Causality and Dispersion Relations - 1 : Introduction

Aditya Gilra

Abstract

This talk introduces the concepts of causality, and the dispersion and absorption of electromagnetic signals so that their relation may be shown in subsequent talks. A simple model for the frequency dependence of permittivity in low-density dielectrics is developed. This leads to a complex-valued permittivity which exhibits normal dispersion as well as anomalous dispersion or resonant absorption [1, 2]. The causality conditions are studied and their mathematical expression for the propagation function alongwith advanced and retarded propagation functions are discussed [3]. The next talk on the Titchmarsh theorem is motivated.

References

[1] J.D. Jackson, *Classical Electrodynamics*, 3rd ed., sec. 7.5, John Wiley & Sons, 2004.

[2] D.J. Griffiths, *Introduction to Electrodynamics*, 3rd ed., sec. 9.4.3, Pearson Ed., 2003.

[3] J. Hilgevoord, *Dispersion Relations and Causal Description*, North-Holland Publishing Company, 1960.

[4] G. Arfken and H. Weber, *Mathematical Methods for Physicists*, 5th ed., sec 7.3 and 15.7, San Diego: Academic Press, 2001.

[5] J.S. Toll, Phys. Rev. 104, pgs. 1760-1770 (1956).