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Title: The Momentum of Light in Dielectric Materials:
A 100 Years Old Controversy
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Abstract:

There has been a rapid development in recent years in the construction of "traps" for confining collective states of matter on scales intermediate between macro- and micro-dimensions. Condensates of cold atoms and fabricated nano-structures offer many new avenues for technological development when coupled to probes by EM fields. The constitutive properties of such novel material will play an important role in this development. Space science is also progressing rapidly and can provide new laboratory environments with variable gravitation and controlled acceleration in which the properties of such states of matter may be explored. We calculated the form of the phenomenological stress-energy-momentum tensor for the electromagnetic field in a class of inhomogeneous, anisotropic magneto-electric media from first principles in terms of a fully relativistic covariant variational framework.

Our results offer a new and efficient way to establish a coherent understanding of the stresses and energy-momentum exchanges induced by electromagnetic interactions with such matter. Supplemented with additional data based on mechanical and elasto-dynamic responses one gains a more confident picture of a total phenomenological symmetric stress-energy-momentum tensor for a wide class of moving media than that based on previous ad-hoc choices.

This talk is based on the joint published work
T.Dereli, J. Gratus, R.W.Tucker, Phys.Lett. A371 (2007) 190-193
It is quoted in Nature News and Views, Vol 444/14 December 2006, p.823