



1
00:00:08,070 --> 00:00:04,020

[Music]

2
00:00:08,090 --> 00:00:12,090

Ted Gull: Eta Carinae is one of the most

3
00:00:12,110 --> 00:00:16,120

intriguing sources in the sky. And there's actually a large group of us

4
00:00:16,140 --> 00:00:20,180

around the world that are keenly interested in it.

5
00:00:20,200 --> 00:00:24,230

Tom Madura: Eta Carinae is one of the most massive stars in the galaxy, and it is also

6
00:00:24,250 --> 00:00:28,260

a very evolved massive star that we think is near the end of its

7
00:00:28,280 --> 00:00:32,290

lifetime. It is believed to be about 90 solar

8
00:00:32,310 --> 00:00:36,300

masses, and it was thought to be a single star star for the longest time,

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00:00:36,320 --> 00:00:40,320

but it turns out that we know that it is actually a binary system and there is a second

10
00:00:40,340 --> 00:00:44,350

star that we believe to be about 30 solar masses that exists

11
00:00:44,370 --> 00:00:48,360

in the system. In the 1840s, Eta Carinae

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00:00:48,380 --> 00:00:52,410

experienced what we call the "Great Eruption" where it blew out somewhere between

13
00:00:52,430 --> 00:00:56,430

10 and 40 times the mass of our sun in material.

14

00:00:56,450 --> 00:01:00,460

And that material formed this nebula that now surrounds the system.

15

00:01:00,480 --> 00:01:04,510

Ted: The nebula itself is a little bit large to map completely by Hubble,

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00:01:04,530 --> 00:01:08,530

and actually we did that a long time ago with the Space Telescope Imaging Spectrograph

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00:01:08,550 --> 00:01:12,570

However, we were only able to see evidence of the

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00:01:12,590 --> 00:01:16,610

dust, dusty regions. Tom: So, the thing that we did is

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00:01:16,630 --> 00:01:20,650

we had a international collaboration, and we used the

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00:01:20,670 --> 00:01:24,740

Very Large Telescope, in Chile, to do

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00:01:24,760 --> 00:01:28,770

spectroscopic mapping of the entire Homunculus Nebula, and what makes

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00:01:28,790 --> 00:01:32,840

our mapping unique is that previously only about

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00:01:32,860 --> 00:01:36,870

five slits had been used to map the entire Homunculus

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00:01:36,890 --> 00:01:40,890

whereas we used closer to 100 slits across the entire

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00:01:40,910 --> 00:01:44,940

length of the nebula to map everything including very small details.

26
00:01:44,960 --> 00:01:48,960
This is one of the first times we not only have a

27
00:01:48,980 --> 00:01:52,980
3D model for an astrophysical object, but we were actually able to take our

28
00:01:53,000 --> 00:01:57,010
3D model and print it on a 3D printer.

29
00:01:57,030 --> 00:02:01,050
Ted: What we find here is that there's dimples in the two lobes:

30
00:02:01,070 --> 00:02:05,090
here in the blue shifted--that which is approaching us--and in the red shifted

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00:02:05,110 --> 00:02:09,100
section here. And then most peculiarly, in between,

32
00:02:09,120 --> 00:02:13,130
where we might expect to see something fairly symmetrical around here, we see

33
00:02:13,150 --> 00:02:17,170
these two wings coming out, tilted both with respect to the

34
00:02:17,190 --> 00:02:21,180
bi-polar structure and with respect to the orbit of the two stars.

35
00:02:21,200 --> 00:02:25,240
Tom: That gives us very important information

36
00:02:25,260 --> 00:02:29,260
about the physical mechanisms that are responsible for forming the

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00:02:29,280 --> 00:02:33,280
nebula. For example: trying to determine whether or not it was a single

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00:02:33,300 --> 00:02:37,330

star that had an explosion, or if the binary had some

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00:02:37,350 --> 00:02:41,340

important effect on shaping the nebula. Ted: This new model tells

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00:02:41,360 --> 00:02:45,380

us that, potentially, the explosive event happened

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00:02:45,400 --> 00:02:49,390

when the stars were closest to each other, and that

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00:02:49,410 --> 00:02:53,410

the material that came out not only came out in the polar regions

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00:02:53,430 --> 00:02:57,450

but was shaped in the orbital plane, which is between

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00:02:57,470 --> 00:03:01,480

these two systems. It tells us that the explosion event

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00:03:01,500 --> 00:03:05,510

probably started on one side of the star and then propagated elsewhere.

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00:03:05,530 --> 00:03:09,530

Tom: Prior to these observations and the modeling, there was no

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00:03:09,550 --> 00:03:13,590

reason to think that binarity played any role

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00:03:13,610 --> 00:03:17,640

in the eruption or the forming and shaping of the homunculus.

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00:03:17,660 --> 00:03:21,660

But now that we have this more detailed model, it turns out that the

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00:03:21,680 --> 00:03:25,680

distance between each of these features is very similar to

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00:03:25,700 --> 00:03:29,730

measurements of the central binary, and so for the first time,

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00:03:29,750 --> 00:03:33,760

we have evidence that binarity played a role

53

00:03:33,780 --> 00:03:37,800

either in the Great Eruption itself, or in shaping

54

00:03:37,820 --> 00:03:41,850

the nebula after the initial explosion.