



1  
00:00:02,902 --> 00:00:03,670  
>> TO ANSWER SOME OF

2  
00:00:03,670 --> 00:00:05,372  
THE BIGGEST QUESTIONS

3  
00:00:05,372 --> 00:00:06,439  
ABOUT WHAT'S OUT THERE

4  
00:00:06,439 --> 00:00:07,440  
IN THE UNIVERSE

5  
00:00:07,440 --> 00:00:08,908  
AND WHAT IT ALL MEANS,

6  
00:00:08,908 --> 00:00:11,378  
WE NEED POWERFUL TELESCOPES.

7  
00:00:11,378 --> 00:00:13,179  
NASA UNRAVELS THE MYSTERIES

8  
00:00:13,179 --> 00:00:14,514  
OF THE COSMOS,

9  
00:00:14,514 --> 00:00:16,816  
USING OBSERVATORIES IN SPACE

10  
00:00:16,816 --> 00:00:18,618  
THAT STUDY DIFFERENT WAVELENGTHS

11  
00:00:18,618 --> 00:00:20,854  
AND PROPERTIES OF LIGHT.

12  
00:00:20,854 --> 00:00:22,322  
THE IMAGING X-RAY

13  
00:00:22,322 --> 00:00:25,492

POLARIMETRY EXPLORER, OR IXPE,

14

00:00:25,492 --> 00:00:26,760

WILL STUDY X-RAYS

15

00:00:26,760 --> 00:00:28,495

FROM SOME OF THE MOST EXTREME

16

00:00:28,495 --> 00:00:30,296

OBJECTS IN THE UNIVERSE,

17

00:00:30,296 --> 00:00:33,833

LIKE BLACK HOLES IN A NEW WAY.

18

00:00:33,833 --> 00:00:35,001

IXPE WILL LOOK AT

19

00:00:35,001 --> 00:00:36,836

A SPECIAL PROPERTY OF X-RAYS

20

00:00:36,836 --> 00:00:38,505

THAT HAS GONE MOSTLY UNEXPLORED

21

00:00:38,505 --> 00:00:39,806

UNTIL NOW,

22

00:00:39,806 --> 00:00:41,808

IS CALLED POLARIZATION.

23

00:00:42,942 --> 00:00:43,810

X-RAYS COME FROM

24

00:00:43,810 --> 00:00:44,778

THE HOTTEST PLACES

25

00:00:44,778 --> 00:00:46,079

IN THE UNIVERSE.

26  
00:00:46,079 --> 00:00:48,681  
IMAGINE POWERFUL EXPLOSIONS,

27  
00:00:48,681 --> 00:00:50,583  
VIOLENT COLLISIONS,

28  
00:00:50,583 --> 00:00:52,752  
AND STRONG MAGNETIC FIELDS

29  
00:00:52,752 --> 00:00:54,220  
CREATING CHAOS

30  
00:00:54,220 --> 00:00:55,955  
IN THE DARKNESS OF DEEP SPACE.

31  
00:00:57,090 --> 00:00:58,258  
X-RAY TELESCOPES

32  
00:00:58,258 --> 00:01:00,059  
CAN TRACE CLOUDS OF GAS

33  
00:01:00,059 --> 00:01:02,595  
HEATED TO MILLIONS OF DEGREES

34  
00:01:02,595 --> 00:01:03,830  
AND DETECT THE SHOWER

35  
00:01:03,830 --> 00:01:05,899  
OF PARTICLES FUELED BY

36  
00:01:05,899 --> 00:01:08,535  
A FEEDING BLACK HOLE.

37  
00:01:08,535 --> 00:01:09,869  
BUILDING ON THE DISCOVERIES

38  
00:01:09,869 --> 00:01:11,271

OF NASA'S CHANDRA

39

00:01:11,271 --> 00:01:12,739

X-RAY OBSERVATORY

40

00:01:12,739 --> 00:01:14,908

AND OTHER SPACE TELESCOPES,

41

00:01:14,908 --> 00:01:16,676

IXPE MEASURES THE ORIENTATION

42

00:01:16,676 --> 00:01:17,877

OF X-RAYS FROM SOME OF

43

00:01:17,877 --> 00:01:19,279

THE MOST BRILLIANT

44

00:01:19,279 --> 00:01:21,881

AND BIZARRE OBJECTS IN SPACE.

45

00:01:21,881 --> 00:01:23,483

LIKE ALL FORMS OF LIGHT,

46

00:01:23,483 --> 00:01:25,218

X-RAYS CONSIST OF MOVING

47

00:01:25,218 --> 00:01:27,854

ELECTRIC AND MAGNETIC WAVES.

48

00:01:27,854 --> 00:01:29,989

USUALLY, THE PEAKS AND VALLEYS

49

00:01:29,989 --> 00:01:30,790

OF THESE WAVES

50

00:01:30,790 --> 00:01:32,992

MOVE IN RANDOM DIRECTIONS.

51  
00:01:32,992 --> 00:01:34,027  
POLARIZED LIGHT

52  
00:01:34,027 --> 00:01:35,528  
IS MORE ORGANIZED,

53  
00:01:35,528 --> 00:01:36,863  
WITH THE TWO TYPES OF WAVES

54  
00:01:36,863 --> 00:01:38,832  
VIBRATING IN THE SAME DIRECTION.

55  
00:01:40,099 --> 00:01:41,000  
YOU MIGHT HAVE HEARD

56  
00:01:41,000 --> 00:01:42,769  
OF POLARIZED SUNGLASSES.

57  
00:01:42,769 --> 00:01:44,003  
BOATERS AND FISHERMEN

58  
00:01:44,003 --> 00:01:45,238  
USE THESE LENSES

59  
00:01:45,238 --> 00:01:47,273  
TO REDUCE GLARE FROM SUNLIGHT

60  
00:01:47,273 --> 00:01:49,442  
ACROSS A BODY OF WATER.

61  
00:01:49,442 --> 00:01:51,244  
WATER REFLECTS LIGHT IN A WAY

62  
00:01:51,244 --> 00:01:52,612  
THAT CAUSES SOME OF IT

63  
00:01:52,612 --> 00:01:54,547

TO VIBRATE IN A DIRECTION

64  
00:01:54,547 --> 00:01:57,250  
PARALLEL TO THE WATER'S SURFACE.

65  
00:01:57,250 --> 00:01:58,985  
POLARIZED LENSES BLOCK LIGHT

66  
00:01:58,985 --> 00:02:00,687  
MOVING HORIZONTALLY,

67  
00:02:00,687 --> 00:02:03,089  
BUT LET OTHER LIGHT THROUGH.

68  
00:02:03,089 --> 00:02:04,958  
MUCH LIKE THE WAY LIGHT CHANGES

69  
00:02:04,958 --> 00:02:06,993  
WHEN IT BOUNCES OFF OF WATER,

70  
00:02:06,993 --> 00:02:07,961  
IN SPACE,

71  
00:02:07,961 --> 00:02:09,362  
LIGHT BECOMES POLARIZED

72  
00:02:09,362 --> 00:02:09,929  
DEPENDING ON

73  
00:02:09,929 --> 00:02:11,097  
WHERE IT COMES FROM

74  
00:02:11,097 --> 00:02:13,299  
AND WHAT IT PASSES THROUGH.

75  
00:02:13,299 --> 00:02:14,567  
BY MEASURING THE AMOUNT

76  
00:02:14,567 --> 00:02:16,970  
AND DIRECTION OF POLARIZATION,

77  
00:02:16,970 --> 00:02:18,671  
IXPE GIVES US CLUES

78  
00:02:18,671 --> 00:02:20,707  
ABOUT THE SHAPES, STRUCTURES,

79  
00:02:20,707 --> 00:02:21,841  
AND INNERWORKINGS

80  
00:02:21,841 --> 00:02:23,576  
OF ALL TYPES OF OBJECTS

81  
00:02:23,576 --> 00:02:25,478  
THAT SHINE IN BRIGHT X-RAYS.

82  
00:02:27,347 --> 00:02:29,082  
THE IXPE OBSERVATORY HAS

83  
00:02:29,082 --> 00:02:31,117  
THREE IDENTICAL TELESCOPES,

84  
00:02:31,117 --> 00:02:32,886  
WITH THREE MAIN PARTS:

85  
00:02:32,886 --> 00:02:35,355  
MIRRORS, DETECTORS,

86  
00:02:35,355 --> 00:02:36,656  
AND AN EXTENDABLE MAST,

87  
00:02:36,656 --> 00:02:37,790  
OR BOOM,

88  
00:02:37,790 --> 00:02:39,659

THAT SEPARATES THEM.

89

00:02:39,659 --> 00:02:41,094

EACH MIRROR ASSEMBLY

90

00:02:41,094 --> 00:02:43,930

CONTAINS 24 NESTED MIRRORS

91

00:02:43,930 --> 00:02:45,999

THAT COLLECT AND FOCUS X-RAYS.

92

00:02:47,066 --> 00:02:48,635

LOCATED AT THE FOCAL POINT

93

00:02:48,635 --> 00:02:50,003

OF THE MIRRORS,

94

00:02:50,003 --> 00:02:51,704

SENSITIVE DETECTORS

95

00:02:51,704 --> 00:02:53,606

MADE WITH INTERNATIONAL PARTNERS

96

00:02:53,606 --> 00:02:55,475

IN ITALY ARE THE SECRET

97

00:02:55,475 --> 00:02:57,076

BEHIND IXPE'S UNIQUE

98

00:02:57,076 --> 00:02:58,711

X-RAY VISION.

99

00:02:58,711 --> 00:02:59,812

THEY TRACK AND MEASURE

100

00:02:59,812 --> 00:03:01,047

ALL FOUR PROPERTIES

101  
00:03:01,047 --> 00:03:02,649  
OF INCOMING LIGHT--

102  
00:03:02,649 --> 00:03:05,218  
ITS ARRIVAL TIME, DIRECTION,

103  
00:03:05,218 --> 00:03:07,587  
ENERGY, AND MOST IMPORTANTLY,

104  
00:03:07,587 --> 00:03:09,522  
POLARIZATION.

105  
00:03:09,522 --> 00:03:10,557  
OVER THE TWO YEARS

106  
00:03:10,557 --> 00:03:12,025  
OF ITS PRIME MISSION,

107  
00:03:12,025 --> 00:03:13,660  
IXPE WILL OBSERVE MORE THAN

108  
00:03:13,660 --> 00:03:16,362  
50 BRILLIANT OBJECTS--

109  
00:03:16,362 --> 00:03:17,263  
LIKE THE LEFTOVERS

110  
00:03:17,263 --> 00:03:19,065  
OF HUGE STARS THAT EXPLODED

111  
00:03:19,065 --> 00:03:21,501  
INTO SUPERNOVAE.

112  
00:03:21,501 --> 00:03:23,136  
THE SUPERMASSIVE BLACK HOLE

113  
00:03:23,136 --> 00:03:24,337

## AT THE HEART OF OUR OWN

114

00:03:24,337 --> 00:03:26,706

MILKY WAY GALAXY

115

00:03:26,706 --> 00:03:28,841

AND PULSARS, THE DENSE REMAINS

116

00:03:28,841 --> 00:03:31,744

OF STARS THAT ONCE WERE.

117

00:03:31,744 --> 00:03:32,946

THESE OBSERVATIONS

118

00:03:32,946 --> 00:03:33,947

WILL HELP SCIENTISTS

119

00:03:33,947 --> 00:03:36,316

TACKLE LONG-STANDING PUZZLES,

120

00:03:36,316 --> 00:03:38,151

LIKE TESTING COMPETING THEORIES

121

00:03:38,151 --> 00:03:40,453

ABOUT PULSARS AND THE DETAILS

122

00:03:40,453 --> 00:03:42,288

OF HOW OF EINSTEIN'S THEORY

123

00:03:42,288 --> 00:03:44,757

OF GENERAL RELATIVITY WORKS.

124

00:03:44,757 --> 00:03:46,526

NEW INSIGHTS FROM IXPE

125

00:03:46,526 --> 00:03:47,427

WILL HELP US PAINT

126

00:03:47,427 --> 00:03:48,528

A FULLER PICTURE

127

00:03:48,528 --> 00:03:49,729

OF THE UNIVERSE-

128

00:03:49,729 --> 00:03:51,898

CONFIRMING OR CONFOUNDING