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Kinetic Description of Particle Interaction with a Gravitational Wave

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The interaction of charged particles, moving in a uniform magnetic field, with a plane polarized gravitational wave is considered using the Fokker–Planck–Kolmogorov (FPK) approach. By using a stochasticity criterion, we determine the exact locations in phase space, where resonance overlapping occurs. We investigate the diffusion of orbits around each primary resonance of order m by deriving general analytical expressions for an effective diffusion coefficient. A solution of the corresponding diffusion equation (Fokker–Planck equation) for the static case is found. Numerical integration of the full equations of motion and subsequent calculation of the diffusion coefficient verifies the analytical results.

KEY WORDS : Fokker–Planck equation with magnetic field

1. INTRODUCTION

The many efforts that have been made to detect gravitational waves have so far given no convincing evidence that they have actually been seen [1]. This is due to the fact that not only is their amplitude very small [2], but it is highly possible that some kind of damping mechanism operates on them as they travel through space [3–5]. This damping may originate in the interaction of the gravitational wave with interstellar matter [6,7].

In a recent paper [8], hereafter is referred to as Paper I, the problem of the interaction of a charged particle with a gravitational wave, in the

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