Theoretical seminar
(22 December, 16:00 Conference Room)

Closure relations for electromagnetism

Alberto Favaroof PhysicsCollege London

December 22, 2011

Abstract
The electromagnetic response of a local and linear medium is described by a $6 \times 6$ constitutive matrix $\kappa$, which includes four familiar $3 \times 3$ blocks: the permittivity, the permeability, and the electromagnetic/magneto-electric couplings. It is often useful to demand that $\kappa$ is invariant under the transformation $(\mathcal{H}, \mathcal{D}) \rightarrow \zeta(E,B)$ and $(E,B) \rightarrow -\zeta^{-1}(\mathcal{H}, \mathcal{D})$, where $\{\mathcal{H}, \mathcal{D}, E, B\}$ are the fundamental fields of electrodynamics. When the medium is indeed endowed with this symmetry, that is, when the medium is “electric-magnetic reciprocal”, one can show that $\kappa$ obeys closure relation [see the book by Hehl and Obukhov (Birkhäuser, 2003)]. In the present talk, the transposed constitutive matrix $\kappa^t$ is introduces to construct the generalisation of the closure relation. The solutions of the generalised closure relation are derived explicitly. As a consequence, the previously unknown roots of the usual closure relation are obtained. The discussion is finally applied to two specific problems.