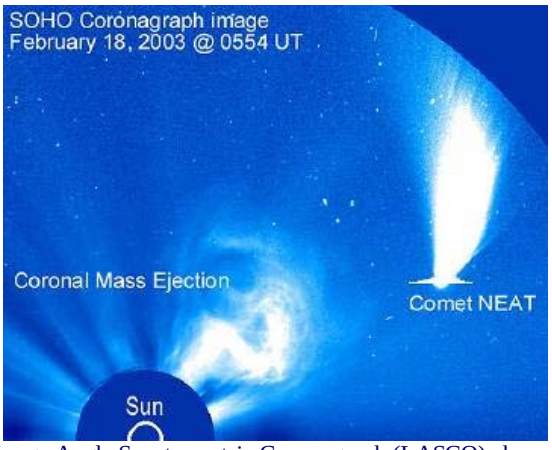
Scientist's Record Sun's Plasma Interaction with Comet NEAT

I believe this is the first time we have observed a coronal mass ejection (from the sun) apparently interacting with a comet."

- Gareth Lawrence, Ph.D., Goddard Space Flight Center



Large Angle Spectrometric Coronograph (LASCO) aboard the Solar and Heliospheric Observatory (SOHO) satellite captured this image of the sun's ejection of a large plasma toward the approaching Comet NEAT on February 18, 2003 at 05:54 Universal Time. The head of the comet was estimated to be 100,000 kilometers in diameter (62,150 miles). Image courtesy of NASA/SOHO/JPL.

March 7, 2003 Greenbelt, Maryland - Comet NEAT was named after the "Near-Earth Asteroid Tracking System" based at the Jet Propulsion System in Pasadena, California. NEAT's job is to monitor the solar system for comets and asteroids that might be on a collision course with Earth and warn about size and nearest approach date. The comet was not discovered by the NEAT system until November 6, 2002. When it was first seen, it was extremely faint to even the most sensitive ground-based observatories. But as it moved in its orbit toward the sun, it began to brighten intensely as gas and dust cooked off the comet and deflected sunlight back towards the Earth. The comet brightened so much faster than predicted that some scientists were worried nothing would be left. At its closest to the Earth on December 24, 2002, it was .8 of an Astronomical Unit from our planet, or about 74 million miles.

But when NASA's Large Angle Spectrometric Coronograph (LASCO) on board the Solar and Heliospheric Observatory (SOHO) satellite was aimed at the sun during the comet's predicted closest approach, the big, bright, icy ball showed up right on schedule, February 16, 2003. The diameter of its glowing gas, ice and rocky head was estimated to be 100,000 kilometers (62,150 miles) and its long tail was about twelve times longer. The actual rock which is the source of all the dust is thought to be no more than about 10 kilometers (6 miles) wide inside the glowing head. The images of the comet near the sun recorded by the LASCO/SOHO satellite were stunning. "Instrument saturation" made the comet

appear artificially bright because the LASCO detector is so sensitive.

Then on February 17 and 18, the unexpected occurred. The sun belched a large jet of plasma known as a coronal mass ejection, or CME, out into space right toward Comet NEAT on *both days*. The LASCO image above was taken on February 18, 2003, at 05:54 Universal Time. This is the first time that human science has recorded a solar plasma explosion in the same frame with a large comet at its nearest approach to the sun.

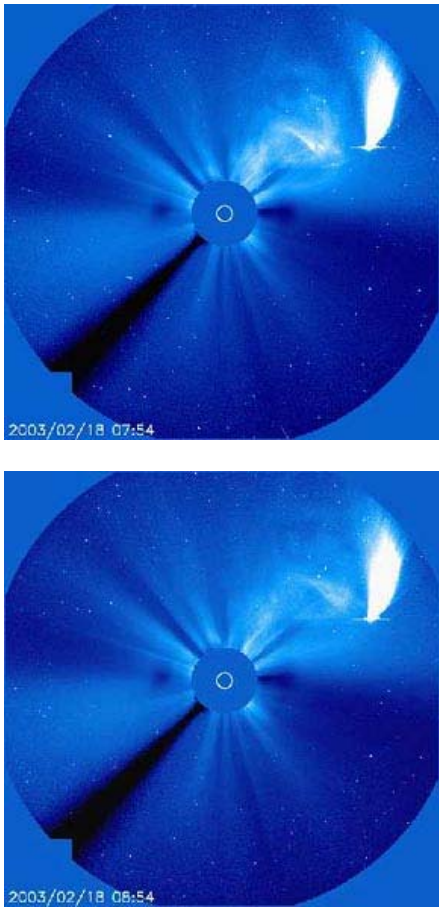
I asked Gareth Lawrence, Ph.D., Operations Scientist for the Large Angle Spectrometric Coronograph on board the SOHO satellite what the sun's coronal mass ejections would have done to the passing comet.

Interviews:

Gareth Lawrence, Ph.D., Operations Scientist for the Large Angle Spectrometric Coronograph (LASCO) on board the Solar & Heliospheric Observatory (SOHO) Satellite, Goddard Space Flight Center, Greenbelt, Maryland: "Well, we think that in terms of the comet itself it would have had little effect. But we believe that we see evidence from the comet's ion tail for some kind of interaction with the CME as it passed and we are still at the very preliminary stage of the analysis. So, I can't really say anything more unequivocal than that.

WHAT YOU MEAN IS THAT THE TAIL OF THE IONS WHICH ARE THE CHARGED PARTICLES IN THE TAIL OF THE COMET?

Precisely.



When Comet NEAT was near the sun on February 18, 2003, it was the first time scientists observed a coronal mass ejection apparently interact with the ion plasma of a comet.
These two images were taken one hour apart at 07:54 and 08:54 Universal Time by LASCO/SOHO, courtesy of NASA/SOHO/JPL.

THE COMET'S IONS INTERACTED WITH THE CORONAL MASS EJECTION FROM THE SUN?

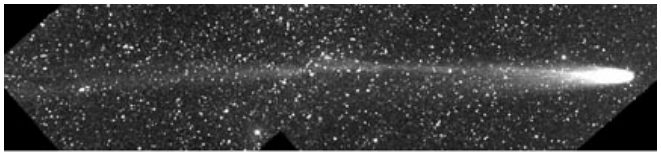
That's right. You have to remember that the ion tail is pretty much channeled and governed in its behavior by the magnetic field in the vicinity (of the sun), and so we believe what we were seeing is an interaction between the magnetic field within the ion tail and the magnetic field within the coronal mass ejection.

IS THIS THE FIRST TIME THAT THERE WAS A MASS CORONAL EJECTION AT THE SAME TIME A COMET WAS NEAR THE SUN?

I believe I'm correct in saying that this is the first time we have observed a CME apparently interacting with a comet.

In this case, we believe the CME was sufficiently close to the comet that there was some kind of interaction between the two. The other thing that I would stress here is that even though LASCO/SOHO has now observed maybe 600 comets, the majority of those have only had a dust tail.

It is this comet NEAT and comet Hyakutake that are the only two that we have been able to clearly identify an ion tail as well as a dust tail. We do not believe nor expect in the majority of cases there would have been the likelihood of interaction between the dust tail and anything really. Even if there had been a CME directed squarely at one of the earlier comets, we would not have expected to see an interaction between the dust tail and the CME.



Yuji Hyakutake (Hayato-machi, Aira-gun, Kagoshima-ken, Japan) discovered this comet with 25x150 binoculars on January 30, 1996. This was his second comet discovery in five weeks
and the position was less than 4 degrees from the spot where his last comet was discovered! The comet
was estimated as magnitude 11.0, and was described as diffuse with a central condensation. The coma
was 2.5 arc minutes across.This image is a wide-field mosaic image of comet Hyakutake, taken on
April 6, 1996, with the 90mm f/2.8 lens, a CCD camera, and a narrow-band H2O+ filter. Each frame
was exposed for five minutes. Copyright ©1996 by Herman Mikuz, Crni Vrh Observatory, Slovenia.

THOSE ION TAILS OF THE COMETS ARE ESSENTIALLY PLASMAS, RIGHT?

Yes, that's right.

THE SUN IS PLASMA, IS EJECTING PLASMA, AND THIS COMET HAD A PLASMA TAIL?

That's right.

AND THAT'S WHY THERE IS APPARENTLY THE INTERACTION BECAUSE MAGNETIC FIELDS WERE INVOLVED?

That's exactly right.

MANY PEOPLE HAVE E-MAILED ME ASKING, 'IS THIS COMET THAT CAME SO CLOSE TO THE SUN IN THE BEAUTIFUL PICTURES LIKELY TO COME NEAR THE EARTH? COULD IT HIT THE EARTH? COULD YOU GIVE SOME PERSPECTIVE?

The comet came very close to the sun, but it will not be coming especially close to the Earth at all. The orbit indicates that the comet passed closest to Earth on December 24, 2002. So, the comet is now moving away from both the sun and the Earth.

AND IT IS NOT EXPECTED TO RETURN UNTIL WHEN? DOES ANYBODY KNOW?

Yes, the approximate period of the orbit is on the order of 37,000 years.

IN 37,000 YEARS, HAS ANYBODY PROJECTED HOW CLOSE IT MIGHT RETURN?

That depends very much on where the Earth is relative to the sun, but given that the perihelion distance (closest approach to the sun) is within the orbit of Mercury, I would expect it is unlikely that the next close passage of this comet to the Earth will not be significantly closer than this time. So, I think again about .8 Astronomical Unit is a fair estimate of its next proximity.

HOW DO COMETS SNEAK UP ON US, SUCH AS THIS ONE BETWEEN NOVEMBER AND FEBRUARY? THIS WAS ONE THAT HAD A DRAMATIC SHOW AT THE SUN, BUT WE DIDN'T KNOW ABOUT IT BEFORE NOVEMBER?

That's the whole reason why the NEAT system was created and made operational in the first place, to provide as early as possible warning of these objects before they are too close for comfort really.

ANYTHING ON THE CURRENT HORIZON THAT SOHO/LASCO HAS PICKED UP ABOUT INCOMING COMETS?

I don't think we are anticipating another close passage this year. We were contacted three to four months in advance by various observing teams for Comet NEAT and also the previous one, Comet Kudo-Fujikawa back in January 2003. They had made orbit calculations and noticed that the orbit of the comet was going to take it through the LASCO field of view and contacted us before hand. But to the best of my knowledge, no one has contacted anyone on the LASCO team regarding additional observations this year of 2003.

Over the seven years of the SOHO mission to date, I would say we average about three comets every two years that pass through the LASCO field. So, we've had our three in fact, there were two last year as well. So, I guess we've beaten the average with five in two years.

More Information:

Bogus Internet Story About Sun Warming Up To Explode

IS IT TRUE THAT THERE HAVE BEEN ASTROPHYSICAL OBSERVATIONS THAT THE SUN IS WARMING?

This I believe is not born out, no. There certainly is no data from SOHO to suggest that either the outer layers or the core of the sun are undergoing temperature changes at any significant rate.

There was a bogus press release which was attributed to the European Space Agency and a particular scientists saying that the sun was warming at an alarming rate and was due to blow up in six years. But that was a complete fabrication. There was no such press release from the European Space Agency and the scientist to whom it was attributed does not exist and has never worked for the ESA.

DID ANYONE FIND OUT WHO CREATED THE BOGUS E-MAIL?

No.

SO IF THERE ARE E-MAILS FLOATING ON THE NET ABOUT THE SUN REACHING SOME KIND OF EXPLOSIVE STAGE, THE BEST THING IS FOR EVERYBODY TO TAKE IT WITH A GRAIN OF SALT AND DO SOME RESEARCH.

That's right. The best thing to do if you see something like that is to check official sources. Go take a look at the SOHO page, for instance, because if anything comes out of SOHO, it will be real. We don't keep things secret."

Website:

http://sohowww.nascom.nasa.gov/

Credits