The Plasma Blackout Problem Equation Cheat Sheet

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Intro to the Blackout Problem

Lorentz Windows

These are the equations used by Kim et. al. in the computer modeling of a plasma sheath in the vicinity of an $\mathbf{E} \times \mathbf{B}$ field [1].

[1] M. Kim, M. Keidar, and I. D. Boyd, "Analysis of an Electromagnetic Mitigation Scheme for Reentry Telemetry Through Plasma," 2008

Ion Transport Equations

$$\nabla \cdot (\mathbf{V_i} n) = 0 \tag{1}$$

$$m_i n(\mathbf{V_i} \cdot \nabla \mathbf{V_i}) = en(\mathbf{E} + \mathbf{V_i} \times \mathbf{B}) - m_i n \nu_c \mathbf{V_i} \tag{2}$$

Current Density of Plasma Sheath

$$\mathbf{j} = \sigma \left(\mathbf{E} + \frac{kT_e}{e} \nabla \ln n - \frac{\mathbf{j} \times \mathbf{B}}{en} + (\mathbf{V_i} \times \mathbf{B}) \right) \tag{3}$$

Current Density Conservation

$$\nabla \cdot \mathbf{j} = 0 \tag{4}$$

References

[1] M. Kim, M. Keidar, and I. D. Boyd, "Analysis of an Electromagnetic Mitigation Scheme for Reentry Telemetry Through Plasma," 2008.