Contributed Talk

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Title: Gravitational wave Poynting vector and gravitoelectromagnetism

Abstract: Gravitoelectromagnetism (GEM) is a formalism based on general relativity that uses mathematical tools from the electromagnetic theory to investigate gravitational systems. This is possible when one seeks a general linear solution of the gravitational field equations while the Minkowski metric is perturbed due to the presence of gravitating sources and the perturbation obeys the transverse gauge condition. The source in general rotates and must consist of a finite distribution of slowly moving matter. As the perturbation is small, all terms of O(c^{-4}) are neglected. Under these conditions GEM fields, E and B, can be defined in direct analogy with electromagnetism and GEM field equations are obtained. From the Lagrangian for the motion of a massive test particle written to linear order in the scalar and vector GEM fields an analogue of the Lorentz force law can be obtained. Under the GEM gauge transformation the GEM fields are invariant in close analogy with electrodynamics. In the case of a stationary configuration the GEM Poynting vector (PV) can be defined [arXiv:gr-qc/0311030v2 (2008)]. The suggestion of a PV for gravitational waves was posed by one of us in the context of general relativity [MNRAS 274, 670 (1995)]. In this work we discuss the relation between this proposed PV and the GEM PV to analyse the possibility of relating the GEM formalism of [arXiv:gr-qc/0311030v2 (2008)] to the gravitational waves investigated in [MNRAS 274, 670 (1995)].