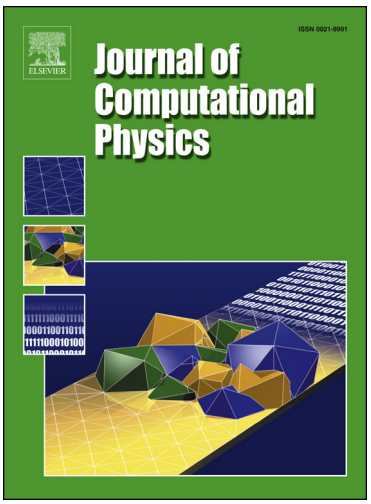
Accepted Manuscript



A multigrid AMR algorithm for the study of magnetic reconnection

D. Del Sarto, E. Deriaz

PII: S0021-9991(17)30627-7
DOI: http://dx.doi.org/10.1016/j.jcp.2017.08.046
Reference: YJCPH 7548

To appear in: *Journal of Computational Physics*

Received date: 24 January 2017
Revised date: 10 July 2017
Accepted date: 23 August 2017

Please cite this article in press as: D. Del Sarto, E. Deriaz, A multigrid AMR algorithm for the study of magnetic reconnection, *J. Comput. Phys.* (2017), http://dx.doi.org/10.1016/j.jcp.2017.08.046

A multigrid AMR algorithm for the study of magnetic reconnection

D. Del Sarto[a,b], E. Deriaz[a,c]

[a] *Institut Jean Lamour, CNRS UMR 7198*
[b] *Université de Lorraine, Nancy*
[c] *Centre national de la recherche scientifique*

Abstract

We address the study of reconnecting instabilities in magnetized plasmas, a highly multiscale process, using an innovative adaptive scheme based on Adaptive Mesh Refinement (AMR) and Multigrid Algorithms. The reduced model we exploit is very sensitive to numerical errors and demands high order solvers which we develop for this purpose. We validate our approach with two numerical experiments of physical interest.

Keywords: Reduced Magnetohydrodynamic, Adaptive Mesh Refinement, Magnetic Reconnection, Multigrid, CFL stability
2000 MSC: 65Z05, 65D05

1. Introduction

Through a global change of the magnetic topology, which locally occurs where spatial and/or temporal gradients of macroscopic quantities, such as density current, magnetic field or anisotropic pressure components become important, magnetic reconnection [1] emphasizes the multi-scale character usually displayed by plasma instabilities. The fact that the nonlinear dynamics of reconnection instabilities typically remains confined in a relatively small region of the macroscopic domain makes Adaptive Mesh Refinement (AMR) techniques of integration particularly suited to numerically investigate this problem. To this purpose, they have been already used in many previous studies, both in fluid and kinetic frameworks, among which we mention Refs.[2, 3, 4, 5, 6, 7, 8, 9, 10][11].

Here we present a new AMR algorithm that integrates a set of reduced magnetohydrodynamics (RMHD) equations (see later) by adopting a wavelet-