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Retarded Fields of Null Particles and the Memory Effect ALEXANDER TOLISH, The Univesity of Chicago, ROBERT WALD, The University of Chicago — We consider the scalar, electromagnetic and linearized gravitational fields produced by a particle moving on a null geodesic. We cut off the null source at a finite time t_0 and then consider two limits: (i) the limit as the observation point goes to null infinity at fixed t_0, and (ii) the limit $t_0 \to -\infty$ at fixed observation point. Limit (i) gives rise to a velocity kick on distant test particles in the scalar and electromagnetic cases, and a memory effect (permanent change in relative separation of test particles) in the gravitational case, in agreement with past analyses. Limit (ii) does not exist in the scalar case or for the Lorenz gauge potential and metric perturbation in the electromagnetic and gravitational cases. However, we find well defined distributional limits for the electromagnetic field strength and Riemann tensors. In the gravitational case, there is no memory effect associated with this limit. This suggests that the memory effect should not be interpreted as arising simply from the passage of null stress energy to null infinity but rather as arising from a burst of radiation associated with the creation of the null stress-energy (as in case (i)) or, more generally, with radiation present that was not produced by the null stress-energy.

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