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I. PHYSICS

Astrophysics (Solar Corona)

SEARCH FOR A RING AROUND THE SUN

U. R. RAO, T. K. ALEX, V. S. IYENGAR, M. S. PHADKE, P. D. PRASAD, K. KASTURIRANGAN, T. M. K. MARAR, R. S. MATHUR *and* D. P. SHARMA

ISRO Satellite Centre, Peenya, Bangalore-560 058

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THE aim of the experiment was to detect the possible existence of a permanent ring structure around the Sun. The possibility of such a ring was pointed out by Brecher *et al.* (1979) based on evolutionary, physical and chemical considerations as well as constraints arising from observational astronomy related to Sun and its immediate neighbourhood. More explicitly, if such a ring were to exist, the considerations of various dynamical forces such as Poynting-Robertson drag, radiation pressure effects and the Yarkovsky drag effect on rotating heated bodies (Peterson, 1976) place a lower limit on the allowed size of particles in the ring. Combining these effects with the requirement of survival from ablation due to solar particle sputtering has led Brecher *et al.* (1979) to conclude that such a ring, located at about 4 R_0 must consist of refractory particles (graphite, for example) of size greater than 10 km at about 1000 °K to 2000 °K which, therefore, will emit thermal radiation peaking around 1.5μ to 3.0μ.

Keywords : Ring; Sun; Poynting-Robertson Drag; Yarkovsky Drag; IR Imaging.

EQUIPMENT

The experimental set up consisted of a 6-inch *f*/6 Newtonian telescope coupled to a coelostat. The detector assembly consisted of a PbS detector, a chopper with its motor, a filter and a detector cooling box. The 1mm × 1mm PbS detector, cooled to liquid nitrogen temperatures had a NEP of 1.3×10^{-10}W at a chopping frequency of 1.042 KHz. The interior of the cooling box was continuously purged by dry argon gas to prevent frosting of the filter detector assembly. The IR filter with anti-reflection coating had a transmission of about 75 per cent in the 1.9–2.8 micron range. The electronics consisted of a preamplifier (ORTEC model 5001), lock-in amplifier (ORTEC Model 9501), chopper reference circuit and a tape recorder. The entire detector assembly was suitably mounted on a moving carriage that enabled bidirectional scan of the corona in the image plane, upto 6 R_0, on either side of the solar disc. A complementary IR imaging experiment was also carried out using on IR camera consisting of an InSb detector cooled to liquid nitrogen temperatures. This had a FOV of 7° × 7° and provided on IR image of the Sun and its immediate neighbourhood.

SUMMARY OF PRELIMINARY RESULTS

The present observations do not yield evidence for the existence of a ring in the equatorial plane of the sun, corresponding to a 3 σ sensitivity of 10^{-7}W/(cm/^{2}sr μ)

at 2.2 microns for our detection system. This places the following constraints on the Brecher *et al.* hypothesis :

(*a*) The ring, if it exists in the equatorial plane, has an IR brightness lower than the above limit. The excess emission observed at 4 R_0 by Peterson (1976) and MacQueen cannot be ascribed to a stable ring structure, since, if that were true, the dispersion time for such a ring being of the order of 10^{13}yr, we should have seen in it the present experiment.

(*b*) The above upper limit would also imply an upper limit to the total number of 10km objects of about 100 million, based on the visual magnitude $m_v = +8$ to $+10$ for the individual objects as hypothesised by Brecher *et al.* (1979).

(*c*) If the ring resides at $R = 5.5\ R_0$, the total mass in the ring is 3×10^{25}g which in turn will limit the total number of 10 km objects (made of graphite with a density of 2 g/cm^3) to about 3 million.

Location

Hosur (Long. 75° 09′ 04″, Lat. 15° 00′ 12″).

References

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