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Bobbing and Kicks in Electromagnetism and Gravity SAMUEL E. GRALLA, ABRAHAM I. HARTE, ROBERT M. WALD, University of Chicago — We exploit the analogy between gravitation and electromagnetism to gain some insight into the origin and nature of "bobbing motion" and momentum "kicks" that occur in the merger of black hole binaries with spin. Specifically, we consider two charged magnetic dipoles in a slow-motion approximation, and examine the role that field momentum plays in their motion. As expected, there is significant exchange of momentum between field and bodies during bobbing. However, the bodies store this momentum as "hidden mechanical momentum" rather than center-of-mass velocity. In fact, the center-of-mass bobbing is entirely caused by a "purely kinematical" spin-acceleration effect that has nothing to do with electromagnetism (or gravity). A spinning binary will bob regardless of the source of acceleration, whereas the presence of a kick requires a release of field momentum. We conclude that the kick is not an inertial continuation of the bobbing.

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