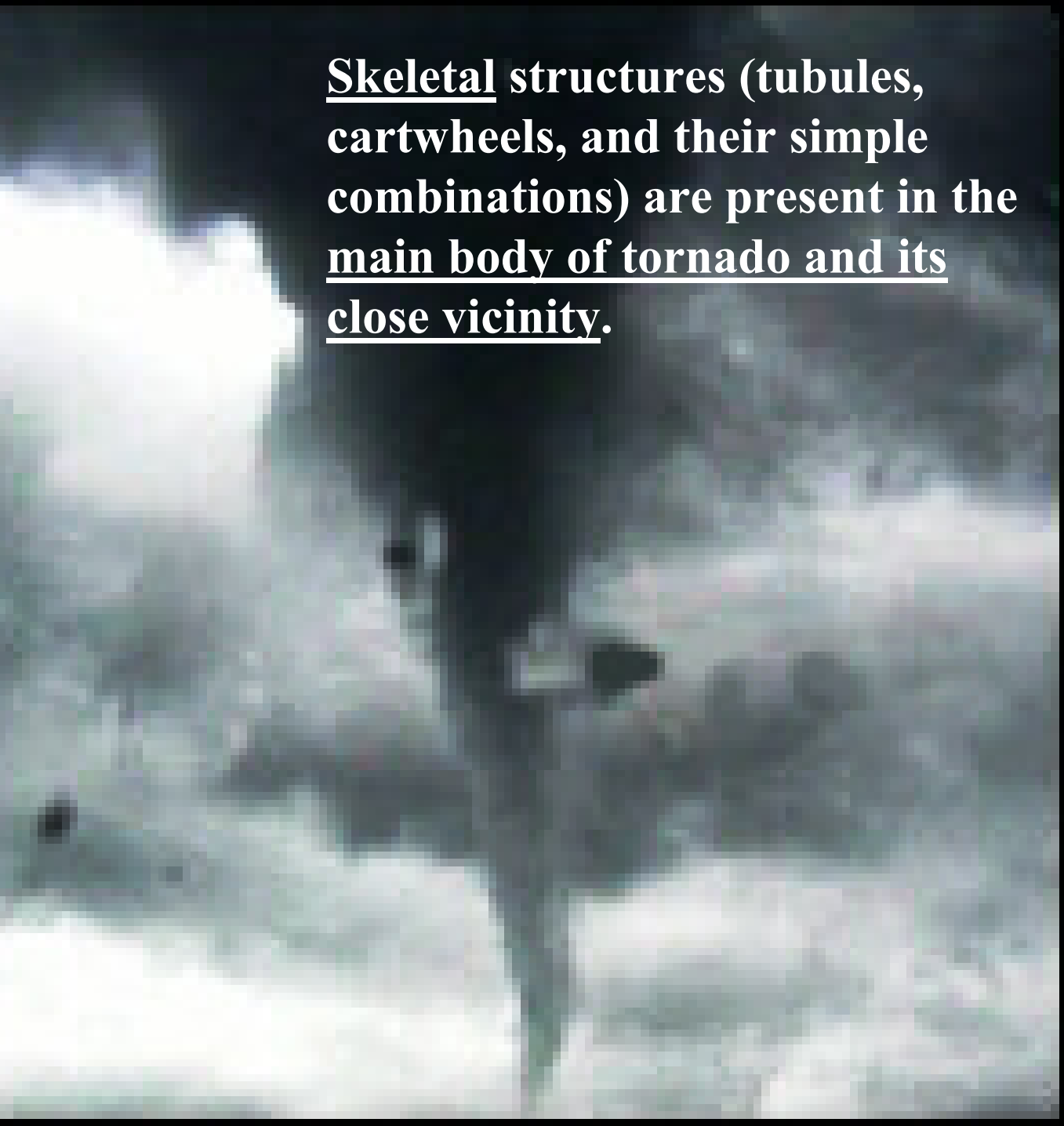
What is surprising (and resolvable without any processing of images)

1. Tornado funnel possesses a distinct large horizontal branch.

2. A horizontal structure (to the right from tornado funnel) has a coaxial structure.

3. Dark spots to the left from funnel are the central points of similar tubular formations.

Skeletal structures (tubules, cartwheels, and their simple combinations) are present in the main body of tornado and its close vicinity.





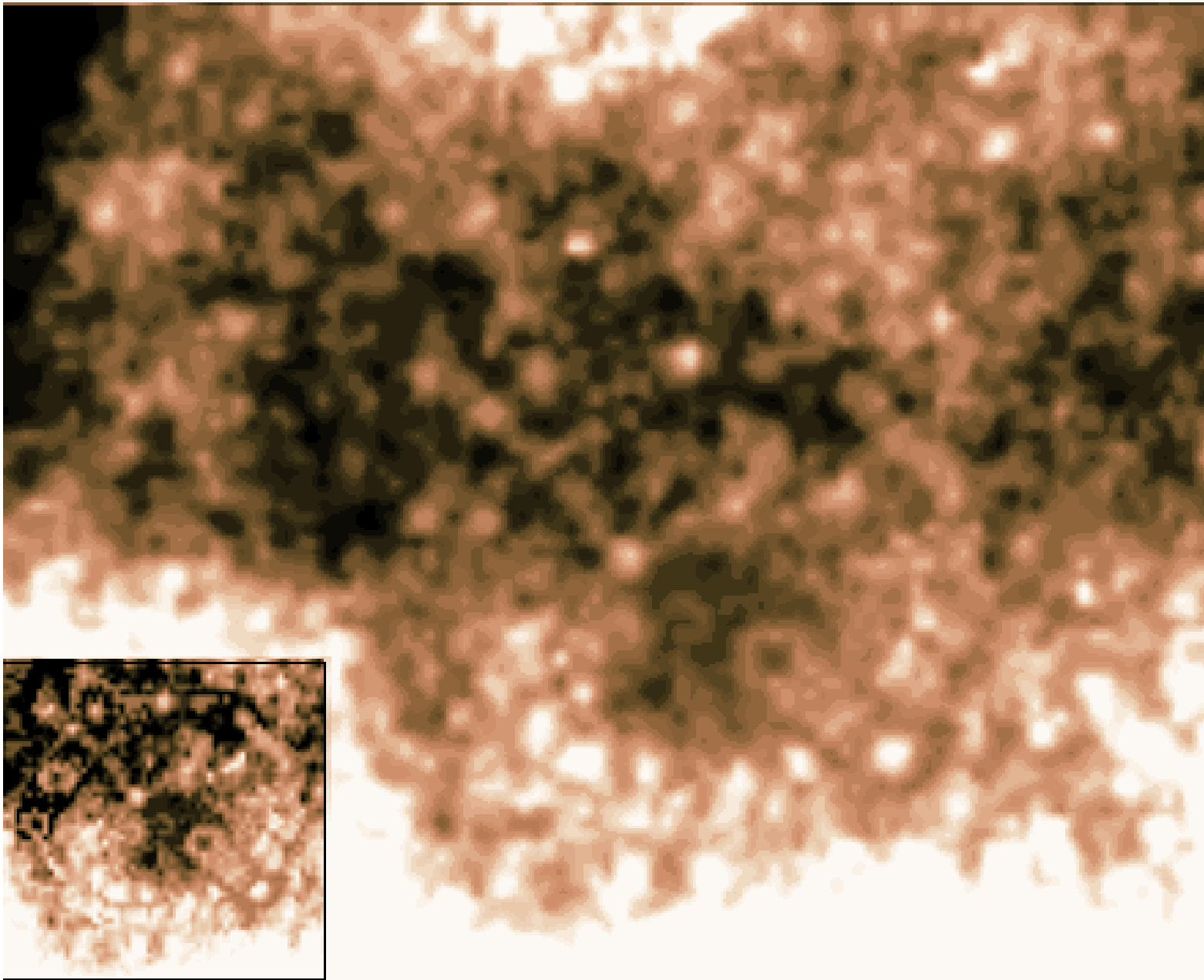
General view:

photographic image of a massive tornado of estimated size of **some hundred meters** in diameter.

Insert:

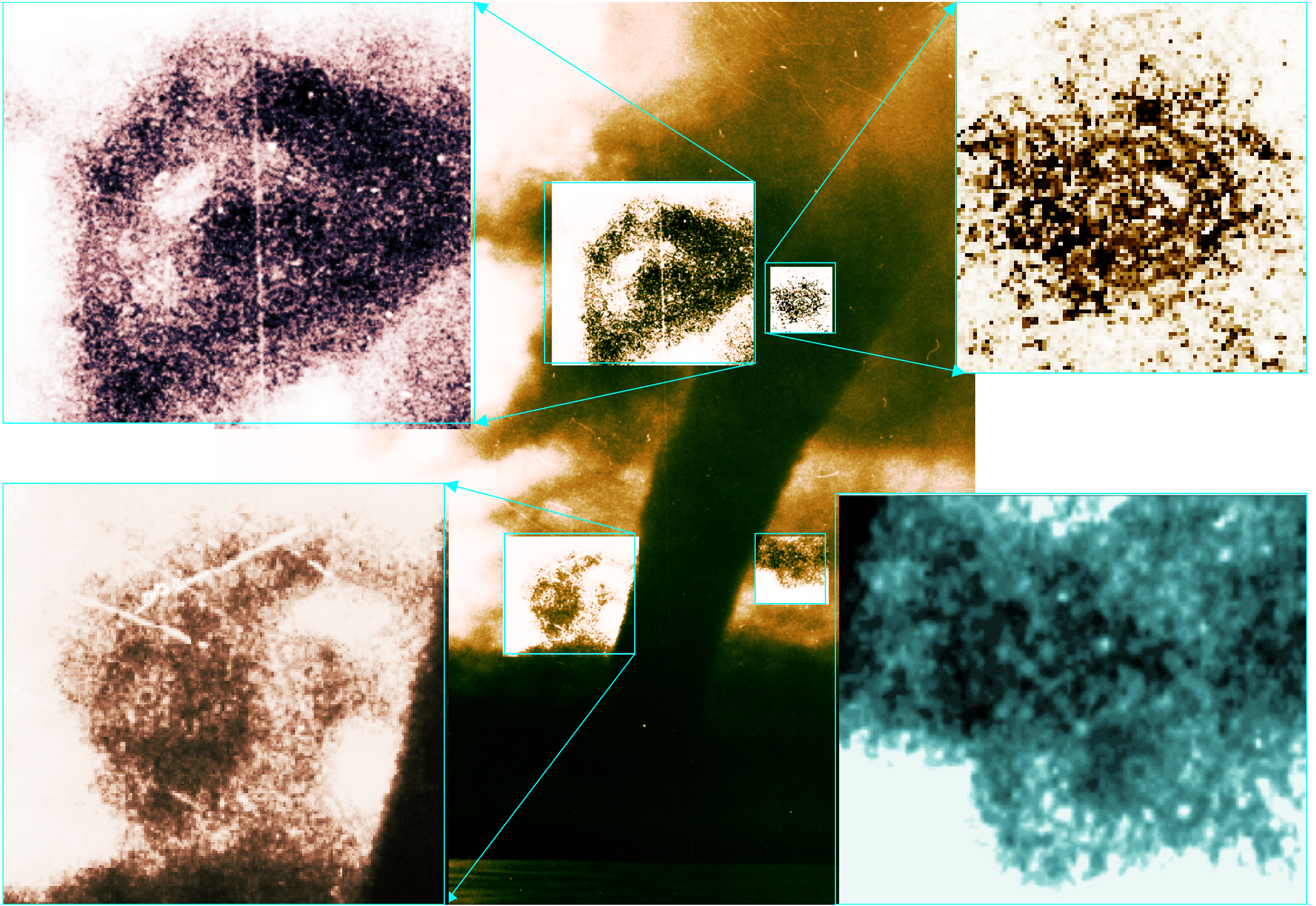
A fragment which shows the cartwheel whose slightly elliptic image is seen in the centre. The cartwheel seems to be located on a long axle-tree directed down to the right and ended with a bright spot on the axle's edge (see its additionally contrasted image in the left corner insert on the bottom image).

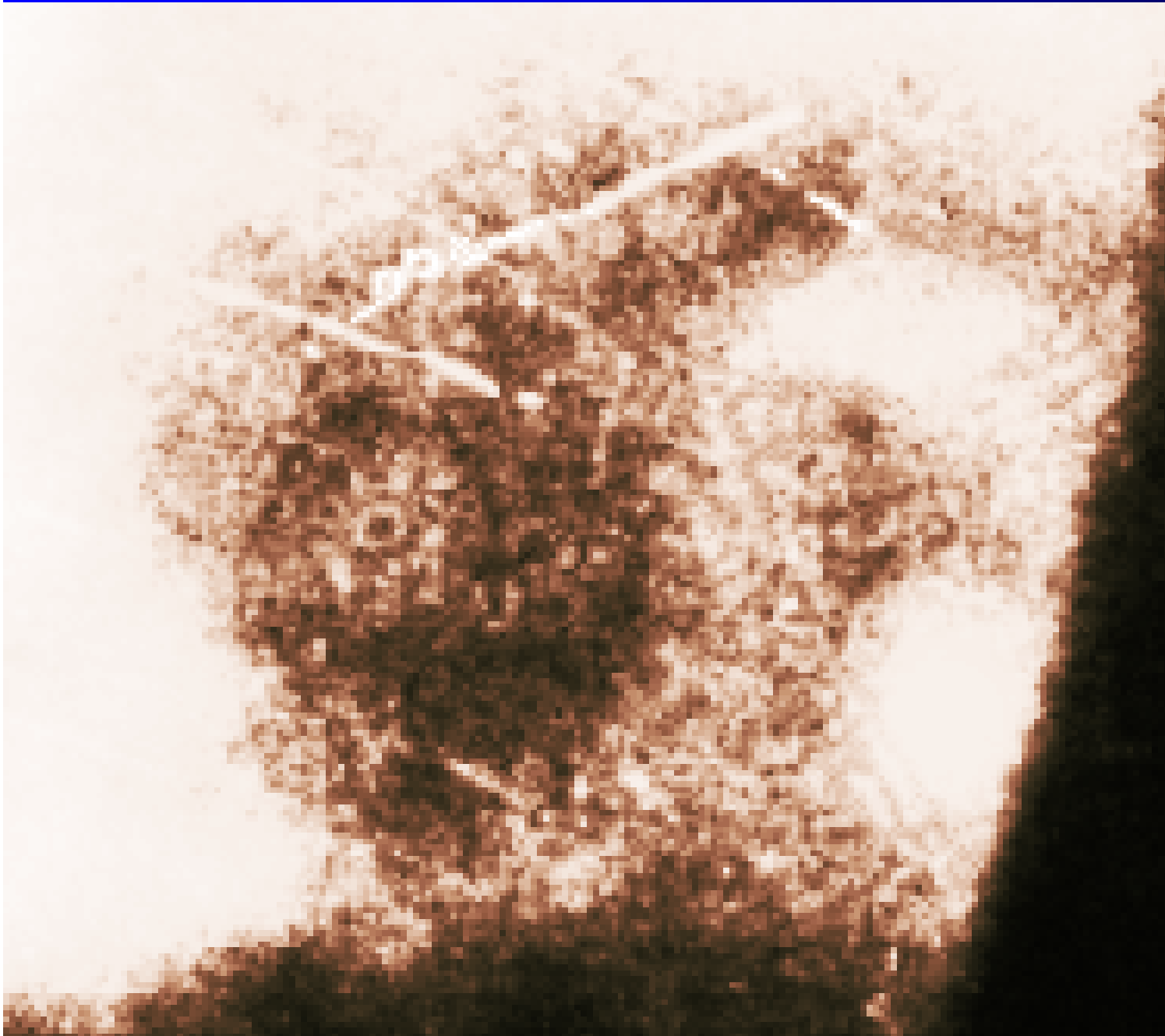
<http://www.photolib.noaa.gov/historic/nws/wea00216.htm>



Cartwheel whose slightly elliptic image is seen in the centre.

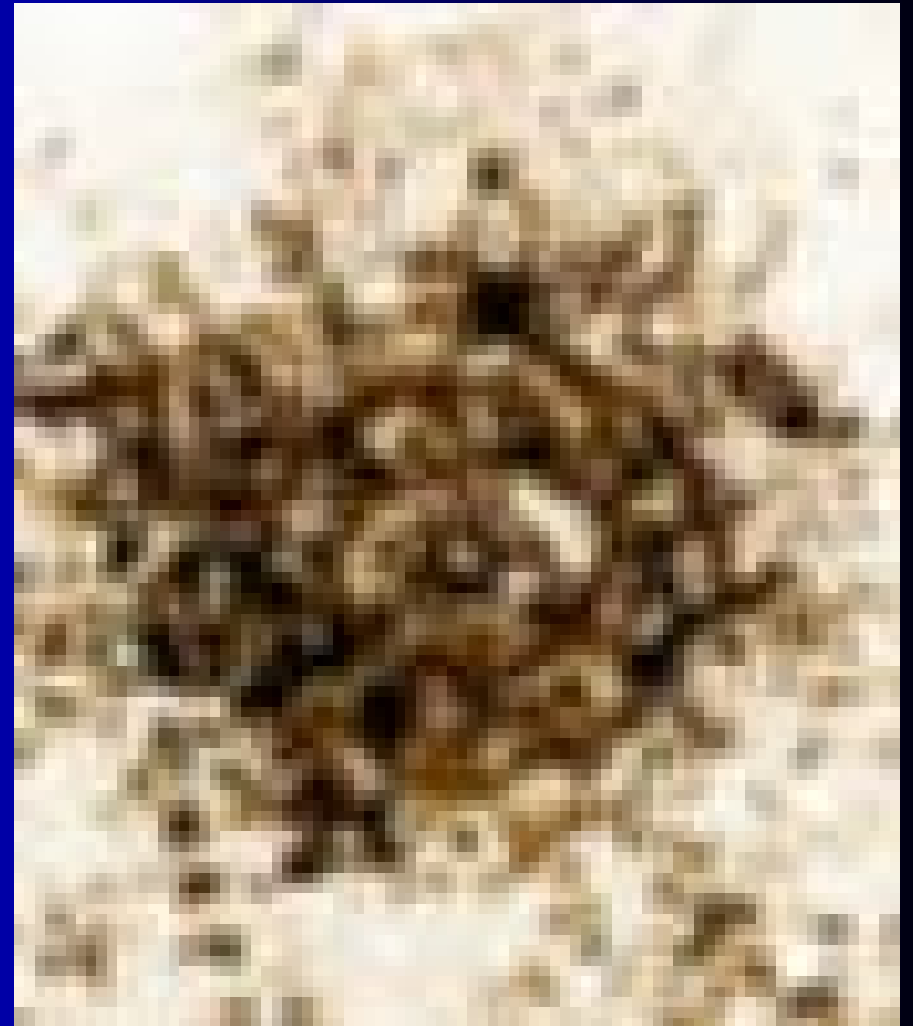
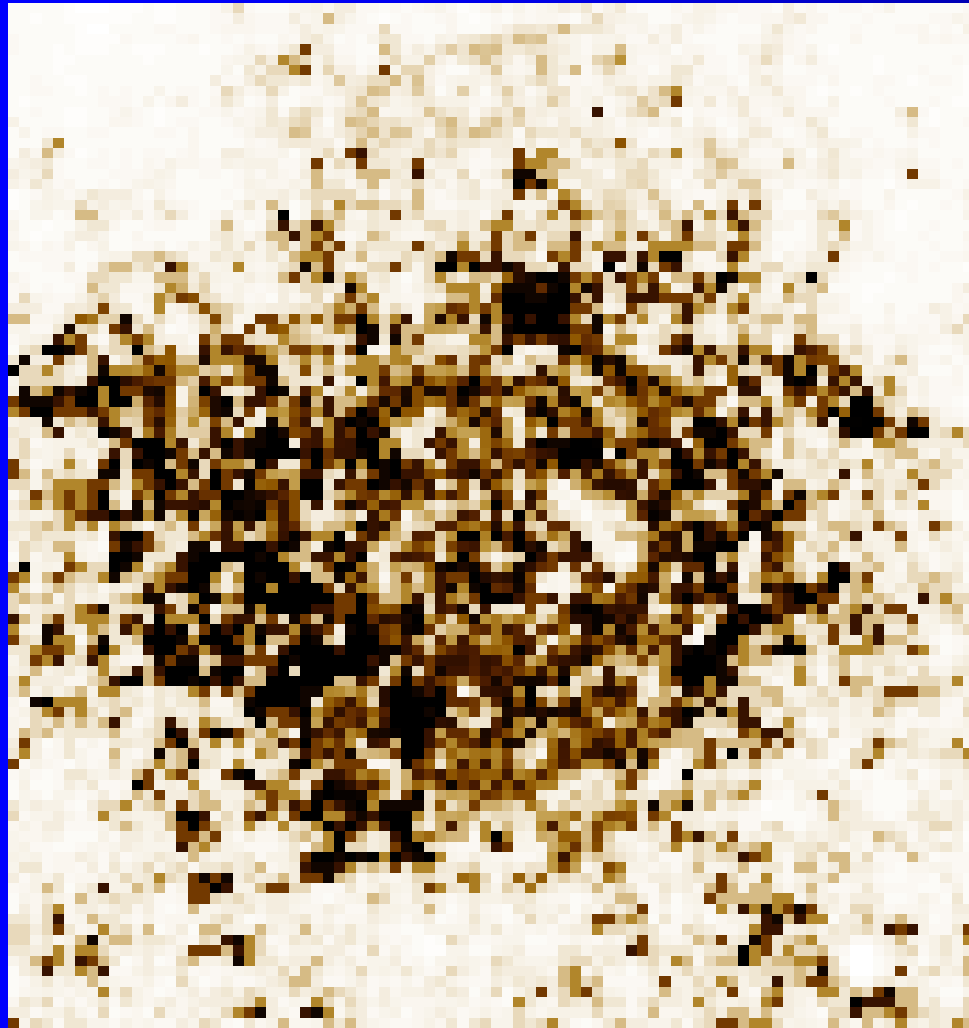
The cartwheel seems to be located on a long axle-tree directed down to the right and ended with a bright spot on the axle's edge (see its additionally contrasted image in the left corner insert on the bottom image).





The cartwheel-like structure is seen in the center of the image.

The straight filaments may possess tubular structure as is suggested by the images of their edges.

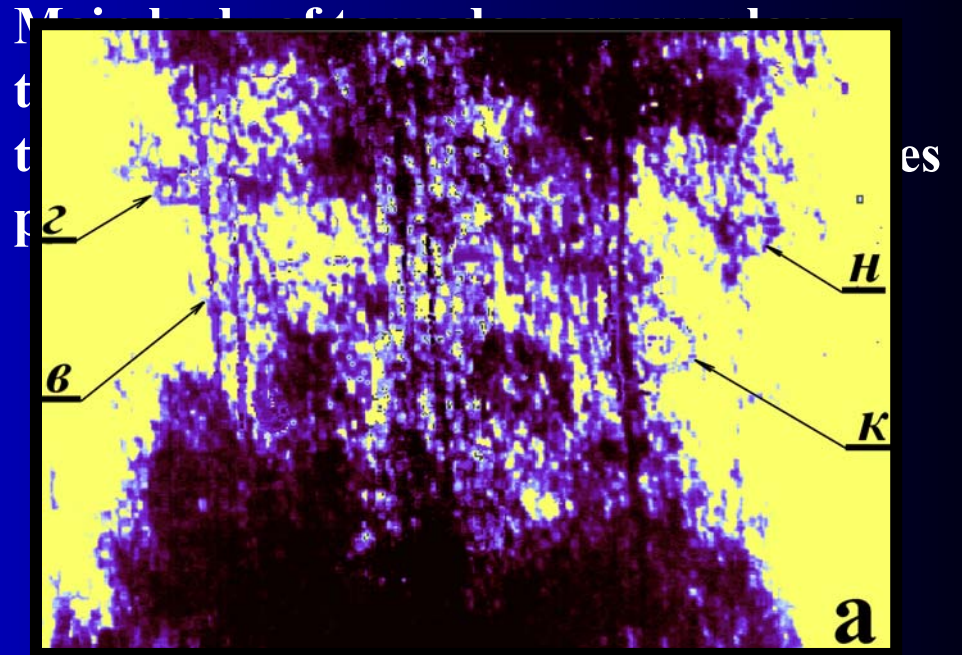


**The cartwheel-like structure with the axis directed to the observer
(two images with various maps/levels of contrasting the image are
given to illustrate the merit of image processing procedure)**



<http://www.photolib.noaa.gov/historic/nws/wea00248.htm>

The tornado at Norton, Kansas, from the collection of S.D. Flora . In: 'Monthly Weather Review,' July 1919, p. 448. Image ID: wea00248, Historic NWS Collection
Location: Norton, Kansas
Photo Date: 1909
June 24



The visible light image of the “neck” in the vertical plasma column of the Z-pinch.

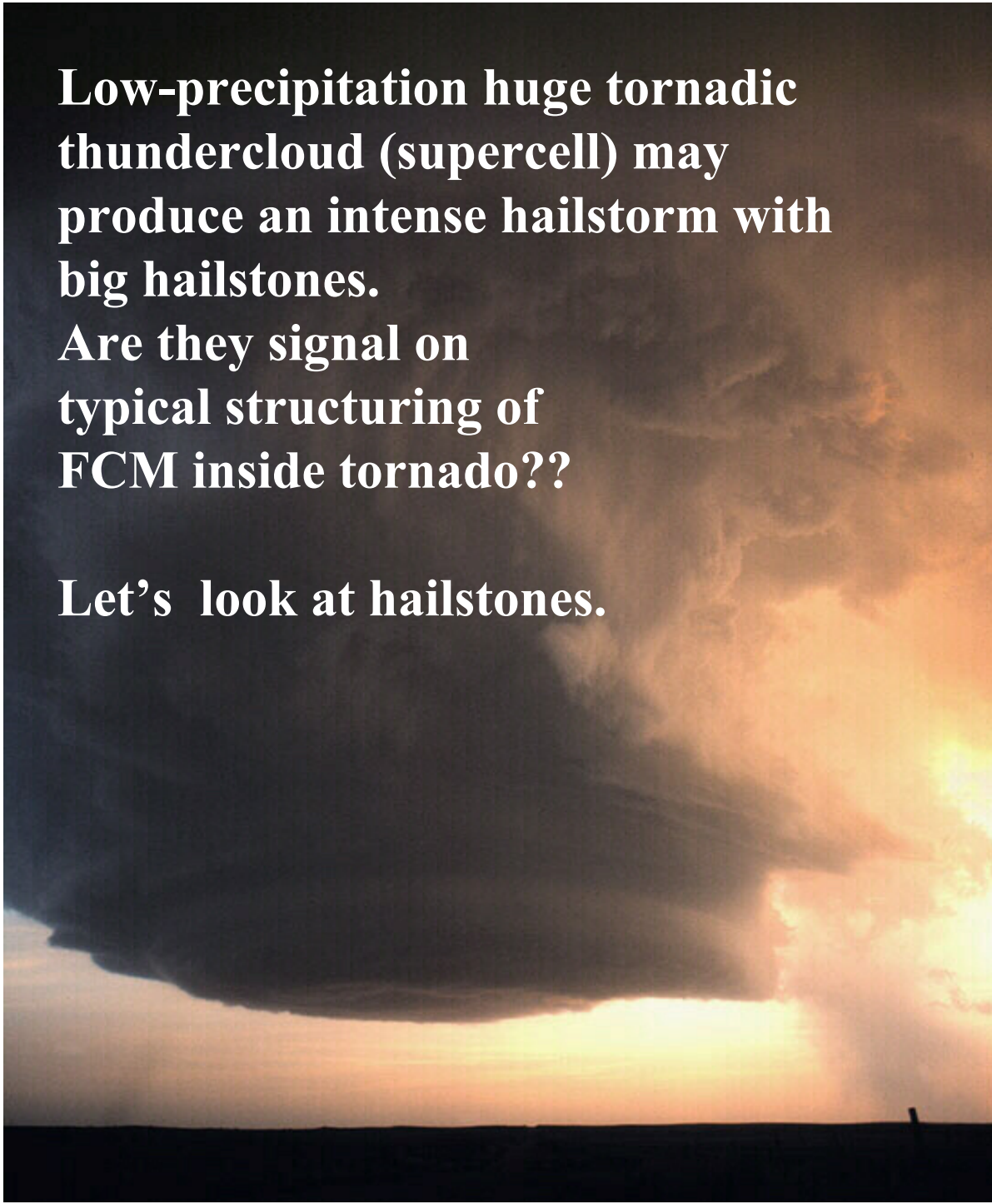
Negative, time exposure 2 ns; image’s height **1.65 cm**.

A skeletal structure appears to be «stripped» when magnetic field pushed the plasma out of the neck. Vertical tubules **d ~0.3 mm**, horizontal tubules **d ~0.1-0.2 mm**, coaxial tubule **d ~1 mm**.

Low-precipitation huge tornadic thundercloud (supercell) may produce an intense hailstorm with big hailstones.

Are they signal on typical structuring of FCM inside tornado??

Let's look at hailstones.



Vertical Looking LP Supercell and Big Hail Producer

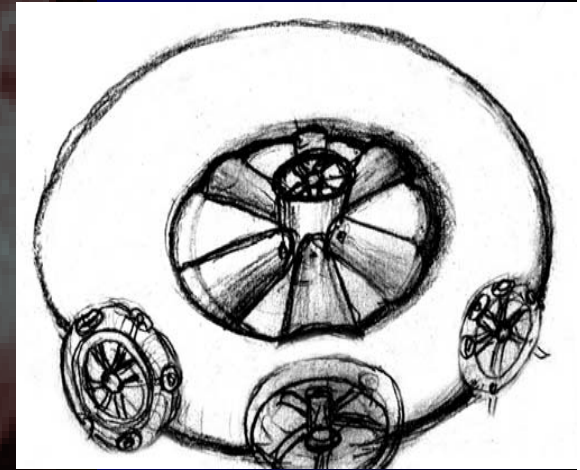
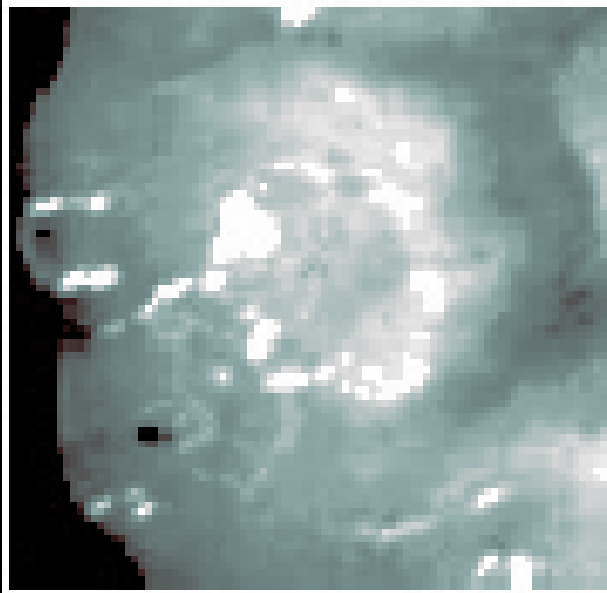
This is an example of a LP thunderstorm in far western Oklahoma. The hail streamers were evident on this storm in advance of the main storm cloud. Much of the hail came out of the anvil, the ice crystal cloud that sweeps down stream in the jet stream. Vehicles were struck many miles in front of the storm with baseball hail while in the sunlight of the setting sun. Most did not know where the hail came from. In some cases storms like this will throw hail out the top and it may land anywhere within a few miles of the main thunderstorm cloud. This storm rotated for hours and had a tornadic signature on radar but no tornadic circulation ever made it to cloud base or the ground. Cells like this are a hazard to aviation flying in the near vicinity.

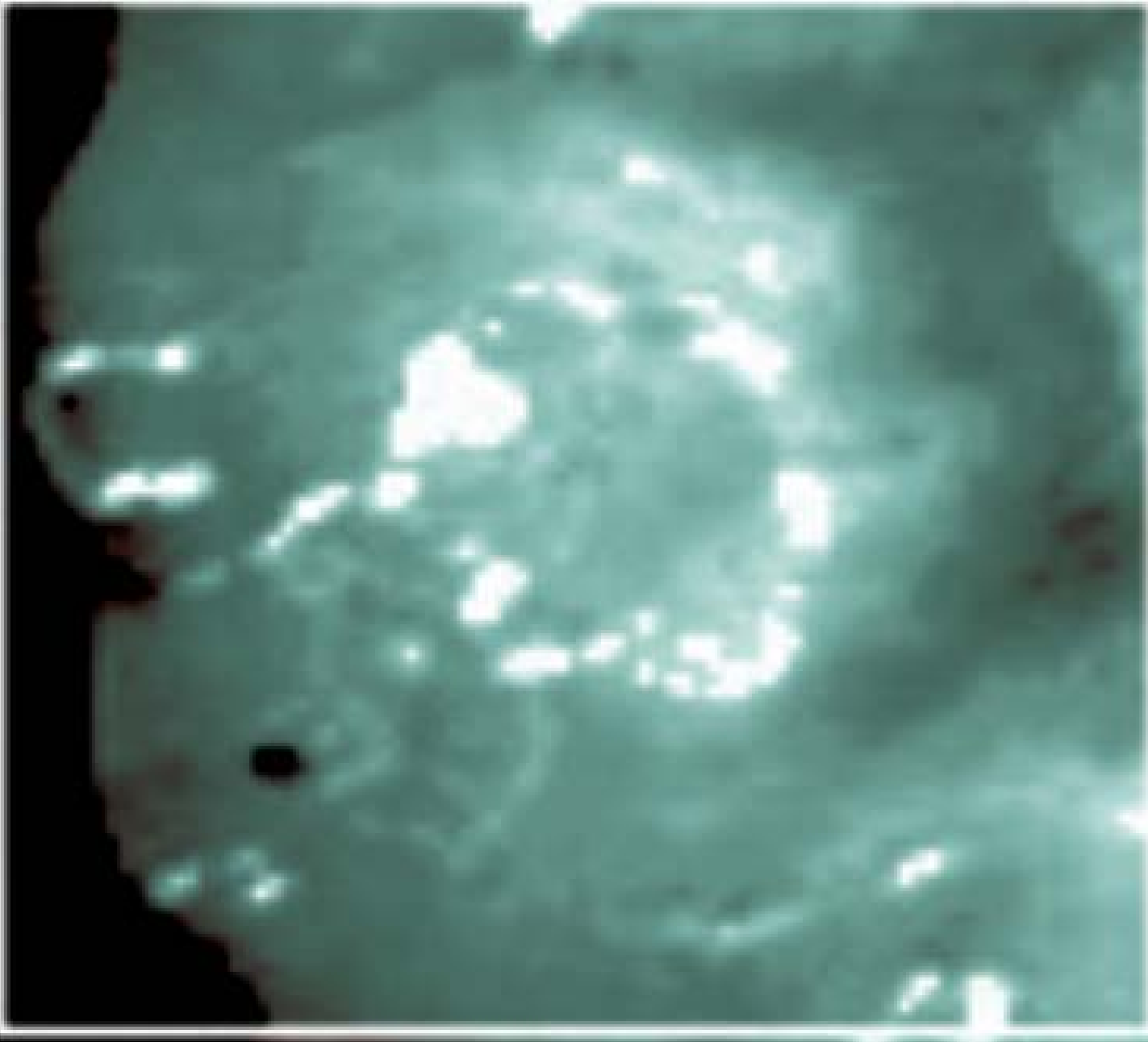
<http://www.chaseday.com/hailstorms.htm>



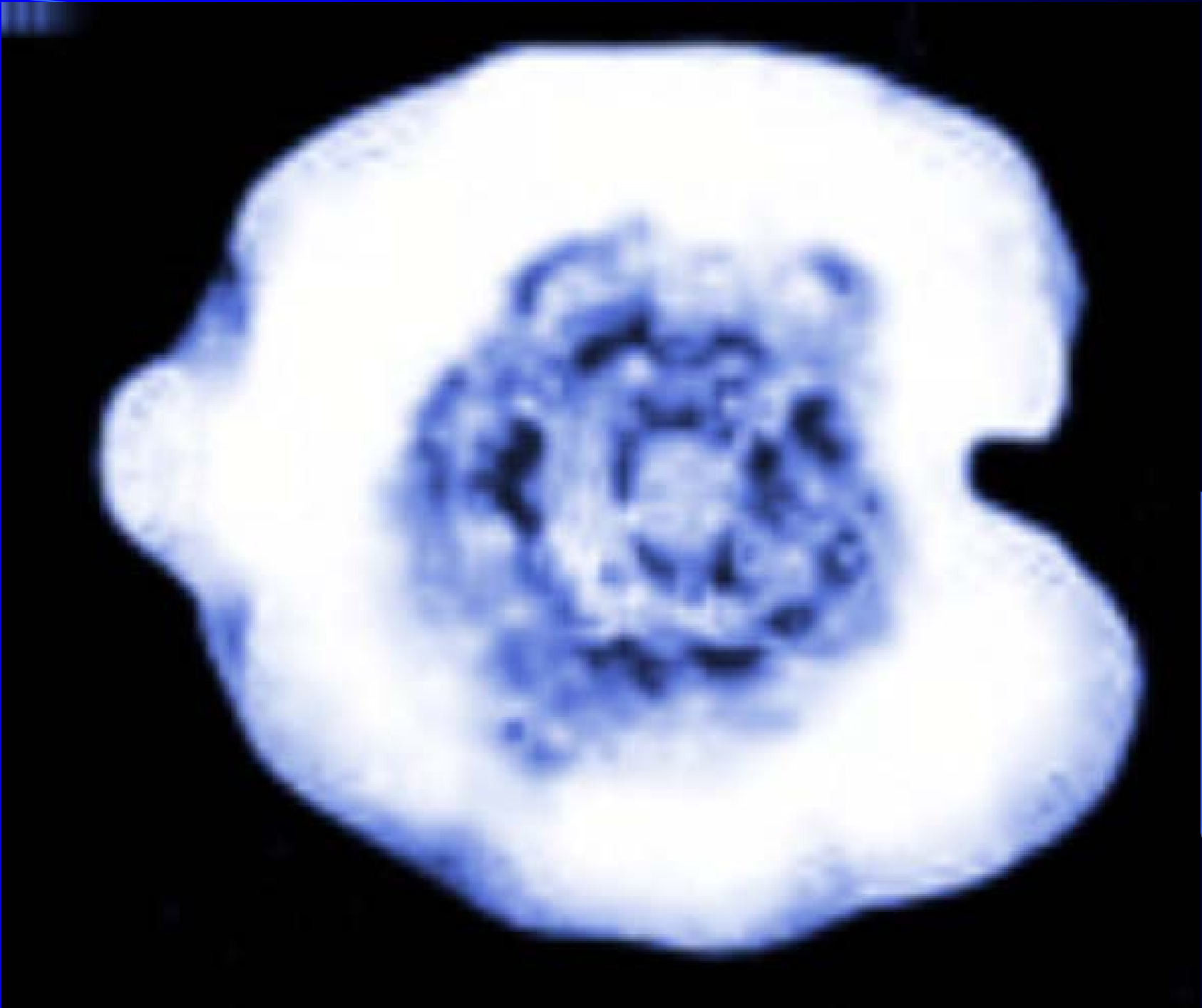
Hailstones

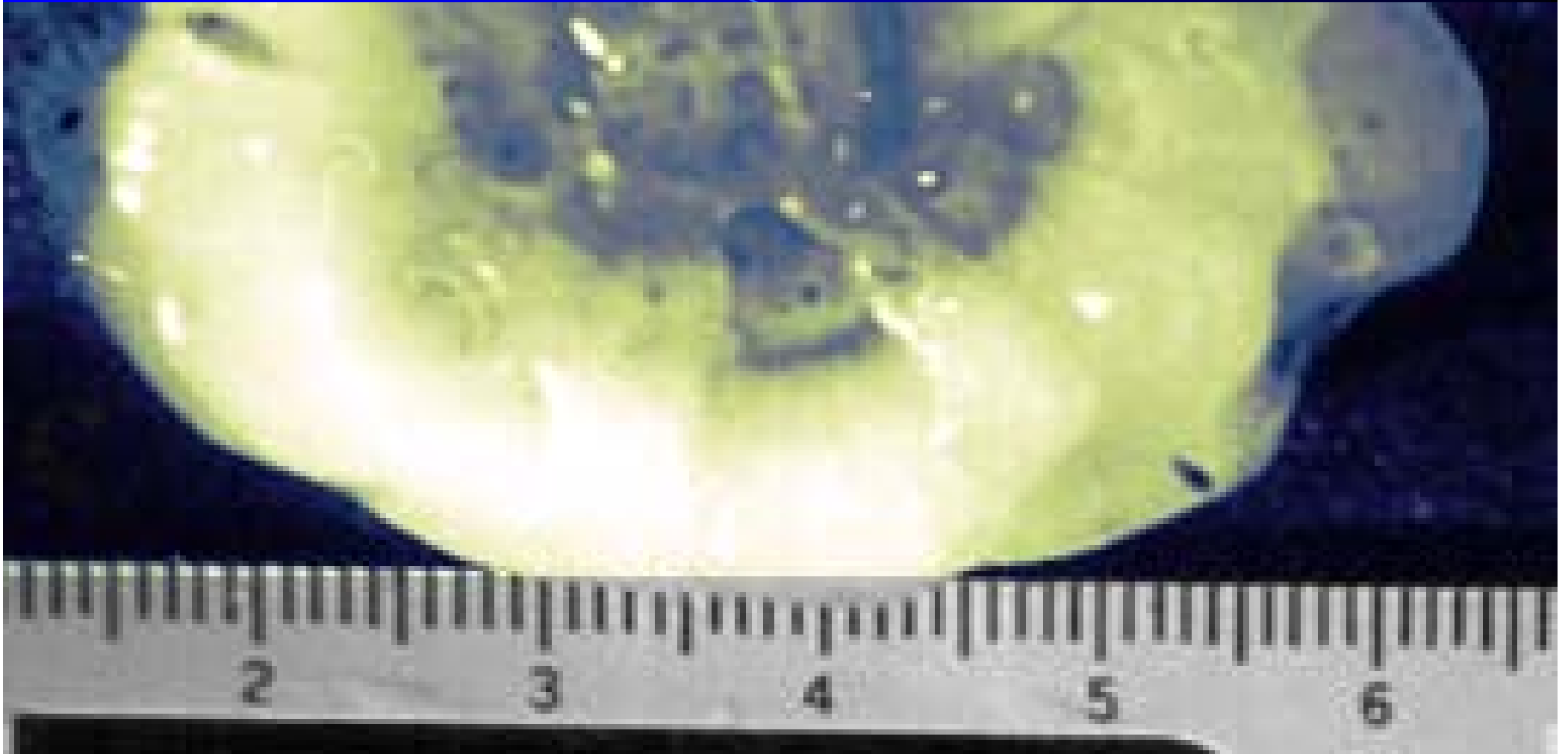
**Trend toward
self-similarity
(cartwheel
contains smaller
cartwheels on
the outer side of
the rim)**





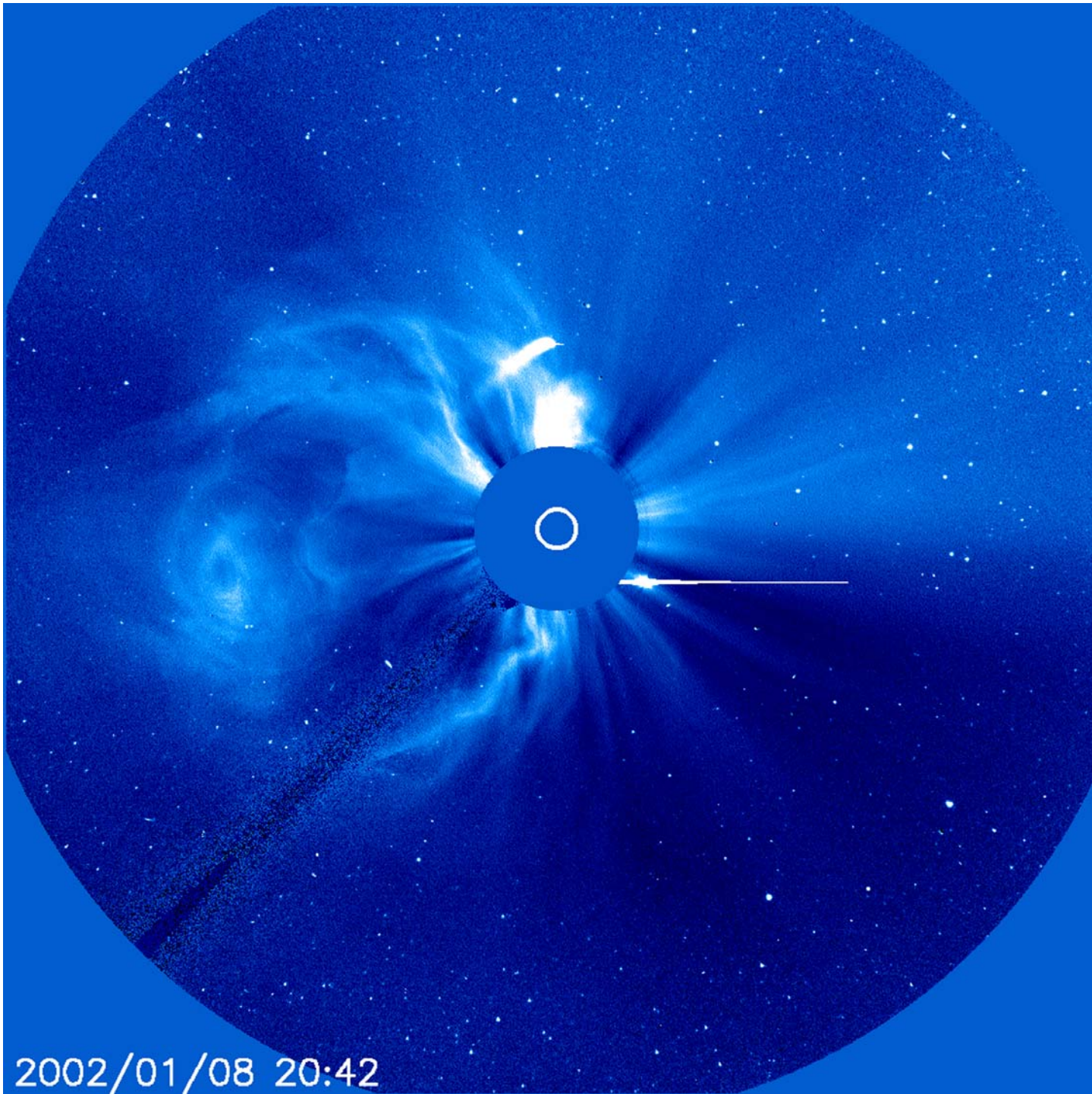
The magnified
image of the
window in the
left lower
corner of the
previous figure





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 - space (supernova remnants and some galaxies of similar form, “colliding galaxies”, etc.);



The image of solar coronal mass ejection with the solar disk overshadowed and indicated with a white circle.

**NASA/ESA SOHO
(Solar and Heliospheric Observatory) Hot Shots**

2002/01/08 20:42

A fragment of solar coronal mass ejection of estimated diameter $\sim 5 \cdot 10^{11}$ cm

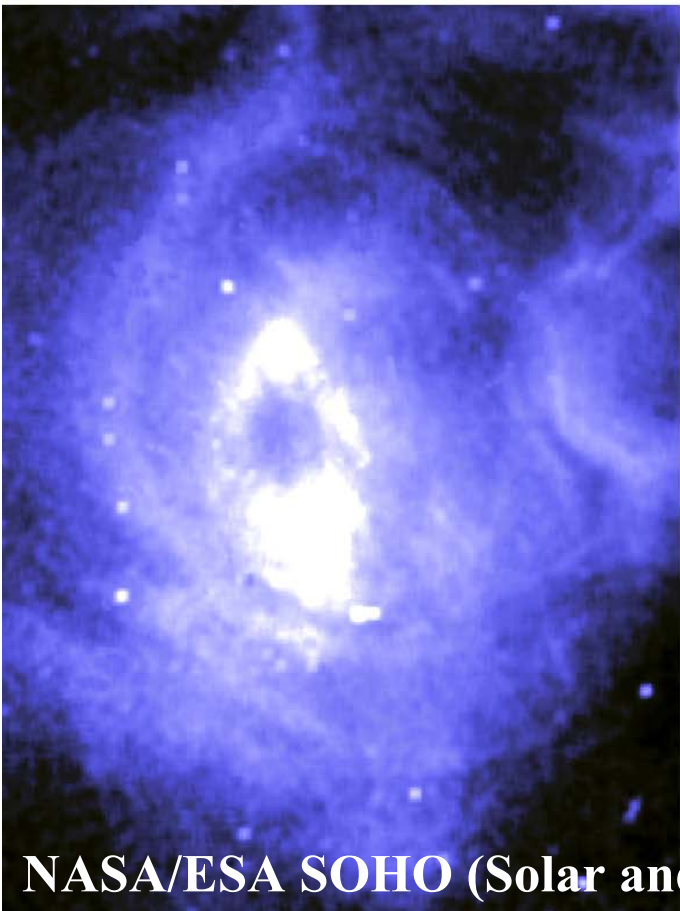
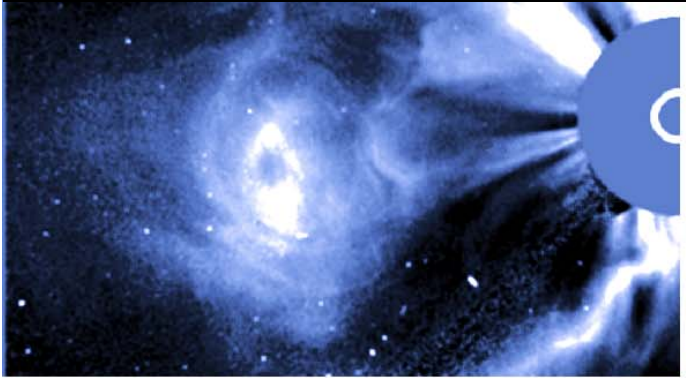
1. The image of solar coronal mass ejection with the solar disk overshadowed and indicated with a white circle.

NASA/ESA SOHO (Solar and Heliospheric Observatory) Hot Shots

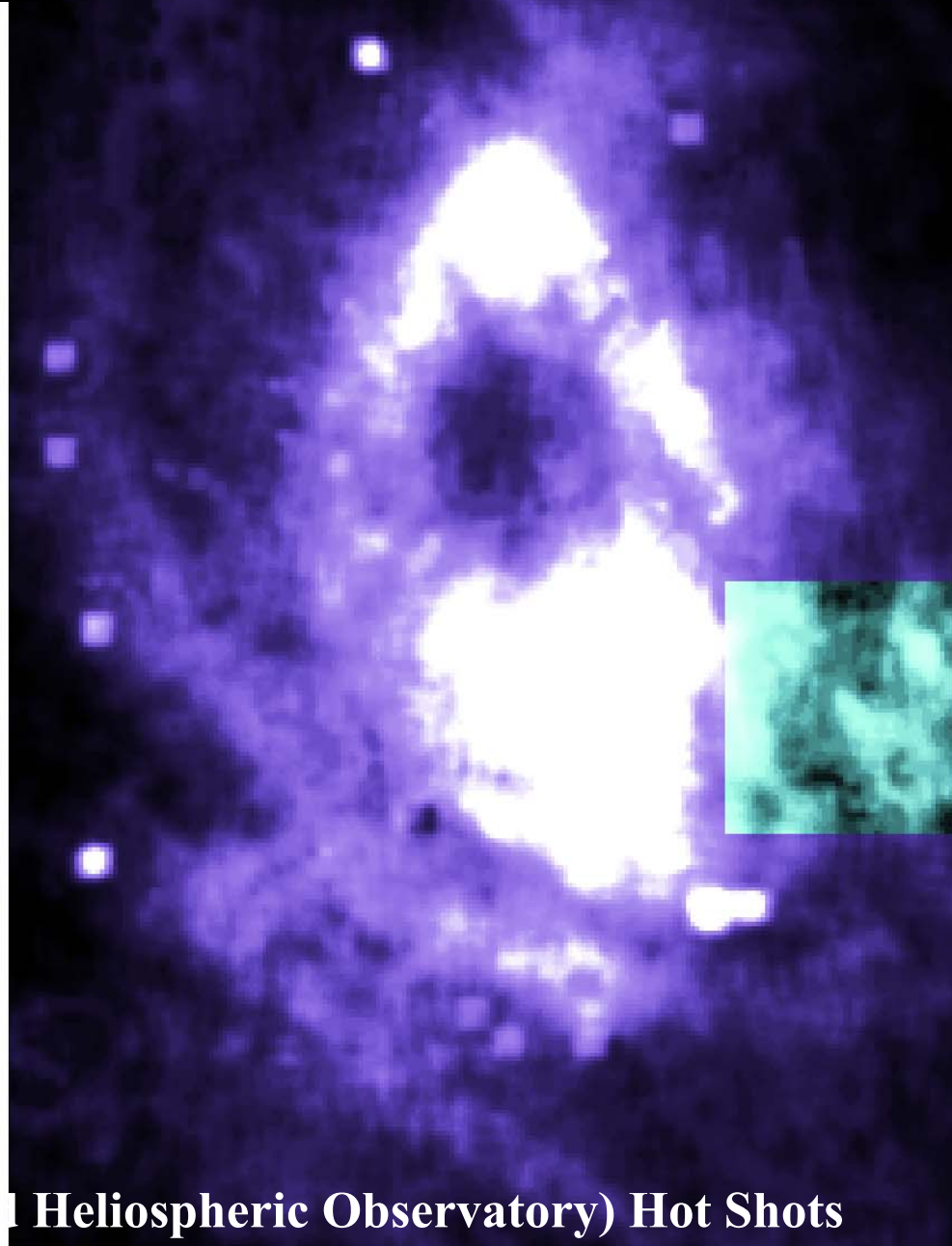
2. Magnified image of the front of the jet reveals a wheel-like structure with straight radial bonds between thick central point and circular/toroidal formation.

3. Magnified and additionally contrasted image of the wheel-like structure; the window (seen on the right-hand side) differs by contrast and colour to show the continuity of radial spoke of the wheel. The elliptic images with the small central point (which are seen on the front edge of this spoke and in the central point of the wheel, and in the right-hand radial spoke) suggest all these formations to possess a tubular (and even coaxial) structure.

solar disk is overshadowed and indicated with a white circle

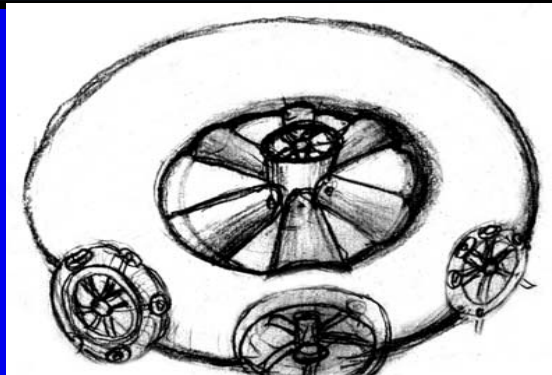
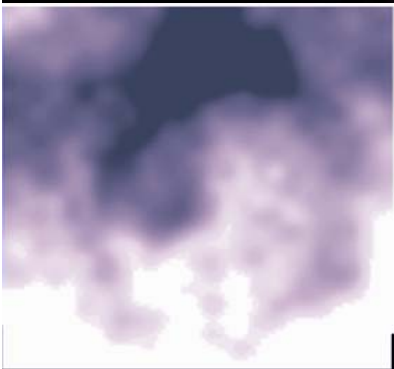
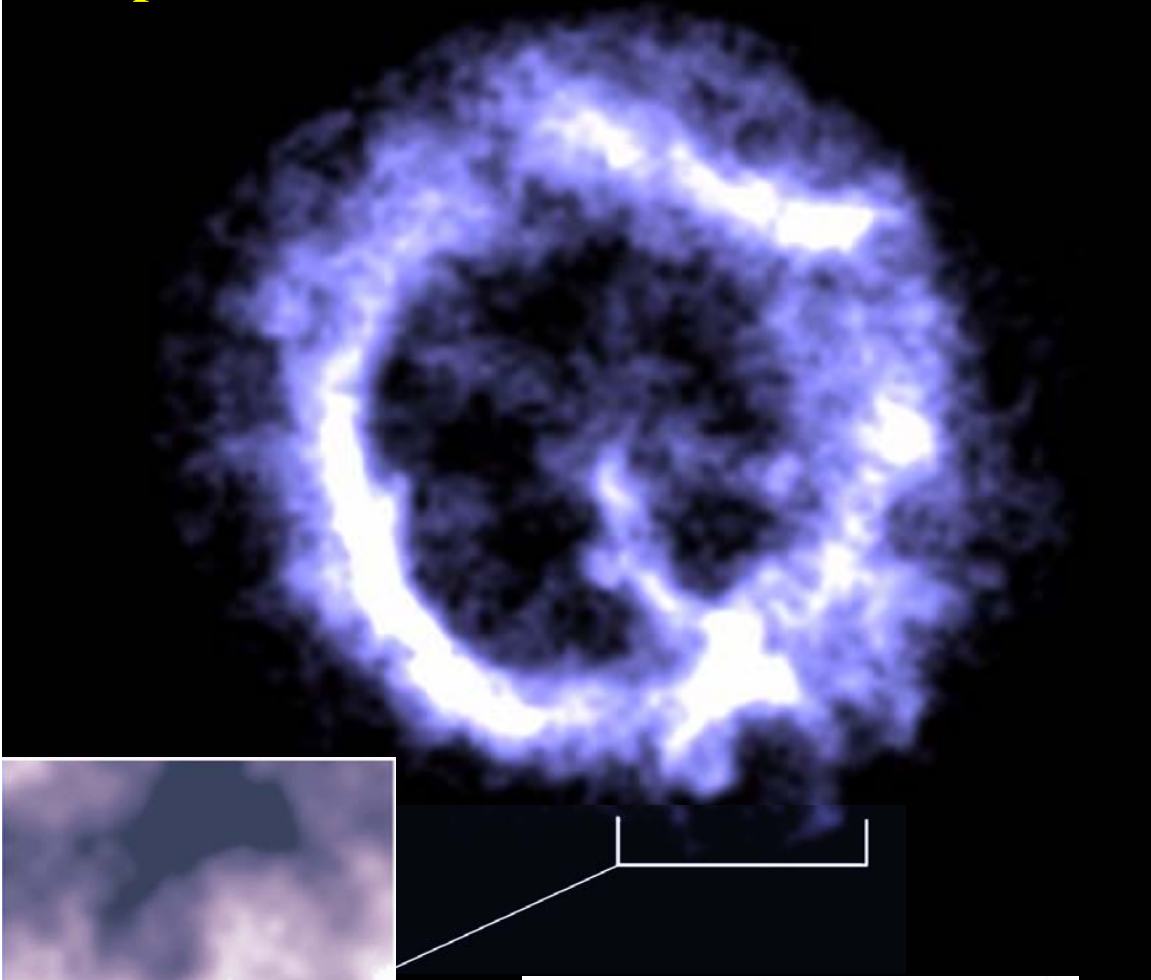


Solar coronal mass ejection
of estimated diameter $\sim 5 \cdot 10^{11}$ cm



Wheel-like structure:
straight
radial bonds
between
thick central
point and
toroidal
formation

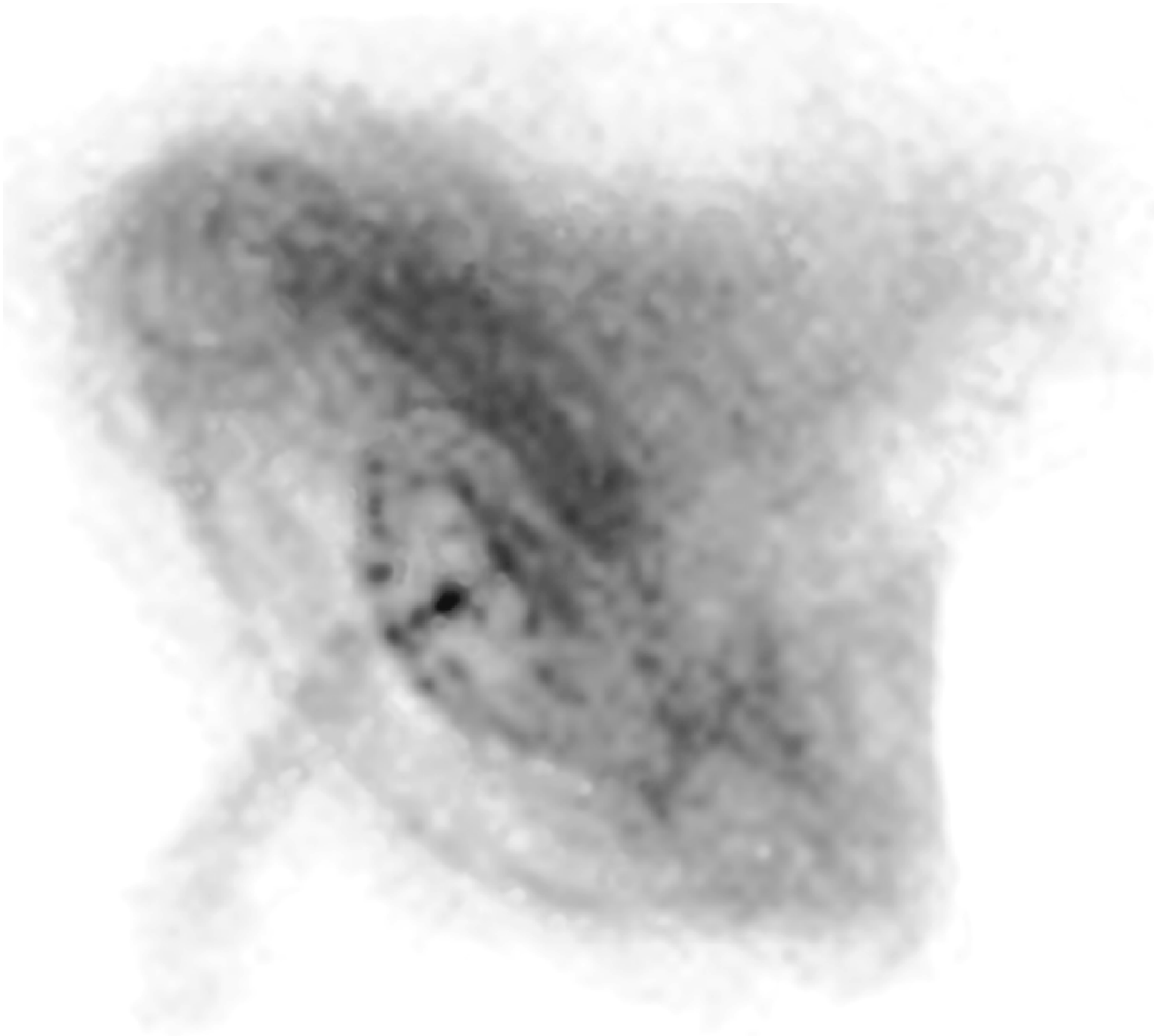
Supernova Remnant



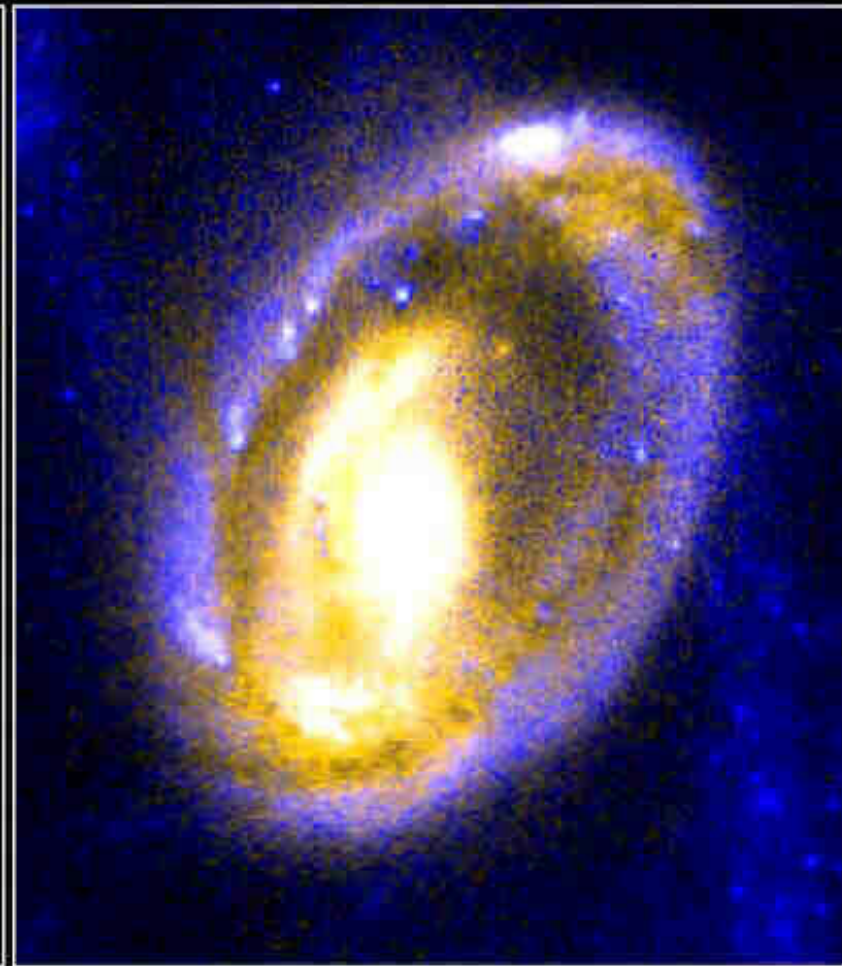
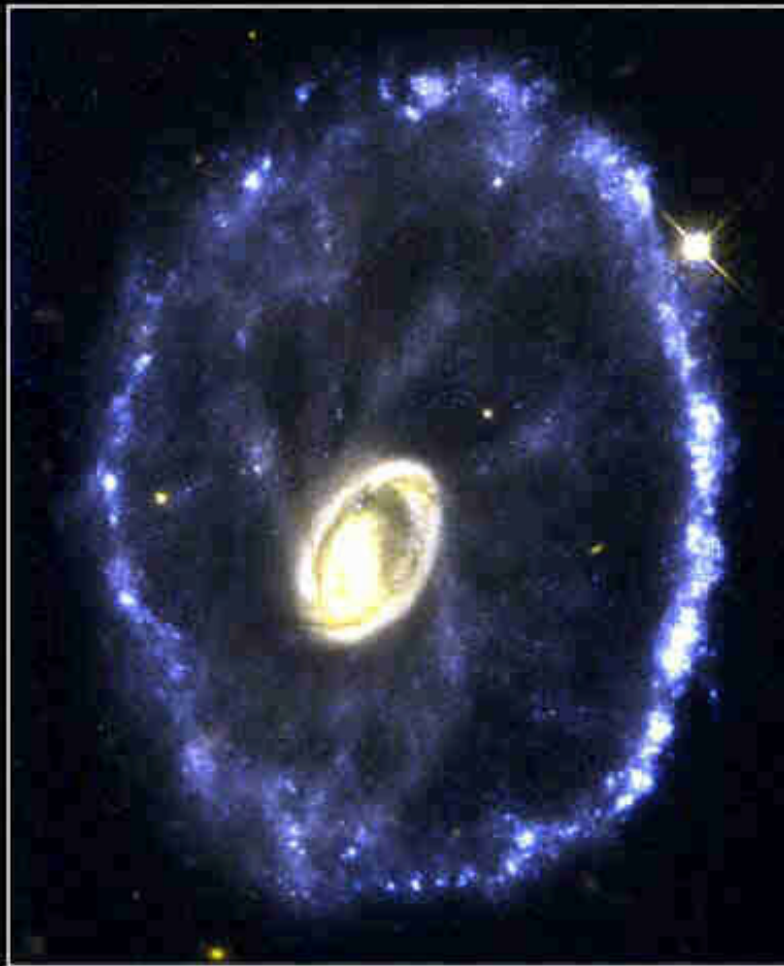
«A flaming cosmic wheel» of the supernova remnant E0102-72, with «puzzling spoke-like structures in its interior», which is stretched across forty light-years ($\sim 4 \cdot 10^{19}$ cm) in Small Magellanic Cloud, 190,000 light-years from Earth.

The radially directed spokes are ended with tubular structures seen on the outer edge of the cartwheel. The inverted (and additionally contrasted) image of the edge of such a tubule (marked with the square bracket) is given in the left corner insert.

Thus, the cosmic wheel's skeleton tends to repeat the structure of the icy cartwheel up to details of its constituent blocks.



The Crab Nebula is the remnant of a supernova explosion that was seen on Earth in 1054 AD. It is 6000 light years from Earth, with the inner ring of **one light year** (10^{18} cm) in diameter. At the center of the bright nebula is a rapidly spinning neutron star, or pulsar that emits pulses of radiation 30 times a second



Cartwheel Galaxy Detail

HST · WFPC2

PRC96-36a · ST ScI OPO · November 26, 1996
C. Struck and P. Appleton (Iowa State University),
K. Borne (Hughes STX), R. Lucas (ST ScI) and NASA

Located 500 million light-years away in the constellation Sculptor, **150,000 light-years across**, the galaxy looks like a wagon wheel. The galaxy's nucleus is the bright object in the center of the image; the spoke-like structures are wisps of material connecting the nucleus to the outer ring of young stars.