Abstract

This work is a follow-up to the paper, "Numerical Relativity as a Tool for Studying the Early Universe". In this article, we determine if cosmological gravitational waves can be accurately extracted from a dynamical spacetime using an averaging process as opposed to conventional methods of gravitational wave extraction using a complex Weyl scalar. We calculate the normalized energy density, strain and degree of polarization of gravitational waves produced by a simulated turbulent plasma similar to what was believed to have existed shortly after the electroweak scale. This calculation is completed using two numerical codes, one which utilizes full General Relativity calculations based on modified BSSN equations while the other utilizes a linearized approximation of General Relativity. Our results show that the spectrum of gravitational waves calculated from the nonlinear code using an averaging process are nearly indistinguishable from those calculated from the linear code. This result validates the use of the averaging process for gravitational wave extraction of cosmological systems.