R39

Transverse shifts experienced by radio waves due to ionosphere

Niña Angelica F. Zambale [1] , and Nathaniel Hermosa [1]

[1]National Institute of Physics, University of the Philippines Diliman, Diliman, Quezon City, Philippines, 1101

A plane electromagnetic wave propagating through an interface can be described by the laws of reflection and refraction. However, corrections to these laws arise when we consider physical electromagnetic waves due to their finite transverse extent. These shifts, which can be spatial or angular in nature, are called Goos-Hanchen (GH) and Imbert-Fedorov (IF) effects [1]. In this study, we investigate the ionosphere-induced out-of-plane IF shifts of radio waves. We treat the ionosphere as a collection of electrons moving in a uniform magnetic field, as described by the Appleton model, and used the resulting dispersive expressions to calculate for the IF shifts [2]. We confirm that the ionosphere may behave like a dielectric, metal or epsilon-near-zero material depending on the value of the incident frequency of the radio wave and the plasma frequency of the ionosphere. We calculate the shifts for the three cases and find that the maximum shift can be observed when the ionosphere acts like an epsilon-near-zero medium. Finally, we discuss how the generated IF shifts can be used as a potential tool to profile the ionosphere using reflected radio waves.

[1] K. Bliokh and A. Aiello. "Goos–Hänchen and Imbert–Fedorov beam shifts: an overview." Journal of Optics **15.1**, 014001 (2013).

[2] J. D. Jackson, "Classical electrodynamics." (1999): 841-842.