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LETTERS AND COMMENTS

Reply to 'Comment on "A note on the formulation of the Maxwell equations for a macroscopic medium"'

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Abstract
A brief response to the preceding comment on our paper is provided.

The main purpose of our previous note [1] was to point out the fallacy of the argument presented in many popular EM textbooks in their formulation of Maxwell's electrodynamics for a material medium, utilizing results for the potentials which were derived *only* limited to electrostatics and magnetostatics. We then presented in [1] our approach starting directly from the definitions of the polarization and magnetization vectors in the spirit of Landau and Lifshitz [2], together with the introduction of our slight modifications to these definitions.

In their comment [3], the authors have essentially agreed with our criticism on the unjustified usage of the 'static potentials' in the formulation of the *dynamical* Maxwell equations. While not addressing the rest of our note, which presented a more justified formulation of electrodynamics in a medium, the authors of [3] went on to show the existence of the dynamical (retarded) version of the dipolar scalar and vector potentials which are consistent with the full electrodynamics of Maxwell. These results for the dipole potentials are really analogous to those corresponding time-dependent generalizations of the static Coulomb and Biot–Savart fields which are well established in the literature [4]. Presumably, the authors also implied that starting with these retarded potentials, one should then be able to formulate Maxwell's equations for a macroscopic medium with no inconsistency any more.

While we fully agree with the consistency of the approach by the authors in their comment [3], we certainly have some reservation in using these authors' formulation in an introductory class of electromagnetism. The mathematical complexity as demonstrated in the authors' work—especially that encountered in the derivatives involving retarded times—will likely complicate the matter rather than clarifying it for students at the introductory level.

Nevertheless, we believe that the authors' work [3] does help to highlight the complication of the problem we brought up in our note [1], and it will be of interest to compare our approach with that of the authors in [3] and see which one will be easier to follow for a class of electromagnetism at the introductory level.

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