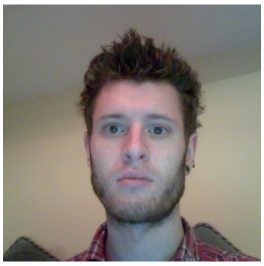
43ème Séminaire de la Modélisation
13 juin 2017

MAISON DE LA SIMULATION



A new approach to stellar models: The MUlti-dimensional Stellar Implicit Code

Tom Goffrey
Associate Research Fellow, Physics and Astronomy, University of Exeter

I will describe the development of a new code aimed at the study of hydrodynamical processes in stellar interiors. Current understanding of the evolution of stellar interiors relies on one-dimensional calculations. Complex physical processes which drive this evolution, such as convection, rotation, or accretion, are described by simplified, phenomenological approaches. However, the predictive power of these methods is severely hindered by the many free parameters employed by them. In an effort to redress this situation the Multi-dimensional Stellar Implicit Code (MUSIC) has been developed. By solving the equations of hydrodynamics in spherical coordinates the multi-dimensional processes at the heart of stellar evolution can be studied directly. The use of time-implicit methods allows the specific time-scale of interest to be targeted, and for statistically meaningful quantities of data to be gathered. Recent results from two applications will be presented: first, the accretion onto a young solar type star, and its impact on subsequent evolution; and second the problem of convective overshooting and its influence on lithium depletion.

RAMBODY : coupling codes for multi-scale simulations

Maxime Delorme
Astrophysics Scientific Programmer, Department of Physics, University of Surrey

With the advance of modern high performance computing, large scale simulations have been able to account for more and more realistic physics, capturing very large dynamical ranges. One of the challenges in the current approaches towards exascale computing and ever increasing resolutions is the change of physics in-between scales. The simulations currently running on supercomputers have been designed for specific purposes and cannot be easily modified to accommodate more physics. But reaching to different orders of magnitudes in scales requires also to change the physics computed. Moreover, writing new software to account simultaneously for different scales, while at the same time including as much features as the legacy codes that have been written and maintained for decades is getting harder and harder. One solution to that problem is, instead of rewriting them, coupling existing codes. I will present the efforts that have been made at University of Surrey to couple two astrophysics codes : Ramses (P3M + hydrodynamics using an AMR grid) and NBody6 (direct summation code) via MPI and MIMD techniques. This coupling will allow us to run precise simulations of globular clusters in interaction with a host galaxy. In these runs, Ramses is managing all the hydro and collisionless dynamics of a host galaxy while NBody6 is in charge of integrating precisely the trajectory and stellar evolution of stars in a globular cluster. Such a system allow us to precisely simulate tidal interaction between the two objects, something that has been done with rough analytical models until now. Such systems allow us to cover up to nine orders of magnitude in space, time and mass resolutions.

Tuesday, June 13th, 9:30 AM (coffee offered, talks start at 10:00 AM)
Maison de la Simulation, CEA Saclay, Digiteo building (565), room 34
Contact: seminar-modeling@maisondelasimulation.fr - ☎: 01 69 08 07 34
Mailing list: https://groupes.renater.fr/sympa/info/mdls-seminar
Program : http://www.maisondelasimulation.fr/seminar/

cea · cnrs · Inria · Université Paris Sud · Université de Versailles Saint-Quentin-en-Yvelines