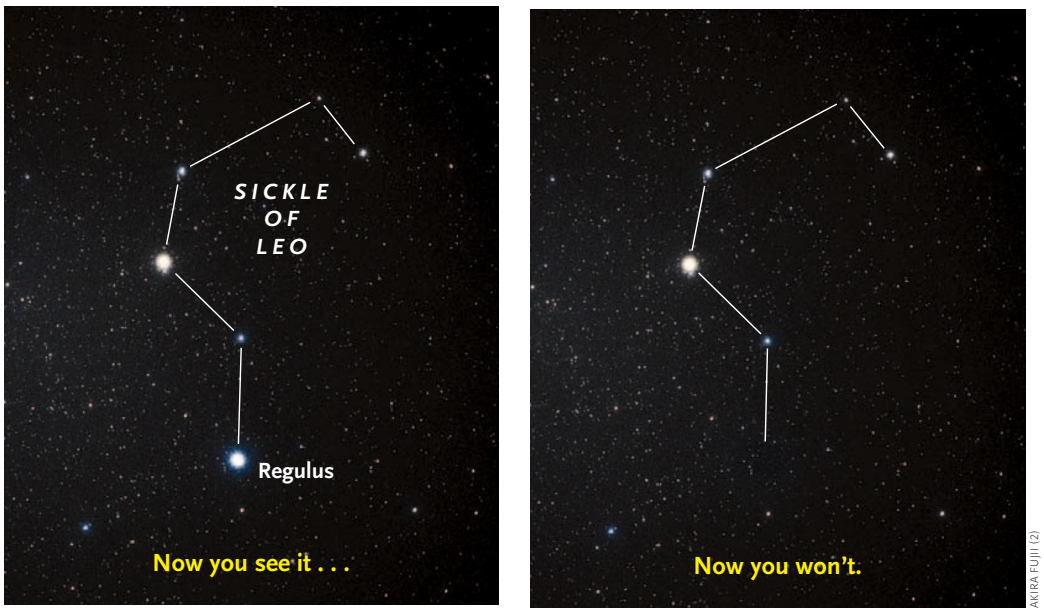
Asteroid to Occult



Millions of viewers can see one of the brightest stars in the sky black out when an asteroid crosses in front of it.

GET READY for the best and brightest asteroid occultation ever predicted for North America. It will happen late on the night of March 19–20, within a few minutes of 2:07 a.m. Eastern Daylight Time, for more than 20 million people in the New York metropolitan area and parts of Long Island, New Jersey, Connecticut, upstate New York, Ontario, and Quebec. Anyone in the occultation path who looks up should be able to see (weather permitting) the 1st-magnitude star Regulus vanish from the sky for as long as 14 seconds, as the invisibly tiny asteroid 163 Erigone passes in front of it and blocks its light.

Regulus will be about 40° high in the southwest. (On the evening map on page 43, Regulus and its constellation Leo are still high in the southeast). The bright Moon shining above your left shoulder as you face Regulus will hardly matter, nor will most light pollution.

This is the first time in history that such a strikingly obvious asteroid occultation has been predicted to cross such a heavily populated area. But this is more than just a chance to watch a moment of rare celestial drama. We hope to enlist thousands of people in a citizen-science effort to document this event more thoroughly than any asteroid occultation has been up to now. From this, we hope to obtain a very precise picture of the size and shape of Erigone (Eh-RIG-uh-nee), something that cannot be done any other way without sending a spacecraft there.

The International Occultation Timing Association (IOTA) collects observations for about 200 asteroid occultations around the world each year. They come mostly from amateurs, who either make video recordings of the star vanishing and popping back, with a time stamp on each video frame, or who sometimes just make eyeball judgments of the times.

In many cases, only a single observer documents the event. This doesn't tell us much, aside from setting a lower limit on the asteroid's size and perhaps refining its orbit a bit. Two or three successful observers at well-separated sites may produce a fairly good indication of the asteroid's diameter. But if many people make timings from well-spaced locations, we can construct the asteroid's entire irregular silhouette, as in the examples on page 32.

Above: **Late on the night of March 19–20, bright Regulus will briefly go missing for well-positioned skywatchers.**

Regulus *over* New York

STEVE PRESTON

The more good timings we have, the better this is done.

Since the first predicted asteroid occultation was seen in 1961, just one other has involved a 1st-magnitude star: Regulus again, occulted by 166 Rhodope for parts of Europe in 2005.

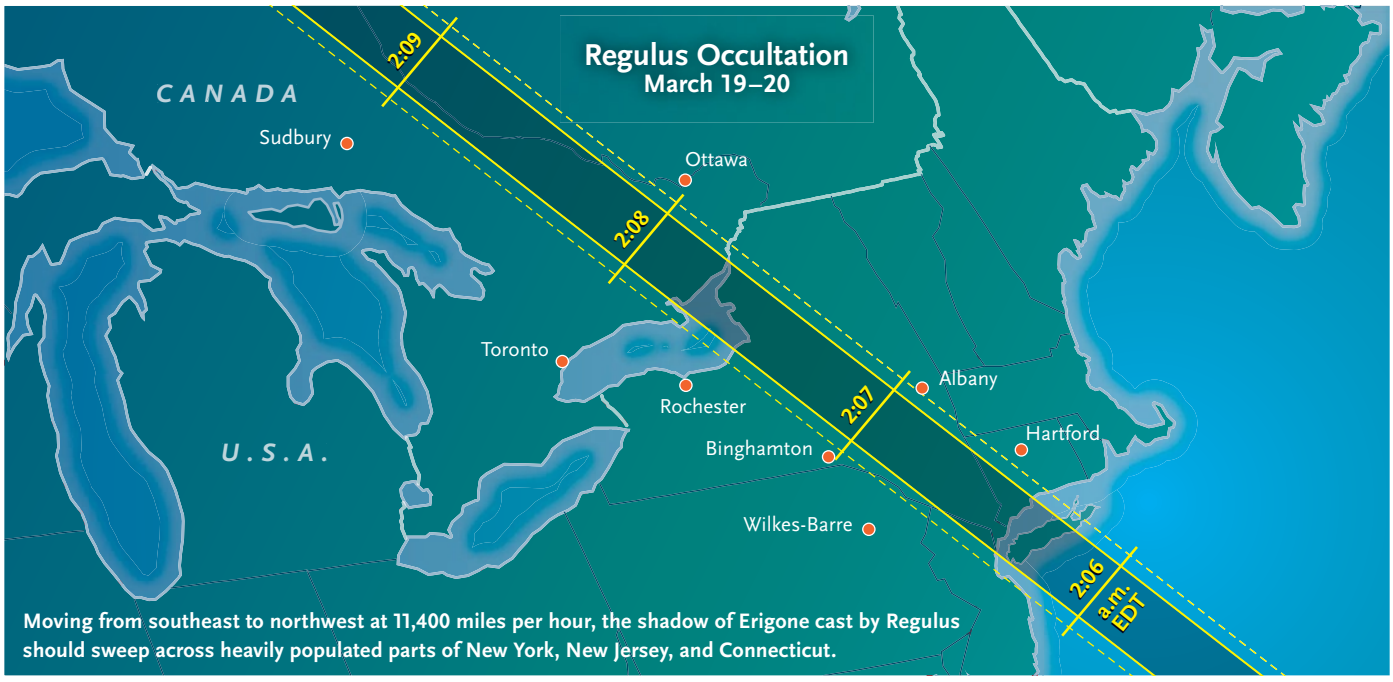
The map below shows where the Regulus-shadow cast by Erigone is predicted to go this March. IOTA encourages everyone anywhere near the path to watch for this striking event and to spread the word to the public in the weeks and days beforehand.

Asteroid occultations are enormously exciting events to watch, and nothing else in amateur astronomy can match the precision that comes from the data collected. We hope to obtain 1-kilometer resolution of Erigone's presumably rugged outline, even from our distance 177 million kilometers (110 million miles) away. What else could most of us ever hope to measure to better than one part in 100 million? To look at it another way, that's a resolution of about 1 milliarcsecond, hundreds of times finer than any amateur telescope could ever resolve directly.

The Odds of Success

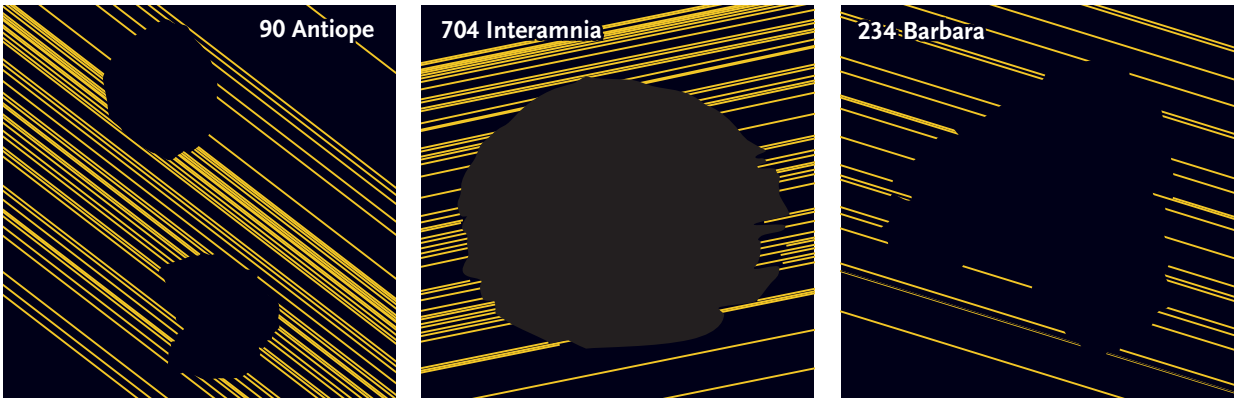
Chasing asteroid occultations is always a game of chance. Predictions are imperfect, and the shadow might miss you completely. But this time your chances look very good.

The shadow path is always as wide as the asteroid or a little wider, depending on the incoming shadow's angle to the ground. Even the best star catalogs and asteroid orbits have uncertainties that are significant compared with most asteroids' tiny angular diameters. In the worst cases, the uncertainty may be several times the path width. But not this time: we're confident that the path below is pretty accurate. The positional data for Regulus (both its position and its proper motion year by year) were confirmed by the 2005 occultation. And Erigone, discovered in 1876, is relatively large and well observed. So the uncertainty this time is relatively small compared with the asteroid's assumed diameter of about 73 kilometers (45 miles). The dotted lines on the map show the remaining position uncertainty of the path edges at the 68% confidence level. That is, the actual path has a 68%



Moving from southeast to northwest at 11,400 miles per hour, the shadow of Erigone cast by Regulus should sweep across heavily populated parts of New York, New Jersey, and Connecticut.

S&T: LEAH TISCIONE



S&T: LEAH TISCIONE; SOURCE: IOTA (3)

Thanks to inexpensive automated video setups, amateurs are accurately timing ever more asteroid occultations from many sites. Each line shows the times when one observer saw the star present (yellow) and absent (black). Based on your location (GPS accuracy is good enough), your timings can be aligned with those from other observers to reveal the asteroid's silhouette, as above. Antiope proved to be double!

chance of falling entirely between the dotted lines.

Similarly, the predicted times on the map should be off by no more than a fraction of a minute. But check for late refinements on IOTA's web page, listed below, as the date draws near.

Of course, we need negative observations from just outside the path too, to determine where the asteroid's edges *don't* extend! And if by chance Erigone has a small moon, observers far from the path could catch it.

Don't expect to observe Erigone directly near the time of the event. At magnitude 12.4, it will be hopelessly lost in the glare of Regulus, which is 26,000 times brighter.

How to Time

The goal of observing an asteroid occultation may be simple, but achieving it can be challenging. The challenge is to determine when the star disappears and reappears very accurately — ideally to 0.1 second or better. Most experienced IOTA observers now record asteroid occultations with a video camera and use a GPS-based video time inserter, which places a very accurate time stamp into every video frame. This equipment is fairly inexpensive.

You can also collect useful data with less specialized equipment. Most of today's DSLR cameras have a video mode that should record Regulus at a reasonably high frame rate. Test this in advance. You can establish an accurate time base for each frame by recording the shortwave-radio time signals broadcast by WWV (at 2.5, 5, and/or 10 MHz) on the audio track of the DSLR.

And it's still worthwhile to make old-fashioned visual timings. Play WWV while holding an audio recorder, and shout when you see the star disappear and reappear. You can later extract the times of your shouts amid the time ticks, then apply a correction for your estimated reaction time. With care, this method can be good to a few tenths of a second. But video is much better.

The Size of Regulus Too?

Most asteroid occultations happen instantaneously as far as the eye can tell. But maybe not this time! Regulus is close (79 light-years) compared with most occulted stars and presents a bigger apparent disk. Like many hot, blue-white stars it's a fast rotator, spinning once every 16 hours (compared with about 27 days for our Sun). That's fast enough to spin it into an ellipsoidal shape. Using interferometry, astronomers have measured Regulus's ellipsoid as presented to Earth: It's 1.25 by 1.65 milliarcseconds in size, with the long axis oriented north-south.

Erigone will be moving across the sky by 6 milliarcseconds per second of time, so the disappearance and reappearance may appear not quite instantaneous, especially when seen from near the edges of the path, where the asteroid's limb will graze the star at an angle. In fact, you can see this happening in a video of the 2005 Regulus occultation made in Italy near the path edge; watch it at **youtu.be/7BXpK5sbOGY**. The larger your telescope, the higher your frame rate can be, so the more useful your video could be for profiling the disk of Regulus itself.

On the ground, the shadow will be moving northwest at 5.1 km (3.2 miles) per second, or 11,400 miles per hour.

More Information

IOTA has set up a dedicated web page with much more information, at **www.occultations.org/Regulus2014.** Check there for news, details of everything you'll need to time the event visually or by video, and where to report your results. The site also contains introductory material for the public, where you can point friends, relatives, news media, science teachers, and anyone else who wants to learn more about what promises to become an exciting public happening. ✦

Steve Preston *has long been a key player in the asteroid occultation world, supplying comprehensive predictions and maps at* ***asteroidoccultation.com****.*