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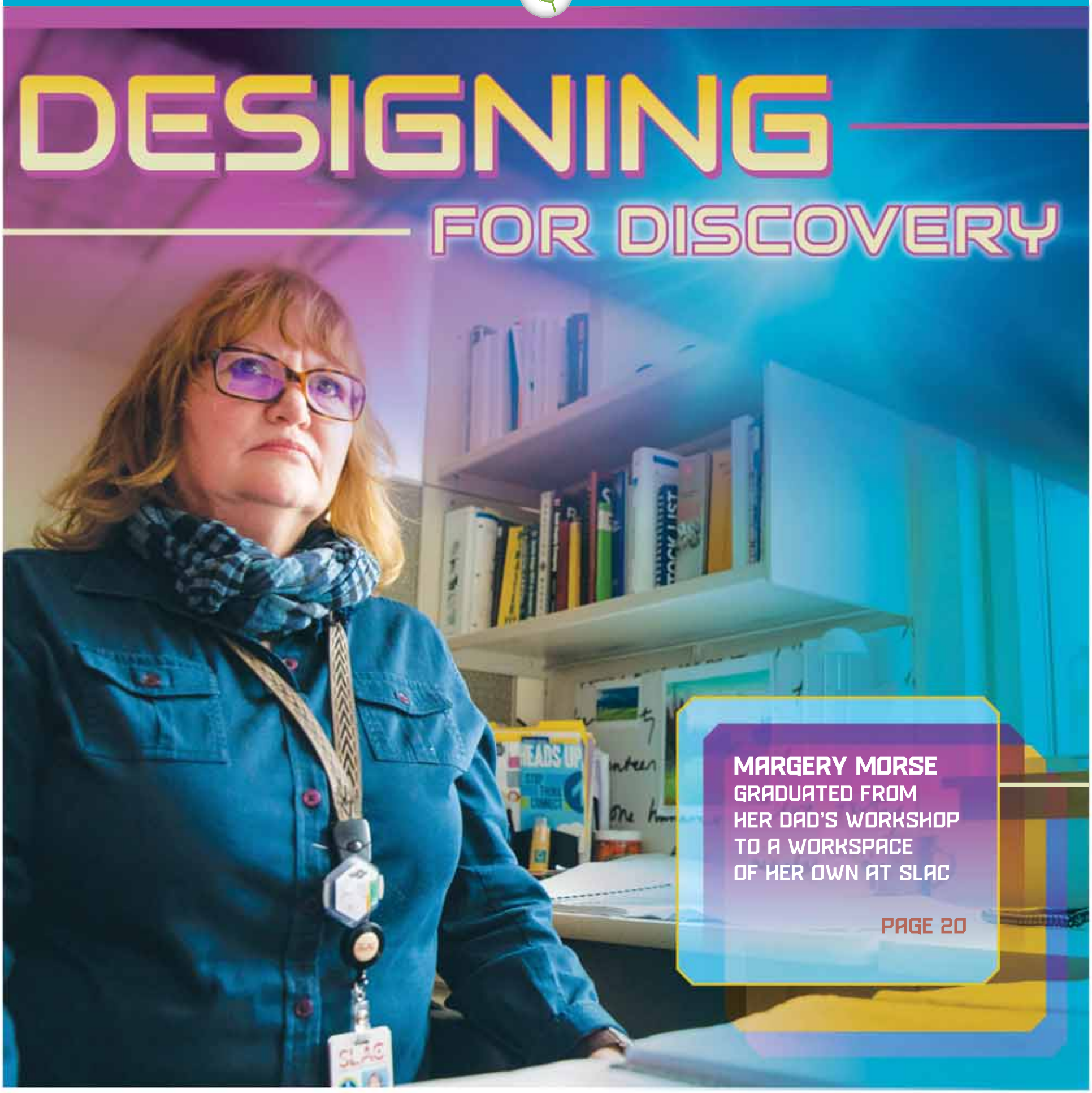

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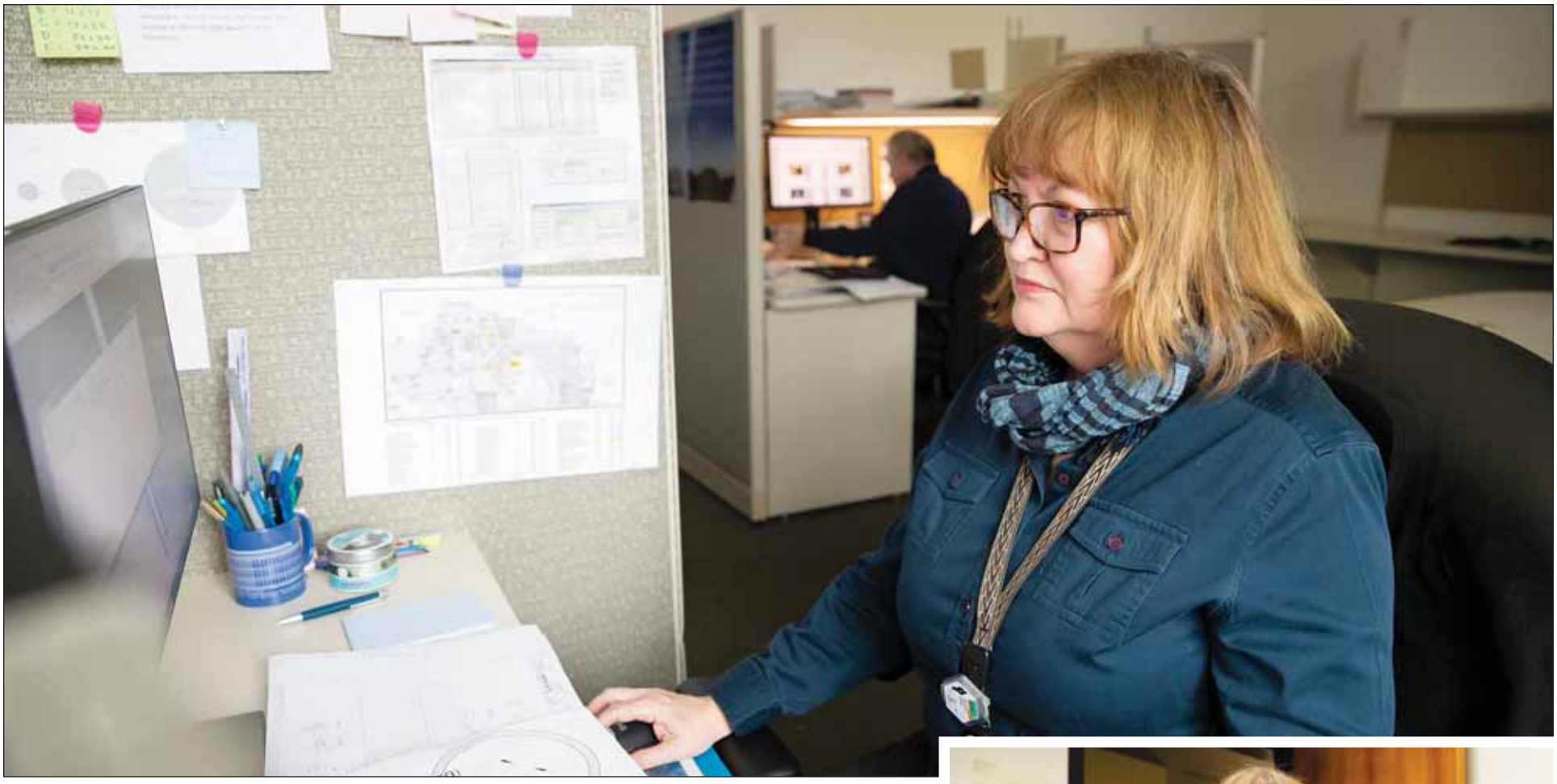
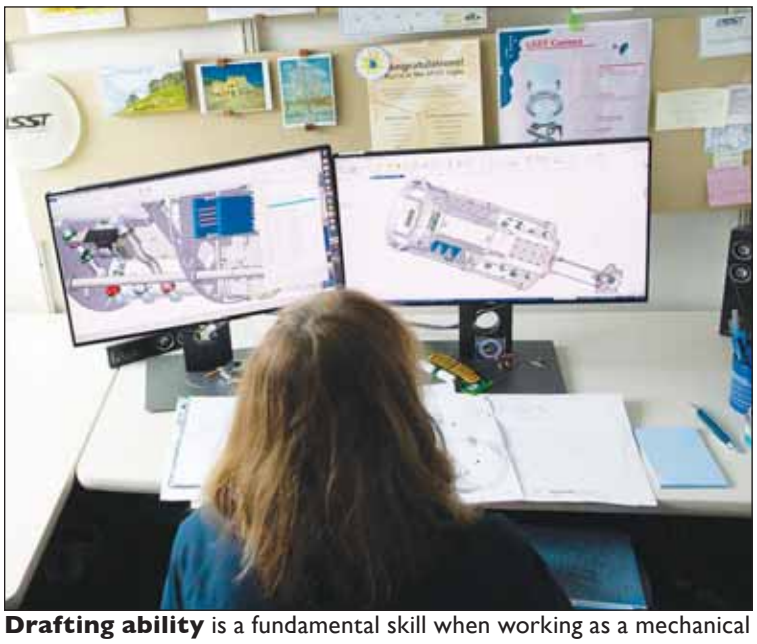


Margery Morse, a mechanical designer with SLAC National Accelerator Laboratory in Menlo Park, is designing a cylindrical trunk to protect the utilities and electronics powering a camera inside a telescope that will photograph the night sky of the entire Southern Hemisphere over and over for years from its perch in the high desert in Chile.

Designing for discovery

Margery Morse graduated from her dad's workshop to a workspace of her own at SLAC

By Dave Boyce | Photos by Magali Gauthier



Drafting ability is a fundamental skill when working as a mechanical designer at SLAC National Accelerator Laboratory, a research powerhouse run by the U.S. Department of Energy.

Margery Morse admires good design. She likes the hidden efficiencies incorporated into IKEA furniture, toggle switches, Oxo kitchen utensils, and the design of the websites of the Internal Revenue Service and online hardware vendor McMaster Carr — "Amazon.com for engineers," she says.

An appreciation of industrial design is what you'd expect from someone in Morse's profession. She is a mechanical designer at Menlo Park's SLAC National Accelerator Laboratory, where she works with engineers and other members of a deep bench of manufacturing expertise to make machines for scientists exploring the behavior of subatomic particles.

Morse's most recent project is designing a trunk about 3 feet in diameter and 6 feet long to house utilities, pumps, coolant equipment and many electronic components for a camera SLAC is building for the Large Synoptic Survey Telescope. Two immediate design challenges: making the trunk easy to assemble on site in the Atacama Desert in Chile, and providing room inside for maintenance in a "really tight" space, says Morse, a North Fair Oaks resident. If a part or assembly needs to be removed for maintenance, "we have to make sure that we have an easy method of taking it out," Morse explains. A good solution, she says, would be a simple process, such as loosening a couple of screws and having the room to reach in and pull the assembly out.

The telescope, when it's up and running, will photograph the sky above the entire Southern Hemisphere during three or four nights, and repeat that process for 10 years, SLAC experimental cosmologist Aaron Roodman has said. In collecting 15 terabytes of data every night, the camera will eventually provide 800 to 1,000 sets of night-sky images, enabling scientists to observe, for example, phenomena that might not be noticed without such a detailed and consistent record, including some 20 billion galaxies, 17 billion stars in the Milky Way, and between 5 million and 6 million solar-system objects, Roodman said.

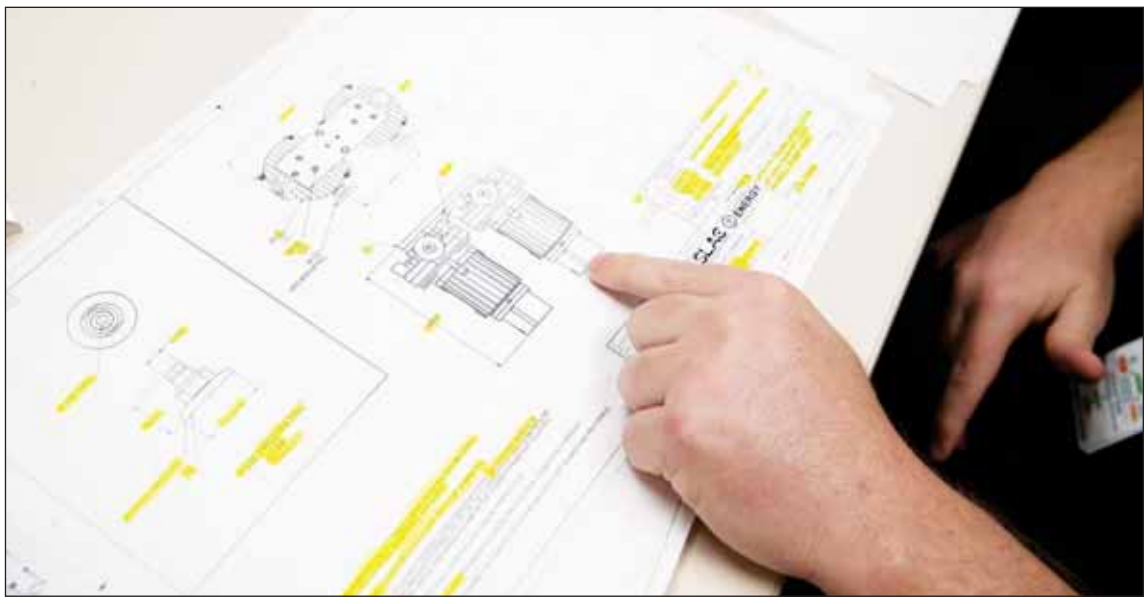
The camera's sensor — which will be about 250 times larger than its counterpart in a smartphone camera — will be extraordinarily flat, varying from perfect flatness by no more than 11 microns — a small fraction of the width of a human hair, Roodman said.

Morse had a hand in designing a frame that supports the grid that holds the sensor. The original plan had the frame composed of many of interlocking parts. To achieve the necessary flatness, the assembly would be machined after it was put together.

Morse had a different idea, one that might not have been possible had she not been employed at this particular national laboratory. "What's unique about (SLAC) is that everything is here," she says, referring in particular to the manufacturing group. Importing parts is unnecessary, she says. When a scientist needs a new piece of equipment, it's made from scratch on site. "You can talk to welders. You can talk to machinists. You can talk to (metal) platers," she says. "It's pretty amazing."

Morse suggested that the frame for the sensor be made of a single piece of stainless steel, with the excess removed by means of a water-jet cutter, a precise cutting tool. A one-piece frame would save money and be easier to machine, she said. "I'm just putting this on the table," she recalled

Mechanical engineer Shawn Ossier and Margery Morse confer about her designs for components of the Large Synoptic Survey Telescope at SLAC offices in Menlo Park.



The finger of SLAC mechanical engineer Shawn Ossier points to one of two pumps designed and drafted by Margery Morse.

saying. "Is it possible? It's just a wild idea."

It was possible, Morse says, recalling the view of a SLAC manufacturer, and so the frame came to be made of one piece. "It's much better to machine something out of a solid piece, if you can," she says. "I felt like it was a feather in my cap."

It probably helps your career at SLAC to be adding feathers to your cap, and to let it be known that you'd like the chance to add more. A tone of excitement behind the questions, "What's the next project?" and "What's next?" helps her keep her presence known, Morse says. "In a place like this, you have to constantly kind of prove yourself ... because if you don't impress people, you may not get assigned to anything. Sometimes you have to seek out your next assignment."

> **'Form follows function' is a popular notion of good design. 'I think form follows function (at SLAC).' Though 'function is number one. ... If it doesn't function, you're out of the game.'**
>
> **— Margery Morse —**

Working in "a place like this," among so many high-achievers, can present another challenge: "I always feel like I'm not creative enough, especially when (I'm) working with a really smart engineer," she says. "That person always has a better way to do something."

Morse notes that she is a minority as a woman in mechanical design at SLAC, but adds: "This is a great place to work. This is the best job I've ever had." After a pause of several seconds, she concludes: "I think women have a problem sometimes instilling confidence."

Which is better: praise or criticism? "I find that when I have praise, I want to work harder and do more," she says. "But you do need criticism because that helps you grow. And that's painful to get criticism, but it's necessary. You need it. Especially if it's constructive."

A life in mechanics

Morse grew up in Belmont in an environment amenable to an interest in machines: There was a woodworking shop in the basement. Her dad, an engineer who designed vacuum tubes, allowed her to use the shop equipment, including the band saw and the drill press, which she says she employed with her friends to make mobiles and necklaces out of seashells.

They were made conscious of the dangers of using power tools. "My dad used to say, 'The machines always win,' so you have to make sure your limbs are out of the machines. 'And if you lose a limb, make sure you retrieve it because a doctor may want to sew it back on,'" she recalls him saying, laughing with the memory.

Morse, a graduate of Menlo-Atherton High School, earned an associate's degree in drafting technology from the College of San Mateo and a bachelor's degree in industrial technology from San Jose State University. She came to SLAC in 2009 after 17 years in the private sector designing equipment associated with semiconductors.

Morse was married to Stephen Morse, a musician, sculptor, roller-coaster designer and craftsman. Her husband died last September at the age of 66 when the motor scooter he was riding collided head-on with a truck on La Honda Road in Woodside.

Margery Morse's career at SLAC, besides design work on the telescope's camera, includes design work on an ultra-fast electron camera — specifically, a viewing chamber for materials testing. The camera is capable of such feats as capturing photosynthesis in action and analyzing proteins to find evidence of disease.

Morse, who is 58, says that when she retires, she plans on exploring her interest in acrylics and painting landscapes, painting with wax — known as encaustic —, making mosaics, and gardening. She used redwood and stainless steel screws — which SLAC uses exclusively — to craft a worm bin and a cover for her irrigation system.

Solving problems

A career in design is a career in solving problems, Morse says. Among the key questions to keep in mind: Can the object be successfully assembled? Can it be easily machined? When different types of materials are placed next to each other, are they compatible? How many tool bits are needed to make it? Fewer is better to keep costs down and manufacturing time to a minimum, she says.

"Form follows function" is a popular notion of good design. "I think form follows function (at SLAC)," she says, though "function is number one. ... if it doesn't function, you're out of the game."

In general, it's obvious how to assemble and use a well-designed item, a principle sometimes lost on manufacturers today, she says. Small print is bad design, whether in prescriptions or user manuals, and is the bane of members of the baby-boom generation whose eyesight is worsening, as well as anyone with impaired vision, she says.

Furniture maker IKEA uses pictures, not print, to accompany its products and therefore escapes Morse's scorn. "Most people don't like IKEA products," she says. "I like IKEA products because everything is done without language. It's all pictures. I would like to see more pictures."

A model of the camera's cryostat — a compartment designed to maintain extremely cold temperatures — includes a grid for mounting the camera's sensors

She says she's assembled many pieces of IKEA furniture and hasn't had a problem. "You have to pay attention (to the pictures). The furniture is well designed, she says, so long as you don't try to get more out of it than is intended. "What's funny about IKEA is that they design things just strong enough," she says. "It's hard to modify something."

Online, the IRS has a well-designed website, Morse says. "I had to get a tax ID number," she says. "I did it in, like, 15 minutes."

The website of hardware vendor McMaster Carr "is amazing design," she says. "They have drawings available of every part they supply, and if the drawing isn't available on the website, they will get it to you in an hour," she says.

She likes Oxo, the manufacturer of fat-handled kitchen utensils. Oxo handles are ergonomic and easier for people to hold, she says, and an example of industrial design reflecting ergonomic thinking.

Morse says mechanical buttons, a favorite of hers, are losing favor in industrial design, perhaps because touchscreens are easier to manufacture and program. "I like knobs," she says. And toggle switches? "Toggle switches are on-off," she says, laughing. "What's not to like."

Morse is skeptical of adding "smartness" to everyday machines, and of the Internet of Things. A smart thermostat may be useful, she says, "but I don't want my appliances talking to each other." The necessary software will add complexity, and ongoing customer support for that software will become a problem, she says, adding, "It just means that the product is going to become ... waste sooner than it needs to be."

On the cover: Margery Morse is designing mechanical parts for a telescope's camera at SLAC in Menlo Park. Photo by Magali Gauthier/The Almanac