



1
00:00:00,640 --> 00:00:06,460

Music

2
00:00:06,460 --> 00:00:10,960

Narrator: Two wide rings of high-intensity particles encircle our planet's equator.

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00:00:10,960 --> 00:00:16,840

Known as the Van Allen Radiation Belts, their behavior in response to the sun directly impacts

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00:00:16,840 --> 00:00:19,590

life on Earth and in orbit.

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00:00:19,590 --> 00:00:21,150

Nicky Fox, Deputy Project Scientist/Johns Hopkins University Applied Physics Laboratory :

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00:00:21,150 --> 00:00:24,600

We live in the atmosphere of the sun. So when the sun sneezes, the Earth catches a cold.

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00:00:24,600 --> 00:00:31,800

So whatever is happening on the sun, the Earth will feel an effect and will respond to that changing space weather.

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00:00:31,800 --> 00:00:37,890

Narrator: NASA's two-year Radiation Belt Storm Probes mission aims to study this ever-changing space environment

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00:00:37,890 --> 00:00:40,210

in greater detail than ever before.

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00:00:40,210 --> 00:00:42,170

Jim Stratton, Mission Systems Engineer/Johns Hopkins University Applied Physics Laboratory: Definitely the biggest

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00:00:42,170 --> 00:00:46,770

challenge that we face is the radiation environment that the probes are going to be flying through.

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00:00:46,770 --> 00:00:52,040

Most spacecraft try to avoid the radiation belts -- and we're going to be flying right through the heart of them.

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00:00:52,040 --> 00:00:58,150

Narrator: The mission's twin probes will help scientists characterize changes within the radiation belts.

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00:00:58,150 --> 00:01:04,670

An advanced instrument suite on each probe offers a complement of new, state-of-the-art tools in the quest

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00:01:04,670 --> 00:01:09,390

to learn more about this mysterious and powerful region surrounding our planet.

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00:01:09,390 --> 00:01:14,170

Stratton: So the Radiation Belt Storm Probes will actually give us a better understanding of how the radiation

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00:01:14,170 --> 00:01:19,220

belts actually work, and allow us to do a better job of predicting and protecting against the

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00:01:19,220 --> 00:01:21,750

radiation that's up there in the future.

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00:01:21,750 --> 00:01:26,240

Narrator: The discovery of the radiation belts dates all the way back to 1958.

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00:01:26,240 --> 00:01:31,090

That's when NASA launched its first spacecraft, Explorer 1, built by James Van Allen and

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00:01:31,090 --> 00:01:37,730

his team from the University of Iowa. More than half a century later, RBSP will carry an array of

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00:01:37,730 --> 00:01:42,340

instruments designed to measure the properties of charged particles speeding through the

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00:01:42,340 --> 00:01:47,490

radiation belts, as well as the plasma waves, electric fields and magnetic fields

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00:01:47,490 --> 00:01:50,130

that transport and guide those particles.

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00:01:50,130 --> 00:01:54,040

Fox: There are particle instruments that literally go from very, very low energies

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00:01:54,040 --> 00:01:58,620

around the plasma energies that we're interested in, the slow-moving,

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00:01:58,620 --> 00:02:06,030

cold, dense plasma that we want to measure, up to extremely high proton energies that we see.

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00:02:06,030 --> 00:02:10,720

They're the very dangerous, fast-moving, very high-energy protons that are in the inner belt.

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00:02:10,720 --> 00:02:17,050

We also have instruments that measure both magnetic and electric fields.

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00:02:17,050 --> 00:02:22,080

Narrator: The RBSP mission is part of NASA's Living with a Star program, which is managed by the

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00:02:22,080 --> 00:02:28,960

agency's Goddard Space Flight Center in Greenbelt, Maryland. Built by the Johns Hopkins University Applied P

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00:02:28,960 --> 00:02:34,440

Laboratory in Laurel, Maryland, the eight-sided probes are basically identical.

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00:02:34,440 --> 00:02:40,560

Each weighs in at more than 1,400 pounds, and measures about six feet wide by three feet high.

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00:02:40,560 --> 00:02:43,410

But don't let their compact size fool you.

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00:02:43,410 --> 00:02:49,910

The sensors measuring magnetic fields are mounted on booms that will extend nearly 10 feet from the spacec

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00:02:49,910 --> 00:02:55,270

and the electric fields instruments are set at the ends of long antennae, which will stretch up to more than

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00:02:55,270 --> 00:03:00,400

160 feet away -- tip to tip, the length of a football field.

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00:03:00,400 --> 00:03:04,300

These booms are tucked away inside the spacecraft during launch.

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00:03:04,300 --> 00:03:09,880

They'll be deployed after the probes reach orbit. The long booms help distance these sensitive

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00:03:09,880 --> 00:03:15,880

instruments from the immediate vicinity of the spacecraft's own electric and magnetic fields.

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00:03:15,880 --> 00:03:21,870

Data filters and metal shielding on spacecraft electronics also helps prevent interference.

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00:03:21,870 --> 00:03:26,380

The result is a magnetically and electrically "clean" spacecraft.

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00:03:26,380 --> 00:03:30,530

Stratton: And so as we're going through these big solar storms and these high-radiation environments,

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00:03:30,530 --> 00:03:34,400

the instrumentation will just keep going, our data recorders will just keep going, and we'll be able to

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00:03:34,400 --> 00:03:38,090

capture all that great information about what's going on.

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00:03:38,090 --> 00:03:44,480

Narrator: But before RBSP and its science team can get to work, it has to endure the journey into space.

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00:03:44,480 --> 00:03:50,120

This isn't the first time NASA's Launch Services Program has prepared two probes for liftoff.

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00:03:50,120 --> 00:03:54,890

In 2006 the twin STEREO spacecraft were launch, and just a year ago, the

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00:03:54,890 --> 00:04:01,500

launch team was gearing up for the GRAIL mission, which sent two spacecraft to the moon in September 2011

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00:04:01,500 --> 00:04:05,440

Tim Dunn, RBSP Launch Director/NASA's Launch Services Program: For GRAIL, we were able to launch the

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00:04:05,440 --> 00:04:10,640

two GRAIL probes side-by-side within the fairing. And that was because they were much smaller and

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00:04:10,640 --> 00:04:17,880

about half the weight of RBSP. RBSP, a larger spacecraft, we're going to launch them in a stacked

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00:04:17,880 --> 00:04:24,490

configuration with the A spacecraft on top, inside the Atlas V payload fairing.

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00:04:24,490 --> 00:04:29,480

Narrator: The twin spacecraft are launching from Cape Canaveral Air Force Station aboard an Atlas V rocket

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00:04:29,480 --> 00:04:32,080

built by United Launch Alliance.

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00:04:32,080 --> 00:04:38,290

Dunn: NASA has an excellent history with the Atlas V rocket. As a matter of fact, we are 100 percent,

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00:04:38,290 --> 00:04:46,790

six for six, launching on Atlas V. We have launched missions to Jupiter, Pluto, the sun, the moon,

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00:04:46,790 --> 00:04:53,780

and two missions to Mars. So we're very excited with RBSP being the seventh NASA mission on an Atlas V.

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00:04:53,780 --> 00:04:58,600

Narrator: During prelaunch integration and testing, working with two probes --

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00:04:58,600 --> 00:05:01,790

rather than the usual one -- was fairly straightforward for the team.

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00:05:01,790 --> 00:05:04,340

Rex Engelhardt, RBSP Mission Manager/NASA's Launch Services Program: Essentially for most of the proces

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00:05:04,340 --> 00:05:08,070

the integration, it's a single spacecraft. But when you get down to the aspects of the details of the

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00:05:08,070 --> 00:05:12,690

separation and some of the on-orbit operations, it's two.

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00:05:12,690 --> 00:05:16,500

Narrator: After launch, each spacecraft will head off into a different orbit.

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00:05:16,500 --> 00:05:21,580

That means the rocket's Centaur upper stage has to spin up and deploy the first probe...

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00:05:21,580 --> 00:05:27,060

and then stop the spin, and move to a new orientation for release of the second probe.

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00:05:27,060 --> 00:05:30,700

Engelhardt: Then you've got to point it in the right direction, spin it back up again,

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00:05:30,700 --> 00:05:37,040

separate the second one, then you've got to spin the Centaur back down again, and quietly back away.

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00:05:37,040 --> 00:05:41,500

Narrator: The mission starts with a 60-day "commissioning period" so the team can check the probes'

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00:05:41,500 --> 00:05:45,840

health and activate the instruments to ensure they're working properly.

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00:05:45,840 --> 00:05:50,300

It's also when the team will extend the instrument booms away from the spacecraft.

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00:05:50,300 --> 00:05:53,520

Stratton: To do those EFW boom deploys, we spin up to about 15 rpm, because just like a figure skater,

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00:05:53,520 --> 00:05:57,320

as they start putting the arms out, they're going to slow down. And so we spin the spacecraft up,

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00:05:57,320 --> 00:06:03,430

and do partial deploys on those booms, and then spin it up, and do another partial on those booms.

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00:06:03,430 --> 00:06:07,200

And it actually takes about two weeks to get all of those booms deployed all the way out.

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00:06:07,200 --> 00:06:11,930

Narrator: The orbiting probes will lap one another, traveling at varying speeds and distances --

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00:06:11,930 --> 00:06:18,020

sometimes close together, sometimes far apart, but always within the radiation belts.

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00:06:18,020 --> 00:06:24,410

Having two probes will give scientists a way to compare data and see whether each change they see is isolated

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00:06:24,410 --> 00:06:27,380

or part of a larger trend.

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00:06:27,380 --> 00:06:35,320

Fox: So if you imagine having two buoys in the ocean, and one goes up, and comes down again, you don't

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00:06:35,320 --> 00:06:40,600

know anything about what caused that to go up and down. If both of them go up, then you know you've

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00:06:40,600 --> 00:06:45,750

got a very big feature that is affecting both of them at the same time. If you have, one goes up and then

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00:06:45,750 --> 00:06:49,970

the other one goes up, you can measure how fast that wave has traveled between them and what

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00:06:49,970 --> 00:06:54,190

direction it's going into. And if only one goes up and comes down again, then you've got a very,

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00:06:54,190 --> 00:06:57,680

very localized feature that didn't travel anywhere.

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00:06:57,680 --> 00:07:02,820

Narrator: The RBSP team has been working for 11 years to bring this mission to fruition.

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00:07:02,820 --> 00:07:08,760

Launch day can be a bittersweet time after so many years of preparation.

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00:07:08,760 --> 00:07:12,380

Stratton: There's a fair amount of nerves that go along with building a spacecraft, designing it,

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00:07:12,380 --> 00:07:17,650

testing it, we're always finding things that could work better, or don't work the way they should,

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00:07:17,650 --> 00:07:22,730

that we have to go fix. So once we get through launch and get the spacecraft up there, and check them out,

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00:07:22,730 --> 00:07:26,280

it's really going to be a great sense of relief but a great sense of accomplishment too.

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00:07:26,280 --> 00:07:30,170

We've got an amazing team that's been working on this for a long time.

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00:07:30,170 --> 00:07:36,500

Fox: I've had this mission longer than I've had my children. So for me, it's probably like sending your

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00:07:36,500 --> 00:07:39,790

children to college or something. You know, you bring them up the best you can,