

## Nonlinear Dispersion Relation for Harmonic Electromagnetic Waves

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A theory for harmonic electromagnetic waves has been developed in the framework of electromagnetic weak turbulence theory. This work is motivated by numerous observations of multiple harmonic electrostatic (and possibly electromagnetic) wave excitation during laboratory beam-plasma interaction experiments, space, and simulations [1–3]. A nonlinear dispersion relation for harmonic *electromagnetic* waves near the multiples of the plasma frequency is derived, which is distinct from the *electrostatic* harmonic dispersion relation [4] in that typical wavelengths associated with the higher harmonic EM modes are much longer than the electrostatic counterparts. This study forms the first step in a forthcoming complete theory in which not only the wave dispersion relation but also the wave intensity will be computed in self-consistent manner.

## References

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