Investigating the Penumbra Reduction Effect During Deep Phases of a Solar Eclipse

I have occasionally seen articles regarding the possible change in how shadows appear during the deep portions of a Total Solar Eclipse. A couple months out I also reviewed a very nice YouTube video by Gordon Telepun, MD where he gave a brief talk about this phenomena where shadows can appear much sharper when deep into the partial phase of the eclipse.

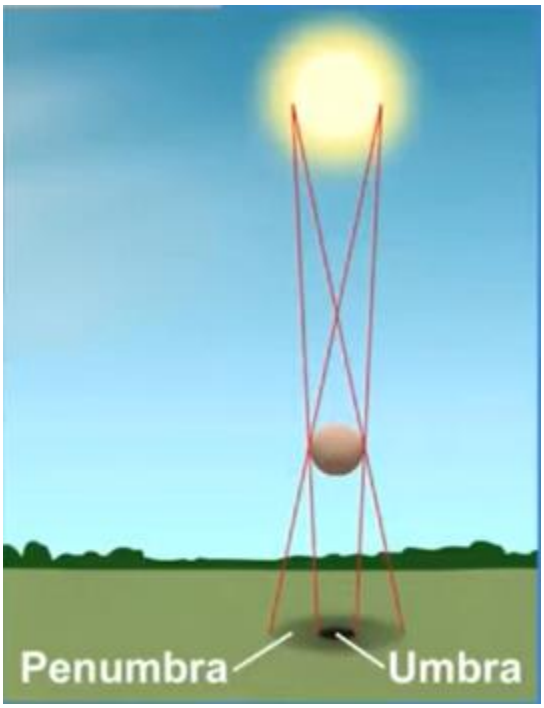
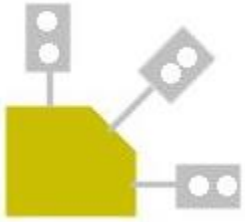


Diagram explaining the Penumbra surrounding shadows cast by our Sun.
https://youtu.be/h_vxRgpIJHE?si=2S380lyuoSUBfaDT

In brief, the premise is that with the Sun reduced to a crescent rather than a ½° disk in the sky, the shadows will appear sharper. Normally, because the Sun is not a point source of light, we have a penumbra attending the umbra (shadow) cast by an object. Furthermore, the appearance of a sharpened shadow should be maximized when the object is tangential to the crescent and discounted when perpendicular.

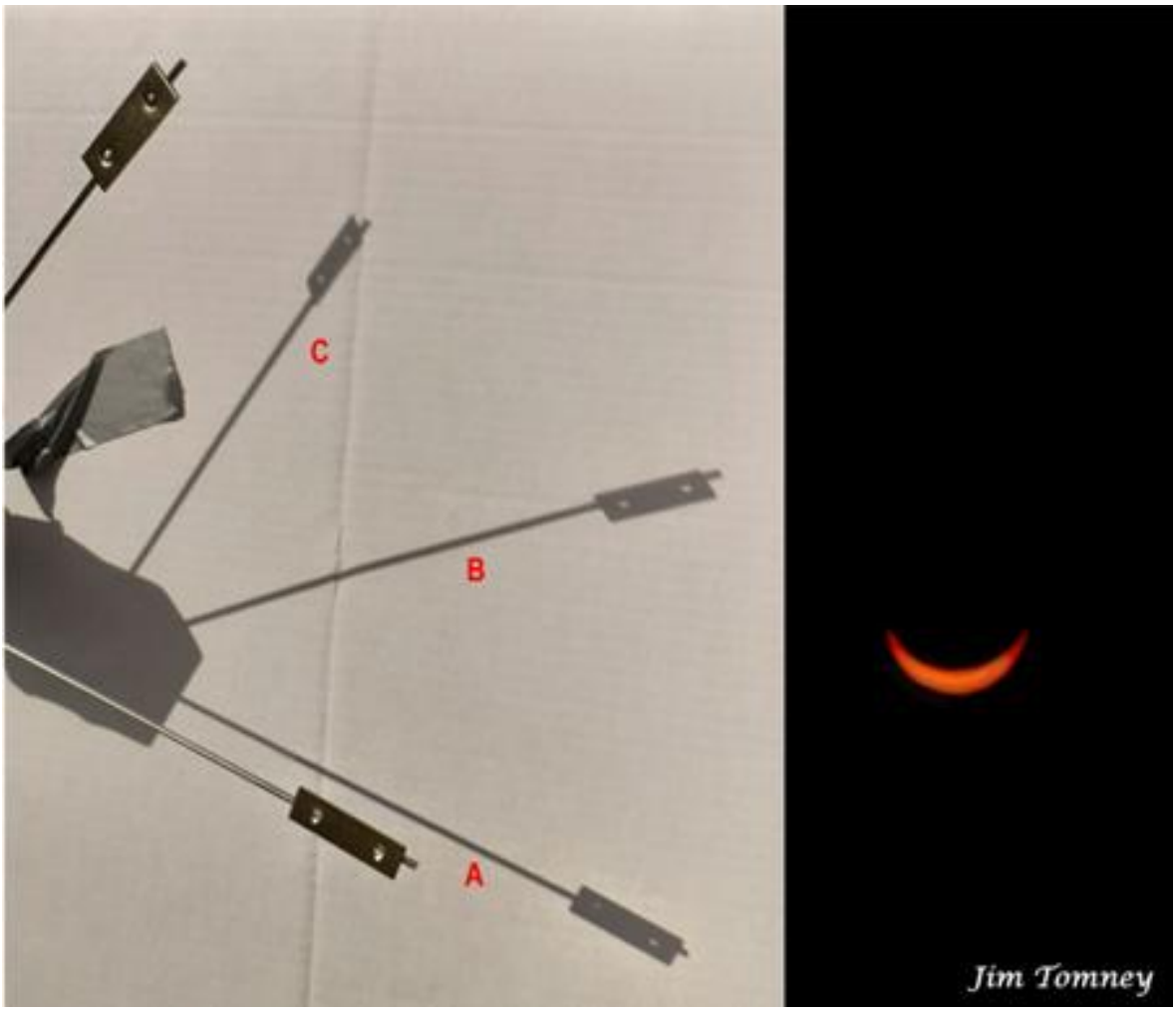
I decided that it might be fun to test this out and try to observe the phenomenon at the April 8, 2024, eclipse. In preparation for it I built a very rudimentary shadow caster. It consisted of a small block of wood with three 3mm aluminum rods set at 45° angle from one another. At the end of the rods I also attached a mending plate. Another rod was placed perpendicularly into the wooden block so that it could be slipped through a white project board and rotated as desired.



As noted by Dr. Telepun, the observation needed to be carried out within a few minutes prior to C2 or following C3 while the crescent was still very thin. Given the excitement and need to focus on equipment prior to totality I set an alarm to remind me following C3. At 19:32 UT, some 3 minutes following the end of totality for us at Plattsburgh, I examined the shadow caster (below, next page). It was clear to me as well as three other companions that the (somewhat) horizontal rod (A) was casting a distinctly sharper shadow compared to the one 90° away from it (C) or even the one 45° away. It was also true that rod A was more tangential to the crescent Sun, supporting the premise that there was less sunlight able to extend around the rod to generate a fuzzy penumbra. At this point in time the Sun was nearly 96% obscured by the Moon.[1]

While not necessarily of scientific value, this Penumbra Reduction Effect was fascinating to observe and yet another transient phenomenon one can watch for only during a very deep eclipse of the Sun.

[1] Based on data generated from https://eclipse2024.org/eclipse-simulator/2024/index.html


C
B
A
Jim Tomney