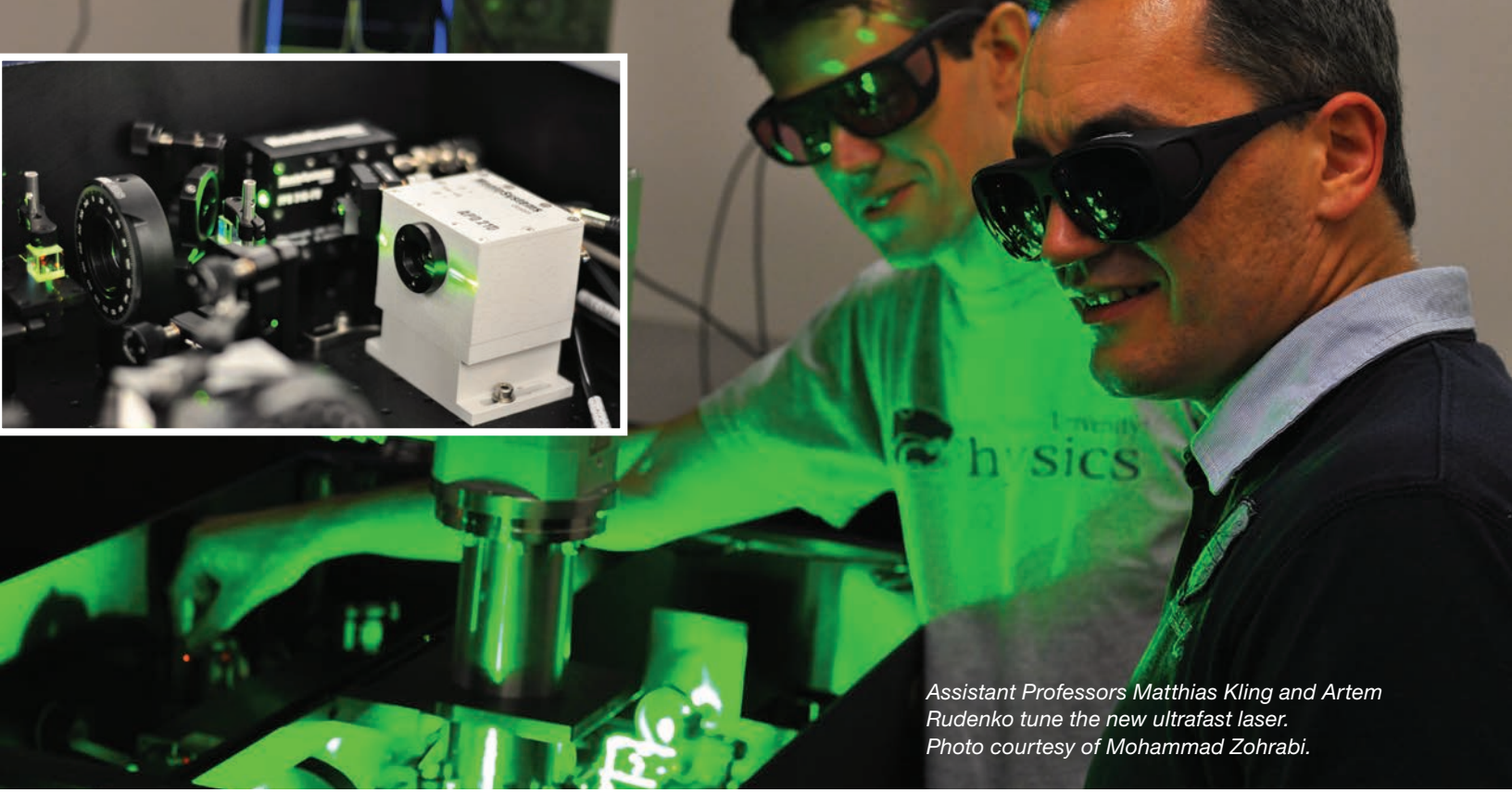

Assistant Professors Matthias Kling and Artem Rudenko tune the new ultrafast laser. Photo courtesy of Mohammad Zohrabi.

Poised for the next frontier

The James R. Macdonald Laboratory is accelerating research across the globe

A shiny new laboratory and laser in Cardwell Hall are helping Kansas State University physicists continue a decades-old exploration of the structure and dynamics of atoms, ions, molecules and surfaces. For more than 30 years, this exploration was carried out through the means of ion-atom collisions. Since the start of the new millennium, the focus is on intense, ultrafast lasers.

The James R. Macdonald Laboratory — which focuses on atomic, molecular and optical physics — now houses a $1.3 million laser system funded by the U.S. Department of Energy. Kansas State University provided more than $500,000 for a laboratory upgrade, which was completed in summer 2012.

"The new lab space is a state-of-the-art ultrafast laser lab," said Itzik Ben-Itzhak, the director of the Macdonald Laboratory and who was named a university distinguished professor in 2012. "It accommodates a high repetition rate, intense laser system that serves a multitude of experiments mainly focused on attosecond physics. These experiments and the laser system require a high level of environmental control, which the new lab space provides."

Even though the new laser system was only installed in July 2012, researchers have already taken important data and are preparing publications. This rapid turnaround is the result of hard work by both the researchers and the laboratory technical staff.

It is because of these advanced facilities and high-profile research projects that U.S. News and World Report has ranked the university's atomic, molecular and optical physics graduate program, which includes the Macdonald Laboratory, as the 13th best in the nation. The program is also one of the largest in the country.

Each year, the Macdonald Laboratory is supported by multiple agencies, including a $2.5 million grant from the Department of Energy. The laboratory includes eight experimental and three theory faculty who all continue to receive international and national recognition for their work. Three research faculty, numerous postdoctoral fellows, graduate students and undergraduates round out the laboratory's workforce.

Carlos Trallero, assistant professor of physics, recently was awarded two instrumentation grants: a nearly $1 million National Science Foundation Major Research Instrumentation grant and nearly $200,000 from an Air Force Office of Scientific Research Defense University Instrumentation Program grant. The resulting acquisition of a high intensity tunable long-wavelength femtosecond laser will facilitate his exploration of high harmonic generation, attosecond and strong-field physics.

Matthias Kling, assistant professor of physics, recently received a $750,000 Early Career Research Program Award to explore controlling and tracing of electrons in nanosystems — the first step to improving electronics and communication technology. This research was enabled by his work on steering electrons in molecules, for which he was awarded the Nernst-Haber-Bodenstein Prize of the German Bunsen Society in 2012.

Artem Rudenko, assistant professor of physics, recently joined the program and was one of the principal investigators in the international collaboration that used the Linac Coherent Light Source to create unprecedented high-charge states of atoms and molecules. The work recently appeared in Nature Photonics.

The year 2012 has also been a successful one for the theory group, highlighted by a Nature publication co-authored by Chii-Dong Lin, university distinguished professor of physics.

As faculty members continue high-profile research, the atomic, molecular and optical physics program is poised to achieve even greater success as an international research leader for the foreseeable future.