tude greater than that for the Sun. This is because of the high energy density of the radio emission leading to the induced scattering effect. The energy density of radio emission in model 3 is comparable with that of the field $H^2/8\pi$ (see ref. 6). Hence, in the emitting region $H \sim 10$ oersteds and $\omega_H \sim 2 \times 10^8$ s$^{-1}$.

The separation of pulses into two subpulses[2] is accounted for by the presence of two emitting regions (the two poles). With an asymmetrical orientation of the dipole, the intensity of the subpulse will be different from the main pulse. Another feature is pulse splitting, produced by the structure of a collisionless shock wave. In models 2 and 3 there may be breaks in the radio emission of pulsars because after the ejection by the shock wave of cold plasma responsible for radio emission, some time is needed for its restoration. In model 2 we deal with the "exhaustion" of the radiation belts and the time to fill them again with particles.

Analysis of the polarization of radiation allows us to find some criteria which characterize the magnetic field and the plasma density in the region of pulsations and in the vicinity of the star. So, in order to explain the linear polarization, it is necessary that the generation take place in the condition of quasi-transverse propagation of radio waves and transition to quasi-longitudinal propagation is realized in the region with $n \lesssim 10^2$ cm$^{-3}$. (We have prepared for publication a detailed consideration of the problem of polarization.) The absence of correlation of radio emission at close frequencies (discussed by J. G. Bolton at the Trieste Symposium on Contemporary Physics, June 1968) may be explained, in principle, by radio wave scattering in the interstellar medium[11].

We have assumed that the dimension of the emitting region is less than or of the order of white dwarf dimensions, $r \sim 5 \times 10^8$ cm. We must take into account, however, that for coherent mechanisms of radio emission, when we are dealing with the negative reabsorption, the estimation of the emitting region dimensions $L \lesssim c\tau$ ($\tau$ is the pulse duration) may appear groundless. In fact, $c\tau$ is only the upper limit for the dimension of the region of which the optical depth (for wave amplification) is of the order of unity. Hence the dimensions of the emitting region of pulsars may be much greater than $5 \times 10^8$ cm. The grounds for identifying pulsars with objects of small sizes therefore arise only from consideration connected with estimations of the pulsation period ($\sim 1$ s). At the same time the analysis of radiation mechanisms testifies that the magnetic models of white dwarf seem more reasonable than a number of the other models discussed in the literature.

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## Proper Motion of the Blue Star in the Field of Pulsar *CP* 1919

AFTER the discovery of the first pulsating radio source *CP* 1919 (ref. 1), Liller[2] obtained a preliminary proper motion based on two Harvard patrol plates, epoch 1938 and 1940. Six more pulsars were later discovered, but two of them could not be optically identified, at least not to a plate limit of twenty-third magnitude[3].

Determination of the precise position and proper motion was based on four plates with an epoch difference of about 30 yr. Two of these plates were borrowed from Harvard College Observatory, from which Liller has measured a relative proper motion. Two recent plates were taken by the Yale 40 inch reflector at Bethany, Connecticut. The procedure of reduction resembles the techniques used for determining the absolute proper motion of X-Ray Sco *X*-1 (ref. 4).

The principal results, referred to as the *FK*4 system, are listed in Table 1 together with the (R.M.S.) errors.

Table 1. POSITION AND PROPER MOTION

$\alpha_{1950} = 19^{h}\, 19^{m}\, 37{\cdot}027^{s} \pm 0^{s}{\cdot}025$ $\delta_{1950} = +21°\, 46'\, 56{\cdot}144'' \pm 0{\cdot}355''$
$\mu_\alpha = -0{\cdot}0076'' \pm 0{\cdot}0080''$ yr$^{-1}$ $\mu_\delta = -0{\cdot}0012'' \pm 0{\cdot}0034''$ yr$^{-1}$

Twenty-two faint field stars were also selected and measured. The proper motion of the blue star is very close to the average proper motion of these field stars. The estimated distance of 126 pc for *CP* 1919 yields a proper motion of 0·3″ per year. This estimated value and the results found in this investigation indicate that the blue star is probably an ordinary star[5,6] and may not be associated with the pulsating radio source. The relative proper motion of the blue star was also calculated according to the two Harvard plates, and in Table 2 the results of this calculation are compared with those of Liller[2].

Table 2. COMPARISON OF PROPER MOTIONS OBTAINED FROM TWO HARVARD PLATES

| | $\mu_\alpha$ | $\mu_\delta$ | $\mu$ | R.M.S. error |
|---|---|---|---|---|
| Lu | +0·078″ | −0·039″ | 0·088″ | ±0·067″ |
| Liller | | | 0·22 | ±0·14 |

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## Distances to Pulsars

Habing and Pottasch[1] have argued that pulsars are likely to be at distances considerably greater than the commonly assumed values of $\sim 100$ pc, and we have recently obtained observational evidence regarding the neutral hydrogen content in the directions of the first five known pulsars which supports this view.

On July 26 we obtained 21 cm line profiles in the directions of the five pulsars known at the time, using the 25·6 m antenna of the Dominion Radio Astrophysical

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