Tech-X Corporation November 2015 Newsletter

TECH-X

VSim USim GPULib

SIMULATIONS EMPOWERING YOUR INNOVATIONS

VSim to Be Used in Groundbreaking "Particle Accelerator-on-a-Chip" Research

An international collaboration, led by Stanford University, and including Tech-X Corporation as a partner, has been awarded $13.5 million by the Gordon and Betty Moore Foundation to take an innovative particle accelerator design dubbed the “accelerator-on-a-chip” and make it into a fully functional and scalable working prototype. This laser-driven particle accelerator could have a major impact on the physics community and science in general by providing new particle and photon sources that are less expensive to build, address current infrastructure challenges, and provide broader access to the scientific community.

The international effort to demonstrate a working prototype of an accelerator is based on experiments published in 2013 by the project’s two principal investigators, Dr. Robert Byer of Stanford University in Nature

In this Issue

News

[VSim to Be Used in Groundbreaking "Particle Accelerator-on-a-Chip" Research]

[USim Used for Modeling a Plasma Vacuum Window for High Power Beam Applications]

[VSim Tip: Use PersistentParticles to Track Positions of Particles Through Time]

[Tech-X Develops Solar Energy Forecast Service and Resource Assessment Database]

Regular Features

[Upcoming Events]

[Recent Publications]

and Dr. Peter Hommelhoff of Friedrich-Alexander University Erlangen-Nuremberg in Physical Review Letters.

Tech-X will participate in computational research for the project, simulating prototype devices and helping to interpret experimental results. To do so, Tech-X and other collaborators on the project will use VSim, a high-performance, flexible electromagnetic and particle physics software application. "Particle accelerators are some of the most complex devices ever built," said Dr. Benjamin Cowan, a Tech-X Senior Research Scientist, who will be leading the Tech-X effort on the project. "Simulations are especially critical to this research, since the devices are 100,000 times smaller than conventional accelerators." By using VSim software, researchers will be able to tackle the most complicated problems, since VSim is able to run on thousands of processors at the nation's largest computing facilities.

Tech-X was involved in earlier research in this area, which led to a publication in *Nature* in 2013. As part of this new effort, Tech-X will be working with world-renowned experts in accelerator physics, laser physics, nanophotonics and nanofabrication. The ultimate aim of the project is to develop a functional, scalable prototype accelerator within five years, yielding electron and x-ray sources that are orders of magnitude smaller than current particle accelerators.

Along with the leads at Stanford University and Friedrich-Alexander University, the international collaboration includes three national laboratories: SLAC National

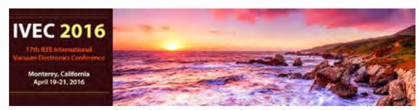
Upcoming Events

February 13-18, 2016: Tech-X Will Exhibit at Photonics West

SPIE. PHOTONICS WEST

Tech-X scientists will attend SPIE Photonics West 2016 in San Francisco, California. We look forward to seeing you at our booth, #2304.

April 19-21, 2016: Tech-X Will Exhibit at the 17th International Vacuum Electronics Conference



Join Tech-X in our booth at IVEC 2016 in Monterey, California.

June 19-23, 2016: Tech-X Will Exhibit at the 43rd International Conference on Plasma Science (ICOPS)

Join Tech-X in our booth at ICOPS 2016 in Banff, Alberta, Canada.

Recent Publications

December

Accelerator Laboratory in Menlo Park, CA; Deutsches Elektronen-Synchrotron (DESY) in Hamburg, Germany; and the Paul Scherrer Institute in Villigen, Switzerland. It also includes five universities: University of California Los Angeles, Purdue University, University of Hamburg, the Swiss Federal Institute of Technology in Lausanne (EPFL) and Technical University of Darmstadt.

For the past 75 years, particle accelerators have been an essential tool for physics, chemistry, biology and medicine, leading to multiple Nobel-Prize winning discoveries. Without new accelerator technology to reduce the cost (in the billions) and size (several miles in length) and provide increased access for scientists, the field of particle physics and structural biology could stall.

The opportunities for discovery have never been greater, yet commitment and funding for science—from government, from industry, and from philanthropy—fall far short of what is needed today to accelerate progress into the future. While philanthropy alone cannot entirely fill this gap, the Gordon and Betty Moore Foundation believes in the importance of investing in basic research to fuel innovation that can have a significant impact on future generations. The foundation is one of the world's largest private funders in science, including scientific research and technology development, investing more than $1.15B over the past 15 years.

USim Used for Modeling a

Pletzer, Alexander, and David Fillmore. "Conservative interpolation of edge and face data on n dimensional structured grids using differential forms." Journal of Computational Physics 302 (2015): 21-40. doi:10.1016/j.jcp.2015.08.029

November

Jenkins, Thomas, D. N. Smithe, K. Beckwith, B. D. Davidson, S. E. Kruger, A. Y. Pankin, and C. M. Roark. "Plasma--Surface Interactions and RF Antennas." Bulletin of the American Physical Society 60 (2015).

Cowan, Benjamin, John Cary, and Dominic Meiser. "GPU acceleration of particle-in-cell methods." Bulletin of the American Physical Society 60 (2015).

King, J. R., K. H. Burrell, A. M. Garofalo, R. J. Groebner, J. D. Hanson, J. D. Hebert, S. R. Hudson, A. Y. Pankin, S. E. Kruger, and P. B. Snyder. "Accurate Experiment to Computation Coupling for Understanding QH-mode physics using NIMROD." Bulletin of the American Physical Society 60 (2015).

Smithe, David, Thomas Jenkins, and Jake King. "Allowing for Slow Evolution of Background Plasma in the 3D FDTD Plasma, Sheath, and Antenna Model." Bulletin of the American

Plasma Vacuum Window for High Power Beam Applications

Tech-X, in collaboration with the Facility for Rare Isotope Beams (FRIB), investigated the effect of plasma arc heating on vacuum window performance. Tech-X's fluid plasma modeling tool, USim, was used to simulate the flow, which enabled researchers to understand parameters such as the gas flow rate as a function of arc current.

As a benchmark, the team looked at subsonic (on-axis M = 0.1) flow in a constant radius tube with a constant viscosity. In this case, known as Poiseuille flow, the flow has an analytical solution. Next, researchers compared predicted flow rates for air flow with no arc heating with recent measurements taken at FRIB.

Using USim, researchers were able to see the effect of the plasma arc in reducing the flow rate. These types of simulation results will allow researchers to optimize the gas cell design.

Physical Society 60 (2015).

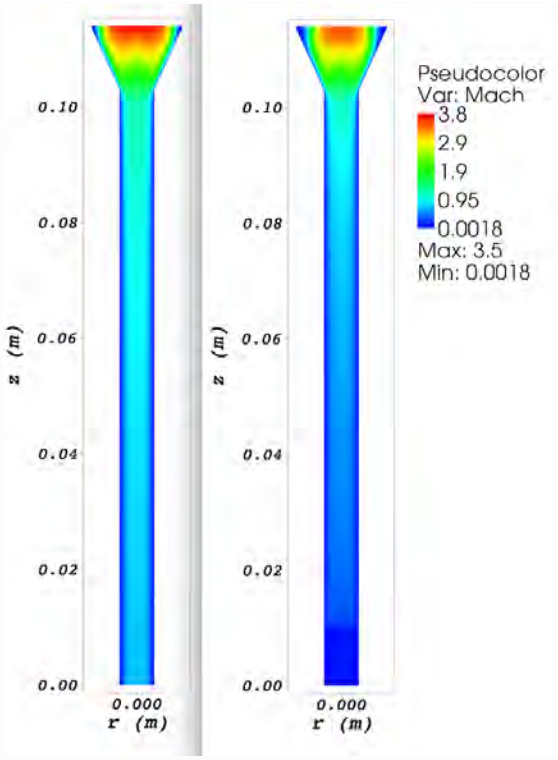
Kruger, Scott, T. G. Jenkins, E. D. Held, and J. R. King. "NIMROD Modeling of Sawtooth Modes Using Hot-Particle Closures." Bulletin of the American Physical Society 60 (2015).

Cassibry, Jason, Scott Hsu, Kevin Schillo, Roman Samulyak, Peter Stoltz, and Kris Beckwith. "Modeling of the merging, liner formation, implosion of hypervelocity plasma jets for the PLX-$\ alpha $ project." Bulletin of the American Physical Society 60 (2015).

Rafiq, T., A. H. Kritz, J. Weiland, A. Y. Pankin, and L. Luo. "Model for transport driven by microtearing modes in tokamak discharges." Bulletin of the American Physical Society 60 (2015).

Pankin, Alexei, Andrea Garofalo, Brian Grierson, Arnold Kritz, and Tariq Rafiq. "Computational Study of Anomalous Transport in High Beta DIII-D Discharges with ITBs." Bulletin of the American Physical Society 60 (2015).

Stoltz, Peter, Kristian Beckwith, Madhusudhan Kundrapu, and Felix Marti. "Modeling of a plasma vacuum window for high power beam applications." Bulletin of the American Physical Society 60 (2015).



Above: For modeling the arc discharge, we need an air conductivity model. We have both a hard sphere and LMD model, and we have compared with experiment.

VSim Tip: Use PersistentParticles to Track Positions of Particles Through Time

After producing an image in VSimComposer, you can open the VisIt GUI and use the PersistentParticles operator to track the positions of the particles through time for the same image. This short Tech-X YouTube video shows the PersistentParticles operator (as well as other operators) on a modified version of the 2D magnetron example that is distributed with VSim for Microwave Devices.

Tech-X Develops Solar Energy Forecast Service and Resource

October

Jenkins, Thomas, Kris Beckwith, Bradley Davidson, Scott Kruger, Alexei Pankin, Christine Roark, and Peter Stoltz. "Developing Chemistry and Kinetic Modeling Tools for Low-Temperature Plasma Simulations." Bulletin of the American Physical Society 60 (2015).

Veitzer, Seth, Kristian Beckwith, and Peter Stoltz. "Development Of Sputtering Models For Fluids-Based Plasma Simulation Codes." Bulletin of the American Physical Society 60 (2015).

Veitzer, Seth A., Kristian RC Beckwith, Madhusudhan Kundrapu, and Peter H. Stoltz. "Numerical modeling of the SNS H- ion source." In FOURTH INTERNATIONAL SYMPOSIUM ON NEGATIVE IONS, BEAMS AND SOURCES (NIBS 2014), vol. 1655, no. 1, p. 030004. AIP Publishing, 2015. http://dx.doi.org/10.1063/1.4916431

Assessment Database

Tech-X Corporation will be developing a solar energy forecast service and resource assessment database called SolarFS. SolarFS will be based on the NASA Clouds and the Earth's Radiant Energy System (CERES) data collections that have been assembled over the last two decades from NASA's fleet of Earth Observation System (EOS) satellites. SolarFS will provide unique services and products to the solar power industry, with an emphasis on global coverage for emerging markets.

September

Jenkins, Thomas G., and Eric D. Held. "Coupling extended magnetohydrodynamic fluid codes with radiofrequency ray tracing codes for fusion modeling." Journal of Computational Physics (2015).doi:10.1016/j.jcp.2015.05.035

July

Nguyen, Hung D., and Gynelle C. Steele. "An Overview of SBIR Phase 2 In-Space Propulsion and Cryogenic Fluids Management." (2015).

May

Jenkins, Thomas G., Kris Beckwith, Jonathan D. Smith, Scott E. Kruger, Alexei Y. Pankin, Christine M. Roark, David N. Smithe, Peter H. Stoltz, and Sean C-D. Zhou. "Developing chemistry, visualization, and RF sheath modeling tools for fusion and low-temperature plasma simulations." In Plasma Sciences (ICOPS), 2015 IEEE International Conference on, pp. 1-1. IEEE, 2015. doi:10.1109/PLASMA.2015.7179828

Beckwith, Kris, Peter H. Stoltz, Stephen F. McCormick, and John W. Ruge. "Physics-based preconditioners for fluid-plasma simulations with electromagnetics." In Plasma

Sciences (ICOPS), 2015 IEEE International Conference on, pp. 1-1. IEEE, 2015. doi:10.1109/PLASMA.2015.7179918

Beckwith, Kris, Seth Veitzer, and Peter H. Stoltz. "RF ion source modeling using fluid-based plasma models." In Plasma Sciences (ICOPS), 2015 IEEE International Conference on, pp. 1-1. IEEE, 2015. 10.1109/PLASMA.2015.7179829

Kundrapu, Madhusudhan, John Loverich, Kristian Beckwith, Peter Stoltz, Alexey Shashurin, and Michael Keidar. "Modeling radio communication blackout and blackout mitigation in hypersonic vehicles." Journal of Spacecraft and Rockets (2015): 1-10. doi: 10.2514/1.A33122

Connect with Tech-X

LinkedIn

Twitter

Website

YouTube

Email