

dyablo-Whole Sun : A new simulation code on AMR grids for the simulation of the Sun and solar-like stars on exascale architectures.

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Numerical simulations have become in the last decades one of the main pillars of research in stellar and solar physics. The modelling of local phenomena such as flux emergence at the surface of the Sun in large scale simulations now require using adaptive mesh refinement (AMR) techniques. Using AMR allows the resolution of finer scales with a lower memory footprint, but at the expense of an increase in algorithmic complexity. We present the dyablo framework and one of its associated codes Dyablo Whole Sun (DWS). Dyablo is a modern C++ framework allowing the execution of kernels on AMR grids with a domain decomposition relying on MPI and shared parallelism handled by the performance portability framework Kokkos. Performance portability allows us to run simulations on heterogeneous architectures (CPU, GPU, ARM) without specific porting of the code. Dyablo exposes modular interfaces allowing users to develop codes with a high degree of scalability and fully benefiting from the AMR grids. DWS is a Solar simulation code (extensible to Solar-like stars) based on dyablo and developed in the context of the ERC Synergy Whole Sun. DWS aims at running the first simulations of the Sun going from the core all the way to the corona. DWS is still in development but preliminary results have been obtained in the context of two international benchmarks on surface convection, in particular for the formation of solar granules. The organization and the coordination of these benchmarks have allowed us to validate the first results of DWS against the well established codes Bifrost, Dispatch and Mancha.