A New Window on the Universe

This new telescope design allows people who use wheelchairs to reach for the stars. | **By Charles Schweighauser**

FOR THE PAST 20 YEARS THE University of Illinois at Springfield has hosted more than 100,000 visitors at its observatory. We hold Friday-night star parties and special events such as comet and eclipse viewing. Located on top of the university's library, the observatory consists of a large deck with five telescopes ranging in size from 3 to 14 inches. Visitors climb four flights of stairs to reach the deck, which can accommodate up to 200 people at a time.

Occasionally, people who use wheelchairs or have other physical disabilities come to the star party. Until recently we had to turn them away since we had no way to get them to the deck or let them look through a conventional telescope.

In the summer of 1995 the university retrofitted its campus facilities to make them accessible to people who use wheelchairs. These modifications included building a ramp to the observation deck. However, people still couldn't use the telescopes due to the constantly changing position of the eyepiece.

Before the University of Illinois at Springfield inaugurated its new, computer-driven telescope last March, people with physical disabilities who attended the university's star parties had no way of enjoying telescopic views of the heavens. Thanks to the state's support, now they can.

Remembering a fixed focal-point reflector I saw at Stellafane's Breezy Hill in Springfield, Vermont, in 1956, I contacted Ron Hilliard of Optomechanics Research, Inc. in Vail, Arizona, to see if he could design and build an instrument patterned after the "Springfield mount."

Hilliard proposed a modified version of the original Springfield design, invented by Russell W. Porter in 1920. He suggested using modern technology to manufacture a much more versatile, computer-driven telescope that would still offer the benefit of a stationary eyepiece. His design and bid of $19,800 were accepted by the Capital Development Board, the state agency responsible for all publicly financed buildings in Illinois. On August 1, 1996, our new instrument arrived.

The telescope is a modified 8-inch Celestron f/10 Schmidt-Cassegrain reflector. Its optical tube assembly is fitted with a relay system that sends light through the declination and right-ascension axes to an essentially "fixed" eyepiece. The eyepiece is actually mounted so that it can swing vertically through about 40° to accommodate people of all sizes and degrees of disability. The eyepiece can also be moved forward and backward in its tube as much as seven inches without refocusing.

Software developed by Comsoft of Tucson, Arizona, runs the telescope through a laptop PC computer. The laptop eliminates the need for a large keyboard and monitor, the light from which we found to be distracting in the quiet darkness of the observation deck. A simple set of commands moves the telescope rapidly around the sky.

This custom-built telescope features a modified 8-inch Celestron optical tube assembly and a coudé system that offers an essentially stationary focal point. The eyepiece mount can actually be adjusted vertically and along its length to accommodate stargazers who use wheelchairs.

A Rewarding Experience

We start each observing session with a briefing and 15-minute slide show to acquaint visitors, especially novices, with the celestial objects they will see through our new telescope. We describe the physical characteristics of each object and point out what to look for at the eyepiece.

On the observation deck persons with disabilities wheel up to the eyepiece for their first look. We have found that a 40-millimeter eyepiece giving 50× magnification and a 0.6° field works best for our guests, particularly those looking through a telescope for the first time. Because we want them to have as stimulating an experience as possible, we show them the Moon when it's close to first quarter and near the meridian. Other bright objects we present whenever they're visible include Venus, Mars, Jupiter, and Saturn, as well as the double stars Albireo and Mizar. Only the brightest deep-sky objects, such as the Orion Nebula or Andromeda Galaxy, appeal to first-time viewers. The rest are too badly washed out by light from our campus and the city of Springfield.

We find that 10 persons with disabilities and their families — about 40 persons in all — can enjoy the night sky with the telescope in about an hour and a half, including the briefing session. One student volunteer runs the laptop, another assists people at the eyepiece, and a third helps guests who use wheelchairs move around the observation deck, into the elevator, and through the library's main floor.

Future plans include star parties for disabled youngsters from local schools. This program will also be offered during the day so children can observe sunspots in white light and view prominences and other solar features through a hydrogen-alpha filter.

A number of students on our campus have disabilities, including those who have hitherto been unable to use the observation deck or telescopes as part of their laboratory work. They now have access to both.

We have discovered a new and deserving constituency who, at last, are able to appreciate the beauty and wonders of the nighttime sky. The opportunities to work with them are endless.

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A Unique Project

By Ron Hilliard

My research for this project uncovered no previous work on the design of astronomical telescopes for persons with disabilities. I therefore interviewed a number of people who represent this group in various capacities to gain a better understanding of their needs and limitations.

One key requirement was that the eyepiece remain stationary while the instrument moves about the sky. Furthermore, the eyepiece must be located and oriented so that a person who uses a wheelchair can comfortably use it from his or her normal sitting position.

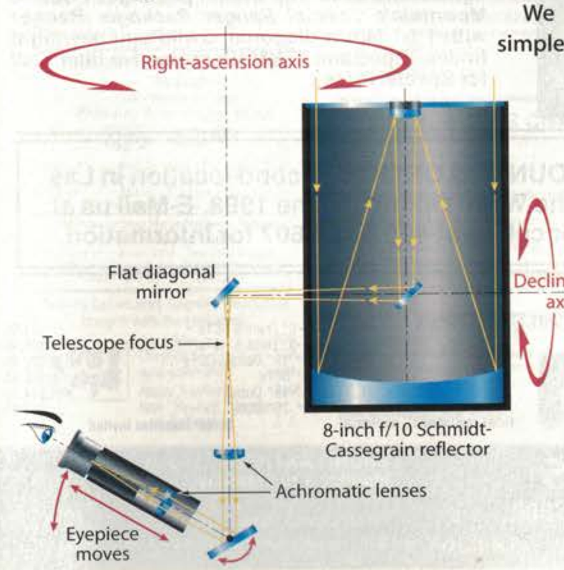
To achieve a stationary focal position, I used a coudé optical system. A 45° flat diagonal mirror is placed between the secondary and primary mirrors of the Celestron C8 optical tube assembly. The diagonal deflects the light beam from the secondary 90° along the declination axis to a second diagonal at the intersection of the declination and right-ascension axes. This mirror then redirects the beam 90° along the right-ascension axis to a third diagonal.

To transfer the image to a location where it can be viewed from a wheelchair, I used a pair of achromatic lenses that extend the length of the coudé path. The first lens, several inches after the telescope's focal plane, collimates the light and forms an exit pupil in the vicinity of the second achromat, which then reimages the light at the eyepiece.

The eyepiece assembly has two adjustments to accommodate a wide variety of viewer positions. It can be tilted upward from nearly horizontal to about 40°. The third diagonal is mounted on the tilt axis and rotates at half the tilt's rate to keep the image centered in the eyepiece. The eyepiece tube can also be extended or retracted by about seven inches. Since the second achromatic lens is mounted inside the eyepiece tube and the light rays have been made parallel by the first lens, the eyepiece's focus remains unaffected by this adjustment.

This project demonstrates that a modern telescope, using readily available technology, can allow most disabled persons to observe with little or no assistance. I designed the mount to be driven on both axes by worm gears and computer-controlled microstepper motors. The rates can be adjusted from less than 1 arcsecond per second for guiding to a few degrees per second for slewing. The telescope's positioning is controlled by the PC-TCS software developed by Comsoft's Dave Harvey (comsoft@primenet.com). It uses either a keyboard or a joystick, with an option for later adapting other user interfaces (such as a voice-command system) to meet one's particular needs.

We have tried to make the telescope simple to operate, even for people who have difficulty doing things most of us take for granted. This simplicity is skin deep; the telescope is in fact a fairly complex system. Perhaps this instrument will foster development of simpler and more affordable telescopes for all those who want to contemplate the universe through a fixed eyepiece.



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