McGill Computational Science and Engineering Seminar

Friday March 23rd at 14:00 in Burnside Hall room 1205

A Computational Approach to Problems in Solar Physics

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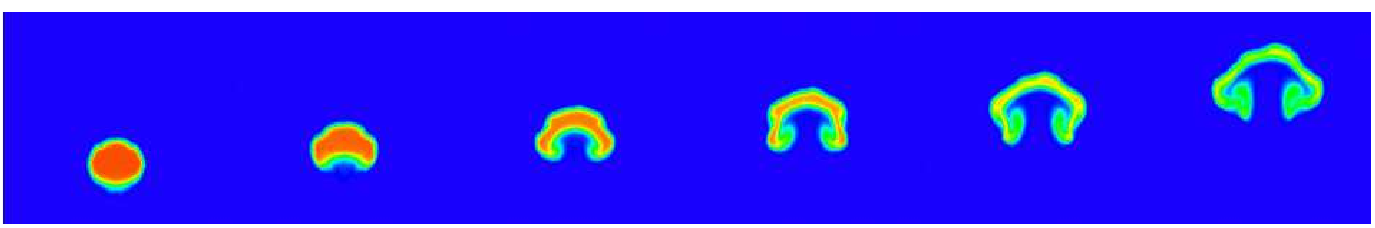
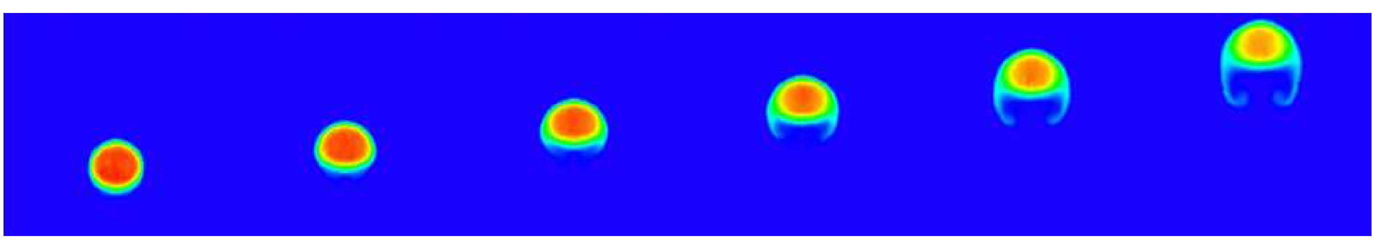
The interaction of hydro-dynamical, magnetic and radiation effects in the plasma of the convection zone and atmosphere of the sun leads to prominent physical phenomena like sun spots. In the talk we will focus on the rise of so-called magnetic flux tubes which are closely related to the development of sun spots.

In the first part we will consider the underlying mathematical model consisting of the equations of compressible magneto-hydrodynamics and the stationary radiation transport equation. A numerical method in three space dimensions is proposed. The algorithm is a Riemann-solver based finite-volume scheme on unstructured grids together with a local adaption strategy for refinement and coarsening of the grid. The code is integrated in a recently developed parallel environment allowing for dynamic load balancing. In the case of a (very) simple model problem the convergence of the algorithm to the exact solution will be proven.

In the second part we present a number of computational results. These results cover MHD-instabilities of Rayleigh-Taylor- and Kelvin-Helmholtz type and simple shock wave structures to validate the code. Finally a simulation on the rise of a stabilized magnetic flux tube is shown.



Rise of a magnetic flux tube, simulated without stabilization



Rise of a magnetic flux tube, simulated with stabilization.

Coffee and desserts are served after the seminar at 15:00 in the lounge, Burnside Hall 1024