LETTERS TO THE EDITOR

RADIO ASTRONOMY

Detection of Fine Structure in the Crab Nebula at 38 Mc/s

SEVERAL observations of the distribution of radio brightness across the Crab Nebula have been reported over a wide range of frequencies[1,2,4–6]. The results indicate that the distribution, while slightly elongated, has an approximately Gaussian profile. There is some evidence that the angular diameter increases at the lowest frequencies[1], but no fine structure has been detected. Kuz'min and Salamonovich[6], observing at a wave-length of 8 mm, noted a small source slightly displaced from the centre of the nebula which they ascribed to an independent source of thermal origin.

During the course of an investigation of the scattering of radio waves in the solar corona and the interplanetary medium[3], new information has become available on the angular diameter of the Crab Nebula at a frequency of 38 Mc/s. These results show that fine structure is present which has not been detected at higher frequencies but give no evidence of a significantly increased angular diameter. Further results derived from a recent lunar occultation of the nebula support these conclusions (see following communication).

The observations at 38 Mc/s were made with phase-switching interferometers on an east–west baseline. The arrangement of the aerials for spacings of 200 and 560 wave-lengths has been described elsewhere[3]. For spacings of 903 and 1,290 wave-lengths a system of higher sensitivity was devised which incorporated grating arrays to produce a reception pattern having a triple response. One array was a corner reflector 3,000 ft. in length containing dipole elements spaced by 1·4 wave-lengths and the other was a similar array 800 ft. in length. Signals from the distant array were conveyed to the receiver by a direct cable link. The Crab Nebula was observed at meridian transit, corresponding to an east–west aerial separation of 1,290 wave-lengths, and also at times displaced by ± 3h 20m from the meridian transit, which gave projected spacings of 903 wave-lengths.

The different systems were calibrated with reference to the source 3*C* 123, which is known to have an angular diameter < 12″. At the larger aerial spacings 3*C* 123 and the Crab Nebula yield comparable fringe amplitudes so that calibration is simple and direct. No attempt was made to determine the absolute phase of the fringes.

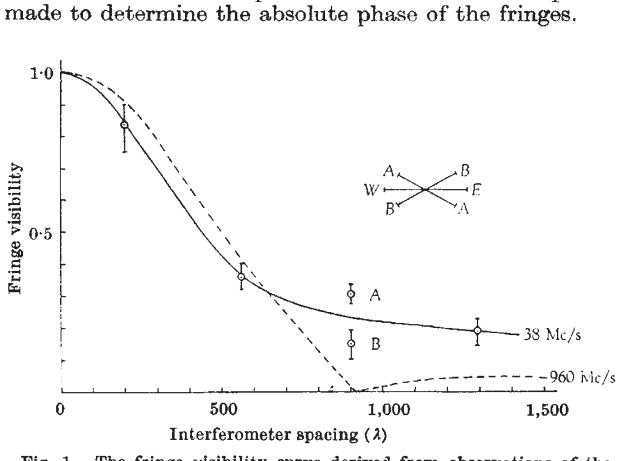

Fig. 1. The fringe visibility curve derived from observations of the Crab Nebula at 38 Mc/s. The broken line indicates corresponding results at 960 Mc/s

The fringe visibility curve derived from our measurements is shown in Fig. 1. The two points at a spacing of 903 wave-lengths correspond to different position angles of the fringes as indicated. By comparison with the results of Maltby and Moffet[4], also shown in the figure, it is clear that observations at 38 Mc/s indicate fine structure which is not present at higher frequencies. The simplest model which may be chosen to fit the observed visibility curve comprises two Gaussian sources having east–west angular diameters of 3′·7 ± 0′·5 and 30″ ± 15″. The flux densities of the two components are in the ratio of approximately 4 : 1. This result has been confirmed by recent observations of a lunar occultation of the nebula at 26 Mc/s which suggest that the small diameter component becomes even more pronounced at lower frequencies (following communication).

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Radio Observations of the Crab Nebula during a Lunar Occultation

ON April 16, 1964, a lunar occultation of the Crab Nebula was observed at Cambridge at 408, 178, 81·5 and 26·5 Mc/s. East–west interferometers were used at all frequencies and strip brightness distributions were obtained across the nebula in two directions.

The path of the radio source relative to the Moon is shown in Fig. 1. Immersion and emersion of the optical centre of the nebula occurred at position angles, measured on the Moon from north positive to east, of 43° and 295° respectively. The directions *OB* and *OA* (Fig. 1) correspond approximately to the major and minor axes of the optical object, the size of which is about 6′ arc by 4′ arc in these two directions. The Moon crossed the source at the rate of 22″ arc per minute of time perpendicular to the limb during immersion and emersion.

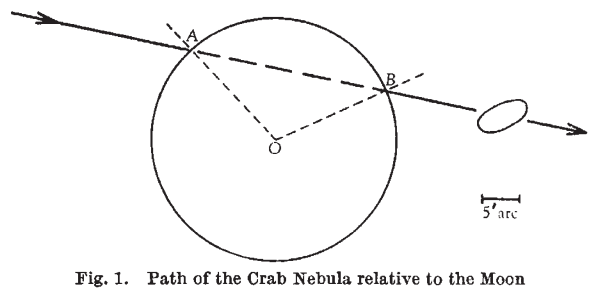

Fig. 1. Path of the Crab Nebula relative to the Moon

At 408 Mc/s the source was tracked continuously using two 60-ft. diameter paraboloids at a separation of 225λ. The 178-Mc/s observations were made with two 8λ corner reflector aerials separated by 130λ. It was necessary to move these aerials in azimuth between immersion and