

Your City on the Edge of the Total Eclipse Path – a citizen science opportunity to measure the size of the Sun

Your city is in a great position, straddling either the northern or southern edge of the path of totality of the August 21st eclipse. With the conspicuous nature of the total eclipse phenomena and their strong dependence on geographical location, scientifically useful observations can be made with modest equipment, even with just a smart phone. The edge of the gaseous Sun is not perfectly sharp, so the edges of the path of totality are also not sharp, but there is a rapid change over a distance of a few hundred yards. The International Occultation Timing Association (IOTA) encourages **citizen science** observations of the 2017 eclipse from locations near the edges of the path of totality, to see how well it can be defined. Several efforts have been made at past eclipses to station observers at intervals across the predicted edges of the path of totality. All of these efforts were visual, most noteworthy being a large effort in New



York City (see picture at right) at the southern limit of the January 1925 total solar eclipse, as described at <http://www.eclipsetours.com/eclipse-edge-2017/>. Unlike past eclipses, now we can better document the complex phenomena using the video function of ubiquitous smart phone cameras. IOTA's Web page

<http://occultations.org/eclipse2017/smartphonesimple/> describes how useful smart phone observations can be made. It notes how small cheap clip-on telephoto lenses (shown to the right with smart phone attached to a photographic tripod), available at Walmart and other outlets, can improve your recording. We seek such observations from locations within a half mile-wide "graze zone" along the northern and southern limits of the path of totality. Most of the past efforts

assumed that the start and end of totality were instantaneous, that one either had at least a short duration of totality, or none. Although the start and end of totality are quick, they are in fact gradual, especially within the graze zone.

This is what we want to study using smart phone videos obtained from many locations across the graze zone. They don't need to be made from one city or area; they can be made anywhere within the graze zone from coast to coast. The observations can be made by individual observers working alone (or better, in pairs, as described on the Web page specified above) or in organized groups, like the past efforts, or like the effort being organized in Minden, Nebraska discussed at <http://www.eclipsetours.com/eclipse-edge-2017/>. Perhaps other group efforts, organized by schools, libraries, or other local organizations, can bracket the graze zone with multiple observers in cities crossed by



Group of Observers on Roof of Building

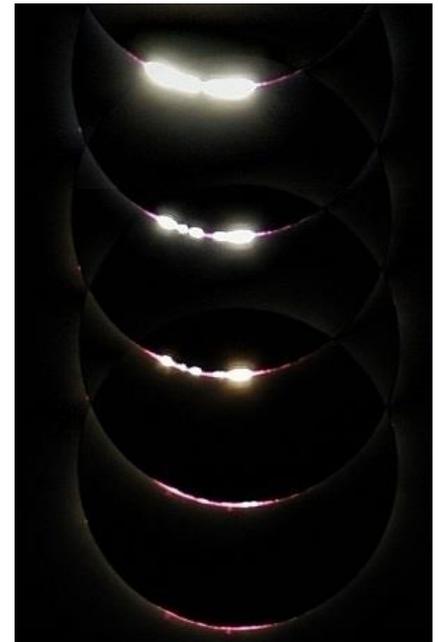
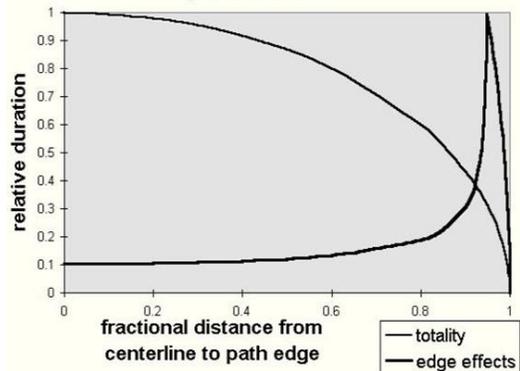


the northern and southern limits, such as St. Louis and Kansas City. A list of other cities and towns that are especially well-positioned is given at the end of the eclipsetours.com Web page.

Important: The intensity of the part of the Sun that remains visible at central eclipse will change considerably across the graze zone; that's what we want to measure! North of the north edge of the northern-limit graze zone (or south of the south edge of the southern one), the remaining piece of the Sun will be very bright, and it is recommended that observers there use eclipse glasses the whole time. Those in the graze zone, and farther south, should look for the splendor of totality during the minute surrounding the central time for your location, but use the eclipse glasses when the eclipse is too bright to comfortably look at without them. A supply of safe eclipse glasses are available, first come/first served, to supply observers in the graze zone; contact me if your team could use them. More on viewing the eclipse safely is at <https://eclipse.aas.org/eye-safety/safe-viewing>.

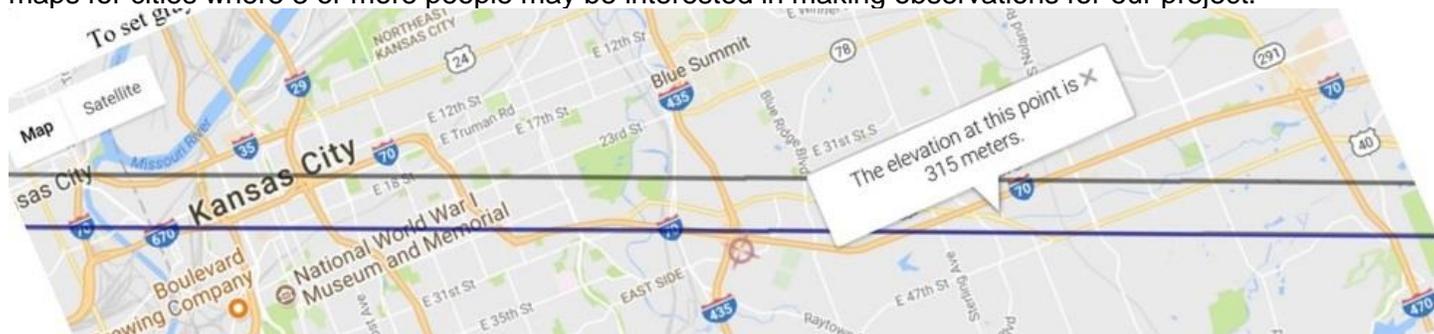
Other Observations: Besides lines of observers with cell phones bracketing the "graze zone" at the limits, we want observations made with various past-used techniques, mainly telescopic, to determine their consistency. The goals are to help determine the accuracy to which the edge of the path of totality can be defined, and to contribute to a long-term study to try to measure changes in the size of the Sun, and the accuracy to which that can be done. I will be bringing 4 or 5 extra small telescopes and video systems that I hope some observers in the graze zone, in the area where he observes, can operate. We hope to train the local observers in their use the afternoon (Sun. Aug. 20) before the eclipse. Our planned location is Moberly, Missouri, but we will travel to other (probably) northern-limit locations if the weather forecast is unfavorable for north-central Missouri. Information about these small systems, which can record Baily's beads in more detail than smart phones, is at <http://occultations.org/eclipse2017/advanced/>.

Near the path edges, many dozens of Baily's beads (shown in the picture at right, from the [eclipsetours](http://eclipsetours.com) Web site) are visible over a period of a couple of min-utes, a much richer display than the brief view of them seen near the path central line. The Baily's beads and chromosphere, are enhanced by a factor of about 10 for locations a short distance inside the path edges while the duration of totality is still a quarter to a third of that at the center.



Few amateur astronomers will be observing from the graze zone since most of them will travel deeper into the path of totality. If you live in or near the graze zone, and are content to observe there, you are encouraged to contribute to our experiment by recording the eclipse with a smart phone. But if you have a small telescope, and/or a DSLR camera, you can make observations of even more value. You can just hold your smart phone, to point its camera lens into a low-power eyepiece, although it may be a little difficult to line the two up to keep recording a good image. There are devices to attach smart phones to telescopes; one source for them is www.phoneskope.com. **Caution:** If you use a telescope, its front end needs to have a full-aperture solar filter, or else you could damage your smart phone during the partial phases. Information about these more sophisticated observations are given at <https://eclipsemega.movie/megamovie> (one of their goals is to obtain images of Baily's beads and the diamond ring), some at IOTA's site at <http://eclipsetours.com/eclipse-edge-2017/>, and at general sites such as <http://www.eclipse2017.org/2017/photographing.HTM> (but note that in the graze zone, the best images will be of Baily's beads and the diamond ring, NOT of the corona).

Where are the eclipse “graze zones”? Observations of recent eclipses indicate that the solar diameter is a little larger than the standard value used for predictions, so IOTA defines the eclipse “graze zone” as extending from 300 meters (~1000 feet) outside the predicted limit to 700 meters (~2000 feet) inside the limit. An example, showing the graze zone near the southern limit over Kansas City, is below; more detailed maps of the northern graze zone, across the St. Louis area, is at <http://occultations.org/documents/StLouisPath.pdf>. Ideally, we would like to have observers at about 175-foot (50m) intervals across the eclipse graze zone, but as noted before, they don't need to be along one road, or in one north-south line; they can be spread east and west within the graze zone. Note that the graze zone shifts about 500 ft. south (measured perpendicular to the limit line) for each 1000 ft. of elevation above sea level. Instructions on how to plot the graze zone in your area are at <http://occultations.org/eclipse2017/grazezone/>. If time allows, I will generate, upon request, graze zone maps for cities where 3 or more people may be interested in making observations for our project.



Reporting the graze zone observations: After the eclipse, we will collect observations, probably via the **Eclipse Megamovie Project** (<https://eclipsemega.movie/>), especially if there are large numbers of graze zone observations. But we expect to also post a report form that you can email to us, and may have a DropBox or Google Drive address where you can upload your smart phone videos; more about reporting will be posted at <http://occultations.org/eclipse2017/> when we can, it may be soon after the eclipse.

Practice: Whichever way you observe the eclipse, you should make a dry run, to test the full procedure during a day before August 21st, at the same time that the eclipse will occur on August 21st; then it will be in the same general direction in the sky as the eclipse will be. I think it will help if you select a day that is mostly cloudy, so the Sun is fainter shining through the clouds, which can mimic the deep partial phases before totality.

Links to additional IOTA material about observing total solar eclipses are given at the bottom of IOTA's Web page about the eclipse (it includes much of the material above) at <http://occultations.org/eclipse2017>. There are links to videos showing Baily's beads recorded at some past eclipses observed near the path edges.

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