Unraveling the Explosion Mechanism of Massive Stars
Supernova Models Confronting Observations

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When a massive star reaches the end of its life, the core of the star collapses to a neutron star or black hole while the outer stellar layers are expelled in a supernova explosion. These cosmic catastrophes are not only among the most spectacular celestial phenomena, they are also responsible for the production and dissemination of a major part of the heavy elements in the universe. A better understanding of the role of supernovae in astrophysics and as laboratories for nuclear and particle physics at extreme conditions requires the solution of one of the most long-standing problems of stellar physics: What is the mechanism that initiates and powers the explosion of stars? Increasingly sophisticated numerical models provide growing support that the energy deposition by neutrinos radiated from the hot, newly formed neutron star and aided by violent hydrodynamic mass motions is the driving agency of the explosion. In this talk I will review recent successes of theoretical modeling and new questions arising as simulations currently push forward to meet the grand computational challenges of the third spatial dimension. I will also discuss possibilities to confront the theoretical picture with observational tests and constraints.

Hybrid linear solvers on parallel hybrid computers

Luc Giraud
Research Director at Inria

In this work we investigate the parallel scalability of variants of additive Schwarz preconditioners for three dimensional non-overlapping domain decomposition methods. To alleviate the computational cost, both in terms of memory and floating-point complexity, we investigate variants based on a sparse approximation. The robustness of the preconditioners is illustrated on a set of linear systems arising from the finite element discretization of academic convection-diffusion problems (un-symmetric matrices), and from real-life structural mechanical problems (symmetric indefinite matrices). Parallel experiments on up to a thousand processors on some problems will be presented and results of an ongoing implementation on top of runtime systems for heterogeneous computing will be discussed. The efficiency from a numerical and parallel performance view point are studied on problem ranging from a few hundred thousands unknowns up-to a few tens of millions.

Tuesday, November 5th 9:30 AM (coffee offered, talk at 10 AM)
Maison de la Simulation, Digiteo building (565), room 33

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