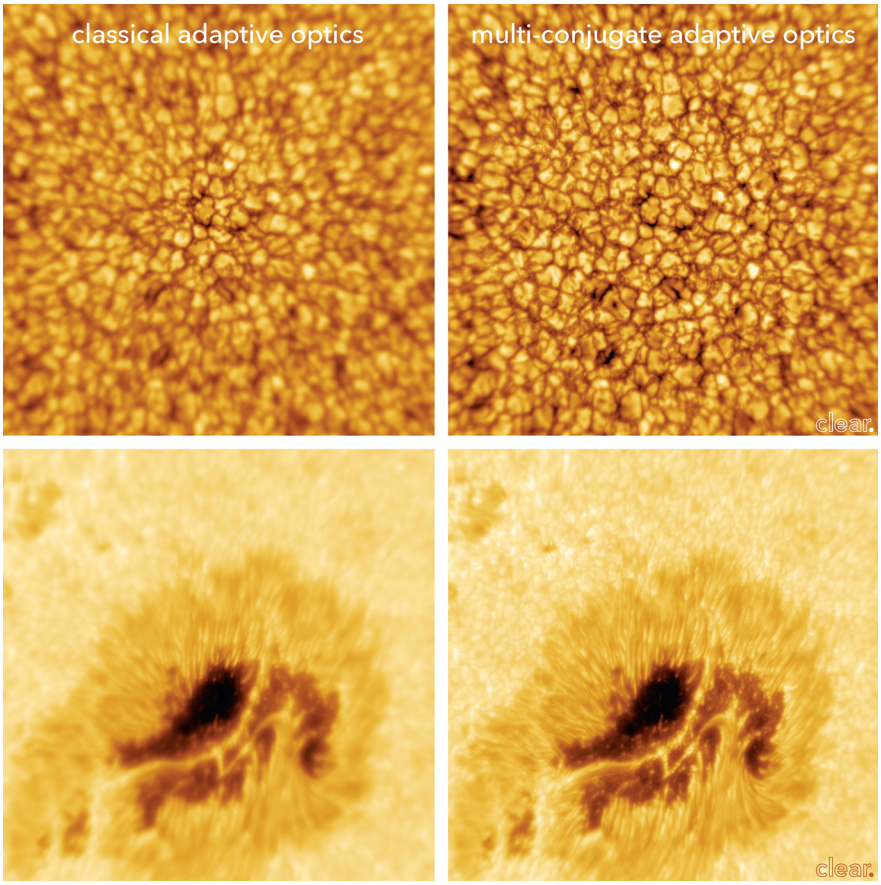

The BBSO's 1.6-meter New Solar Telescope can now produce simultaneous images of massive explosions such as solar flares.

NEXT-GEN OPTICS UNVEIL SUNSPOT-WIDE PANORAMAS ON THE SUN'S SURFACE

A groundbreaking new optical device, developed at NJIT's Big Bear Solar Observatory (BBSO) to correct images of the Sun distorted by atmospheric turbulence, is providing scientists with the most precisely detailed, real-time pictures to date of solar activity occurring across vast stretches of the star's surface.

The observatory's 1.6-meter New Solar Telescope can now produce simultaneous images, for example, of massive explosions such as solar flares and coronal mass ejections occurring at about the same time across a 20,000-mile-wide sunspot in the Sun's photosphere.

"During large flares, magnetic field changes appear to occur at many different places with near simultaneity," explains Philip Goode, distinguished research professor of physics at NJIT and the leader of an international team of researchers funded by the National Science Foundation (NSF) to develop the device.

"Only by seeing the comprehensive array of eruptions all at once can we accurately measure the size, strength and sequencing of these magnetic events and analyze the forces that propel the star's magnetic fields to twist around each other until they explode, spewing massive amounts of radiation and particles that, when directed earthward, can cause disruptive space weather," he said.

The multi-conjugate adaptive optics (MCAO) system is composed of three mirrors that change shape to correct the path of the incoming light waves, guided by a computer attached to ultra-fast cameras that take more than 2,000 frames per second to measure aberrations in the wave path. The system is called multi-conjugate because each mirror captures light from a different altitude, and the three corrected images together produce a distortion-free picture that eliminates the effects of turbulence up to about seven miles.

Blurring occurs when air masses at different temperatures mix, distorting the propagation of the light and causing it to take a changing, random path from the distant object. That same atmospheric turbulence causes the twinkling of stars.

The MCAO system has tripled the size of the corrected field available with the existing technology, known as adaptive optics, which employs a single shape-shifting, or deformable, mirror to correct images. An article showcasing these advances was published this year in the journal *Astronomy & Astrophysics.*

"Correcting for multiple layers of turbulence in the atmosphere is an engineering tour-de-force," comments Peter Kurczynski, director of the astronomical sciences program at the NSF that funded the research. "This study demonstrates technology that is crucial for next-generation observatories and it will improve our understanding of the Sun." ■

Author: Tracey L. Regan is an NJIT Magazine *contributing writer.*