LETTERS TO THE EDITOR

PHYSICAL SCIENCES

Pulsar *PP* 0943

THE radio astronomy station of the P. N. Lebedev Physical Institute of the USSR Academy of Sciences in Pushchino (near Serpukhov) is investigating pulsars in the metre wavelength range. The east–west arm of the cross radio telescope DCR-1000 is used, and we can observe a pulsar for about 1 min each day.

During these investigations we detected a new pulsar, which we first observed on December 2, 1968, at frequencies of 89·6 and 90·4 MHz. Further observations during the next 2 months were also made at frequencies of 70 and 80 MHz; during this time we detected the new pulsar on eight occasions (Fig. 1).

We found that the intensity of the new pulsar, *PP* 0943, varies within wide limits. There is a considerable change of intensity between adjacent pulses. Usually a succession of 5–10 pulses is recorded, and then the pulses disappear. The strongest pulses have intensities of about $70–270 \times 10^{-26}$ Wm^{-2} Hz^{-1}, at a frequency of 70 MHz with a bandwidth of 80 kHz. Because the bandwidth of a single pulse is more than 80 kHz, the data are equal to the spectral density of the pulsed radiation. Even when the bandwidth is as wide as 250 kHz, this pulsar seldom gives good records (compared with *CP* 0950 and *CP* 0808). Thus the errors in determining its parameters are high.

The position of *PP* 0943 is R.A. 9 h 43 m 15 s ± 30 s; decl. 8° ± 4°.

We measured the period as $P = 1{\cdot}093 \pm 0{\cdot}003$ s. The time interval between pulses varies by about 30 ms, probably because of the complex structure of the pulses.

The frequency dispersion is 3·7 MHz s^{-1} at 81·5 MHz, corresponding to an integrated electron density along the line of sight of 17·5 cm^{-3} pc. The pulse duration is at 70 MHz about 60 ms.

A comparison of records at neighbouring frequencies and with narrow and broad bandwidths showed fine structure in the spectrum. The width of the structure at 90 MHz is about 1 MHz. An analysis of records at two close frequencies with a difference of 0·8 MHz shows that the intensity ratio can vary from one pulse to another by a factor of several times. These kinds of variations are also observed after three to five pulses.

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Received May 30, 1969.

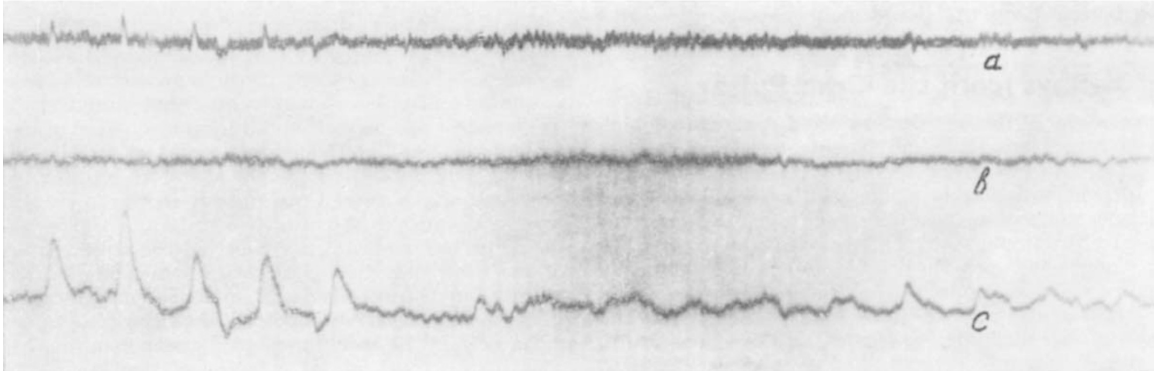

Fig. 1. Pulses from *PP* 0943, January 17, 1969. *a*, $f=80$ MHz, $\Delta f=80$ kHz; *b*, $f=70$ MHz, $\Delta f=80$ kHz; *c*, $f=80$ MHz, $\Delta f=250$ kHz.

Bremsstrahlung Radiation in Intense Magnetic Fields

IT has been recognized that the very high surface brightness temperatures of pulsars at radio frequencies imply that the radiation at these frequencies must be produced by some type of coherent emission mechanism. Chiu and Canuto (ref. 1 and unpublished work) have proposed that such emission is due to a modified bremsstrahlung mechanism which may take place in the very strong magnetic fields expected to be associated with neutron stars. They have argued that oscillations of the neutron star may cause a population inversion of the radiating electrons, thus possibly giving rise to coherent radiation. The purpose of this communication is to point out that their modified bremsstrahlung mechanism cannot, for any electron distribution, lead to coherent radiation.

In the strong magnetic fields invoked by Chiu and Canuto ($H \sim 10^9$ G) an electron can move freely along the field, but its motion in the plane perpendicular to the field is in quantized orbits. Chiu and Canuto point out that continuous radiation is emitted in transitions between states of the same total energy quantum number, hence the analogy with ordinary bremsstrahlung. The transitions that Chiu and Canuto consider take place in the electron ground state, so that the only component of momentum that the electrons have is p_z, along the magnetic field taken to be in the z direction.

Let $f(p_z)$ be the electron momentum distribution, and Q_ω (ω, p_z, θ, H) be the rate at which energy is emitted spontaneously by the electron with momentum between p_z and $p_z + dp_z$, at the frequency ω, per $d\omega$, per unit solid angle, in the direction θ, θ being the angle between the wave vector and the z-axis. The general relations for the emission coefficient of the medium j_ω (power emitted per unit volume, per $d\omega$, per unit solid angle) and the absorption coefficient α_ω (fractional loss of intensity in a $d\omega$ per unit path length) in terms of any f and Q_ω have been given by Wild, Smerd and Weiss[2] and by Bekefi[3]. In the

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