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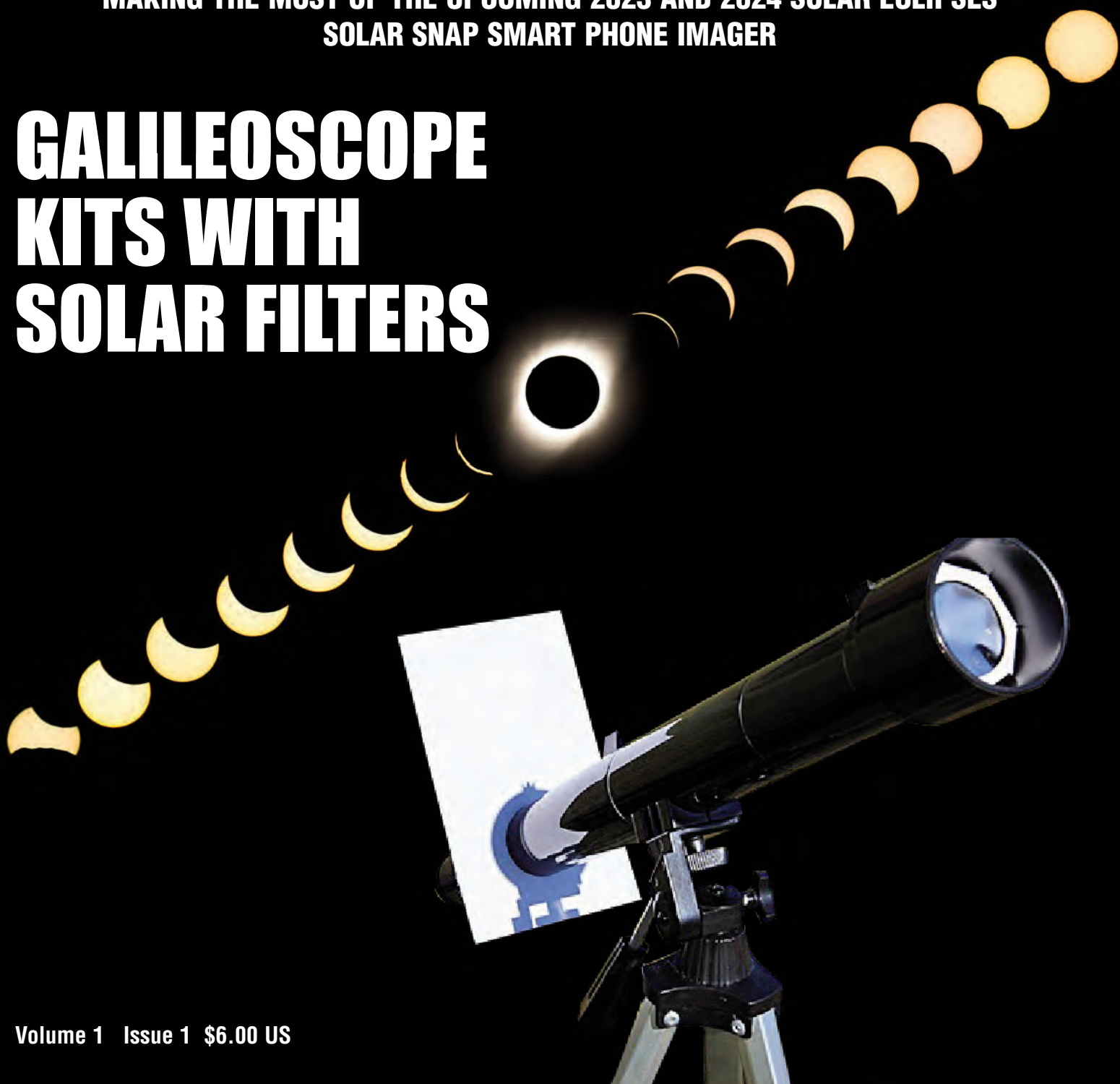


ASTRONOMY TODAY

Your Complete Guide to Solar Astronomy Equipment

**INDUSTRY NEWS • PRODUCT NEWS • ASTRO HUTECH HINODE SOLAR GUIDER
MAKING THE MOST OF THE UPCOMING 2023 AND 2024 SOLAR ECLIPSES
SOLAR SNAP SMART PHONE IMAGER**

GALILEOSCOPE KITS WITH SOLAR FILTERS



Volume 1 Issue 1 \$6.00 US

Cover Article - Page 47

Shown on the cover is a solar ready Galileoscope telescope with safe solar filter and sun shade. In his article, Dr. Douglas Arion provides an overview of the Galileoscope's new solar functionality. The background eclipse image is courtesy of Dr. James Dire (see his eclipse planning article in this issue). The image features all the phases of the July 2, 2019 eclipse whose path only crossed land in Chile and Argentina.



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The Galileoscope enables kids of all ages (adults included) to build and observe with a telescope similar to (but much better than) Galileo's. With the new solar filters, a Galileoscope can now be used to study the Sun every day – and especially for the two eclipses coming up soon!

by Douglas Arion, PhD

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I have travelled around the globe to see myriad solar eclipses over the course of my life. These include five continents and countries such as China, Iceland, Turkey, and Zambia, and tropical islands such as Aruba and Hawaii (the official name of the Big Island). It goes without saying that I have a lot of experience planning these trips and knowing what typically goes right and what can go wrong.

by Dr. James Dire

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Douglas Arion, PhD is the Executive Director of Mountains of Stars, and is Professor Emeritus of Physics and Astronomy and Donald D. Hedberg Distinguished Professor Emeritus of Entrepreneurial Studies at Carthage College. He is deeply concerned about human impact on the environment, and founded Mountains of Stars to change attitudes and actions of the public by creating 'environmental awareness from a cosmic perspective'. He co-founded Galileoscope, a worldwide project to provide high quality, low cost telescopes for worldwide promotion of science education and outreach. More than 260,000 are now in use in over 110 countries. He was the driving force in the creation of the AMC Maine Woods International Dark Sky Park, which protects over 75000 acres of land in the last dark sky region of the eastern United States.



James Dire has a M.S. degree in physics from the University of Central Florida and M.A. and Ph.D. degrees from The Johns Hopkins University, both in planetary science. He has travelled around the globe to see myriad solar eclipses including five continents and countries such as China, Iceland, Turkey, and Zambia, and tropical islands such as Aruba and Hawaii. He has been a professor of chemistry, physics and astronomy and an administrator at several colleges and universities. He has played a key role in several observatory projects including the Powell Observatory in Louisburg, KS, which houses a 30-inch (0.75-m) Newtonian; the Naval Academy observatory with an 8-inch (0.20-m) Alvin Clark refractor; and he built the Coast Guard Academy Astronomical Observatory in Stonington, CT, which houses a 20-inch (0.51-m) Ritchey Chrétien Cassegrain. Dire is a seasoned visual observer and veteran astro-imager.



Austin Grant is teacher and self-described perpetual hobbyist, experienced in such areas as building computers and repairing arcade equipment. Austin stumbled into astronomy several years ago and it soon became his primary interest. Being a child of the digital age, it didn't take long for him to find digital astro-imaging.



Stuart Parkerson has been the publisher of Astronomy Technology Today for the last 17 years offering news and editorial content covering the amateur astronomy products industry. Solar Astronomy Today was launched to help those interested in imaging and viewing the Sun learn about the products and services available.



Bradley Worrell is an award-winning editor and writer with significant experience producing quality editorial content across a variety of formats, including magazines, websites, eNewsletters and social media. He was the founding editor of RV PRO Magazine and currently works with the University of Colorado Boulder's "Colorado Arts & Sciences Magazine" which provides news and editorial on in more than 60 fields, including the natural sciences, social sciences and arts and humanities. His article in this issue covering the Solar Snap originally appeared on the Colorado Arts & Sciences Magazine website.

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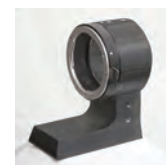
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MAKING THE MOST OF THE UPCOMING 2023 AND 2024 SOLAR ECLIPSES

By Dr. James Dire

I have travelled around the globe to see myriad solar eclipses over the course of my life. These include five continents and countries such as China, Iceland, Turkey, and Zambia, and tropical islands such as Aruba and Hawaii (the official name of the Big Island). It goes without saying that I have a lot of experience planning these trips and knowing what typically goes right and what can go wrong.

I have been the leader or co-leader of many eclipse expeditions. The largest had 610 people on three chartered airliners to Aruba in 1998. The smallest were seven member teams to Zambia in 2001 and Turkey in 2006.

For the Great American Solar Eclipse on August 17, 2017, there was no choice for me where I wanted to be: Saint Joseph, Missouri. St. Joe, as we call it, is where I grew up. Although I haven't lived there since I graduated high school, my parents still lived there



Image 1 - Matt Konon (red shirt), James Dire (green shirt) and Trey Gilliam (blue shirt) await second contact during the August 21, 2017 total solar eclipse. The observing site was where the eclipse centerline intersected US Highway 50 (seen in the background below the tower). They photographed the eclipse with a Stellarvue 70mm f/6 Apo on an iOptron Cube Pro mount with a Canon 600D camera and a Canon 30D camera with a 70-200mm f/2.8 zoom lens on a tripod.



Image 2 - 2017 total solar eclipse, mid eclipse, shot with a Stellarvue 70mm f/6 Apo on an iOptron Cube Pro mount with a Canon 600D camera. The exposure was 1/25s at ISO 200.



Image 3 - 2017 total solar eclipse, just before third contac, shot with a Stellarvue 70mm f/6 Apo on an iOptron Cube Pro mount with a Canon 600D camera. The exposure was 1/125s at ISO 200.

in 2017, as well as siblings, friends and more cousins than I can count. When I first learned several decades back that the centerline of the 2017 solar eclipse would pass through St. Joseph, there

was never any question in my mind I would go there for the eclipse, forty years after I graduated from St. Joe's Central High School.

Most of my usual criteria for the

best spot to go for an eclipse include in no particular order:

- Ease to get there from points far away.
- Weather prospect for the site.
- Ease to relocate if the last-minute weather forecast is poor.
- Length of totality compared to other sites.

I flew into Missouri for the 2017 eclipse. My brother and his wife drove up from Texas and my niece's stepson drove in from Oklahoma. Some friends of mine flew down from Juneau, Alaska with their two young daughters. We were all eager to see the Great American Eclipse.

Most of the times I have travelled around the globe to see an eclipse the weather cooperated. Unfortunately, the day before the eclipse, thunderstorms were predicted in St. Joseph during the early afternoon eclipse. I had two backup sites selected, one east and one west, both under a six-hour drive. The day of the eclipse, I awoke at 5:00 am to check the weather forecast for St. Joseph. It still was not good. It didn't look better for the backup site to the west, but was favorable at the backup site to the east between Jefferson City and St. Louis.

I called and awakened everyone in my group and told them to be ready to roll at 6:00 am. Everybody, except my niece's stepson and my friends from Alaska, decided to stay in St. Joseph for the eclipse and take their chances with the weather. They saw nothing but clouds during the eclipse. The rest of us took off in two vehicles travelling east to where the centerline crossed US Highway 50.

On the drive south down I-29 to-



Image 4 - 2017 total solar eclipse, mid eclipse, shot with a Canon 30D camera with a 70-200mm f/2.8 zoom lens on a tripod. The lens was set at 70mm f/4. The exposure was not recorded.



Image 5 - The author awaits second contact at 8000 feet elevation east of Bella Vista, Argentina during the July 2, 2019 total solar eclipse. He is photographing the eclipse with a Stellarvue 70mm f/6 Apo on an iOptron Cube Pro mount with a Canon 600D camera. Note in the distance the dust over Bella Vista in the valley below the ridge we were on.

wards Kansas City, we observed unusually heavy traffic heading the other way from Kansas City into St. Joseph. I know St. Joseph was on the centerline. But I kept thinking: “why didn’t these people check the weather forecast?” They should have been heading east out of Kansas City towards St. Louis. Surprisingly, when we made the exchange to I-70 east near Independence, Missouri, we encountered very little traffic heading in that direction.

The closer we got to our destination, the fewer clouds were above us. Another car joined us in Jefferson City with a high school friend, her boyfriend and dog. So our caravan was now three vehicles.

We had planned to conduct some experiments during the eclipse that required hours to set up. Since we did not arrive with enough time to set everything up, we decided to only photograph and watch the eclipse. We arrived at the time of first contact (the star of the partial eclipse) and set up two cameras (**Image 1**).

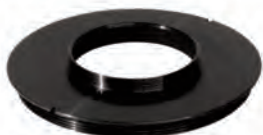
Image 2 is a photo in the eclipse during the middle of the total eclipse phase. The coronal rays and arcs were magnificent! **Image 3** is a short exposure of the eclipse taken seconds before third contact (when the Moon stops covering the entire Sun) capturing some pink solar prominences and a bit of the Sun’s pink chromosphere. These two images were captured with a small telescope. The next picture (**Image 4**) was taken with a camera and zoom lens on a tripod.

After the eclipse ended, I drove back to St. Joseph, dodging areas of strong thunderstorms the entire way

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Image 6 - Just before second contact during the July 2, 2019 total solar eclipse, the author frames a camera on a tripod for a wide-field picture of the total solar eclipse.

home. Several people scattered between Jefferson City and St. Joseph saw the eclipse in breaks in the clouds. Most were clouded out, except Columbia and Jefferson City, which were also clear.

My next solar eclipse was on July 2, 2019. This eclipse path only crossed land in Chile and Argentina. The climate data indicated that Bella Vista, Argentina had the best chances for clear skies during the eclipse, so that's where we headed. My wife and I flew from Chicago to Mendoza, Argentina with one stop in Panama City, Panama.

It was an afternoon eclipse. So, to beat traffic, we departed Mendoza to Bella Vista early in the morning. We actually did not set up in the Bella Vista valley, but on the ridge to the east at 8,000 feet elevation. This would afford us a spectacular view of the late afternoon total solar eclipse over the snow capped peaks of the Andes Mountains to the west. Our site was where the eclipse centerline crossed Argentina Highway 149 (**Image 5**).

Tens of thousands of eclipse chasers gathered in Bella Vista, only to experience a dust storm that hindered their view of the eclipse (**Image 6**). We could see the dust cloud in the valley below us. Fortunately, we were above it with nothing above us but clear blue skies.

Image 7 is a montage of the partial and total phases of this solar eclipse. The Sun set before the partial eclipse ended (called fourth contact). But we saw all the splendor of totality. I had planned this trip for years in advance. My de-

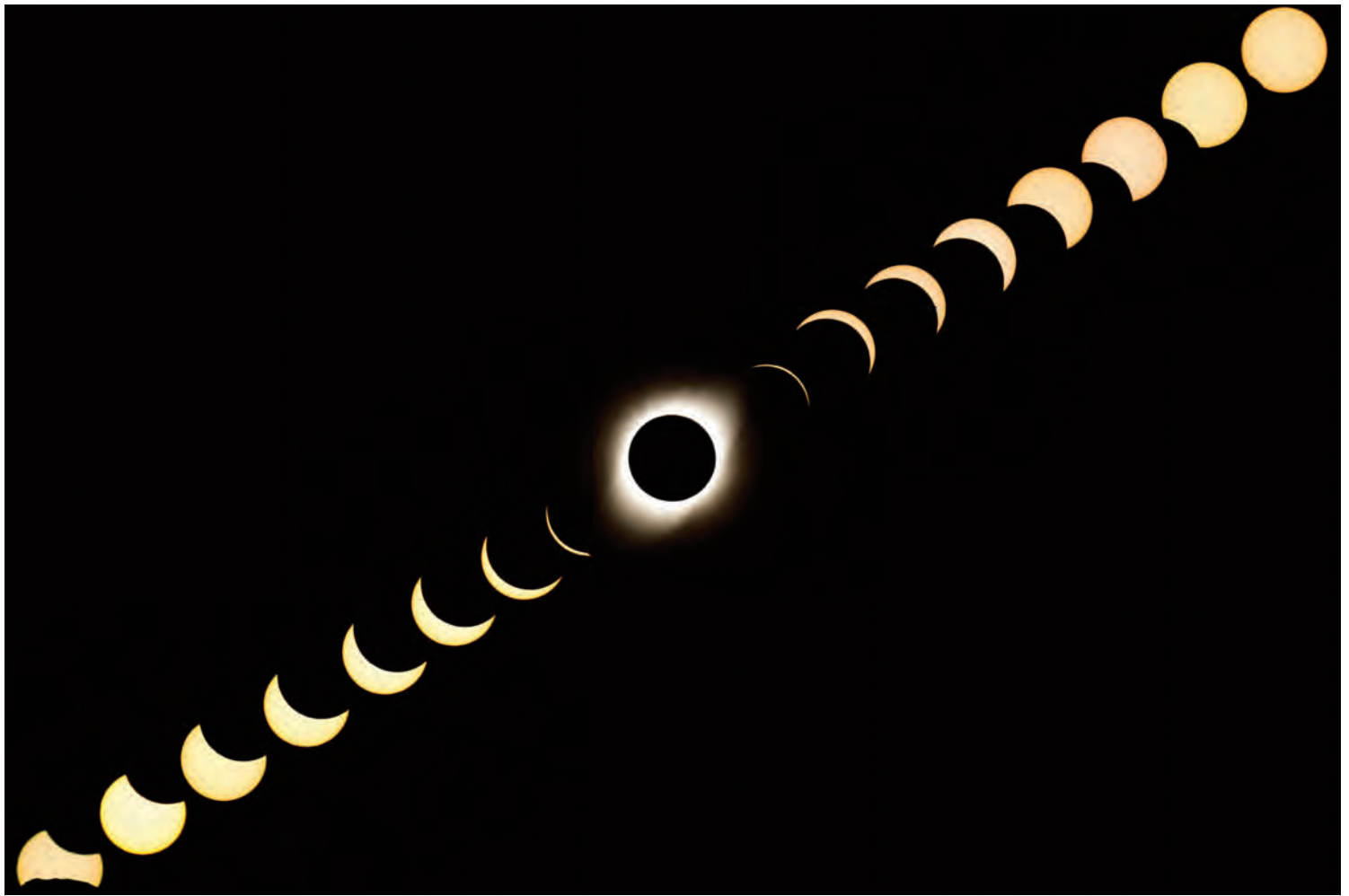


Image 7 - All the phases of the July 2, 2019 total solar eclipse. First contact is the image on the upper right. In the image on the lower left, the partially eclipsed Sun sets behind a mountain peak.

sire was to capture a wide-field picture of the solar corona over the Andes. My picture appears in **Image 8!**

The COVID-19 pandemic forced

us to cancel our next solar eclipse trip. So we are eagerly awaiting the second Great American Solar Eclipse in April of 2024. As a warm up for that eclipse,

there is a splendid annular eclipse in the U.S. six months before the 2024 total solar eclipse.

Image 9 shows the paths of both of

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Image 8 - Total solar eclipse over the Andes on July 2, 2019. The snow-capped peaks are 63 miles away and range in height from 18,000 to 21,000 feet. The picture was shot with a Canon 30D camera with an 18-55mm zoom lens. The exposure was 1/10s at ISO 200.

these eclipses (Eclipse Predictions by Fred Espenak, <https://www.eclipse-wise.com/>). The October 14, 2023 an-

nular solar eclipse begins in North America on the coast of Oregon and ends in Corpus Christie, Texas. The

maximum duration of the annular phase in the U.S., 5m2s, will be in Corpus Christie. The April 8, 2024 total solar eclipse begins on the continent in Mazatlán, Mexico and leaves the continent north of St. Johns, Newfoundland.

The April 8, 2024 eclipse follows very closely the path of the May 10, 1994 solar eclipse. In 2024, the Moon's umbra will cover regions in Texas, Oklahoma, Arkansas, Missouri, Illinois, Kentucky, Indiana, Ohio, Pennsylvania, New York, Vermont, New Hampshire and Maine. The very southeastern tip of Michigan, north of Toledo, Ohio, will experience a few seconds of totality, as well as a few acres in Tennessee at the northern end of State Highway 22 north of Tip-tonville. The maximum duration of totality for this eclipse is 4m28s.

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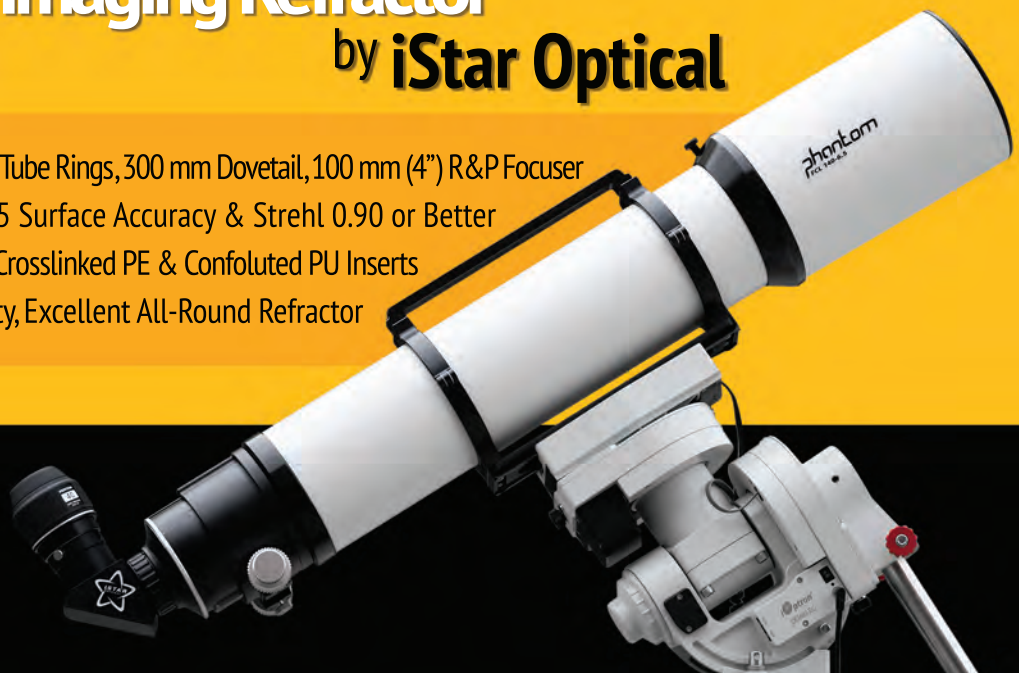
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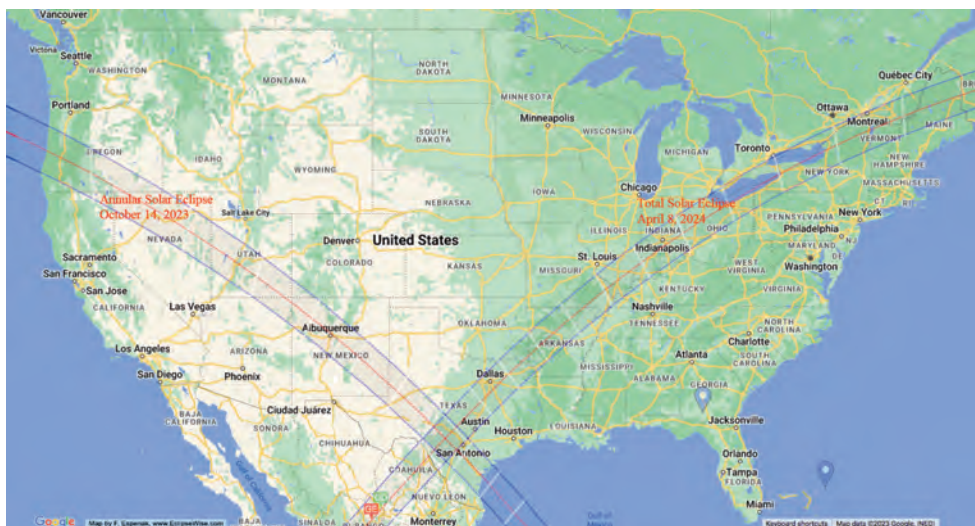


Image 9 - Within a six-month period in late 2023 and early 2024, an annular solar eclipse and total solar eclipse will occur in the United States. The two eclipse paths cross in Texas.

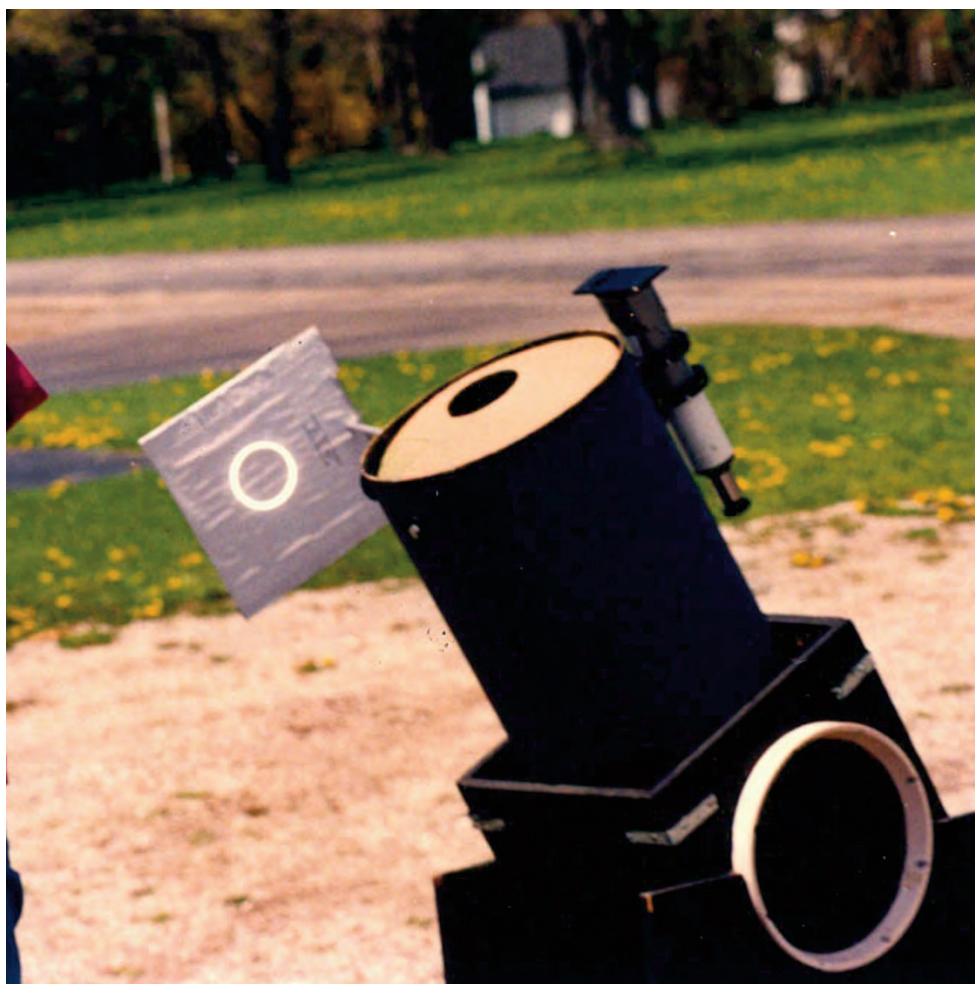


Image 10 - The April 8, 2024 eclipse will follow a path very close to that of the May 10, 1994 annular solar eclipse. The author projected the 1994 annular eclipse using a stopped down ten-inch home-made Dobsonian reflector. The eclipse was observed near Lake Erie, 40 miles southwest of Buffalo, New York.

Notice in Image 9 both eclipse paths cross in Texas, northwest of San Antonio. So for these eclipses, as George Strait sings, “Texas is the place I'd dearly love to be”. In the U.S., Texas will have the longest duration for both of these eclipses. The weather prospects for both are pretty good, and it will be easy to drive to another location should clouds hinder my choice locations for each. Where the center-lines intersect, the annular eclipse will last 4m58s and the total solar eclipse 4m26s.

A great way to view an annual eclipse is to project an image of the Sun onto a screen using a Newtonian telescope (**Image 10 and Image 11**). Many people can view a projection at the same time. No solar filters are required. Three- to four-inch apertures are great for this. Larger Newtonians can be stopped down as in Image 10 as they generate too much heat at the eyepiece and the image on a close-by screen is too bright.

You don't want to project with expensive eyepieces like Nagler, Ethos, or Plossls. They will not survive. I use a two-element 18mm Ramsden eyepiece. The elements are widely separated inside the barrel and they contain no optical adhesives. My 18mm Ramsden eyepiece has survived decades of solar projection.

You can use the same technique for a total solar eclipse. You can see all of the partial phases, the diamond ring, Bailey's beads, prominences and the solar corona on such a projection.

For determining the exact beginning and end times of totality, which has scientific use, I record video of a projection of the eclipse with a timer

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in the field of view (Image 12). On the recording, I also capture audio from a shortwave radio time broadcast. Using a GPS receiver, I collect the latitude, longitude and altitude of the telescope's location for use in these scientific calculations. The data are used to determine the exact size and shape of the Sun the day of the eclipse. Most stars, like the Sun, vary in size and shape during their mid-life ages.

To photograph the eclipse, I use small refractors with safe solar filters over the objective ends of the tubes for the partial eclipse phases. For the two Texas (not to be confused with the Texas two-step) eclipses, I plan to use a 110mm William Optics refractor, a 70mm Stellavue refractor and a Lunt 50mm hydrogen alpha telescope. Since I will be travelling by car to Texas, I'll easily be able to transport all of the telescopes, mounts, cameras, and other equipment.

I will have a team of family members, fellow astronomers and friends with me to help conduct all of the work. The group size should allow all of us time to look up and enjoy the total solar eclipse phase naked-eye, in between operating equipment.

So bring your boots and Stetons to Texas and enjoy two marvelous solar eclipses. This is the first occasion in our generation for two central solar eclipses occurring in the United States within six-month period. And it might be the only time such has occurred in that time period at the same location! 



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Image 11 Above - Here the author uses a six-inch Newtonian on a powered polar-aligned equatorial mount to project the Sun on a screen attached to the telescope.

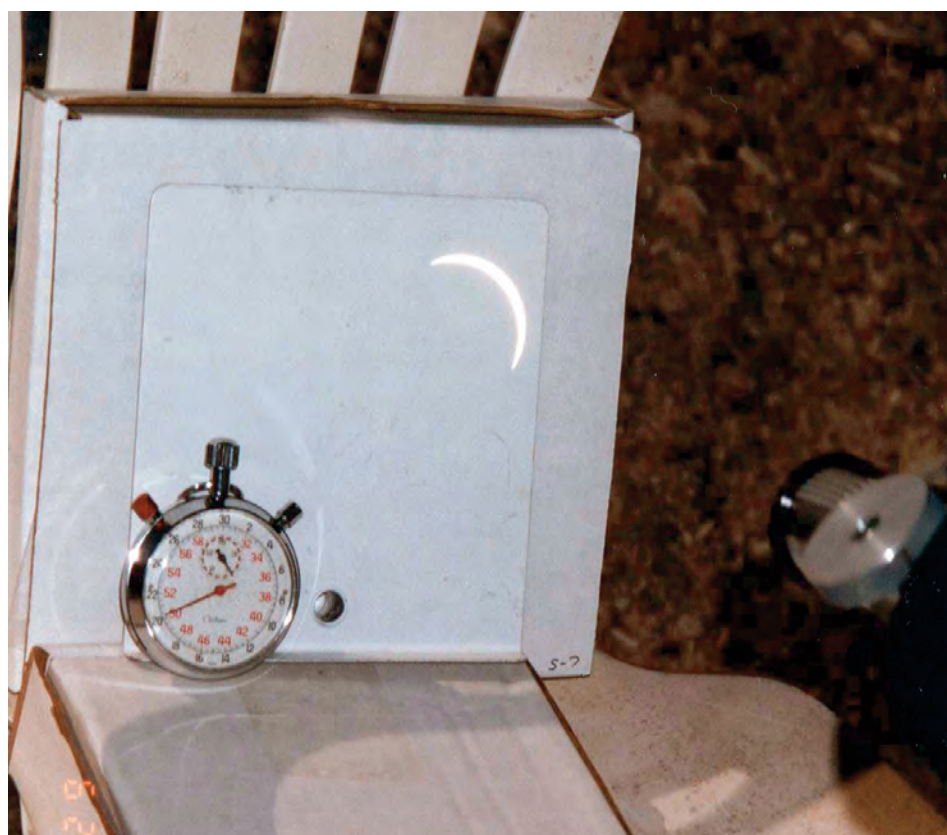


Image 12 Left - Contact timings are recorded on video by projecting the eclipse onto a screen with a timepiece. A broadcast of WWV short wave radio time signals is simultaneously recorded by the video camera. The exact times of second and third contacts is preserved on the video.