A safe solar viewer (SSV) as a tool for engaging STEM minorities in eclipse activities

T.R. Richardson, Michael Larsen

Department of Physics and Astronomy, College of Charleston, Charleston, SC

Introduction

This paper describes a project for the August 2017 total solar eclipse to develop a simple solar image projector that anyone can build using inexpensive surplus optics and simple materials. We planned free workshops in the summer of 2017 in which STEM minority children would build a solar viewer to take back to their communities to use during the eclipse. In addition we planned visits to schools by our majors to leave a completed viewer and provide instructions on eclipse safety.

Figure 1. A two-lens Safe Solar Viewer (SSV) as described in this presentation.

History

One of us (Richardson) became interested in the safe viewing of partial solar eclipses at the time of the annular solar eclipse on May 30, 1984. After that event he built a simple solar projector with the optics being a ½-diopter lens from reading glasses producing a 2.0 cm image on wax paper at the end of a 2-meter long carpet tube. During eclipse events children were delighted by this viewer and would drag their parents over to see the lens still in its eyeglasses frame.

Figure 2. The image made by a ½ diopter reading glass viewer on wax paper taped inside the end of a carpet tube.

A One-Lens Viewer

That original viewer is still a crowd pleaser but the length is problematic. Finding the materials is harder and transport is difficult but the problems are solved if a smaller solar image is accepted. The image brightness makes these SSVs superior to the pinhole viewers. Reading glasses (+1 or +2 diopters) selling for $1.00 at discount retailers make fine lenses for those viewers. They viewers are easy to construct guaranteeing a no fail project for children old enough to use a ruler. (Figure 3) It is necessary to stop down the lens (¼ – ½ in.) for the best image brightness. Using the entire lens produces an overly bright image that is difficult to view.

The Two-Lens SSV

The goal for 2017 was to locate inexpensive optics that could be easily assembled into a safe solar viewer (SSV) less than 1 meter in length producing a solar image 5-8 centimeters across. After calculations and testing, we settled on Galilean optics arranged to make an extreme telephoto lens with an effective focal length of 5100 mm to 8900 mm.

The objective of the final SSV was a simple double convex lens of 50 cm focal length. (Lenses from 30 to 60 cm fl work well.) For the Barlow, lenses with a focal length of -15 mm to -25 mm provided sufficient magnification. Our supplier of lenses, Surplus Shed, put a kit together with the necessary lenses and instructions at a price of $5 plus shipping as of this writing.

Figure 3. A one-lens SSV held on a person's shoulder and projecting a 1.0 cm image of the solar disk as the person stands with their back to the sun.

Workshops and School Visits

We scheduled workshops at the local public library and conducted a large workshop at a community center in a minority rural enclave. In total we helped children build 83 wooden two-lens SSVs and 115 cardboard one-lens SSVs. Eleven of our majors made pre-eclipse visits to schools, scout groups and retirement communities in the week before the eclipse. We also mailed lenses to teachers around the country who requested them.

Figure 5. The children at the end of one of our workshops with their completed SSVs.

Figure 4. An SSV in action during the 2017 eclipse.

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Further Information

Complete details on construction is at
http://richardsont.people.cofc.edu/safe_solar_folder/index.html
The Surplus Shed SSV kit is part #L14766.
www.surplusshed.com