

HUBBLE MEMORABLE MOMENTS



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00:00:00,000 --> 00:00:04,004

>>KATRINA: One of the Hubble Space Telescope's most

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00:00:04,004 --> 00:00:06,607

memorable moments was observing the fragments of Comet

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00:00:06,607 --> 00:00:11,712

Shoemaker-Levy 9 impact Jupiter in July, 1994. This was a huge

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00:00:11,712 --> 00:00:14,381

astronomical event that captured the attention of the public

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00:00:14,381 --> 00:00:18,285

across the globe. But what most people don't know is that Hubble

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00:00:18,285 --> 00:00:21,588

came close to not getting those observations. The telescope

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00:00:21,588 --> 00:00:24,091

encountered some problems that might normally take over a month

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00:00:24,091 --> 00:00:27,661

to solve just days before the comet impact.

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00:00:27,661 --> 00:00:34,067

[music]

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00:00:34,067 --> 00:00:38,939

>>HEIDI: Shoemaker-Levy 9 was a comet that was discovered by

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00:00:38,939 --> 00:00:42,609
David Levy, Caroline Shoemaker,
and Gene Shoemaker. We had

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00:00:42,609 --> 00:00:46,880
about nine months of warning
that this comet was going to hit

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00:00:46,880 --> 00:00:51,551
Jupiter. I knew from the
calculations we had done
beforehand that if

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00:00:51,551 --> 00:00:55,522
Hubble was working at the peak
of its game, that we would get

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00:00:55,522 --> 00:00:59,559
images that far surpassed images
that could be taken by any other

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00:00:59,559 --> 00:01:03,697
telescope on the Earth. >>BRIAN
V: So, so we knew that Comet

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00:01:03,697 --> 00:01:07,935
Shoemaker-Levy was going to
impact Jupiter on July 16th, so

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00:01:07,935 --> 00:01:10,237
we wanted to make sure that
Hubble was ready for that.

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00:01:10,237 --> 00:01:13,907
>>BRIAN R: July 5th, 1994
started out as an ordinary day

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00:01:13,907 --> 00:01:16,877
until we were called and told
that the Hubble had been

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00:01:16,877 --> 00:01:19,947

commanded into inertial hold
safemode because it appeared

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00:01:19,947 --> 00:01:22,950

that it was misbehaving and not
executing the proper commands.

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00:01:22,950 --> 00:01:25,319

>>BRIAN V: When they command
inertial hold, all those

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00:01:25,319 --> 00:01:29,022

commands that were loaded stop
executing. We tell it to don't

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00:01:29,022 --> 00:01:31,742

look at those any more and just
hold steady.

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00:01:31,760 --> 00:01:34,960

>>HEIDI: You know your first response is sort of an empty feeling in the pit of

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00:01:34,962 --> 00:01:40,642

your stomach, like oh no, we
have this huge event coming up,

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00:01:41,420 --> 00:01:43,337

and the telescope's not working.

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00:01:43,337 --> 00:01:44,657

>>CHARLIE: We had about a week

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00:01:44,660 --> 00:01:48,775

to resolve the vehicle issue and
bring it back to normal mode.

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00:01:48,775 --> 00:01:51,044

>>BRIAN R: The spacecraft was

not executing the commands in

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00:01:51,044 --> 00:01:53,413
the stored command sequence it
was supposed to be, it looked

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00:01:53,413 --> 00:01:56,817
like it was doing something
completely random. So we

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00:01:56,817 --> 00:01:59,219
immediately suspected that there
was a memory unit problem.

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00:01:59,219 --> 00:02:03,623
>>CHARLIE: We were lucky
because, the previous mission we

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00:02:03,623 --> 00:02:08,095
had done we installed a
coprocessor.

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00:02:08,095 --> 00:02:09,496
>>HARRY: During the first
servicing mission

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00:02:09,496 --> 00:02:12,299
in December of '93, the
coprocessor

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00:02:12,299 --> 00:02:18,439
was basically a memory upgrade,
an additional memory to augment

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00:02:18,540 --> 00:02:21,575
the DF-224 flight computer.

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00:02:21,575 --> 00:02:29,635
>>BRIAN V: Now this coprocessor has what we call a shared memory
that both computers can use.

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00:02:29,640 --> 00:02:34,740

So the shared memory wasn't really configured yet to be useable,

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00:02:34,740 --> 00:02:38,220

but we knew that it was there.

>>CHARLIE: We verified different

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00:02:38,225 --> 00:02:42,162

configurations and different architectures that we could test

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00:02:42,162 --> 00:02:47,534

out, and we found that it was no issue to swap out the memory.

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00:02:47,534 --> 00:02:50,037

>>BRIAN R: So we started doing that, and things were going

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00:02:50,037 --> 00:02:53,273

extremely well. And suddenly while we were in the middle of

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00:02:53,273 --> 00:02:56,643

reconfiguring it, we were told that the spacecraft had entered

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00:02:56,643 --> 00:02:59,846

zero-gyro-sunpoint, which is a more serious version of

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00:02:59,846 --> 00:03:04,584

safemode. What it looked like is that we had just lost two gyros

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00:03:04,584 --> 00:03:08,221

simultaneously, which that can't happen. We had just replaced all

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00:03:08,221 --> 00:03:10,957

six of them in the first
servicing mission along with the

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00:03:10,957 --> 00:03:13,760

coprocessor; this just couldn't
be happening. >>BRIAN V: I

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00:03:13,760 --> 00:03:16,163

remember just going, "What's
going on?" You know, I didn't

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00:03:16,163 --> 00:03:18,598

know what was happening. Because
the hardware guys looked at the

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00:03:18,598 --> 00:03:22,302

gyros — they were fine. But the
software said that they had a

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00:03:22,302 --> 00:03:24,471

problem with two of them.
>>BRIAN R: Here we are halfway

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00:03:24,471 --> 00:03:28,108

through the reconfiguration, and
we were in deeper trouble than

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00:03:28,108 --> 00:03:31,611

we had thought. >>BRIAN V: I
started looking at the time

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00:03:31,611 --> 00:03:34,214

between the two events. Started
figuring out, well okay, it's

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00:03:34,214 --> 00:03:37,517

two and a half days, what is
that in hours, minutes, and

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00:03:37,517 --> 00:03:42,022
seconds. I saw the number, and
it was, you know it was really

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00:03:42,022 --> 00:03:44,524
obvious at that point what had
happened. There was an overflow

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00:03:44,524 --> 00:03:49,362
in the computer. Finally
discovered that we had this

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00:03:49,362 --> 00:03:53,867
thing called a "gyro good count"
that counts up how many seconds

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00:03:53,867 --> 00:03:57,270
has there been since there was
the last, you know, "bad gyro

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00:03:57,270 --> 00:04:01,041
count" if you will. >>BRIAN R:
When the gyros change mode, this

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00:04:01,041 --> 00:04:04,111
counter gets reset. Typically
this will happen several times a

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00:04:04,111 --> 00:04:07,547
day. Well because of the work we
had been doing for the past two,

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00:04:07,547 --> 00:04:10,884
two and a half days, this
counter never got reset. And

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00:04:10,884 --> 00:04:14,121
when it overflowed, or when the
counter value went past the

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00:04:14,121 --> 00:04:17,791

highest value it could count to,
bad things happened in the code.

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00:04:17,791 --> 00:04:20,060

>>BRIAN V: Once we discovered
that, and knew there was an

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00:04:20,060 --> 00:04:22,162

overflow in the software, we
knew we didn't have our computer

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00:04:22,162 --> 00:04:24,631

problem. It was easy; now it was
just, now we just have to

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00:04:24,631 --> 00:04:29,169

recover. So by the time we
finished that and got back up

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00:04:29,169 --> 00:04:33,273

into science operating mode, it
was probably the middle of, end

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00:04:33,273 --> 00:04:36,510

of July 9th. So in plenty of
time for the observations.

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00:04:36,510 --> 00:04:39,012

>>HEIDI: Well as soon as we
heard that Hubble was back on

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00:04:39,012 --> 00:04:42,349

track, we were like, "Yes! Ready
to go!" >>HARRY: It allowed the

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00:04:42,349 --> 00:04:46,419

Shoemaker-Levy campaign to go
forward, and I'd hate to think

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00:04:46,419 --> 00:04:48,989

what would happen if we hadn't gotten the coprocessor in and

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00:04:48,989 --> 00:04:52,359

got it checked out. >>BRIAN R:
We retreated to our offices and

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00:04:52,359 --> 00:04:54,928

waited for the impact, wanted to see the pictures just like

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00:04:54,928 --> 00:04:57,764

everybody else did, so we were watching it on NASA TV just like

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00:04:57,764 --> 00:05:02,035

the rest of the world was. And I remember seeing a press

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00:05:02,035 --> 00:05:04,404

conference at the Science Institute announcing it and they

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00:05:04,404 --> 00:05:08,308

were waiting for the pictures, when Heidi Hammel came in waving

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00:05:08,308 --> 00:05:11,178

the picture, the first picture from Hubble. >>OFF-CAMERA VOICE:

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00:05:11,178 --> 00:05:14,114

Prepper shot, prepper shot, prepper shot! She's going in!

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00:05:14,114 --> 00:05:16,650

Camera 3! She's bursting in, she's bursting in! Go, Heidi!

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00:05:16,650 --> 00:05:20,520
[noise of press conference]

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00:05:20,520 --> 00:05:22,155
>>GENE: ...that probably
indicates

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00:05:22,155 --> 00:05:25,892
we're dealing with larger
objects than was concluded by

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00:05:25,892 --> 00:05:29,329
Asphaug and Benz. And I think we
may have some up-to-date

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00:05:29,329 --> 00:05:32,399
information from Heidi Hammel!
[laughter] >>HEIDI: Eugene

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00:05:32,399 --> 00:05:35,702
Shoemaker said he would be
personally astonished if we saw

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00:05:35,702 --> 00:05:39,906
nothing. Well he's not going to
be astonished. We actually saw

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00:05:39,906 --> 00:05:43,343
some amazing things. The comet
delivered. It delivered

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00:05:43,343 --> 00:05:47,280
big-time. It had big black
spots, and if you looked at

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00:05:47,280 --> 00:05:50,150
certain colors of light it had
white spots, and it had the

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00:05:50,150 --> 00:05:54,154
rings, and it had plumes, and it
had big giant storms! And I was

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00:05:54,154 --> 00:05:56,923
really proud to be a part of
that. And I was really proud

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00:05:56,923 --> 00:05:59,059
that all the engineers and
scientists could pull together

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00:05:59,059 --> 00:06:00,961
and make that happen.

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00:06:00,961 --> 00:06:05,298
[music]

107

00:06:05,298 --> 00:06:06,800
>>KATRINA: Comet
Shoemaker-Levy 9

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00:06:06,800 --> 00:06:09,903
added to our knowledge
of Jupiter's atmosphere
and the

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00:06:09,903 --> 00:06:12,405
physics of atmospheric
explosions, and even influenced

110

00:06:12,405 --> 00:06:15,108
some space policies on finding
near-Earth objects that could

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00:06:15,108 --> 00:06:18,879
impact us. Thanks to the entire
Hubble team, the telescope was

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00:06:18,879 --> 00:06:22,282
able to make these impactful
observations, and perform all of

113

00:06:22,282 --> 00:06:25,819
its incredible science over the
past 25-plus years. The stories

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00:06:25,819 --> 00:06:29,256
don't end here. Stay tuned for
more Hubble Memorable Moments.

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00:06:29,256 --> 00:06:31,758
[music ends]

116

00:06:31,758 --> 00:06:33,460
[spacecraft swooshes by]