

OSIRIS-REx  
TECHNOLOGY



REX IS

1  
00:00:01,001 --> 00:00:12,079  
[music]

2  
00:00:12,079 --> 00:00:15,115  
NASA's OSIRIS-REx spacecraft is  
equipped with a suite of

3  
00:00:15,115 --> 00:00:18,285  
instruments designed to study  
its target: a near-earth

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00:00:18,285 --> 00:00:23,357  
asteroid called Bennu. One such  
instrument is called REXIS – The

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00:00:23,357 --> 00:00:27,060  
Regolith X-Ray Imaging  
Spectrometer. That complex name

6  
00:00:27,060 --> 00:00:31,398  
matches its complex task. "REXIS  
is something completely

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00:00:31,398 --> 00:00:34,935  
different than the rest of the  
instruments aboard OSIRIS-REx.

8  
00:00:34,935 --> 00:00:38,939  
And that's because REXIS will  
detect elements – the individual

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00:00:38,939 --> 00:00:42,743  
atomic elements that make up  
this asteroid. Everything else

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00:00:42,743 --> 00:00:47,314  
is mapping the geology or the  
interior or even the mineral

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00:00:47,314 --> 00:00:51,852  
structure, and we are at the  
most fundamental level looking

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00:00:51,852 --> 00:00:55,589  
at what this asteroid is made  
out of." REXIS works off of how

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00:00:55,589 --> 00:00:58,725  
the Sun's X-ray light interacts  
with the surface material

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00:00:58,725 --> 00:01:02,729  
covering Bennu. Atoms on the  
asteroid absorb these X-rays,

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00:01:02,729 --> 00:01:06,066  
causing their electron levels to  
temporarily change and emit

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00:01:06,066 --> 00:01:09,436  
their own X-rays. These  
re-emitted X-rays have a

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00:01:09,436 --> 00:01:12,239  
specific energy that tells us  
about the atom that they came

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00:01:12,239 --> 00:01:16,376  
from. This process is called  
fluorescence, but you can think

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00:01:16,376 --> 00:01:20,514  
of it like a glow. REXIS is a  
telescope that images that X-ray

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00:01:20,514 --> 00:01:23,583  
glow which allows scientists to  
create a map of the different

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00:01:23,583 --> 00:01:26,653  
elements present on Bennu's  
surface. And REXIS has the

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00:01:26,653 --> 00:01:30,424  
ability to do all this based on  
its design and its position on

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00:01:30,424 --> 00:01:34,594  
the spacecraft. "REXIS is about  
the size of a shoebox. It's

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00:01:34,594 --> 00:01:37,731  
located on the main instrument  
deck of the OSIRIS-REx

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00:01:37,731 --> 00:01:40,634  
spacecraft – basically this is  
the side that's always facing

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00:01:40,634 --> 00:01:44,104  
the asteroid." "The pieces of  
the REXIS instrument are  
composed

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00:01:44,104 --> 00:01:48,909  
of two primary parts. We have  
the main REXIS telescope, which

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00:01:48,909 --> 00:01:53,380  
views the asteroid Bennu – it's  
consisting of four CCDs that

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00:01:53,380 --> 00:01:57,250  
look through a coded aperture  
mask. The coded aperture mask is

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00:01:57,250 --> 00:02:01,121  
just a stainless steel plate  
with a number of holes that are

31  
00:02:01,121 --> 00:02:04,458  
known to us. The second part of  
the X-ray instrument is called

32  
00:02:04,458 --> 00:02:09,196  
the Solar X-ray Monitor, or the  
SXM. The SXM is viewing the Sun

33  
00:02:09,196 --> 00:02:12,165  
at all times so that we can  
monitor the X-ray spectrum, the

34  
00:02:12,165 --> 00:02:15,869  
solar x-ray spectrum incident on  
the surface of the asteroid."

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00:02:15,869 --> 00:02:20,040  
"The Solar X-ray Monitor let's  
us calibrate out the day-to-day,

36  
00:02:20,040 --> 00:02:23,410  
even the hour-to-hour,  
variations in the X-ray flux

37  
00:02:23,410 --> 00:02:27,647  
that comes from the Sun." So  
like your digital camera or

38  
00:02:27,647 --> 00:02:31,218  
camera phone, the main  
spectrometer uses a light  
sensor, known as a

39  
00:02:31,218 --> 00:02:35,455  
CCD or charge-coupled device. In  
this case there are four of

40  
00:02:35,455 --> 00:02:39,693  
them, and they're only sensitive  
to X-ray light. Before the X-ray

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00:02:39,693 --> 00:02:43,530  
photons from Bennu are detected  
by the CCDs, however, they pass

42  
00:02:43,530 --> 00:02:46,133  
through a mask with a random  
pattern of open and closed

43  
00:02:46,133 --> 00:02:50,370  
holes. By analyzing how the  
shadow of the mask pattern is

44  
00:02:50,370 --> 00:02:53,907  
shifted on the CCDs, scientists  
can determine the location of

45  
00:02:53,907 --> 00:02:57,477  
the X-rays coming from the  
asteroid's surface. This is how

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00:02:57,477 --> 00:03:01,281  
REXIS images Bennu. And one  
surprising aspect of the REXIS

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00:03:01,281 --> 00:03:05,318  
instrument is the team that  
built it: students from MIT and

48  
00:03:05,318 --> 00:03:08,188  
Harvard. "The students are  
fantastic to work with, they're

49  
00:03:08,188 --> 00:03:11,258  
so eager to learn. It's been  
great sort of watching them as

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00:03:11,258 --> 00:03:14,294  
they grow in this experience.  
And I think they've come with

51  
00:03:14,294 --> 00:03:17,364  
some interesting ideas and some  
ways of looking at it that we

52  
00:03:17,364 --> 00:03:20,400  
may not have had had we been  
with someone who's been doing

53  
00:03:20,400 --> 00:03:23,370  
this for, you know, years and  
years and years." "Other  
missions

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00:03:23,370 --> 00:03:26,973  
have had x-ray spectrometers  
onboard, but not nearly the

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00:03:26,973 --> 00:03:30,077  
level of sensitivity and  
sophistication of REXIS. And

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00:03:30,077 --> 00:03:34,181  
this really is a new generation,  
a next-generation in X-ray

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00:03:34,181 --> 00:03:37,918  
imaging for planetary science,  
and it's all being done by