Ground states of time-harmonic semilinear Maxwell equations

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We investigate the existence and the nonexistence of solutions $E : \mathbb{R}^3 \to \mathbb{R}^3$ of the time-harmonic semilinear Maxwell equation

$$\nabla \times (\nabla \times E) + V(x)E = \partial_E F(x, E) \text{ in } \mathbb{R}^3$$

where $V : \mathbb{R}^3 \to \mathbb{R}$, $V(x) \leq 0$ a.e. on $\mathbb{R}^3$, $\nabla\times$ denotes the curl operator in $\mathbb{R}^3$ and $F : \mathbb{R}^3 \times \mathbb{R}^3 \to \mathbb{R}$ is a nonlinear function in E. In particular we find a ground state solution provided that suitable growth conditions on F are imposed and $L^{3/2}$-norm of V is less than the best Sobolev constant. In applications F is responsible for the nonlinear polarization and $V(x) = -\mu\omega^2\varepsilon(x)$ where $\mu > 0$ is the magnetic permeability, ω is the frequency of the time-harmonic electric field $\Re\{E(x)e^{i\omega t}\}$ and ε is the linear part of the permittivity in an inhomogeneous medium.

References

[1] T. Bartsch, J. Mederski, *Ground and bound state solutions of semilinear time-harmonic Maxwell equations in a bounded domain*, to appear in Arch. Ration. Mech. Anal. (2014).

[2] J. Mederski *Ground states of time-harmonic semilinear Maxwell equations in* $\mathbb{R}^3$ *with vanishing permittivity*, arXiv:1406.4535.