satisfactory in view of the simplicity of the model. Although this model is certainly not unique, it suggests that models of this type should be explored in attempting to interpret pulsars. If this model is correct, it shows that the diameters of the emitting region and the central object are very much less than the distance given by ct_s, and therefore much less than 3300 km. This is consistent with the limit suggested by the width of the final subpulse of Pulsar 4. This model is most consistent with those concepts of pulsars in which the central object is a pulsating star.

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Parameters of the Plasma Affecting the Radiation of Pulsar 1

Abstract. *Analysis of the relation between time delay and frequency for pulses from Pulsar 1 shows that the dispersive region of the ray path must exceed 300 astronomical units and have an average electron number density less than 8000 per cubic centimeter and average magnetic field strength less than 2×10^{-3} gauss. These requirements almost guarantee that the observed dispersion takes place in the interstellar medium.*

One of the remarkable features in the recent observations of pulsars is the high degree of accuracy with which the arrival time t_1 and t_2 of pulses at different radio frequencies ν_1 and ν_2 satisfy the condition

$$t_1 - t_2 = B\left(\frac{1}{\nu_1^2} - \frac{1}{\nu_2^2}\right)$$

where B is a constant proportional to the total electron content along the path from source to receiver. In fact, data taken at Arecibo between 40 and 430 Mhz for the source located in the constellation Vulpecula shows that this relation is satisfied to an accuracy of about 1 part in 3000 at 40 Mhz (*1*). However, as the relation is an approximation based upon the assumption that the radio frequency greatly exceeds both the plasma and cyclotron frequencies in the ionized interstellar gas, we shall show that the absence of any sizable deviations from this law can be used to establish upper limits on the average electron density and magnetic field along the path of propagation and, from this, lower limits on the extent of the ionized region.

When one retains first-order corrections to the expressions for the travel time of a pulse through a uniform (collisionless) plasma with electron number density n_e and magnetic field strength B_o, one finds that

$$t_1 - t_2 = B\left(\frac{1}{\nu_1^2} - \frac{1}{\nu_2^2}\right)(1 + T_1 + T_2)$$

where

$$T_1 = 3\nu_p^2 (\nu_1^2 + \nu_2^2) / 4\nu_1^2 \nu_2^2$$

and

$$T_2 = \pm 2 f_c \cos\gamma (\nu_2^3 - \nu_1^3) / \nu_2 \nu_1 (\nu_2^2 - \nu_1^2),$$

with ν_p, f_c, and γ the plasma frequency, cyclotron frequency, and angle between the magnetic field and the direction of wave propagation, respectively. From the data at Arecibo over frequencies between 40 and 430 Mhz, we conclude that T_1 and T_2 must be less than 3×10^{-4}. Hence, from T_1 we find

$$n_e < 8000 \text{ electron/cm}^3$$

while (assuming cos γ is of order unity), we have from T_2 that

$$B_o < 2 \times 10^{-3} \text{ gauss}$$

Although these estimates assume a uniform plasma, one can easily show that for a nonuniform plasma where n_e equals $n_{eo} + \delta n_e$, the condition on the average electron number density, n_{eo}, becomes even more restrictive since one obtains $n_{eo} + \langle(\delta n_e)^2\rangle / n_{eo} < 8000$ cm^{-3}, while the magnetic field condition is modified somewhat and becomes simply $\langle n_e B_o \cos\gamma\rangle / n_{eo} < 2 \times 10^{-3}$ gauss.

The upper limit on average electron number density together with the value of 3.84×10^{19} cm^{-2} obtained for $n_{eo} L$ shows that L must exceed 5×10^{15} cm $\cong$ 300 astronomical units. This result eliminates the possibility of the dispersion taking place in a stellar corona. Although an H II region has been observed in the source area at Arecibo, it appears far too small to provide the needed electron content. Hence, it seems almost certain that the dispersion is taking place in the general interstellar medium.

One final point that arises from the expression for time delay is that the time difference at a single frequency between the ordinary and extraordinary waves is given, to lowest order in B_o, by

$$\Delta t = \frac{4 B f_c \cos\gamma}{\nu^3}$$

From the above results one should expect $\Delta t < 15$ μsec (at 430 Mhz), which is considerably less than the observed pulse width of 37 msec. This, plus the fact that the observed pulse shape is qualitatively the same at all frequencies (*2*), suggests that the shape cannot be caused by a difference in arrival time of the two magnetoionic waves.

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Thermally Driven Rossby-Mode Dynamo for Solar Magnetic-Field Reversals

Abstract. *There is increasing interest in the possible existence of large eddies or "Rossby waves" in Sun's convection zone and photosphere. It is shown that many flows of this type, driven by an equator-pole temperature difference, act as hydromagnetic dynamos to produce magnetic fields that periodically reverse. The periods and field amplitudes agree with solar phenomena within an order of magnitude.*

Ward (*1*) postulates the existence of a "Rossby type" general circulation of the solar photosphere, in which large horizontally flowing waves or eddies (larger in dimensions than sunspot