3rd Asia-Pacific Conference on Plasma Physics, 4-8,11.2019, Hefei, China

The electromagnetic PIC code Smilei: physics, performance and highlights

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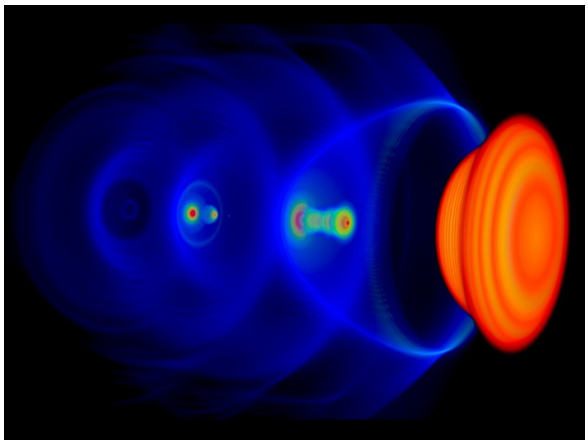
After five years of development, the electromagnetic PIC code Smilei has achieved significant progress, both on the physics and performance aspects. To match its open-source and community-driven approach, it is now well documented and has a user-friendly design.
New physics modules include collisions, ionization, radiation reaction, multiphoton Breit-Wheeler pair creation, an envelope model for laser-plasma ponderomotive interaction, and cylindrical geometry with azimuthal Fourier decomposition.
High scalability and performance are ensured with a hybrid shared/distributed-memory parallel computation, a space-filling-curve dynamic load-balancing technique, and a novel, efficient adaptive vectorization method. Particle merging and splitting processes bring additional control on the performance.
We review these aspects and present some large-scale simulations achieved by the Smilei community.



Three-dimensional rendering of the laser intensity and electron density from a laser-wakefield acceleration simulation

References

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2. A. Beck, J. Dérouillat, M. Lobet, A. Farjallah, F. Massimo, I. Zemzemi, F. Perez, T. Vinci, M. Grech, *Adaptive SIMD optimizations in particle-in-cell codes with fine-grain particle sorting*, Computer Physics Communications (2019), arXiv:1810.03949