LETTERS TO NATURE

PHYSICAL SCIENCES

Radio Emission from the Close Binary b Persei

WE report the detection of faint intermittent radio emission from the close binary star b Persei. Concurrent observations at 2,695 and 8,085 MHz were made with the NRAO interferometer on spacings of 900, 1,800 and 2,700 m. The total observing time was 14.4 h, mostly in short periods between February 7 and February 15, 1972. Further brief observations were obtained on April 28 and June 21, 1972.

Radiation from the direction of b Persei was seen during about 5 h. The position of the intermittent radio source coincides closely with the position given in the SAO catalogue for b Persei:

$$\alpha_{1950} = 04 \text{ h } 14 \text{ min } 28.5 \text{ s} \pm 0.13 \text{ s}, \ \delta_{1950} = +50° \ 10' \ 28'' \pm 2'' \quad \text{(Radio)}$$

$$\alpha_{1950} = 04 \text{ h } 14 \text{ min } 28.443 \text{ s}, \ \delta_{1950} = +50° \ 10' \ 28.94'' \quad \text{(Optical)}$$

The very close positional agreement and the intermittent nature of the radio emission are convincing evidence that b Persei is a radio star.

The source was seen at 8,085 MHz for a few hours on February 7–8 and February 11–12, at an average flux density of 0.012±0.004 f.u. There may have been radiation at 2,695 MHz during the event of February 7–8, with a flux density of 0.005±0.003 f.u., but the detection is by no means certain. At all other times, the flux density was less than 0.008 f.u. at both frequencies. The temporal structure of the radio emission is well shown by the observations made during the event of February 11–12. No radiation was seen from 1914 UT until 2214 UT (February 11). From 2214 UT until 0246 UT (February 12), radiation at an average level of 0.012 f.u. was seen at 8,085 MHz. No radiation was seen during the 2 h following 0246 UT. During this entire time (about 10 h), the b Persei field was observed intermittently at intervals of 25 min out of each hour.

Clearly, the source flared to an observable intensity for about 5 h on at least two occasions. The data are still sparse, but they suggest that the b Persei radio emission is not unlike that of Algol (β Persei)[1–4], although it is much fainter. The essential points of similarity are the flare-like variability of the radiation, and its greater strength toward shorter wavelengths.

The close binary b Persei joins β Persei[1–4], β Lyrae[1,2] and α Scorpii B[5,6] in the class of binary systems with flaring radio emission, but without known X-ray emission. It is an ellipsoidal variable with a period of 1.52738 day; its light curve has an amplitude of 0.06 mag at visual wavelengths[7]. Heard[8] has confirmed earlier work indicating that the orbital elements of the system are probably changing with time. As in the case of β Persei, it is tempting to suspect that the radio emission is related in some way to binary mass exchange phenomena.

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R. M. HJELLMING
C. M. WADE

National Radio Astronomy Observatory,
Green Bank,
West Virginia

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1 Wade, C. M., and Hjellming, R. M., *Nature*, **235**, 270 (1972).
2 Hjellming, R. M., Wade, C. M., and Webster, E., *Nature Physical Science*, **236**, 43 (1972).
3 Hjellming, R. M., *Nature Physical Science*, **238**, 52 (1972).
4 Hjellming, R. M., Webster, E., and Balick, B., *Astrophys. J. Lett.*, **178**, L139 (1972).
5 Wade, C. M., and Hjellming, R. M., *Astrophys. J. Lett.*, **163**, L105 (1971).
6 Hjellming, R. M., and Wade, C. M., *Astrophys. J. Lett.*, **168**, L115 (1971).
7 Stebbins, J., *Astrophys. J.*, **57**, 1 (1923).
8 Heard, J. F., *Astrophys. J.*, **87**, 72 (1938).

The Missing Planet

THE idea that the asteroids are fragments of an exploded planet was first put forward by Olbers more than 150 yr ago and has since been widely accepted. Recently Ovenden[1], in an attempt to account for Bode's Law, has argued persuasively that a planet of 90 $M_{\oplus}$ vanished between Mars and Jupiter some 16 m.y. ago. According to this point of view the asteroids are remnants of this event.

Other possibilities have been suggested, however, for the origin of the asteroids. For example, Kuiper[2] suggested that they are remnants of successive collisions which occurred between a few primaeval planetoids; Alfvén[3] and others regard the asteroids as being in the process of forming a single planet by accretion. The difficulty of disrupting a planet of 90 $M_{\oplus}$ was mentioned by Ovenden. Here we eliminate mechanisms which are incapable of providing the energy needed both to break up the hypothetical planet and to remove most of its mass beyond the Solar System. The mechanisms for disrupting a planet might be chemical, gravitational or nuclear in nature.

In the chemical case, to dissipate a planet of mass M and radius R, an energy $E \sim GM^2/R$ is required, where G represents the gravitational constant. For a mean density comparable to that of the Earth, $R \sim 4.5 \ R_{\oplus}$ and $E \sim 8 \times 10^{42}$ erg, or $\sim 1.5 \times 10^{13}$ erg g^{-1}. This seems to exclude the possibility of a chemical mechanism: the detonation energy of TNT, for example, is $\sim 5 \times 10^{10}$ erg g^{-1}.

Gravitational tidal forces due to the Sun or Jupiter are negligible at a heliocentric distance of 2.5 a.u. The missing planet might conceivably have strayed within the Roche limit of Jupiter. Such a close passage would greatly disturb, if not disrupt, the Galilean satellite system, which, according to Ovenden's theory, required 2×10^9 yr to settle into the observed resonances. Consequently the missing planet could not have strayed so close a mere 1.6×10^7 yr ago.