

Spirit's Journey to the Center of Mars

February 26 2010, by Dauna Coulter



Spirit's view of its own predicament. The rover is now parked for the winter with its solar panels tilted 9 degrees away from the sun.

Mars rover Spirit has tenaciously swept, scraped, and squeezed secrets from the forbidding surface of Mars for 6 years. Now at an impasse, up to its belly in sand, it has struggled to tilt its solar panels toward the sun and collect just enough power to survive the perilously cold Martian winter. If Spirit can make it through to spring, the feisty robot will prove it's still in the game--by solving the mysteries of the Martian core.

Unlocking those secrets will require the guile of a veteran explorer. Like a wily old baseball pitcher who uses knuckle balls to keep winning, the aging Spirit still has a few tricks up its sleeve. It will do its next trick

without moving a single mechanical muscle.

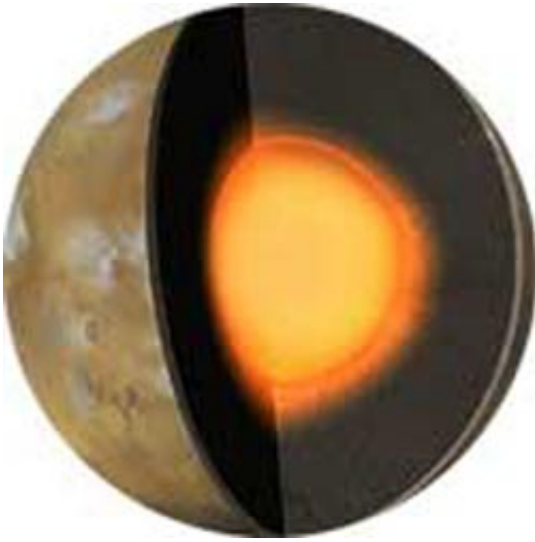
"In this case, it's a good thing Spirit is immobile," says principal investigator Steve Squyres. "We can track its radio signal to determine its motion through space."

[Mars](#) is rotating around its own axis and orbiting the Sun. With the rover stationary, the radio's only motion will be the motion of Mars. Because the scientists already know the specifics of the red planet's orbit, they'll be able to use Spirit's radio signal to hone in on how the planet spins around its own axis.

"Mars wobbles, or precesses, as it spins," says Bruce Banerdt of NASA's Jet Propulsion Laboratory. "We'll measure that wobble by looking at the Doppler shift of Spirit's radio signal."

"Mars completes an entire wobble only once every 170,000 years," he continues. "So we'll be measuring a very tiny motion—looking at minute changes. But these miniscule numbers speak volumes about Mars' core."

First, it will help scientists figure out if the core is solid or liquid. There are clues that it was molten at some time in the ancient past. A molten core is a fluid that moves and conducts electricity, so it sets up a powerful [magnetic field](#). Researchers see remnants of that field today but are unsure how much of the core, if any, is still molten.



An artist's concept of the Martian core. Credit: NASA/JPL.

"If Mars' core is solid through and through, the nature of the wobble will be subtly different from the wobble if the core is liquid," says Squyres.

Spin a hard-boiled egg and then spin a raw egg. You'll see a distinct difference in the way they rotate.

Spirit's radio signals will also reveal the precise speed of Mars' wobble. That, in turn, will help the researchers calculate the planet's moment of inertia, or MOI.

The moment of inertia of a spinning object—in this case, a planet—is a number that describes how easy or how hard it is to change the spin.

"The MOI affects the speed at which the axis of Mars wobbles, so the wobble speed indirectly tells us the MOI," says Banerdt.

They'll add the MOI to what they already know about Mars—its size and mass. "Combining these three things with our understanding of how iron and rock behave inside a planet will allow us to set limits on the size and

density of the Martian core. And the density will tell us what elements must be mixed with iron to make up the core."

"This research has implications that reverberate through all kinds of basic questions about the formation of the solar system and its planets. I have to tip my hat to Spirit. It keeps coming up with new tricks."

But first the rover has to survive the long, hard winter. Baseball great Rogers Hornsby summed it up: "People ask me what I do in winter when there's no baseball. I'll tell you what I do. I stare out the window and wait for spring."

Make that Martian spring.

Source: Science@NASA, by Dauna Coulter

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