1
00:00:05,950 --> 00:00:09,660
- Hi, I'm Ellen Stofan,
also known as Dr. E.

2
00:00:09,660 --> 00:00:12,850
- And I'm Thomas Zurbuchen,
also known as Dr. Z.

3
00:00:12,850 --> 00:00:13,683
- [Dr. E] And we're here

4
00:00:13,683 --> 00:00:16,070
at the Smithsonian's
National Air and Space Museum

5
00:00:16,070 --> 00:00:19,240
for another episode of "EZ Science."

6
00:00:19,240 --> 00:00:20,550
Thomas, I'm really excited today

7
00:00:20,550 --> 00:00:22,380
because we're talking about a new mission

8
00:00:22,380 --> 00:00:24,030
that's going to launch soon,

9
00:00:24,030 --> 00:00:28,070
and it's studying the universe
using a different technique

10
00:00:28,070 --> 00:00:30,330
than one that most
people are familiar with.

11
00:00:30,330 --> 00:00:33,180
- That's right, it's an X-ray telescope.

12

00:00:33,180 --> 00:00:35,802
And it's actually an imaging polarimeter,

13
00:00:35,802 --> 00:00:37,870
also known as IXPE.

14
00:00:37,870 --> 00:00:38,850
It's an explorer mission,

15
00:00:38,850 --> 00:00:41,060
it's much smaller than
many of the other missions.

16
00:00:41,060 --> 00:00:44,170
And it's looking at X-rays
in entirely new ways.

17
00:00:44,170 --> 00:00:45,580
- You know, here at the
Air and Space Museum,

18
00:00:45,580 --> 00:00:47,080
we really try to talk to the public

19
00:00:47,080 --> 00:00:49,560
about how the fact that
we look at the universe

20
00:00:49,560 --> 00:00:52,270
using lots of different kinds of eyes.

21
00:00:52,270 --> 00:00:54,160
And by using those different eyes,

22
00:00:54,160 --> 00:00:56,300
we can actually learn much more.

23
00:00:56,300 --> 00:00:57,370
And what I mean by that

24
00:00:57,370 --> 00:00:59,360
is we're looking at different wavelengths

25
00:00:59,360 --> 00:01:01,270
'cause each of those wavelengths of light

26
00:01:01,270 --> 00:01:03,280
holds different information.

27
00:01:03,280 --> 00:01:04,410
So why X-rays?

28
00:01:04,410 --> 00:01:06,190
Most people are familiar
with a broken bone

29
00:01:06,190 --> 00:01:07,023
and getting an X-ray.

30
00:01:07,023 --> 00:01:09,430
Why do we look at space with X-rays?

31
00:01:09,430 --> 00:01:12,133
- An X-ray as opposed to
much of the other radiation

32
00:01:12,133 --> 00:01:13,860
that we see with our eyes,

33
00:01:13,860 --> 00:01:15,710
or even with our radio telescope,

34
00:01:15,710 --> 00:01:17,780
is really high energy radiation.

35
00:01:17,780 --> 00:01:22,780
So it comes from gases that

are over a million degrees hot.

36
00:01:22,797 --> 00:01:26,256
And so that X-ray comes from objects

37
00:01:26,256 --> 00:01:29,540
that we've read about, like
black holes, like pulsars,

38
00:01:29,540 --> 00:01:32,335
these amazing almost
lighthouse structures,

39
00:01:32,335 --> 00:01:35,760
very compact stars or exploding stars.

40
00:01:35,760 --> 00:01:37,630
That's what X-rays are coming from.

41
00:01:37,630 --> 00:01:38,670
- Well here at the Smithsonian,

42
00:01:38,670 --> 00:01:41,430
we're really proud of
the Chandra Observatory,

43
00:01:41,430 --> 00:01:43,280
which was launched by the Space Shuttle.

44
00:01:43,280 --> 00:01:46,230
There's a model of it up
behind me, and it's operated by

45
00:01:46,230 --> 00:01:48,260
the Smithsonian Astrophysical Observatory,

46
00:01:48,260 --> 00:01:51,080
the Center for Astrophysics up
in Cambridge, Massachusetts.

47
00:01:51,080 --> 00:01:52,940
So Chandra kind of led the way

48
00:01:52,940 --> 00:01:56,080
and has really given us this
rich view of the universe.

49
00:01:56,080 --> 00:01:56,913
- [Dr. Z] I have to tell you,

50
00:01:56,913 --> 00:01:59,780
Chandra is one of the
most productive missions

51
00:01:59,780 --> 00:02:00,740
we've ever done.

52
00:02:00,740 --> 00:02:03,840
Chandra, with its view
on the X-ray universe,

53
00:02:03,840 --> 00:02:05,070
has really transformed

54
00:02:05,070 --> 00:02:07,700
how we're looking at
not just our own galaxy,

55
00:02:07,700 --> 00:02:09,440
but also the galaxies around them

56
00:02:09,440 --> 00:02:11,880
and their relation to black holes.

57
00:02:11,880 --> 00:02:15,670
- Yeah, and obviously looking
at this high energy events,

58
00:02:15,670 --> 00:02:19,480
you know, like super massive
black holes, like nebulas,

59
00:02:19,480 --> 00:02:21,300
trying to understand how
do these things form,

60
00:02:21,300 --> 00:02:22,133
how do they happen?

61
00:02:22,133 --> 00:02:25,830
One of my favorite images or
areas that Chandra has studied

62
00:02:25,830 --> 00:02:27,340
is the Crab Nebula,

63
00:02:27,340 --> 00:02:29,090
and the reason that's so fascinating to me

64
00:02:29,090 --> 00:02:30,630
is first of all, it's actually something

65
00:02:30,630 --> 00:02:33,190
that humans have been able
to observe its history.

66
00:02:33,190 --> 00:02:38,010
So in 1054, Chinese and
Japanese astronomers,

67
00:02:38,010 --> 00:02:41,470
basically early astronomers,
saw a star explode.

68
00:02:41,470 --> 00:02:43,070
You know, this bright light in the skies.

69
00:02:43,070 --> 00:02:46,350
So here you have this
extremely energetic event.

70
00:02:46,350 --> 00:02:48,080
An explosion of a star

71
00:02:48,080 --> 00:02:50,560
and now as we observe the Crab Nebula,

72
00:02:50,560 --> 00:02:53,490
as you see the aftermath
of this explosion,

73
00:02:53,490 --> 00:02:56,590
X-rays are super useful for studying them.

74
00:02:56,590 --> 00:02:57,570
- Exactly right.

75
00:02:57,570 --> 00:02:59,820
And now let's look at IXPE
at what it's going to bring.

76
00:02:59,820 --> 00:03:02,100
So instead of just looking at X-rays

77
00:03:02,100 --> 00:03:06,850
the way Chandra has, just
looking at how many photons,

78
00:03:06,850 --> 00:03:08,800
kind of pieces of light are coming

79
00:03:08,800 --> 00:03:11,340
in the X-ray image in a given direction,

80
00:03:11,340 --> 00:03:13,970

it will also add the polarimetry,

81
00:03:13,970 --> 00:03:17,580
which is the direction in which the light,

82
00:03:17,580 --> 00:03:20,750
the electric field in the
radiation is oscillating.

83
00:03:20,750 --> 00:03:23,400
So there's enormously new information

84
00:03:23,400 --> 00:03:24,530
that's coming from that.

85
00:03:24,530 --> 00:03:26,220
- Now, most of us are
used to polarization,

86
00:03:26,220 --> 00:03:28,570
thinking about sunglasses,

87
00:03:28,570 --> 00:03:31,460
and allowing us to see much
better in bright sunlight.

88
00:03:31,460 --> 00:03:33,730
And that's because you
have light that vibrates

89
00:03:33,730 --> 00:03:35,280
in multiple directions.

90
00:03:35,280 --> 00:03:37,450
And so a polarizing lens

91
00:03:37,450 --> 00:03:40,440
allows you to clear out that information

92
00:03:40,440 --> 00:03:42,370
and reduce the glare,

93
00:03:42,370 --> 00:03:44,910
but there's information
in all of that vibration

94
00:03:44,910 --> 00:03:46,600
and that's what IXPE's
gonna get at, right?

95
00:03:46,600 --> 00:03:49,280
So all the different directions
with vibration of light,

96
00:03:49,280 --> 00:03:50,820
is telling us stuff.

97
00:03:50,820 --> 00:03:53,197
- Yeah, so let's give
an example, at the sun,

98
00:03:53,197 --> 00:03:55,960
but also in some of these
areas in astrophysics,

99
00:03:55,960 --> 00:03:58,440
we think, but we haven't seen it yet.

100
00:03:58,440 --> 00:04:01,650
There's magnetic fields that
are going in a given direction

101
00:04:01,650 --> 00:04:05,303
and electrons are going
around it super, super fast.

102
00:04:05,303 --> 00:04:08,760
Because they're bound to it

and they're emitting radiation.

103
00:04:08,760 --> 00:04:11,690
And it's oscillating, the
radiation is oscillating

104
00:04:11,690 --> 00:04:14,060
right perpendicular to
that magnetic field.

105
00:04:14,060 --> 00:04:15,840
We'll be able to detect that.

106
00:04:15,840 --> 00:04:18,020
So we'll see depressants
of magnetic fields,

107
00:04:18,020 --> 00:04:22,180
for example, at the Crab Nebula,
or if black holes rotate,

108
00:04:22,180 --> 00:04:26,000
there should be a rotational
pattern in that polarization.

109
00:04:26,000 --> 00:04:27,920
Just amazing stuff we can gain

110
00:04:27,920 --> 00:04:30,860
from really observing
the underlying processes.

111
00:04:30,860 --> 00:04:32,240
- I can't wait until IXPE launches.

112
00:04:32,240 --> 00:04:35,857
So when is it gonna launch and from where?

113
00:04:35,857 --> 00:04:38,950

- It's actually ready to get launched

114
00:04:38,950 --> 00:04:40,590
as early as December 9th.

115
00:04:40,590 --> 00:04:42,560
And it's gonna launch from the Cape,

116
00:04:42,560 --> 00:04:43,587
and guess where it's
launching from it's from?

117
00:04:43,587 --> 00:04:48,403
It's from the most famous
launchpad in all of NASA, 39A.

118
00:04:48,403 --> 00:04:51,490
So it's the first time a
dedicated science mission

119
00:04:51,490 --> 00:04:54,050
that is not the Shuttle
will launch from that pad.

120
00:04:54,050 --> 00:04:55,170
- Can't wait.