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SPACE
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said the pool of scientists seeking funds has increased steadily over the last 30 years, while research funding has remained essentially stagnant.

"When I started in the U.S. about 30 years ago, the funding (acceptance) rate was about 1-in-2 or 1-in-3," Gombosi said. "Today it's 1-in-8, 1-in-10, so it's much more difficult to get funding."

Gombosi added the trend over the past several decades has been to shift research dollars away from universities. For years, there was an unspoken agreement that NASA would build the spacecraft and rely on the universities for instruments, but as funding becomes tighter, NASA has elected to keep more projects in-house to save money.

The funding shortfalls contribute to a cyclical decline in the research enterprise as it becomes harder for new researchers to get the needed funding and experience. While the SPRL has not seen any decline in the number of students, most professors acknowledge that the focus has shifted, for better or worse.

The next generation

The 1960s saw a major transformation in STEM education across the country. In addition to unprecedented levels of scientific funding at universities, both the primary and secondary education systems were overhauled to prepare as many students as possible for careers in scientific fields.

During their education, Fisk and many of his colleagues were witness to the seminal events in U.S. space exploration. However, the current generation of young space science graduate and undergraduate trainees were several decades from birth the last time a man walked on the moon.

Yet students continue to pursue space sciences. More graduate students are working in the lab now than during the 1950s and '60s, and they are coming from all over the nation and the world.

"Space research in general and the visuals that go with it are still a stimulus for those who want to go into science and engineering," Fisk said.

At the SPRL, Ruf, the director of the Space Physics Research Lab, said he has observed significant changes in the students entering the field over his 25 years of teaching experience.

According to Ruf, students coming to the University used to enter with a base set of mechanical skills, whereas current applicants more often have developed skills in computer programming.

Tinkering projects, such as car tune-ups, ham radios and model airplanes, were valuable in teaching students basic skills that were applicable once they reached a laboratory setting.

"It's still necessary," Ruf said. "When you build real stuff you've got to get your hands on it and you've got to know how to use tools."

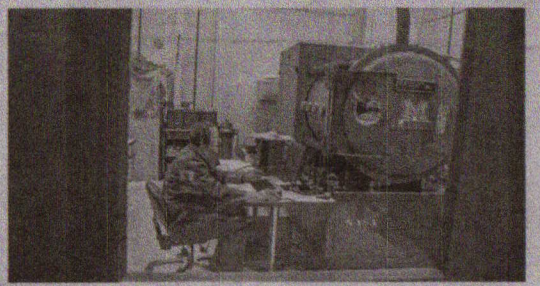
Today, screws and soldering irons have been replaced with laptops and smartphones. Ruf said several of his students played around with coding smartphone apps in high school, building skills in computer science that can sometimes be helpful around the lab. But he said the "shift in culture" has also forced him to change his teaching methods.

"Almost none of them know how to use a screwdriver," Ruf said.

The beginning of the end, or just the beginning?

In 2012, the NASA's Mars Science Laboratory successfully landed Curiosity, a unmanned scientific rover, on the surface of Mars to perform a slew of experiments, in part to determine potential for human settlement of the planet and continue the search for life in the solar system.

The mission is estimated to cost about $2.5 billion. If manned exploration and settlement of the planet was ever pursued, the cost would be significantly higher — potentially $1 trillion, according to Gombosi.



ELIOT WALLACE/Daily

A researcher at the Space Physics Research Lab tests a satellite prototype using a vacuum chamber and other instruments.

But scientists — ever the pragmatists when concerned with funding cuts — will continue to support such efforts as long as the government keeps funding them.

"That's the kind of stuff that catches public attention and sometimes we scientists prostitute ourselves by jumping on things which sell, but it gets you into trouble," said Engineering Professor Emeritus Andrew Nagy.

While a manned Mars mission may fulfill the human desire to explore, Nagy said there are plenty of unanswered questions in the field that could be accomplished for less money.

"A lot of stuff that we want to do can't be done," Nagy said. "Things are getting more expensive. The easy things have been done. There's a lot of research that one wants to do ... there's no resources to do it."

Nagy also noted that some discoveries, such as the transistor, were invented through research that emphasized "science for the sake of science," asserting that researchers not lose sight of the possibility for real discovery.

But on the other side of the SPRL, it appears that pragmatism might be the decision maker, at least for the time being. In 2012, Ruf — along with two other University researchers — were awarded $151.7 million to fund the Cyclone Global Navigation Satellite System — eight satellites that, when launched into orbit, will assist in the process of forecasting and monitoring hurricanes.

"These days there's a lot more emphasis on practical, useful types of space science and less on answering the big questions just for the sake of answering them," Ruf said.

"I think it's a good thing to spend significant money on trying to understand what makes the universe tick — those are important questions," he added. "But they don't practically improve the day-to-day quality of life of anybody other than the scientists working on them."

With advances in smartphones and miniaturization of electronic components, Ruf said space scientists have started to explore the idea of smaller satellites. Instead of launching a single $2 billion satellite each year, researchers are attempting to build a series of smaller $5 to $50 billion dollar satellites that could be launched by a smaller institution, such as a university, which historically have not played a large role in the development and construction of entire space systems.

The CGNSS could provide more accurate weather data, and in general provide "more science per dollar," according to Ruf. At present, it appears policymakers are in support of this pragmatic approach, giving Ruf confidence that his research will continue for the foreseeable future.

But he also recognized that research funding is ultimately dictated by public opinion, which is always subject to change.

"I think there's a mood in general in Washington that they're trying to focus science research funds to more practical things," Ruf said. "This is where the emphasis is going these days. But who knows, maybe it will swing back five or 10 years from now and I'll be scrabbling for funding."

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University of Michigan Law School
South Hall, Room 1225
reception immediately following in the Jeffries Lounge
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