

Gravitational deflection of light: solar eclipse of 30 June 1973 I. Description of procedures and final results

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A condensed account is given of the equipment and procedures of the Texas expeditions to Chinguetti Oasis, Mauritania, to observe the Einstein shift at the eclipse of 30 June 1973. Some of the instrumental problems brought to light in the accompanying paper describing the reductions are identified. The final value is $L = (0.95 \pm 0.11) L_E$, where the error is 1σ and $L_E = 1.75$ is Einstein's value.

THE Department of Astronomy and the Department of Physics of the University of Texas at Austin, in collaboration with the Department of Physics of Princeton University, sent an expedition to Chinguetti Oasis, Islamic Republic of Mauritania, to observe the Einstein shift at the total solar eclipse of 30 June 1973, followed by a supplementary expedition for reference observations in November.

Chinguetti lies at longitude $12^\circ 22'$ W, latitude $20^\circ 27'$ N, at an elevation of about 350 m. The eclipse, one of the six long solar eclipses of the 20th century, took place in a rich Milky Way field, under the following circumstances:

Sun's position: $\alpha = 6^h 37^m$, $\delta = 23^\circ 13'$,
Sun altitude: 61° ,
Time of maximum eclipse: $10^h 48^m 50^s$ UT,
Duration: $6^m 18^s$,
Width of shadow: 250 km,
Observing station: 25 km north of central line.

The instrument used incorporated an old Calvert equatorial mounting, a new drive system and plate-holder assembly, and a 2.1-m focus, four-element, astrometric, blue-corrected flat-field lens, originally made for the late Andre Danjon, but never used, on loan from the Paris Observatory. The equipment was housed on site in an insulated and sealed plywood and styrofoam building, erected in May, and left under guard with the telescope inside in its precise eclipse configuration, until November.

In Austin, after antireflection coating for 4400 Å, of its elements, the lens was stopped from 20.0- to 16.5-cm aperture, a Schott GG-395 flat glass blue filter (also antireflection coated) was added, and then adjusted with extreme care over a period of three months. After hand carriage to Chinguetti excellence of image quality showed that the adjustments had not deteriorated.

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The telescope tube was of 3-mm steel with cast aluminum alloy central mounting base, lens, and plate-holder mounting rings, fitted with a hood at its upper end. The new right ascension drive comprised a rigidly framed tangent screw assembly using a 10-cm micrometer screw of 1-mm pitch. This was driven by a 115-V synchronous motor activated by a 60-Hz crystal-controlled power supply from a 12-V battery. The motor was mounted on a 1.2-m arm which gave a 30-min free run. The whole assembly could be shifted in right ascension and declination by unclamping. Fine control in declination was by hand-operated screws, and in right ascension by a variable-speed motor. In June power and other facilities were supplied by the National Science Foundation logistic support for all expeditions at Chinguetti. In November portable generators were used. The telescope was aligned by star observations through removable ports in the telescope house and through the roof hatch (which gave access to a sky patch 1 h in right ascension and 30° in declination) used in the eclipse observations. During the eclipse and comparison observations the telescope was driven slightly unbalanced, heavy to the east, and no manual guiding was attempted. An alignment telescope on the mount was intended for aiming the camera on ϵ Geminorum, but on eclipse day the sky was so bright that this star could not be seen even a few seconds before second contact, and an emergency system, a Questar aimed at the Sun, was used instead.

Close attention was given to temperature control. The telescope house had a two-door entrance air lock, an evaporative cooler giving 3000 ft³/min maximum air flow to give filtered air and a positive interior pressure, and a 1.4-KVA compressor-type air conditioner to maintain the dark room inside the house near 20°C . The expected outdoor temperature at mideclipse was 29°C but was actually 36°C . Focus runs and adjustments were all made at 29°C and the house was maintained at this temperature for several hours before eclipse. The hooded lens was exposed to the sky only during the brief periods of photographic exposure and at all other times was covered by a cap incorporating several layers of aluminum foil. The entire instrument including the hood was wrapped in a fiberglass blanket