

ATMOSPHERIC STUDY USES NEW INSTRUMENTATION

Photographs by Dr. Timothy Bertram and Dr. Rob McClain

In May 2023, the Arnold and Mabel Beckman Foundation announced \$3 million in funding to support teams at three institutions for the development of novel instrumentation. Specifically, the Foundation challenged these groups to design new prototype instruments that offer the most advanced mass spectrometry detection capabilities and sensitivity levels in lightweight, inexpensive, and easily operable systems for mobile monitoring.

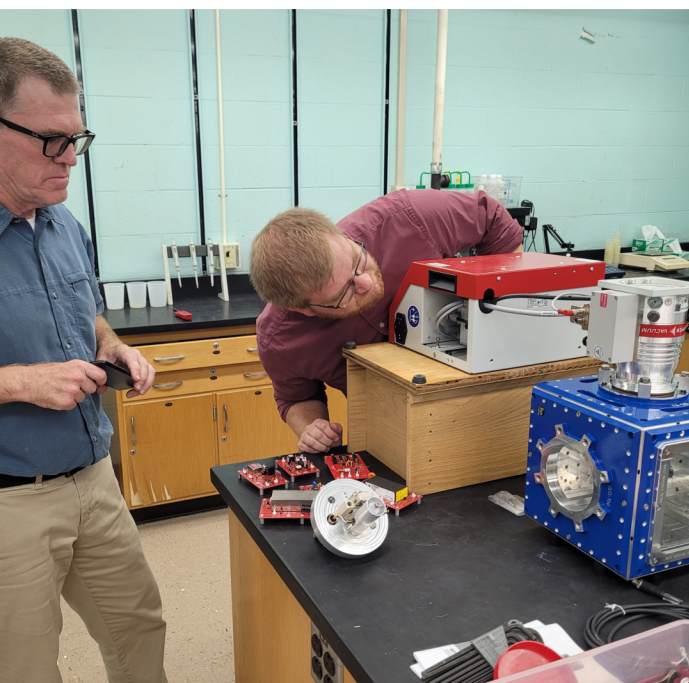
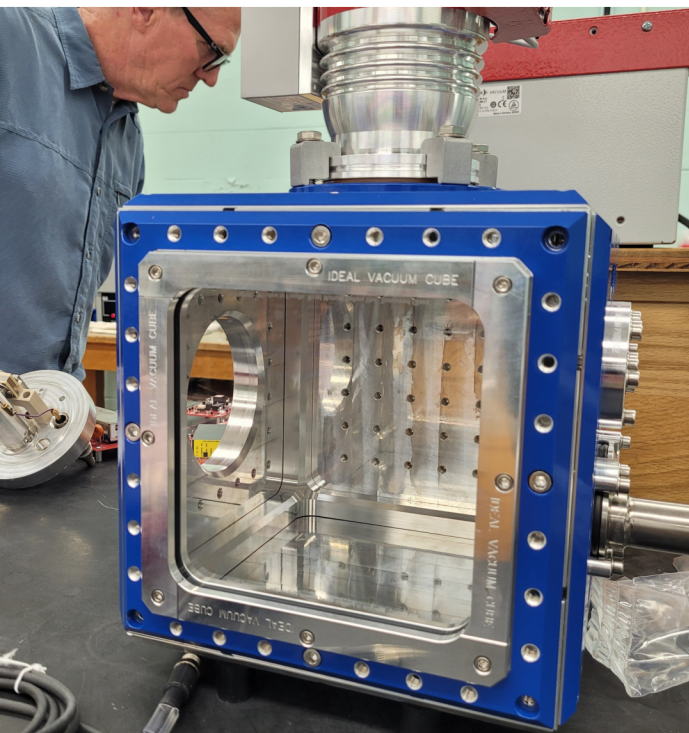
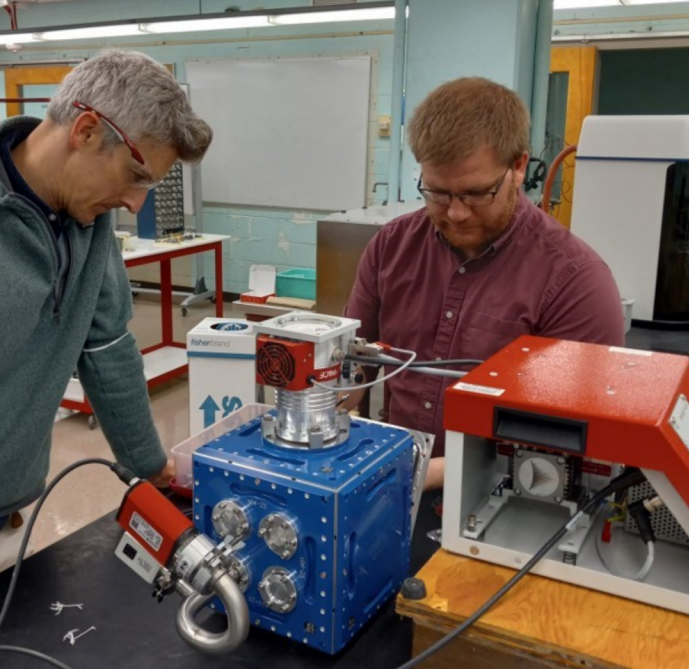
The Bertram-Kregel team at the University of Wisconsin-Madison and Bradley University is composed of members whose academic backgrounds are all rooted in physical chemistry and instrument development, both hardware and software. They've built their own mass spectrometers and partnered with research companies like Tofwerk and Aerodyne.

Dr. Timothy Bertram's research interests focus on atmospheric chemistry and the use of mass spectrometry to study the chemical composition of the atmosphere. In contrast, co-lead Dr. Steve Kregel's interests have largely focused on the development of novel mass spectrometric approaches with applications in laboratory studies in physical chemistry.

"Funding opportunities for the development of new instrumentation are few and far between," stated Bertram. "When we saw the call for applications for this program, we were excited about the opportunity to kick-start development in the area of compact sensors for the measurement of volatile organic compounds."

Their project will produce an autonomous, compact, field-deployable mass spectrometer that can detect reactive trace gases.

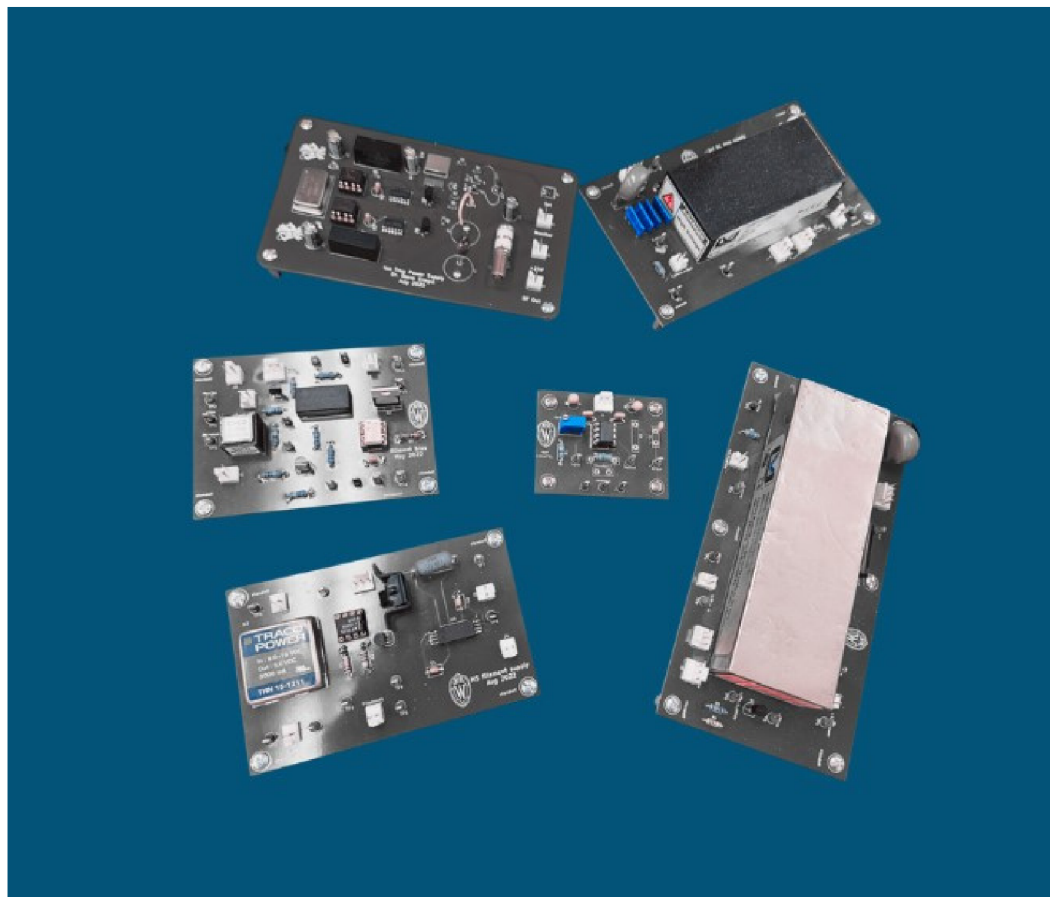
At left: Dr. Bertram, Dr. Kregel, and Dr. McClain work on the assembly of the modular mass spectrometer at the University of Wisconsin-Madison.



Explained Bertram, the instrument is being built "around the concepts of photoionization for robust and reproducible analyte ionization coupled to an ion trap for mass analysis."

In addition to instrument development, the project includes an undergraduate education plan composed of two activities that involve students from three UW campuses: Madison, Eau Claire, and La Crosse. The first activity will refine an existing three-week undergraduate mass spectrometry course module so that it includes a multi-week laboratory exercise using the developed mass spectrometer. The second is an eight-week summer undergraduate research experience at the Madison campus. It will allow participation for six students to focus on mass spectrometer development and deployment.

"Commercialization of instrumentation has led to great scientific advances in physical science. However, this often comes at the expense of training in instrumentation," shared Bertram. "We think the undergraduate program that we have been developing here at UW-Madison, and will grow under this award, will help serve as a model for undergraduate instrumentation classes and the materials developed here will be made broadly accessible to the community



Above: Custom circuit boards made for the compact mass spectrometer by the Bertram-Kregel team at the University of Wisconsin-Madison and Bradley University.

as a resource for teaching and developing mass spectrometers."

The Foundation's intent for the program is to support scientists, with a focus on undergraduates, to become inventors and innovators. If successful, their prototype monitoring systems could have a lasting impact on informing policy decisions on sources of pollution, improving indoor and outdoor air quality, and furthering democratization of access to clean air around the world. This challenge represents an opportunity for interdisciplinary teamwork on a

real-world problem, reminiscent of Dr. Arnold O. Beckman's own efforts in combating smog in Los Angeles via environmental monitoring and the study of physical processes in the air.

The team includes Prof. Tim Bertram, Dr. Steve Kregel, and Dr. Rob McClain, the lab director for analytical chemistry and an instrument building specialist, and Kevin Wokosin, a graduate student in chemistry. Dr. Kregel recently started his own lab at Bradley University, which will be a

partner institution on the project. In addition, the project also includes Dr. Patricia Cleary and Dr. Keith Beyer at the Eau Claire and La Crosse campuses. Dr. Cleary and Dr. Beyer have expertise in atmospheric and physical chemistry and their undergraduate students will work with students at the Madison campus during the summer research experience. ■