photomultiplier. By changing air pressure, scanning is accomplished within one free spectral range. This method is well adapted to stellar spectroscopy.

The etalon can be placed in the same collimated beam as the grating, but a smaller etalon can be used if it is placed in a separate collimated beam, with some additional light loss. Dielectric coatings with high reflectivity, up to more than 97 per cent increase the free spectral range and decrease the intensity between fringe maxima, but the advantage of such films can only be realized if errors in figure of the etalon plates are held well below 1/100 wave length.

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**Edmondson, Frank K. The radio spiral structure of the galaxy in the anti-center region.**

This paper is an extension of work reported at the December 1954 joint meeting of the Astronomical Society of the Pacific and Section D of the AAAS (Edmondson, 1955). Formulae were derived for radial velocities and proper motions due to galactic rotation on the assumption that the mean motions in the galaxy are not at right angles to the radius, but deviate from this by a small angle $\varphi$.

The estimated distances of the radio spiral arms of the galaxy are changed when these formulae are used, because the radial velocities are the distance indicators.

The present paper gives the results of the detailed application of these formulae to the Dutch observations toward the anti-center. Using $\varphi = 4°$, the kink is removed from the outer arm and it is given a tilt that lines it up with the rest of the observed spiral structure.

This same value of $\varphi$ causes the long outer arm to spiral in by a reasonable amount, and is consistent with the discrepancy between direct determinations and differential rotation determinations of the longitude of the center. A more conclusive proof would be the observation of negative velocities toward the galactic center. The predicted radial velocity of the galactic center is $-216 \times 0.07 = -15$ km/sec. Material 4 to 10 kpc beyond the galactic center will have a radial velocity of $-30$ km/sec.

We may conclude that the hydrogen is streaming along the spiral arms if $\varphi = 4°$, and if we assume that the Perseus arm and the Sagittarius arm are parts of the same arm.

Edmondson, F. K. 1955, *Pub. A.S.P.* **67**, 10–11, Feb. 1955.

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**Field, George B. Radiation by plasma oscillations.**

It is well known that plasma waves in a homogeneous medium, without static fields and under non-relativistic conditions, do not radiate electromagnetic waves. This is because the curl-free plasma waves and divergence-free radiation waves are not coupled. However, we have considered inhomogeneous conditions, with the result that the plasma waves and radiation waves are indeed coupled. The coupling is expressed in the equation

$$(\nabla^2 + k^2\mu^2)\nabla \times \boldsymbol{\varepsilon}_r = k^2\boldsymbol{\varepsilon} \times \nabla\mu^2 \qquad (1)$$

where $\mu$ is the ordinary refractive index of a plasma, $k$ the free space wave number, $\boldsymbol{\varepsilon}_r$ the radiation field, and $\boldsymbol{\varepsilon}$ the total field, plasma plus radiation waves.

If the medium is homogeneous, the right-hand side vanishes and there is no source of radiation; on the other hand, components of plasma wave field perpendicular to the gradient of $\mu^2$ serve as a source of radiation if the medium is not homogeneous. In particular, refraction of plasma waves in a region of variable index will generate radiation.

Integration of (1) is difficult even in the case of constant gradient, since the plasma wave field which appears on the right is itself refracted in a complicated way. We have therefore considered the much simpler situation of a discontinuity in $\mu^2$. If a plasma wave is incident on such a discontinuity, which forms the surface between a plasma and vacuum, it is found that a radiation wave is generated in the vacuum. The efficiency of conversion to radiation is found to be

$$C = 4\gamma \begin{Bmatrix} \sin^2\theta, & \sin\theta \ll \beta \\ 1, & \sin\theta = \beta \\ \beta^2\cos\theta, & \sin\theta \gg \beta \end{Bmatrix} \qquad (2)$$

where $\gamma$ is the ratio of radiation to plasma wavelengths and $\beta$ is the ratio of electron thermal velocity to that of light. The angle of incidence of the plasma wave is $\theta$; if the expression (2) is