The Insane Complexity of Modularity and Standardization in Computational Astrophysics

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Résumé

Would not it be nice if simulation and analysis codes were built on modular and interoperable building blocks? Would not it be nice to be able to write physics kernels once and for all and just plug them in our codes? In this talk, largely inspired by informal discussions that happened in the GINEA group, we will go down the rabbit hole of software complexity and explore why modularity in computational astrophysics is anything but a simple problem. Through real-world examples, I will first give an overview of why achieving true modularity can be extremely difficult and why we, as a community, end up writing the same kernels again and again. Based on C++ standardization experience, I will describe what standardization really entails and how it could benefit the astrophysics community at large. I will then discuss the interdisciplinary aspects of software architecture for computational physics and how it constitutes an excellent collaborative platform between computer scientists and astrophysicists. I will also discuss the challenges of it, and propose some directions to make the best out of such collaborations. Furthermore, in the context of possible energy constraints on future HPC platforms, I will explore how questioning the way current codes are written and designed could lead to more energy-efficient simulation and data analysis strategies. I will finally conclude by doing some prospective on the future of code design in numerical astrophysics.

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