Intensity Variation of Photons During The Solar Eclipse

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Abstract

The study was aimed to determine the variation of intensity of photons from the Sun during solar eclipse at Aurangabad (altitude 586 meters, latitude 19°5' and longitude 95°24'). It was carried out with the help of photoconductive cells and G. M. counter. Quantitative estimate of decrease in intensity of photons mostly in eV range has been done. In all the three experiments performed with the help of two photoconductive cells and G. M. counter, the decrease in the intensity of photons is found to be of the order of two and we found many other interesting results in this study.

INTRODUCTION

We have performed experiments at Aurangabad on the intensity variation of photons from the Sun during solar eclipse using photoconductive cells and G. M. counter.

EXPERIMENTAL OBSERVATIONS

This study was made on February 16, 1980 at Aurangabad (altitude 586 meters, lattitude 19°5' and longitude 95° 24') between 2.24 p. m. to 4.53 p.m. where the eclipse was partial (87%). The G. M. counter used was of ECIL make, Model-GCS 4000A operating voltage and paralysis time were 1425 V and 250 μ sec, respectively. Photocells used were ZnS and CdS and were operated with operating voltage 1.5 V.

Our main interest was to obtain quantitative estimate of the decrease in intensity of photons, mostly in the eV range. It is well known that light intensity decreases drastically but prevails even in near darkness at the time of near total solar eclipse. We have measured photon intensity decrease with the help of ZnS and CdS photocells. ZnS and CdS photocells were operated at 1.5 V and we made a plot of current in microampere (μA) as a function of time. The plots for ZnS and CdS photocells are shown in Figure 1, where curves (I, II) and (III, IV) are drawn for ZnS and CdS photocells respectively, and curves (I, III) and (II, IV) represent plots for observations made on normal day and for. observations made on solar eclipse day respectively. From plots I and II (ZnS photocell), it can be seen that at 2.24 p. m, time of first contact, the current was 6 μ A, it slowly decreased to 2.7 μ A, a factor of two less and then it slowly increased to the 6 μ A. On the next day, around the same time 2.20 p. m, the current was about 5.7 μ A and was constant till 3.10 p. m. and then steadily decreased to a value of 4.00 μ A. So one can say that the time of maximum possible eclipse at Aurangabad was at 3.43 p. m. Similar conclusions could be drawn from the plots III and IV (CdS Cell).

There is strong increase in the ZnS photocurrent after the eclipse above the normal curve, which we do not understand. Decrease in CdS photocurrent during solar eclipse period is relatively much smaller than that observed in the ZnS Photocell. Further, there is large photocurrent in the case of CdS photocell. These differences we feel, might be due to large dark current.

Since the photocell responds to photons of energy 1 eV or less, we can say that the eV photons were approximately reduced by a factor of two, between near total solar eclipse (87%) and the bright Sun.

To substantiate these results, G. M. counter experiments were performed. G. M. counter used was as specified above. G. M. counter can be used to count photons of low energy, which by Compton process can produce charged particles and trigger the G. M. counter. Counts/15 sec as a function of time were recorded on the solar eclipse day and on the next day between 2.20 p. m. and 4.35 p. m. Plots of counts/15 sec vs time for both days are as shown in Figure 2. To avoid temperature effect, if any, the counter was kept at a constant temperature. On the eclipse day, the count rate decreased very fast by a factor of 20, and then again reached a value which is a factor of 16 more. If these counts measure photon intensity in the range of hundreds of eV, then this indicates drop in intensity of these photons. The photon intensity measured on the next normal day showed that the decrease in this kind of photons is between 3.00 p. m. and 4.50 p. m., the point of last contact. The count rate during the night was measured and was 46 counts/sec. The area under the normal curve and the eclipse curve is measured. Then the total counts on both days are somewhat similar. Form analysis of the area under the counts/15 sec vs time curve, we observe the total photon intensity of the corresponding energy range has decreased by a factor of order of two over the eclipse period as area under normal curve is 207.33 cm², and area under eclipse curve is 96.58 cm², where time limits were chosen 3.00 p. m. and 4.45 p. m.

CONCLUSIONS

Thus we conclude from the analysis of a simple G. M. counter and ZnS, CdS photocells available at our disposal that the photon intensity in the fraction of the eV range measured by ZnS has decreased between the

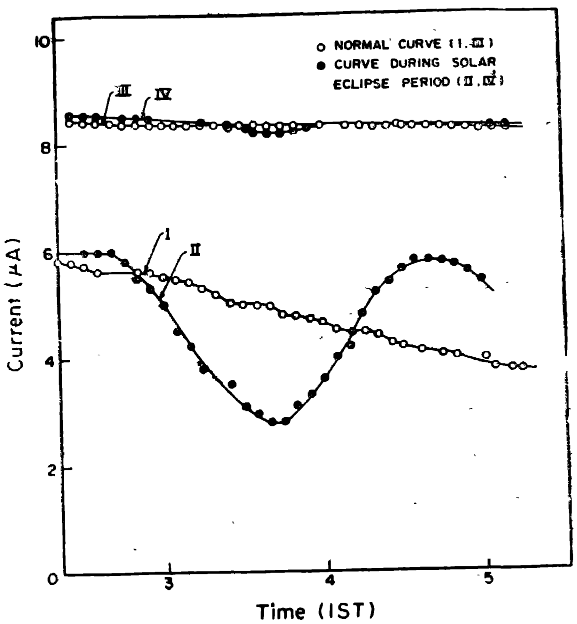

Fig. 1 : Photocurrent as function of time of CdS (I, II) and ZnS (II, IV) photocells. Measurements were made on solar eclipse day and next normal day.

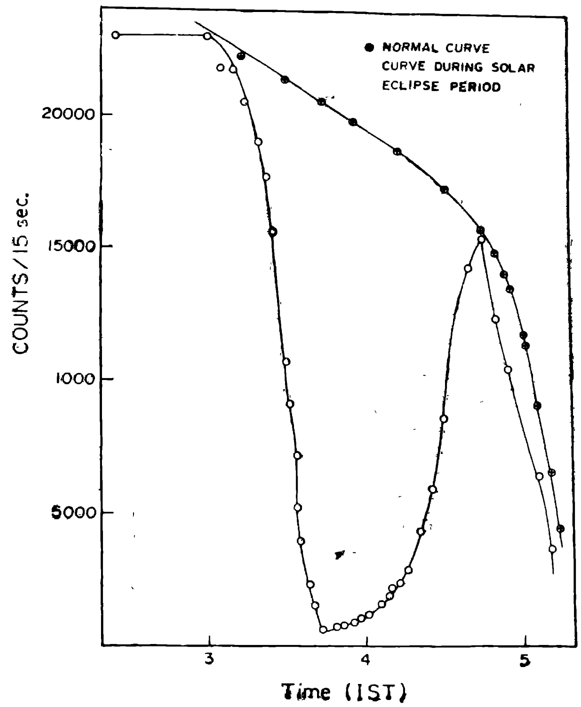

Fig. 2 : Count rate as function of time of the G. M. counter. Measurements were made on solar eclipse day and on next normal day.

point of the first contact and near totality. Similar results are observed with G. M. counter experiment at higher energy range. One may be able to correlate the decrease in temperature during eclipse by observing the decrease in photon intensity.

We would also like to state that the dip in photon intensity observed by ZnS, CdS, and G. M. counter, corresponds to near totality time, which is in close agreement with time predicted for Aurangabad i. e. 3.43 p. m.

ACKNOWLEDGEMENTS

We are extremely thankful to Dr. N. Durgaprasad, Tata Institute of Fundamental Research, Bombay for very useful comments and discussions and for help from Mr. R.S. Khairnar and Miss S.B. Dake and Miss U.V. Hulsurkar during the observations.