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Title: Modeling electromagnetic wave propagation in space plasma.

Abstract: Our upper atmosphere (hundreds km above the Earth's surface) is made of ionized gases also known as plasma. Such space plasma environment is a zoo of various natural and man-made electromagnetic waves. Resonant interaction with those waves controls dynamics of relativistic electrons in radiation belt and therefore understanding the wave propagation and distribution is important. This talk reviews plasma waves ranging from Hz to MHz, whose have different generation origins (various plasma free energy) and different propagation characteristics. In particular, propagation of whistle mode waves, which are very low frequency (VLF) waves generated naturally by electron instability in the magnetosphere, is modeled using ray tracing technique. The WKB approximation under ray tracing is in general valid since whistler wave lengths are small compared with the scale size of magnetospheric medium. Interesting propagation characteristics of whistler mode are presented: 1) wave reflects off the equator where wave frequency is below the lower hybrid resonance frequency; 2) whistler mode waves can be trapped in the high density ducts; 3) Some whistler mode emission can have access to low altitude ionosphere, evolving to an emission trapped in the ionosphere and propagating towards the equator; 4) wave propagation can be guided with the presence of the plasmapause, a sharp boundary of large density gradient just outside the high density plasmasphere. Comparison with satellite observation of waves both in the ionosphere and magnetosphere supports modeling results. Other methods of wave propagation are also presented. Challenging questions on global modeling of wave propagation will be discussed.