



1  
00:00:00,100 --> 00:00:04,671  
Music

2  
00:00:04,671 --> 00:00:08,575  
Magnetic fields have been  
a curiosity for thousands  
of years.

3  
00:00:08,575 --> 00:00:11,078  
And so of course we know  
now that magnetic fields are

4  
00:00:11,078 --> 00:00:13,747  
generated by what's called  
dynamo action,

5  
00:00:13,747 --> 00:00:17,184  
the convective motion of an  
electrically conducting fluid.

6  
00:00:17,184 --> 00:00:20,020  
Even though we can map the  
Earth's magnetic field with

7  
00:00:20,020 --> 00:00:23,824  
extraordinary accuracy, with  
satellites in orbit about  
the Earth,

8  
00:00:23,824 --> 00:00:27,227  
the one thing we can't do  
is see clearly through all the

9  
00:00:27,227 --> 00:00:30,731  
crustal magnetization that  
is right beneath our feet.

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00:00:30,731 --> 00:00:34,201  
Jupiter is a gaseous planet,  
hydrogen, helium, there is no

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00:00:34,201 --> 00:00:38,839  
magnetized crust that obscures  
our view of the dynamo  
deep below.

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00:00:38,839 --> 00:00:41,441  
So the exciting part about the  
Jupiter mission is that

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00:00:41,441 --> 00:00:44,878  
we'll be able to image, for the  
first time, the magnetic field  
on the

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00:00:44,878 --> 00:00:49,483  
dynamo's surface in a way that  
would never ever be possible  
on Earth.

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00:00:49,483 --> 00:00:52,452  
Jupiter's also the planet  
with the largest magnetic field.

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00:00:52,452 --> 00:00:54,421  
Its magnetosphere is huge.

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00:00:54,421 --> 00:00:57,457  
If you were to look up into the  
night sky, and if you could see

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00:00:57,457 --> 00:01:00,093  
the outline of its  
magnetosphere, which you can't,

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00:01:00,093 --> 00:01:02,596  
it would be about the  
size of the Moon in the sky.

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00:01:02,596 --> 00:01:05,332

It's a very, very  
large magnetosphere.

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00:01:05,332 --> 00:01:09,236

In fact, in the Voyager program  
we learned that the  
magnetic tail,

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00:01:09,236 --> 00:01:11,638

the part of the magnetosphere  
that is drawn away

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00:01:11,638 --> 00:01:15,042

from the Sun, extends all the  
way out to the orbit of Saturn

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00:01:15,042 --> 00:01:16,843

and in all likelihood beyond.

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00:01:16,843 --> 00:01:19,913

It's a very large  
feature in our solar system.

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00:01:19,913 --> 00:01:23,050

It's a pity we can't see it.

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00:01:23,050 --> 00:01:27,354

Juno's the fastest spacecraft  
ever to venture into the outer  
solar system.

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00:01:27,354 --> 00:01:31,525

It's the first to orbit pole to  
pole about Jupiter,

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00:01:31,525 --> 00:01:35,128

and it's the most heavily  
shielded spacecraft that  
we've ever launched.

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00:01:35,128 --> 00:01:39,833

The mission is designed to basically wrap Jupiter in a

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00:01:39,833 --> 00:01:43,537

dense net of observations completely covering a sphere.

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00:01:43,537 --> 00:01:46,306

So to do that we need a polar orbit, one that passes over the

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00:01:46,306 --> 00:01:50,510

north pole, along a line of longitude, and over the south pole.

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00:01:50,510 --> 00:01:53,280

And we do this over the thirty-seven orbits of the

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00:01:53,280 --> 00:01:56,683

nominal mission, and by the time we're done we've got orbits

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00:01:56,683 --> 00:01:59,353

separated in longitude by about every twelve degrees,

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00:01:59,353 --> 00:02:02,155

so we completely cover the sphere.

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00:02:02,756 --> 00:02:07,294

A magnetometer is, uh, it's best to think of it as a fancy compass.

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00:02:07,294 --> 00:02:09,997

Unlike a compass that just records the direction of the

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00:02:09,997 --> 00:02:13,133  
magnetic field, our instrument  
tells you both what direction

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00:02:13,133 --> 00:02:15,635  
the field is in and  
what the magnitude is.

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00:02:15,635 --> 00:02:20,107  
And we can measure that very,  
very accurately, to a hundred  
parts per million.

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00:02:20,107 --> 00:02:23,644  
Juno's magnetometer is another  
in a long line of magnetometers

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00:02:23,644 --> 00:02:26,646  
built here at the Goddard Space  
Flight Center, following designs

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00:02:26,646 --> 00:02:29,016  
developed by Mario  
Acuña years ago.

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00:02:29,016 --> 00:02:32,552  
Our instrument is between one  
and two orders of magnitude more

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00:02:32,552 --> 00:02:35,422  
accurate than anything  
that's flown to Jupiter before.

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00:02:35,422 --> 00:02:38,725  
And of course part of that is  
the result of the star cameras

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00:02:38,725 --> 00:02:41,361  
that we're able to fly with

our sensors, so that we can

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00:02:41,361 --> 00:02:45,065

determine the absolute  
orientation in space of  
these sensors.

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00:02:45,065 --> 00:02:48,035

If we did not know the  
orientation of the sensor

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00:02:48,035 --> 00:02:51,038

as well as we can determine it  
with the star cameras,

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00:02:51,038 --> 00:02:53,640

we would lose accuracy in the  
vector measurement.

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00:02:53,640 --> 00:02:58,211

So we carry four star cameras  
with our two magnetometer  
sensors.

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00:02:58,211 --> 00:03:01,815

These have to be held in the  
same orientation with respect to

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00:03:01,815 --> 00:03:05,786

each other under very extreme  
environmental conditions.

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00:03:05,786 --> 00:03:09,723

So we designed what we call  
the magnetometer optical bench.

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00:03:09,723 --> 00:03:12,859

It's a special structure, about  
a square foot in size,

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00:03:12,859 --> 00:03:18,065  
that is made of a carbon silicon  
carbide material, almost  
impossible to machine,

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00:03:18,065 --> 00:03:22,536  
but once it's fabricated and the  
sensors are assembled, they act  
as one.

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00:03:22,536 --> 00:03:25,705  
And that's one of the reasons  
why we can achieve much higher

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00:03:25,705 --> 00:03:29,342  
accuracy than has ever  
been attempted before.

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00:03:29,342 --> 00:03:33,180  
We hope to learn more about how  
a magnetic field is generated

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00:03:33,180 --> 00:03:36,183  
by dynamo action deep in  
a planet's interior.

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00:03:36,183 --> 00:03:39,853  
For me, the great excitement is  
the opportunity to look down

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00:03:39,853 --> 00:03:43,557  
and get the first clear,  
unobstructed view of what the

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00:03:43,557 --> 00:03:47,761  
magnetic field looks like on the  
surface of a dynamo where  
it's generated.

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00:03:47,761 --> 00:03:51,765  
It's always incredible to be the

first person in the world to  
see anything.

69

00:03:51,765 --> 00:03:56,169

We stand to be the first to  
be able to look down upon  
the dynamo