1
00:00:00,849 --> 00:00:00,960
(Music)

2
00:00:00,960 --> 00:00:04,400
Hey guys, this is Mike Meacham at the Jet Propulsion Laboratory and this is an episode

3
00:00:04,400 --> 00:00:09,130
of Crazy Engineering.

4
00:00:09,130 --> 00:00:12,950
(Music)

5
00:00:12,950 --> 00:00:17,120
Here at JPL, we have to solve problems that nobody's ever solved before and sometimes

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00:00:17,120 --> 00:00:19,770
the solutions can seem a little crazy.

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00:00:19,770 --> 00:00:23,510
Today we're going to talk about this bad boy, an ion thruster. What's so special

8
00:00:23,510 --> 00:00:27,539
about an ion thruster? What makes it different and how does it help us get through the solar

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00:00:27,539 --> 00:00:29,660
system? Let's go talk to an expert.

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00:00:29,660 --> 00:00:32,489
Alright guys, we found our expert. This is Marc Rayman.

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00:00:32,489 --> 00:00:34,809
Hi Mike.
Marc, where are we?

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00:00:34,809 --> 00:00:40,329
We're at a vacuum chamber here at JPL where
we test ion engines like this one and we have

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00:00:40,329 --> 00:00:44,449
three just like it on the Dawn spacecraft.
It's out in the main asteroid belt between

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00:00:44,449 --> 00:00:45,739
Mars and Jupiter.

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00:00:45,739 --> 00:00:49,519
Can you explain what makes an ion thruster
different than other types of thrusters?

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00:00:49,519 --> 00:00:52,960
Sure, well first, let's remind ourselves
how a regular rocket engine works.

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00:00:52,960 --> 00:00:57,519
You take a gas and you heat it up, or you
put it under pressure and you push it out

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00:00:57,519 --> 00:01:02,639
of the rocket nozzle, and the action of the
gas going out of the nozzle causes a reaction

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00:01:02,639 --> 00:01:05,519
that pushes the spacecraft in the other direction.

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00:01:05,519 --> 00:01:09,659
With ion engines, instead of heating the gas
up or putting it under pressure, we give the

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00:01:09,659 --> 00:01:16,450
gas xenon a little electric charge, then they're
called ions, and we use a big voltage to accelerate

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00:01:16,450 --> 00:01:22,909

the xenon ions thru this metal grid and we
shoot them out of the engine at up to 90,000

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00:01:22,909 --> 00:01:28,119
miles per hour. And they’re going out so
fast that each individual ion gives a relatively

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00:01:28,119 --> 00:01:30,210
large push back on the spacecraft.

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00:01:30,210 --> 00:01:34,090
So, if I’m the spacecraft could you push
me as hard as I’m going to feel from one

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00:01:34,090 --> 00:01:35,020
of these thrusters.

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00:01:35,020 --> 00:01:36,179
I can try.

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00:01:36,179 --> 00:01:38,880
Okay, I’m ready. I can take it.

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00:01:38,880 --> 00:01:39,659
(Blows air)

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00:01:39,659 --> 00:01:44,350
I barely felt that.
That’s right, the engine pushes on the spacecraft

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00:01:44,350 --> 00:01:48,320
as hard as this single piece of paper pushes
on my hand.

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00:01:48,320 --> 00:01:53,450
In the zero gravity, frictionless, environment
of space though, gradually the effect of this

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00:01:53,450 --> 00:01:54,869

thrust builds up.

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00:01:54,869 --> 00:01:59,469
At full throttle, it would take Dawn four
days to accelerate from zero to sixty miles

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00:01:59,469 --> 00:02:00,359
per hour.

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00:02:00,359 --> 00:02:01,999
Wow that’s a slow car, isn’t it?

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00:02:01,999 --> 00:02:07,380
It is, but instead of thrusting for four days,
if we thrust for a week or a year or as Dawn

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00:02:07,380 --> 00:02:12,000
already has, for almost five years, you can
build up fantastically high velocity.

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00:02:12,000 --> 00:02:15,470
It’s what I like to call acceleration with
patience.

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00:02:15,470 --> 00:02:19,110
Why is that a good thing? What’s the tradeoff?
What can Dawn do that other spacecraft cannot

41
00:02:19,110 --> 00:02:19,780
do?

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00:02:19,780 --> 00:02:24,750
The ion engine gives us the maneuverability
to go into orbit and after we’ve been there

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00:02:24,750 --> 00:02:29,030
for awhile, then to leave orbit and go on
to another destination and do the same thing.

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00:02:29,030 --> 00:02:34,700
In 57 years of space exploration, Dawn is
the first mission targeted to orbit any two

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00:02:34,700 --> 00:02:41,700
extraterrestrial destinations. It wouldn't
be possible without ion propulsion.

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00:02:42,110 --> 00:02:46,730
For two centuries, this has been just a little
smudge of light against the stars.

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00:02:46,730 --> 00:02:53,250
Dawn got to spend 14 months at Vesta and turned
it into a whole new complex, fascinating,

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00:02:53,250 --> 00:02:55,190
alien world.

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00:02:55,190 --> 00:02:59,950
Marc, where are we right now? This is the
Dawn mission control room at JPL. This is

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00:02:59,950 --> 00:03:04,120
where we control the spacecraft from; we tell
the spacecraft where to point the thruster,

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00:03:04,120 --> 00:03:07,630
what throttle level to use and that's how
we guide the spacecraft through the solar

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00:03:07,630 --> 00:03:08,370
system.

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00:03:08,370 --> 00:03:10,260
And we're on to the next location, which
is Ceres.

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00:03:10,260 --> 00:03:13,950
That's right, the dwarf planet, in fact

the first one ever discovered we’re going

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00:03:13,950 --> 00:03:17,590
to get into orbit very soon and the pictures
are going to be coming into this very room.

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00:03:17,590 --> 00:03:20,930
Very cool! Stay tuned for those photos and
stay tuned for some more Crazy Engineering.