Smilei: an open-source collaborative particle-in-cell code for the kinetic simulation of plasmas

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First released in 2015, the particle-in-cell (PIC) code Smilei [1] has grown into a high-performance, user-friendly, multi-purpose tool for the kinetic simulation of plasmas. Production runs have started in 2018, and are now commonly carried out by tens of teams across the world.

In the past four years, significant improvements have been brought to the code. Additional physics modules have been introduced to model various processes: collisions, ionization, nuclear reactions, strong-field QED effects (inverse Compton, Breit-Wheeler pair production) etc. Advanced numerical schemes have been implemented which allow for instance to model relativistically drifting plasmas (numerical Cherenkov mitigation). Performances have also been significantly increased with vectorization technology, new domain decomposition schemes, and reduced models such as quasi-cylindrical geometry and particle merging. Thanks to a growing team of developers, and strong support by high-performance computing specialists, more features will be included in the upcoming years. In particular, GPU capabilities, task-based computing, and spectral solvers are currently under development.

In this presentation, I will give an overview of the Smilei project, discuss the code capabilities and illustrate them with applications to space and astrophysical plasmas, as well as in laboratory astrophysics.

Références

[1] Derouillat et al., Comp. Phys. Comm. 222, 351 (2018); https://smileipic.github.io/Smilei