Solar-eclipse workshop

Ionospheric response to the 1965 solar eclipse was the subject of a meeting held in Oct. 1965 at the IIT Research Institute in Chicago. The eclipse reached totality in the South Pacific, and to study its effects the Institute of Telecommunications Science and Aeronomy operated ionosondes on the island of Aitutaki in the Cook Islands and near the conjugate of the Aitutaki site on Maui, Hawaii. No perturbations were observed at the Maui site that could be strictly related to the eclipse.

Analysis of the time behavior of E- and F-region data from the Aitutaki site indicate that the quadratic electron-loss coëfficient in the F region is about an order of magnitude too small if total obscuration of the ionizing solar radiation is assumed. This result, along with other data, supports the concept of the sun as an extended non-isotropic x-ray source that is not totally eclipsed at optical totality.

A fixed-frequency phase-coherent radar operated at Hilo, Hawaii, by Stanford Research Institute made a second conjugate F-region observation. A mid-morning F-region change was observed similar to that seen at Maui, except that on the eclipse day the magnitude was much larger than normal. An hour after totality there was a negative phase excursion of more than 1000 wavelengths, after which the normal positive diurnal trend resumed. The time delay between totality and the maximum effect was 90 minutes, which corresponds to a disturbance velocity of about one km/sec along the 5400-km magnetic-field line length.

Electron density and temperature. Explorer satellites 22 and 27, which traversed the partially eclipsed regions several times at an altitude of about 1000 km, made direct measurements of both electron density and electron temperature. The general behavior of these phenomena in both time and latitude agreed with the concept of photoelectron heating of the upper F region and protonosphere. The electron temperature decreased during the eclipse, and the electron density decreased over the equator but increased somewhat at higher latitudes, implying electron redistribution along the field lines. The eclipse results suggest that the total electron content along a field tube varies little during the day.

Observers conducted ionospheric soundings near the geomagnetic equator from two mobile sites. One was the Motor Vessel Acania, which carried an ionospheric phase sounder like that used on Maui. The phase-height data varied widely from day to day, but the eclipse changes were large and easily seen. The phase height, which is proportional to the reflection height of the signal and to the integrated ionization up to the reflection height, began to decrease minutes after first contact and reached a minimum 20 to 25 minutes after totality. The latter delay is indicative of E- or F-region changes, whereas the immediate effects after first contact show D- and E-region changes.

The other mobile measurement platform was a KC-135 aircraft from the Air Force Cambridge Research Laboratories. An ionospheric sounder carried by the aircraft obtained both reflection-height and pulse-amplitude data. Use of the airborne instrument did not allow detailed interpretation of F-region results, but pulse-echo amplitudes will yield detailed information on the D- and E-region absorption changes. The aircraft also carried a magnetometer, which showed an eclipse effect suggestive of a diversion of the electrojet around the eclipsed region—that is, north and south of the aircraft.

Riometer observations. IIT Research Institute operated riometers on the eclipse path at the Aitutaki site. One narrow-beam antenna, designed to be centered on the middle of the D-region totality path (30 deg from vertical), was operated in conjunction with a 30-MHz riometer. No conclusive absorption changes were observed near totality. However, definite decreases in absorption were observed with 20-MHz and 30-MHz wide-angle antennas oriented vertically.

Because of poor background statistics caused by propagated interference, the maximum eclipse-related effect observed on 20 MHz was only about 0.1 db centered about totality. On 30 MHz, a long-term decrease in absorption followed the eclipse obscuration and recovery. This decrease was about 0.3 db in magnitude. A 0.2-db noise increase was centered at totality, and after totality there was a somewhat smaller noise increase made up of impulsive bursts. Probably this noise was not associated with the eclipse but was radio noise propagated along the partially eclipsed path.

A group of observers from Cornell Aeronautical Laboratory recorded fixed-frequency partial reflections from the D region before, during and after the eclipse. They found D-region reflections from as low as 45 km, and many of the reflections persisted during the eclipse. Preliminary results indicate that even though there were partial reflections from low in the ionosphere, the electron content was not great enough to cause differential absorption.

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Ion beams and semiconductors

About 50 scientists and engineers attended a conference on ion-beam bombardment and the doping of semiconductors at Pasadena, Calif., in Oct. 1965. D. B. Medved and S. Kaye, both of Electro-Optical Systems, Inc., host for the conference, described recent results and devices prepared by ion implantation. G. D. Alton of Oak Ridge National Laboratory, J. Perel of EOS and T. Everhart of the University of California (Berkeley) described apparatus and diagnostic techniques. Bombardment and radiation-damage effects were discussed in papers read by R. G. Downing of TRW Systems and H. Strack of Texas Instruments, Inc. E. Kay of IBM Research Laboratories discussed sorption at low energy. □