1
00:00:00,010 --> 00:00:04,020
(music)

2
00:00:04,040 --> 00:00:08,040
(Narrator) I am Stefan Immler, an astrophysicist

3
00:00:08,060 --> 00:00:12,060
at NASA's Goddard Space Flight Center. I'd like to

4
00:00:12,080 --> 00:00:16,100
take you on a tour of two nearby galaxies in our cosmic neighborhood,

5
00:00:16,120 --> 00:00:20,170
the Large and Small Magellanic Clouds, as captured in ultraviolet light

6
00:00:20,190 --> 00:00:24,200
by NASA's Swift satellite. These images are the highest-resolution

7
00:00:24,220 --> 00:00:28,240
wide-field surveys of the galaxies at ultraviolet wavelengths.

8
00:00:28,260 --> 00:00:32,320
Both of these galaxies are less then 200,000 light

9
00:00:32,340 --> 00:00:36,350
years away, and each contains a few hundred million stars

10
00:00:36,370 --> 00:00:40,390
like our sun. If you live or travelled to the Southern Hemisphere, you'll

11
00:00:40,410 --> 00:00:44,460
see both of these galaxies as faint cloudy patches in the night

12
00:00:44,480 --> 00:00:48,490
sky. Both galaxies orbit our own as well as each other.

13
00:00:48,510 --> 00:00:52,530

Of the two, the LMC is physically larger and nearer

14
00:00:52,550 --> 00:00:56,600
to us than the SMC. Their messy shapes are products of gravitational

15
00:00:56,620 --> 00:01:00,620
interactions between them, tidal forces from the much bigger Milky Way, and

16
00:01:00,640 --> 00:01:04,680
internal processes like star formation. In visible light,

17
00:01:04,700 --> 00:01:08,770
we see a mix of sun-like stars, along with pink patches that

18
00:01:08,790 --> 00:01:12,800
mark star-formation regions, where hydrogen gas is set aglow by the light

19
00:01:12,820 --> 00:01:16,860
of young stars. These are especially prominent in the LMC.

20
00:01:16,880 --> 00:01:20,970
Viewed at higher energies, in the UV, the LMC looks

21
00:01:20,990 --> 00:01:25,020
very different. This wavelength blocks out the older stars,

22
00:01:25,040 --> 00:01:29,090
mostly showing those less than 500 million years old.

23
00:01:29,110 --> 00:01:33,110
These galaxies are relatively small, but they're also very

24
00:01:33,130 --> 00:01:37,150
close to us. This means that they appear much larger than the field of view

25
00:01:37,170 --> 00:01:41,230
of Swift's telescope. So we had to take many different observations and

26
00:01:41,250 --> 00:01:45,260
stitch them together. Swift had to image 172 separate

27
00:01:45,280 --> 00:01:49,310
fields in 2,200 short snapshots to take in

28
00:01:49,330 --> 00:01:53,390
the whole galaxy. The LMC's most striking feature

29
00:01:53,410 --> 00:01:57,400
is the dramatic Tarantula Nebula. This is the most active

30
00:01:57,420 --> 00:02:01,440
star factory in any of the dozens of galaxies in

31
00:02:01,460 --> 00:02:05,530
the Local Group, which includes the Milk Way and Andromeda.

32
00:02:05,550 --> 00:02:09,540
Thousands of stars form each year within cool, dark

33
00:02:09,560 --> 00:02:13,590
molecular clouds. Once they start shining, they blow off their

34
00:02:13,610 --> 00:02:17,680
birth cloud with powerful outflows called stellar winds.

35
00:02:17,700 --> 00:02:21,700
These winds, in turn, sculpt the gases into the Tarantula's

36
00:02:21,720 --> 00:02:25,750
spider-like shape. One star here, named R136a1,

37
00:02:25,770 --> 00:02:29,810
is one of the most massive known, weighing more than

38
00:02:29,830 --> 00:02:33,840

260 times the sun. The LMC holds more than

39
00:02:33,860 --> 00:02:37,890
a thousand star clusters formed during previous rounds of star formation.

40
00:02:37,910 --> 00:02:41,960
We mostly see hot, young, luminous stars, plus a few stars

41
00:02:41,980 --> 00:02:45,990
in exotic stages as they near stellar death.

42
00:02:46,010 --> 00:02:50,050
Wherever there are hot, young and massive stars there are also

43
00:02:50,070 --> 00:02:54,130
supernovae. In 1987, the closest stellar explosion

44
00:02:54,150 --> 00:02:58,170
in more than 400 years occurred in the outskirts, of the Tarantula Nebula.

45
00:02:58,190 --> 00:03:02,230
Even 26 years later, the after glow of the explosion

46
00:03:02,250 --> 00:03:06,240
remains detectable in the ultraviolet.

47
00:03:06,260 --> 00:03:10,280
All told, the new Swift mosaics reveal about a million objects

48
00:03:10,300 --> 00:03:14,360
in the LMC and about 250,000 objects in the

49
00:03:14,380 --> 00:03:18,380
smaller, less massive and more distant SMC.

50
00:03:18,400 --> 00:03:22,420
For this mosaic of the SMC, Swift imaged about

51
00:03:22,440 --> 00:03:26,510
50 fields and took 656 snapshots.

52
00:03:26,530 --> 00:03:30,530
One interesting feature is the massive young

53
00:03:30,550 --> 00:03:34,560
star cluster NGC 346. It contains

54
00:03:34,580 --> 00:03:38,630
the SMC's brightest star, HD 5980,

55
00:03:38,650 --> 00:03:42,640
a triple star system where all members among the most luminous

56
00:03:42,660 --> 00:03:46,690
stars known. The intense light and strong outflows from these stars

57
00:03:46,710 --> 00:03:50,760
mold the surrounding gas into a shape resembling a cobweb.

58
00:03:50,780 --> 00:03:54,800
The Swift UV mosaics allow

59
00:03:54,820 --> 00:03:58,850
us to study the evolution of young stars in the LMC and SMC

60
00:03:58,870 --> 00:04:02,940
all in one view. That's impossible for us to do for our own galaxy

61
00:04:02,960 --> 00:04:06,970
because we're inside it. The images

62
00:04:06,990 --> 00:04:11,030
give us a panoramic window into how stars are born, evolve and die

63
00:04:11,050 --> 00:04:15,120

across two complete galaxies. That gives us fresh

64
00:04:15,140 --> 00:04:19,150
insight into the many ways stars transformed the universe

65
00:04:19,170 --> 00:04:23,210
into what we see around us today.

66
00:04:23,230 --> 00:04:27,280
Music