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On the effects of rotating gravitational waves

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We study gravitational waves to first and second order in amplitude in vacuum asymptotically flat spacetimes. The Einstein equations are solved to first order and these solutions are superposed to form a time-symmetric ingoing and then outgoing wave-pulse regular everywhere. The waves are assumed to have odd-parity and a non-vanishing angular momentum which keeps them away from the axis at all times. The averaged energy of the waves is evaluated. The relevant Einstein equation is then solved to second order in the amplitude. The influence of the angular momentum of the waves on the rotation of local inertial frames with respect to the frames at great distances is analyzed. The rotation of the frames occurs even in the region around the origin where spacetime is almost flat. The rotation is without time delay as it follows from the constraint equation (Phys. Rev. D **85**, 124003 (2012)).