# Adaptive Algorithms in the Space Weather Modeling Framework

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## Abstract

Physics-based space weather modeling is characterized by disparate temporal and spatial scales as well as by different physics in different domains. A multi-physics system can be conveniently represented by a software framework comprising of several components. Each component corresponds to a physics domain, and each component is represented by one or more numerical models.

The Space Weather Modeling Framework, developed at the University of Michigan, integrates several components extending from the solar surface all the way to the ionosphere and thermosphere of the Earth. The framework adapts to the diversity of physics in the Sun-Earth system, and it also allows resolving the huge spatial and temporal scales with independent spatial and temporal discretizations in the various models.

Several of the computationally most expensive domains of the framework are modeled by the University of Michigan BATS-R-US code that can solve various forms of the magnetohydrodynamics (MHD) equations, including Hall, semi-relativistic, multi-species and multi-ion MHD, MHD with anisotropic pressure, and also radiative transport and heat conduction. BATS-R-US uses block-adaptive mesh refinement both in Cartesian and generalized coordinates, and it also uses several time-integration schemes to address the diverse applications.

The framework and the adaptive algorithms enable us to do physics based space weather modeling as well as scientific investigations of a wide range of physics problems from flux emergence to CME propagation, from comets, moons, planets all the way to the interaction of the outer heliosphere with the interstellar medium.

I will describe some of the algorithms as well as some of the latest highlights in our modeling efforts.

**Date**: Friday 22 October 2010
**Time**: 09:00-13:00
**Room**: Kastler Lecture Hall @ Adriatico Guest House