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## Development of Nonlinear Optics Simulation Using the Accelerator Code ACE3P

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SLAC has been developing the parallel finite element electromagnetics simulation suite ACE3P (Advanced Computational Electromagnetics 3D Parallel) for accelerator modeling using high performance computing (HPC) platforms. ACE3P employs the parallel high-order finite-element method with conformal (tetrahedral) mesh for high-fidelity representation of geometry, and further accuracy can be obtained using quadratic surface and high-order elements resulting in reduced computational cost. Currently, the treatment of material properties applies to linear dielectrics and metals, wherein the electric displacement field is directly proportional to the electric field. There is a rapid need for new interaction regimes of high fields that would drive nonlinear response in materials which are in turn essential for novel accelerator applications. Moreover, efficient conversion between photons of different energies is needed for harmonic and THz generation, as well as quantum sensors which inherently require materials with second- or third-order optical nonlinearity. In this work we present the current status of the development of the nonlinear EM solver, in ACE3P which includes nonlinear response of the dielectric material. This utilizes parallel and scalable architecture to perform simulations and virtual prototyping on multiscale optical and quantum systems.

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### Footnotes

### I have read and accept the Privacy Policy Statement

Yes

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