

CU-Boulder student-built satellite slated for launch by NASA Sept. 15

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CU-Boulder students test the behavior of DANDE satellite parts in a modified NASA jet that creates microgravity conditions. Credit: University of Colorado at Boulder

A small beach ball-sized satellite designed and built by a team of University of Colorado Boulder students to better understand how atmospheric drag can affect satellite orbits is now slated for launch from Vandenberg Air Force Base in California on Sept. 15.

The satellite, known as the Drag and Atmospheric Neutral Density Explorer satellite, or DANDE, is designed to investigate how a layer of Earth's atmosphere known as the thermosphere varies in density at altitudes from about 200 to 300 miles above Earth. There are thousands of satellites orbiting Earth at those altitudes, most of which eventually degrade, lose altitude and burn up in the atmosphere.

The denser the thermosphere—which is most affected by [space weather](#) caused by variations in solar activity—the more drag on spacecraft, said Brian Sanders, deputy director of the Colorado Space Grant Consortium, or COSGC, who is helping to oversee the CU-Boulder student group that designed and built the DANDE spacecraft.

The International Space Station, for example, dropped several miles in altitude in just a few days time when a powerful solar and geomagnetic storm slammed Earth in 2000, dramatically increasing [atmospheric density](#).

DANDE is carrying an accelerometer, a wind and temperature spectrometer, an onboard computer, an orientation control system and radio equipment to send back data to Earth in real time. DANDE, whose primary investigator is COSGC Director Chris Koehler, will launch aboard a commercial Falcon-9 Space-X rocket that also will carry satellites from the Canadian Space Agency, Cornell University and Utah State University.

The accelerometer aboard DANDE can sense the movement, speed and direction of the satellite to help scientists better understand drag forces.

A second onboard instrument, the wind and temperature spectrometer, will provide information on the changing drag forces present in the thermosphere by identifying what kind of particles are impacting the spacecraft as well as their angles and collision velocities.



Former CU-Boulder students Mark Sakaguchi and Bruce Davis test the DANDE satellite. Credit: University of Colorado at Boulder

There are two DANDE project manager co-leaders – senior Miranda Link from Johnstown, Colo., majoring in general astronomy and Brenden Hogan, a junior from Littleton, Colo., majoring in aerospace engineering sciences. The roughly 150 students who have worked on DANDE since its 2007 inception are from several CU-Boulder departments, including aerospace engineering, electrical engineering,

environmental and civil engineering, mechanical engineering, computer science and astronomy.

"All satellites experience drag, which causes their orbits to degrade over time," said Link, who attended Roosevelt High School in Johnstown.

"Knowing more about the drag forces and how they change is information we think would be valuable to any groups flying satellites, whether they are from the government or commercial sector."

Hogan, who attended Mountain Vista High School in Littleton, said changes in the thermosphere can be "quite drastic" at times, especially during major solar events. "The more information that users have on how changes in the thermosphere are going to affect satellites, the better they can plan in order to avoid problems," said Hogan. "What we really are trying to do is to improve models of the atmosphere to better understand how it might affect spacecraft."

The COSGC, which involves 17 universities, colleges and institutes in the state, is headquartered in CU-Boulder's aerospace engineering sciences department. Begun with a \$110,000 seed grant from the U.S. Air Force Office of Scientific Research in 2007, the DANDE project won the University Nanosatellite Flight Competition Review held by AFOSR in 2009—beating out competitors like the University of Texas at Austin and Pennsylvania State University—and earning the students a coveted launch opportunity.

The timing of the DANDE satellite launch is serendipitous because it is coming near a so-called "solar maximum"—the time when Earth's roughly 11-year solar cycle reaches peak activity, said Link, who attended Roosevelt High School in Johnstown. "We think there will be more solar activity and more effects on the atmosphere, allowing us to gather more data."



The DANDE satellite designed and built by CU-Boulder students is expected to help scientists better understand how atmospheric drag affects satellites. Credit: University of Colorado

There are more than 13,000 satellites currently in orbit around Earth. DANDE, measuring roughly 20 inches in diameter and weighing just over 100 pounds, will be deployed into a polar orbit. DANDE team members hope to gather continuous data from the satellite for about one and a half years, downloading it several times a day to the COSGC satellite control facility in the CU-Boulder engineering college.

Roughly 10 members of the present and past DANDE teams are going attend the California launch, including some who are flying to

Vandenberg at their own expense. "They want to see this project all the way to launch," Hogan said.

Since 1989, more than 5,000 students, primarily undergraduates, have been directly involved in COSGC's hands-on space hardware program. Of the space grant consortia established by NASA in all 50 states, Washington, D.C., and Puerto Rico, Colorado's may be the most active, having launched three space shuttle payloads, three sounding rockets, two orbiting satellites, 12 sounding rocket payloads, five long-duration high-altitude balloon payloads and more than 350 short-duration high-altitude balloon payloads.

"When I came here as a freshman I had no idea there was a student organization that built satellites on campus," said Link. "This opportunity with the Colorado Space Grant Consortium just fell into my lap, and it has completely changed my life."

"To see the expertise passed down by students through the seven-year lifetime of DANDE is awesome," said Hogan. "I think the undergraduate experience available designing and building satellites and instruments, not just at the Colorado Space Grant Consortium but in other space research groups across campus as well, is one of the things that makes CU-Boulder a great university."

Provided by University of Colorado at Boulder

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