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RADIATION RESISTANCE OF CORNER-DRIVEN LOOP ANTENNA IMMERSED IN A TWO COMPONENT WARM PLASMA

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LOOP aerials of different types are widely used for satellite communications and rocket-probe studies in the ionosphere. They are simple in construction, and more efficient than conventional dipoles of similar dimensions. Theory of radiation from a corner-driven loop and an Alford loop aerials immersed in one component electron plasma was developed[1,2]. Theoretical study of an Alford loop in two component warm plasma is reported recently[3]. The radiation characteristics of corner-driven loop antenna has not yet been studied in two component warm plasma. The purpose of this note is to compare the theoretical values of the radiation resistance of the corner-driven loop with the experimental observations of the loop used on Ariel-3 satellite and the theoretical results from an Alford loop aerial in an electron-ion warm plasma.

The current on a corner driven loop shown in figure 1a, with a travelling wave distribution and negligible attenuation can be written

$$I(s) = I_0 \exp(-j\beta s) \qquad (1)$$

where β is the propagation coefficient of the current on the wire, and s is the distance along the aerial. The loop is small compared to the wavelength, equation no. 1 gives a constant current distribution. Using linearised hydrodynamic theory in conjunction with the Maxwell's equations and the force and the continuity equation, following are the expressions for the electromagnetic and plasma wave components of the radiation resistance of the aerial in the two component warm plasma:

$$R_e = \frac{480\, a^2 \sin^2\delta}{\pi A} \int_0^{\pi}\int_0^{2\pi} \frac{\sin^2 \frac{\beta l}{2}(1 - a\cos\theta_1)\sin^2\frac{\beta l}{2}(1 - a\cos\theta_2)}{(1 - a\cos\theta_1)(1 - a\cos\theta_2)} \times \left[1 - \frac{(1-a^2)\sin^2\varphi\sin^2\theta}{(1 - a\cos\theta_1)(1 - a\cos\theta_2)}\right] \sin\theta\, d\theta\, d\varphi \qquad (2)$$

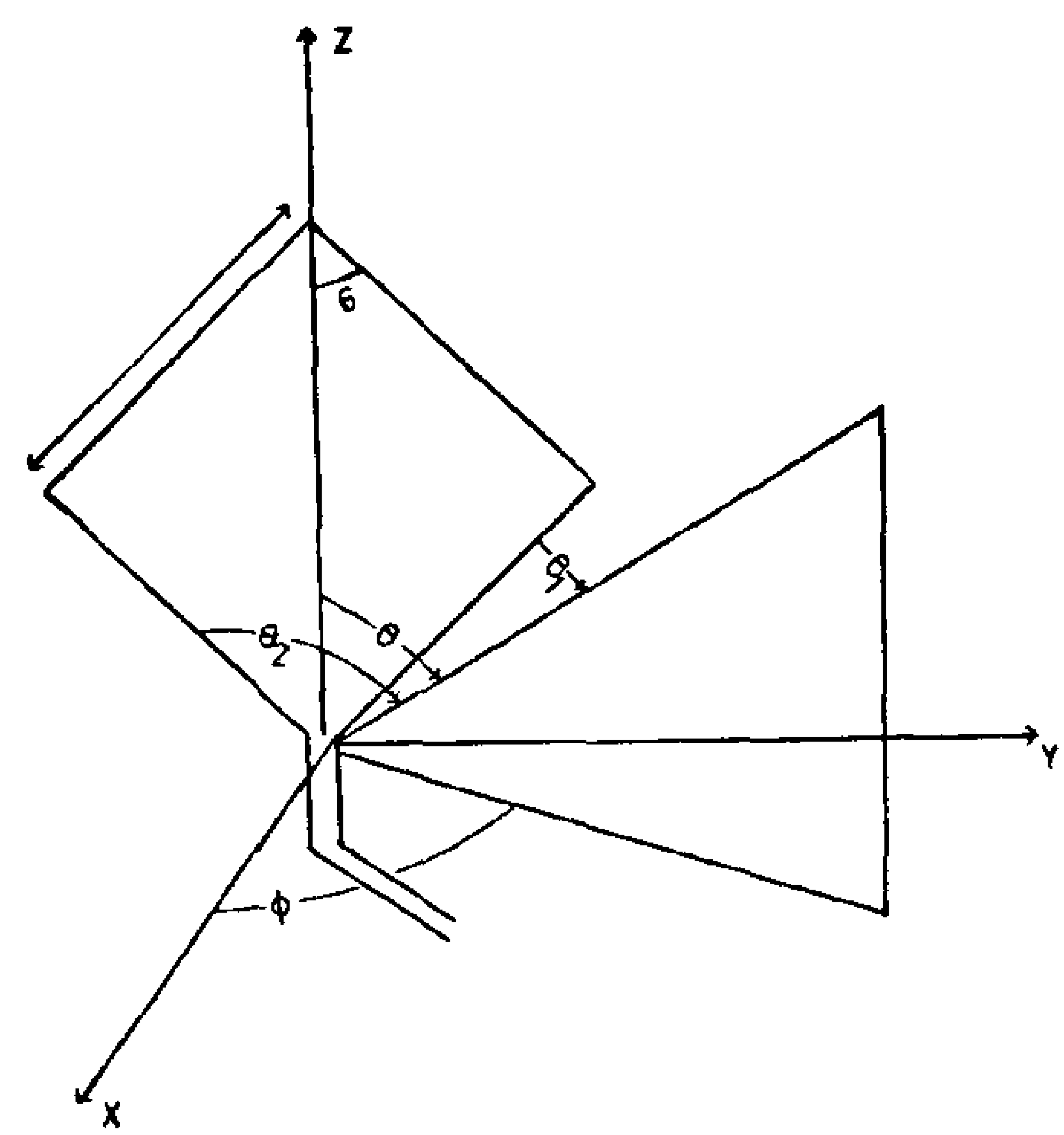
$$R_{pj} = \frac{\omega_{pe}^2 (1-\alpha_j)^2}{\omega\pi^2 u_e^2 \epsilon_0 \beta_{pj}(1+\alpha_j^2)} \int_0^{\pi}\int_0^{2\pi} \sin\theta\, d\theta\, d\varphi \; (1 - b_j\cos\theta\cos\delta)\sin\beta l\,(1 - b_j\cos\theta\cos\delta) \times \left[\frac{-(b_j\sin\theta\sin\delta\sin\varphi)\sin\beta l\,(b_j\sin\theta\sin\delta\sin\varphi)}{(1 - b_j\cos\theta_1)(1 - b_j\cos\theta_2)}\right]^2 \qquad (3)$$

where θ and φ are the azimuth and zenith angles of the spherical polar coordinate system, centred on the aerial and $a, \alpha_j, \beta_{pj}, b_j$ have the same values as defined in earlier paper[3].
and

$$\cos\theta_1 = \cos\delta\cos\theta + \sin\theta\sin\delta\sin\varphi$$
$$\cos\theta_2 = \cos\delta\cos\theta - \sin\theta\sin\delta\sin\varphi \qquad (4)$$

the total radiation resistance R_T is given by

$$R_T = R_e + R_{pj} \qquad (j = 1, 2) \qquad (5)$$



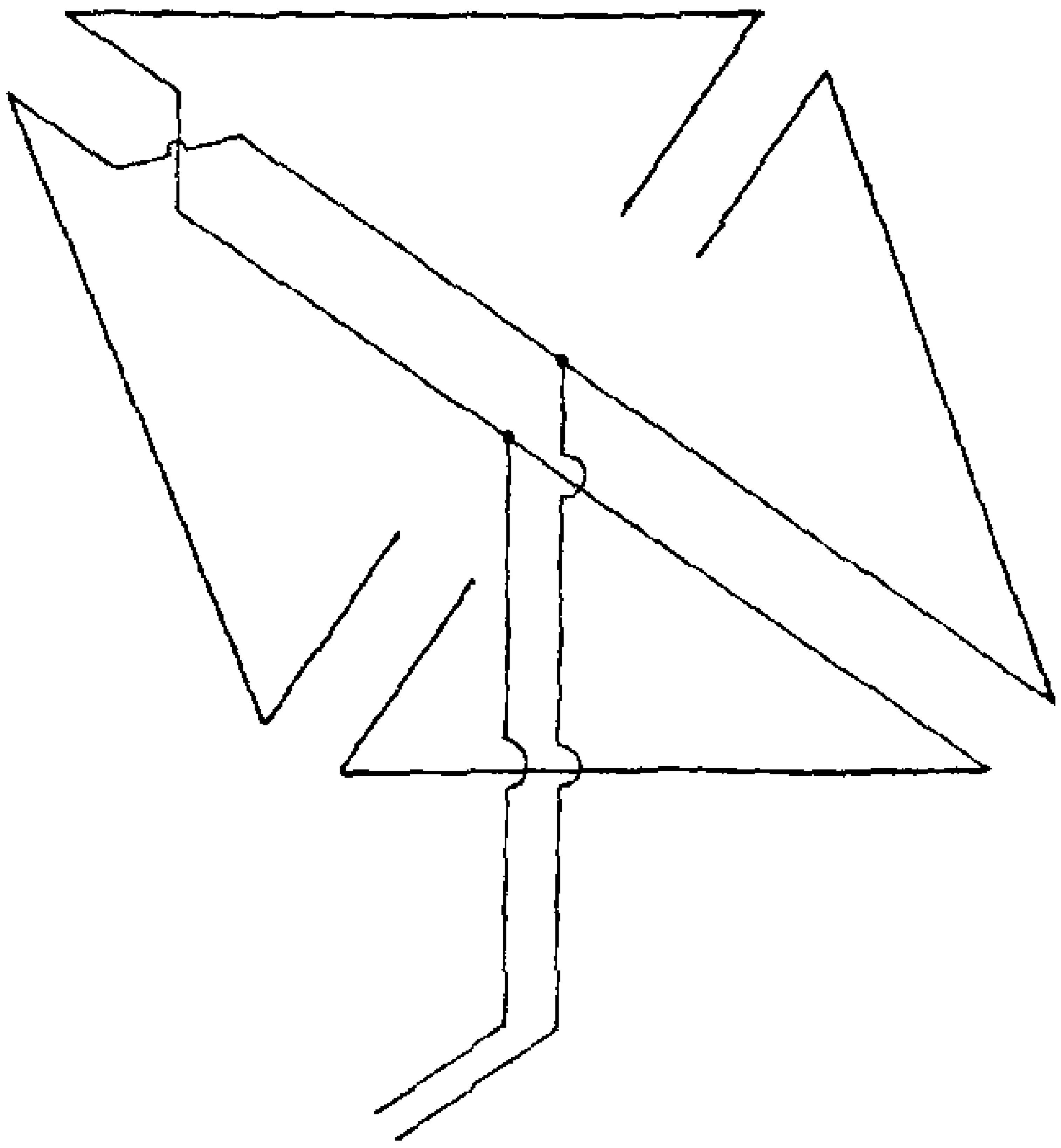


Figure 1. *Geometry of Aerials* **(a)** Corner driven **(b)** Alford loop

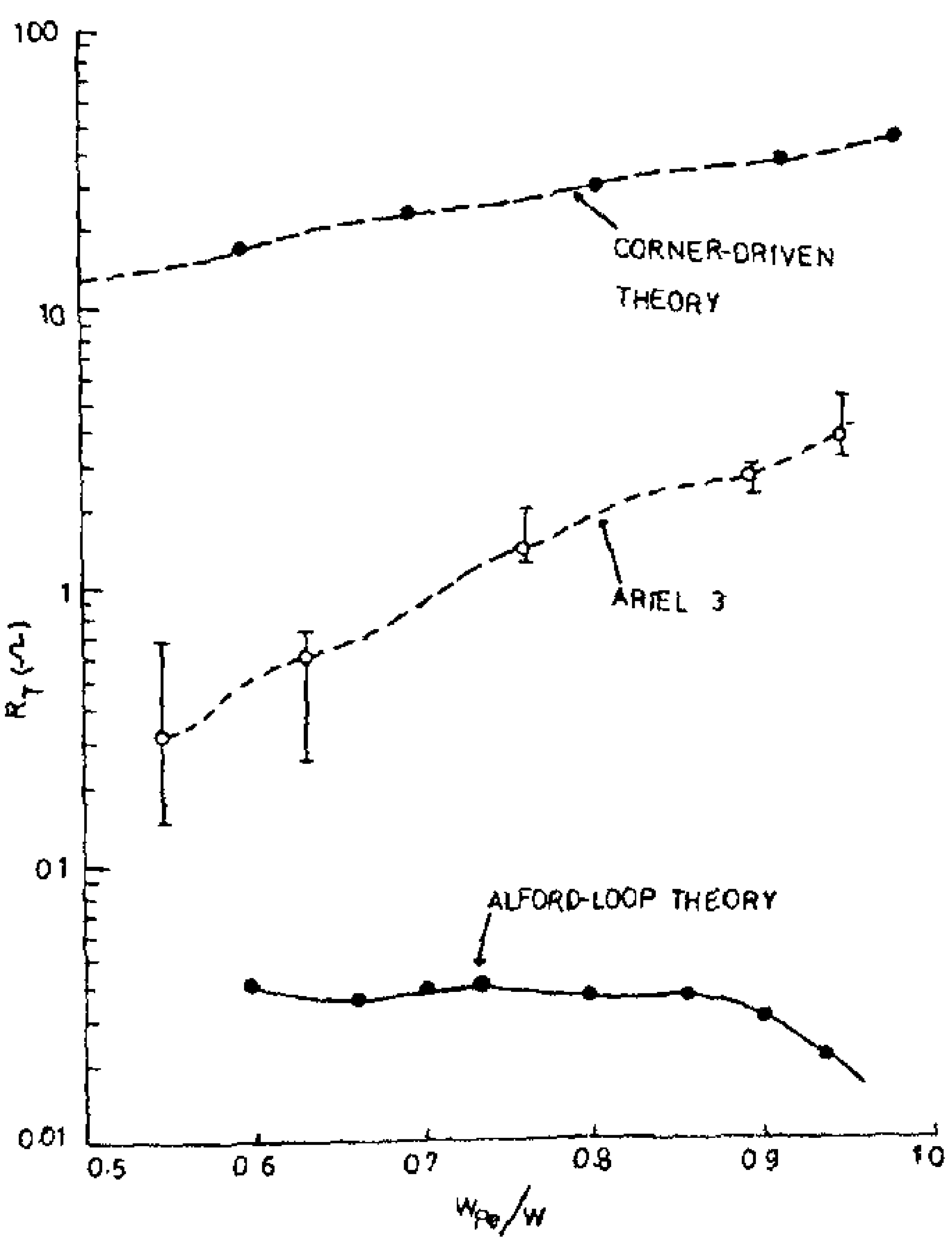


Figure 2. Values of R_T against ω_{pe}/ω for results obtained from Ariel-3 satellite, and for theoretical calculations on Corner driven and Alford loop aerials.

The square loop used on the Ariel-3 satellite has an effective area of 3.93 m^2 which corresponds to $k_0 = l/\lambda_0 = 0.0229$ at the operating frequency of 3.48 MHz. Setting $\beta = \beta_e$, values of R_e and R_{pj} have been calculated numerically for the square loop antenna ($\delta = 45°$). Computed values of R_T, the total resistance for the corner driven loop are shown in figure 2 for various values of ω_{pe}/ω. Figure 2, also shows the experimental values of R_T for the loop used on the Ariel-3 satellite, and the theoretical values of R_T calculated for Alford loop shown in figure 1b.

Due to the presence of plasma, the total radiated power has three components, one due to the electromagnetic mode and other two due to the electron-acoustic and ion-acoustic mode. The total radiation resistance as given by equation (5) is plotted in figure 2 for these two antennas with different ratios of ω_{pe}/ω. The main component in the theoretical value of R_T for corner-driven loop is R_{pj}, the radiation resistance of the plasma waves, whereas this is significantly less for the Alford loop aerial.

If the presence of Earth's magnetic field, sheaths around the aerial etc., affect both types of aerial identically, from above study it may be concluded that the Alford square loop is better suited for use on a space vehicle, because less energy is radiated in plasma modes.

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EFFECT OF $CdCl_2$ ON THE QUANTITATIVE VARIATION OF CARBOHYDRATE, PROTEIN, AMINO ACIDS AND CHOLESTEROL IN *CHRYSOCORIS STOLLI* WOLF (INSECTA: HEMIPTERA)

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AMONG the different metallic components that constitute pollutants, cadmium is considered to be an important heavy metal having manifold toxic effects on living organisms. Their toxicity to the living organism range from mildly harmful to lethal. Since the