NASA nears

The Washington Post · 24 genn. 2018 · BY SARAH KAPLAN

a longsought goal: sending a spacecraft to take a close look at the sun.

Shortly after NASA was established in 1958, the nation's top scientists compiled a list of missions they thought the brand-new space agency should pursue. The proposals were heady, considering that at that point only three satellites had ever been launched. Researchers suggested an Earthorbiting telescope that could detect the universe's most distant stars, probes that would venture to the solar system's other planets, an initiative to land humans on the surface of the moon.

With time, each of those dreams became a reality — the Hubble Space Telescope, the twin Voyager spacecraft, the Apollo program. All except one: an effort to get a close look at the sun, the source of Earth's light and heat, as well as solar storms that could disrupt our satellites and fry our electric grid. It took decades to develop the technology to protect a spacecraft from the sun's ferocious rays.

On a recent morning, a spacecraft not unlike the one envisioned in 1958 sat in a sterile room at NASA's Goddard Space Flight Center. Its side panels were open to expose its inner workings — electronics boxes, a propulsion tank, instruments for measuring the sun's magnetic field and capturing images of its tumultuous atmosphere. Its heat shield was encased in a container emblazoned with large red lettering: "Handle only under supervision" and "Do not expose to direct sunlight."

Pointing out the warnings, engineer Curtis Wilkerson chuckled. This summer, the Parker Solar Probe will launch on a journey that will send it skimming through the sun's atmosphere at 450,000 mph — fast enough to get from Washington to New York in about a second. It will fly within 4 million miles of the sun's surface, seven times closer than any spacecraft has gotten before. That heat shield will not only be exposed to sunlight, it must withstand blasts of 3,000 degrees Fahrenheit while keeping the instruments on the other side at roughly room temperature.

"We will finally touch the sun," Nicola Fox, the mission's project scientist, likes to say.

"But first," Wilkerson said, "we have to get it to the launchpad,"

Wilkerson is a systems assurance manager with the Johns Hopkins University Applied Physics Laboratory, which built the Parker Solar Probe. It's his job to ensure that the scientists and engineers who work on the spacecraft follow the protocols in place to protect it. Metal objects must be demagnetized so they don't affect the instruments. Technicians must wear hairnets, gloves and ground bracelets that dispel static electricity so they won't give the spacecraft a shock. Even ordinary notebooks are banned — instead, visitors are handed sheets of special paper designed not to shed microscopic debris. Harsh though the environment around the sun may be, the biggest threat the probe will encounter in its lifetime is a careless human.

(Here's where I make a confession: I sneezed inside the clean room. If something goes wrong, my mucus and I will take the blame.)

Integration and test lead Annette Dolbow oversees the process of putting the Parker Solar Probe together. In the past few months, under her watchful eye, a collection of metal parts constructed at labs around the country coalesced into a Prius-size, vase-shaped spacecraft.

The Solar Probe Cup, for instance, will poke out from behind the heat shield to scoop up samples from the flood of high-energy particles escaping the sun. "It's the bravest little instrument we have," Dolbow said.

Dolbow compared the probe to a toddler: endearing but constantly giving her cause for anxiety. The probe's cooling system works like a radiator, containing five liters of pressurized water, and is unlike anything ever used on a spacecraft before. "Water and electronics — they're not good friends," Dolbow said.

Dolbow's team has subjected the spacecraft to a battery of tests to ensure it can handle the hazards of flight — baking it, shaking it, blasting it with lasers.

Last week, they began one of the probe's most significant trials yet: thermal vacuum testing. Over the course of seven weeks inside a dark, 40-foot-tall chamber, the spacecraft will be chilled to minus-292 degrees to simulate the bitter cold of space, then blasted with heat proportional to what it might experience during its closest approaches to the sun. Engineers will test the spacecraft's hardware — such as the solar panels that open and close like wings — and perform a flight simulation under a range of harrowing conditions.

Then the spacecraft just has to be packed up, shipped to Florida, placed atop a rocket and blasted off the Earth. Passing by Venus, it'll get a gravitational boost needed to swing into a series of 24 egg-shaped orbits around the sun. With each close approach, the probe will fly through the sun's atmosphere, called the corona.

In those moments, the carboncomposite heat shield, about the thickness of an encyclopedia, will be all that stands between the spacecraft and temperatures hot enough to melt iron.

"That technology just didn't exist 30 years ago," said Eric Christian, a physicist at Goddard and the deputy principal investigator for one of the Parker Solar Probe's main instruments.

Why exert all this effort to fly close to the sun — an endeavor multiple Greek myths warned us against?

The story begins with a solar scientist named Eugene Parker, who realized that the solar wind of charged particles streaming from the corona moves faster than the speed of sound. The acceleration of the solar wind remains one of the "fundamental science questions about the sun," Christian said. NASA named the solar probe after Parker, who is now 90. No other spacecraft has been named for a living person.

The probe will also investigate two related mysteries: Why is the sun's atmosphere hotter than its surface? And how do high-energy particles speed out of the corona and into space?

"These are questions we were trying to answer from 93 million miles away," Christian said. "But the fact is, you've got to go where the action is in order to really understand what's happening."

The answers are keenly relevant to life on Earth. Disruptions in the sun's atmosphere can generate huge explosions of ionized gas, called coronal mass ejections, and bursts of radiation known as solar flares. When these ejections interact with our planet's magnetosphere, they induce electric currents that may travel through the ground and rupture power grids. Solar flares can interfere with radio communication and cause radiation poisoning in astronauts. Predicting these events will require the scientists to figure out the complex physics of the fusion reactor in our sky.

“It’s this really dynamic place,” Christian said. “Now we’re finally getting to go there.”

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