

## Adaptive Optics at Fresno State's Campus Observatory

By Fred Ringwald

On 2003 August 8, Central Valley Astronomers Greg Morgan, Kevin Hansen, Aaron Lusk, and I took the first adaptive-optics images, including the one below, with the 16-inch telescope at Fresno State's Campus Observatory. The instrument used was the AO-7 Adaptive-Optics Accessory, by Santa Barbara Instruments Group (SBIG), the makers of the ST-7 and ST-8 CCD cameras and the Self-Guiding Spectrograph, which the observatory owns.

The AO-7 is a tip-tilt adaptive optics front end, or in other words, a high-speed guider. It looks like a large diagonal, but the mirror inside it moves up-or-down and left-or-right, in response to signals it gets from the autoguider in the ST-7 camera. The AO-7 can make these corrections up to 50 times per second. It can therefore correct for atmospheric scintillation, or twinkling, from turbulence in the Earth's atmosphere: astronomers call this "bad seeing," since it blurs astronomical images. Even if one is using a short focal length, so that the image scale is smaller than the seeing disk, the AO-7 can improve images anyway, since it also corrects for the effects of irregularities in tracking and guiding the telescope, which can be due to poor polar alignment, drive irregularities, dirt in the gears, gusts of wind, etc.

This image of M57, the Ring Nebula in Lyra, was taken at f/10 with the ST-7 camera, through a red (R) filter in the CFW-8 color filter wheel. The exposure time was 5 minutes: until now, exposure times had been limited to 20-30 seconds, since going longer would often result in the star images being trailed, since we couldn't guide the exposures. Now that we can autoguide with the ST-7's second, autoguiding CCD, we can get much deeper images: M57's central star is 16<sup>th</sup> magnitude. The AO-7 can make these images sharper, too: the Ring Nebula is only between 1' and 1.5' across, and this image shows detail as small as 1.0" across, comparable to what the best telescopes in the world could get as recently as ten years ago. Only a faint guide star was available, so the corrections were done "only" at 1 Hz. What makes this image all the more remarkable is that we didn't even bother to take flat fields, and that it was taken during a nearly Full Moon!

A full-color image from which this was taken can be seen at the Campus Observatory's gallery page, at:

<http://zimmer.csufresno.edu/~fringwal/gallery.html>

