The editors of Sky & Telescope *answer your questions about amateur astronomy.*

Planets of a Different Realm

What's the greatest distance at which it is practical to detect extrasolar planets?
— Jerry Fritzke, Walnut Creek, CA

This is an interesting question, and the answer might surprise you. Currently, the most distant known exoplanets have been detected by gravitational microlensing. This technique takes advantage of Einstein's general theory of relativity, which predicts that a massive object (such as a star) can gravitationally bend the light from a more distant star. As the lens star moves through the background star's light path, it induces a beautifully symmetric brightening and dimming pattern that persists for several days. (For a dramatic example, see the July issue, page 26.)

If a planet orbiting the lensing star enters the light path, its gravity induces a deviation in the light curve that lasts for several hours to perhaps a day or two. The Polish Optical Gravitational Lensing Experiment, along with several other groups (including contributions from amateur astronomers), have found several planets toward the galactic center, perhaps 20,000 light-years from Earth (*S&T:* October 2005, page 96).

In principle, gravitational microlensing could reveal planets as far as the Andromeda Galaxy (M31), 2.5 million light-years away, or perhaps even M33, 2.9 million light-years distant in Triangulum. Nobody is currently searching for planets in M31, because it would eat up a great deal of dedicated observing time on large telescopes.

But the large telescopes of today may be the small telescopes of the future, so I would not rule out the possibility that astronomers may someday discover planets in M31 or M33. — *Robert Naeye*

Incredible Accuracy

How can the Gaia spacecraft possibly measure star positions to 7 microarcseconds, the width of an acorn at the distance of the Moon (March issue, page 38)? Telescopes, even the Hubble, can only resolve objects thousands of times larger, and they have the benefit of a larger aperture.
— Adrian Hlynka, Groton, MA

A great question, because all astronomers know that the wave nature of light limits a telescope's angular resolution. Gaia's two

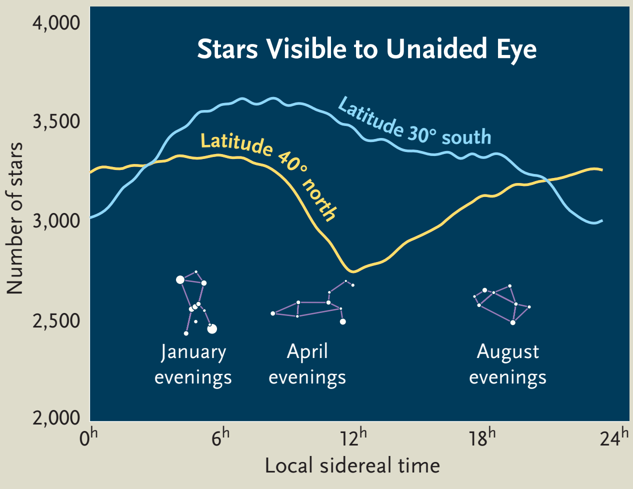
Naked-Eye Star Counts

How many stars are discretely visible to the unaided eye at one time on a dark night? I've read that it's about 6,000 — is that accurate? Also, what season or group of constellations would boost the count?
— Chris Mohr, Raleigh, NC

In all, *Sky Atlas 2000.0* plots 9,141 stars of magnitude 6.50 or brighter. Roughly half of these are below the horizon at any time, and many more are near the horizon, where they're dimmed greatly by the atmosphere. Using some standard formulas and assumptions, atmospheric extinction reduces the average number of stars visible at sea level in perfect conditions to 3,100 for observers at latitude 40° north.

The number varies seasonally as shown below. The tan line has a slight hump around local sidereal time 6^h, meaning right ascension 6^h is overhead and Orion and Canis Major are at their highest. Although the Milky Way in this part of the sky doesn't look nearly as rich telescopically as that in Sagittarius, it's physically closer to Earth and contains more bright, naked-eye stars. The tan curve dips sharply during spring evenings, from sidereal time 9^h to 15^h, when the Milky Way is close to the horizon.

The blue curve for latitude 30° south runs higher overall and is strikingly different in shape, peaking when Puppis, Carina, and Crux are high in the sky (near 8^h).



S&T DIAGRAM

It's often assumed that the naked-eye limiting magnitude under good conditions is 6.5 — though this is conservative. Under good conditions, I can see stars roughly to magnitude 6.8, which would increase the star counts on the graph by about 40%. Some people have reported limiting magnitudes as faint as 7.5, which would roughly triple the star counts.
— *Tony Flanders*

primary mirrors have effective apertures of 1.45 meters (57 inches) and focal lengths of 35 meters. This means any star's image will have a diffraction profile 0.2 arcsecond wide, or about 30 microns on the 10-micron pixels of the spacecraft's CCD detectors.

Because each star's image is spread across several pixels, the centroid of that image can be found to a small fraction of a pixel width. And when two widely separated stars are imaged simultaneously on the same detector, timings of their light curves as they drift from pixel to pixel can yield their *relative* spacing far more accurately still. The technique is a refinement of that proven during the European Space Agency's earlier Hipparcos mission of 1989–93.

Human vision works the same way (sort of). People with superb eyes can resolve details as small as 1 arcminute without optical aid. But according to optics expert Warren J. Smith, we can align a movable wire with a fixed one ("vernier acuity") to better than 5 arcseconds.

— *Roger W. Sinnott*

FAST FACT: Largest Solar-System Model on Earth

I once made a scale model of the solar system for an elementary school, with the Sun three feet across. It's dwarfed by the model that starts in the Boston Museum of Science, with the Sun 11 feet across and Pluto 9 miles away.

The world's largest scale model is in Sweden. It starts with the 110-meter (360-foot) dome of the Stockholm Globe Arena, which represents the Sun and inner corona. Pluto is a 12-cm sphere in the small town of Delsbo, about 285 km (180 miles) to the north. The Swedes even have a model of Sedna, 600 km north of Pluto.

— *Alan MacRobert*

Send questions to qanda@SkyandTelescope.com for consideration. Due to the volume of mail, not all questions can receive personal replies.