



Tech-X Corporation invites you to visit us at our booth (Booth #84) at the International Particle Accelerator Conference, September 5 - 7, at the Kursaal, San Sebastian, Spain.

We are proud to present the latest release of our electromagnetic plasma simulation software, VORPAL (<http://vorpal.txcorp.com>). VORPAL 4.2.2 includes improved documentation, simplified installation on all platforms, additional collision models, import of user-defined secondary electron yield data, a new photoemission model, delta-F particles for modeling tokamak geometries, and new field updaters.

Personnel from Tech-X, with our collaborators and customers, will be participating in the following activities:

ID: 4473 - MOPZ023 VORPAL Simulations of Muon Cooling with an Inverse Cyclotron	
Presenter	Kevin Paul (Tech-X, Boulder, Colorado)
Authors	Kevin Paul, Estelle Cormier-Michel (Tech-X, Boulder, Colorado), Terrence Hart, Don Summers (UMiss, University, Mississippi)
Abstract	Neutrino factories and muon colliders require significant cooling of the muon beam. Most muon cooling channels are long and expensive single-pass structures, due to the difficulty injecting very large emittance beams into a circular device. Inverse cyclotrons can potentially solve the injection problems associated with other circular cooling channels, and they can potentially provide initial cooling of the beam. We present the most recent end-to-end (injection to extraction) simulations of an inverse cyclotron for muon cooling, performed with the particle-in-cell code VORPAL. We study the cooling capability of the device as well as potential limitations due to space charge effects and material interactions with the beam.
Funding Agency	US Department of Energy, Office of High-Energy Physics, SBIR DE-FG02-08ER85044
Type of Presentation	Poster
Main Classification	O3 Linear Colliders, Lepton Accelerators and New Acceleration Techniques
Sub Classification	A09 Muon Accelerators and Neutrino Factories

ID: 3460 - TUPZ039 Spin Dynamics Simulations at AGS and RHIC - Status	
Presenter	Francois Meot (BNL, Upton, Long Island, New York)
Authors	Francois Meot, Mei Bai, Yann Dutheil, Nicholas Tsoupas (BNL, Upton, Long Island, New York), Vahid Houston Ranjbar (Tech-X, Boulder, Colorado)
Abstract	Extensive spin dynamics simulations have been performed at AGS and RHIC in the past months. A status of that work is reported here.
Funding Agency	
Type of Presentation	Poster
Main Classification	O1 Circular Colliders
Sub Classification	A01 Hadron Colliders

ID: 4513 - WEPC131 Plasma Dielectric Modeling of Electron Cloud RF Diagnostics	
Presenter	John R. Cary (Tech-X, Boulder, Colorado)
Authors	Seth Andrew Veitzer, John R. Cary, David Smithe, Peter Stoltz (Tech-X, Boulder, Colorado)
Abstract	Electron Cloud (EC) effects have the potential to limit future accelerator performance by causing beam instabilities. Recent experiments have measured EC by detecting modulation of the cloud density with traveling wave RF. Simulations of these systems using kinetic particles are limited due to numerical noise and long simulation times. We present here new simulations that replace kinetic particles with a plasma dielectric formulation. While the response of the plasma dielectric is the same as for kinetic formulations, the simulations are much faster and numerically robust. We show that by direct modulation of the dielectric constant in these models we can reproduce side bands that are observed in the experiments, and present systematic investigations of the effects of non-uniform density clouds, boundary effects, and rf characteristics on side band amplitudes.

Tech-X Corporation

Funding Agency	This work was performed under the auspices of the Department of Energy as part of the ComPASS SciDAC-2 project (DE-FC02-07ER41499)
Type of Presentation	Poster
Main Classification	05 Beam Dynamics and Electromagnetic Fields
Sub Classification	D06 Code Developments and Simulation Techniques

ID: 3235 - WEPC132 Simulations of Surface Effects and Electron Emission from Diamond-Amplifier Cathodes	
Presenter	Dimitre Dimitrov (Tech-X, Boulder, Colorado)
Authors	Dimitre Dimitrov, Richard Busby [on leave], John R. Cary, David Smithe (Tech-X, Boulder, Colorado), Xiangyun Chang, Triveni Rao, John Smedley, Qiong Wu (BNL, Upton, Long Island, New York), Ilan Ben-Zvi (BNL, Upton, Long Island, New York; Stony Brook University, Stony Brook), Erdong Wang (PKU/IHIP, Beijing)
Abstract	Emission of electrons in diamond experiments based on the promising diamond-amplifier concept* was recently demonstrated**. Transmission mode experiments have shown the potential to realize over two orders of magnitude charge amplification. However, the recent emission experiments indicate that surface effects should be understood in detail to build cathodes with optimal properties. We have made progress in understanding secondary electron generation and charge transport in diamond with models we implemented in the VORPAL particle-in-cell computational framework. We will introduce models that we have been implementing for surface effects (band bending and electron affinity), charge trapping, and electron emission from diamond. Then, we will present results from 3D VORPAL diamond-vacuum simulations with the integrated capabilities on generating electrons and holes, initiated by energetic primary electrons, charge transport, and then emission of electrons from diamond into vacuum. Finally, we will discuss simulation results on the dependence of the electron emission on diamond surface properties.
Footnotes	* I. Ben-Zvi et al., Secondary emission enhanced photoinjector, C-AD Accel. Phys. Rep. C-A/AP/149, BNL (2004). ** X. Chang et al., Phys. Rev. Lett. 105, 164801 (2010).
Funding Agency	The authors wish to acknowledge the support of the U.S. Department of Energy (DOE) under grants DE-SC0004431 (Tech-X Corp.), DE-AC02-98CH10886 (BNL), and DE-SC0005713 (Stony Brook University).
Type of Presentation	Poster
Main Classification	05 Beam Dynamics and Electromagnetic Fields
Sub Classification	D06 Code Developments and Simulation Techniques

ID: 3299 - WEPZ022 Trojan Horse Laser-plasma Acceleration Scheme for Ultralow-emittance Electron Beam Shaping	
Presenter	Bernhard Hidding (HHU, Duesseldorf)
Authors	Bernhard Hidding, Thomas Koenigstein, Georg Pretzler (HHU, Duesseldorf), David Leslie Bruhwiler (Tech-X, Boulder, Colorado), James Rosenzweig, David Schiller (UCLA, Los Angeles, California)
Abstract	The transversal (slice) emittance of electron beams is crucial for (X)-FEL performance. The transversal momenta and source size imprinted during the injection process and in the initial phase of acceleration are key limiting factors. A recently conceived acceleration technique* is presented which decreases the electron emittance to some 10^{-8} m rad or even lower, an order of magnitude better than with the LCLS. The basic idea is to set up a beam-driven plasma wakefield by ionizing a low-ionization-threshold gas component (such as Li), while a second, high-ionization species (such as He) remains un-ionized until a focused, subsequent and co-propagating laser pulse ionizes it. By adjusting the laser intensity to just above the ionization threshold of the high-ionization species (e.g. $a_0=0.018$), the injection is well-defined and highly localized in space and time. Electrons are thus planted directly inside the accelerating and focusing phase of the plasma blowout at arbitrary positions, which is a fundamental advantage to other injection strategies. After He electrons appear within the Li blowout, 10^5 -of-GV/m-scale fields accelerate and focus the electrons to GeV energies.
Footnotes	* B. Hidding, G. Pretzler, J.B. Rosenzweig, T. Königstein, D. Schiller, D.L. Bruhwiler, "Trojan Horse Laser Electron Injection and Acceleration in a Beam-Driven Plasma Blowout", submitted.
Funding Agency	DFG Transregio 18, DOE No. DE-FG02-07ER46272, DE-FG03-92ER40693, ONR No. N00014-06-1-0925, and NERSC DOE No. DE-AC02-05CH11231. DLB was supported by Tech-X Corp. and DOE No. DE-FC02-07ER41499.
Type of Presentation	Poster
Main Classification	03 Linear Colliders, Lepton Accelerators and New Acceleration Techniques
Sub Classification	A20 Plasma Wakefield Acceleration

ID: 3886 - WEPZ033 Low Noise Particle-in-cell Simulations of Laser Plasma Accelerator Stages	
Presenter	Estelle Cormier-Michel (Tech-X, Boulder, Colorado)
Authors	Estelle Cormier-Michel, David Leslie Bruhwiler, John R. Cary, Benjamin Cowan (Tech-X, Boulder, Colorado), Eric Esarey, Cameron Guy Robinson Geddes, Wim Leemans, Carl Bernhardt Schroeder (LBNL, Berkeley, California)
Abstract	Because of their ultra-high accelerating gradient, laser plasma based accelerators (LPA) are contemplated for the next generation of high energy colliders and light sources. The upcoming BELLA project will explore acceleration of electron bunches to 10 GeV in a 1 meter long plasma wakefield driven by a PW-class laser. Simulations of such stages are very computationally demanding and require the use of reduce models such as ponderomotive guiding center for the laser or simulations in a boosted frame. In addition, particle-in-cell simulations suffer from high-frequency particle noise, which artificially increases emittance and energy spread of the accelerated electron beam. We show that calculating the beam self-fields using a static Poisson solve in the beam frame dramatically reduces particle noise. This method is used conjointly with reduced models to simulate BELLA relevant LPA stages.
Funding Agency	DoE, NNSA, NA- 22; DoE Office of Science, Office of HEP contract No. DE-AC02-05CH11231; ComPASS SciDAC project grant No. DE-FC02-07ER41499; Tech-X Corp. Used resources of NERSC.
Type of Presentation	Poster
Main Classification	03 Linear Colliders, Lepton Accelerators and New Acceleration Techniques
Sub Classification	A20 Plasma Wakefield Acceleration

Tech-X Corporation

ID: 4334 - WEPZ034 Resonant Plasma Wakefield Experiments at UCLA	
Presenter	Brendan Donald O'Shea (UCLA, Los Angeles, California)
Authors	Brendan Donald O'Shea, Atsushi Fukasawa, James Rosenzweig, Sergei Tochitsky (UCLA, Los Angeles, California), Bernhard Hidding (HHU, Duesseldorf; UCLA, Los Angeles), David Leslie Bruhwiler (Tech-X, Boulder, Colorado)
Abstract	Present work in Laser Plasma Accelerators focuses on a single laser pulse driving a non-linear wake in a plasma. Such single pulse regimes require ever increasing laser power in order to excite ever increasing wake amplitudes. Such high power pulses can be limited by instabilities as well engineering restrictions and experimental constraints on optics. Alternatively we present a look at resonantly driving plasmas using a laser pulse train. In particular we compare analytic, numerical and PIC simulation results to characterize a proposed experiment to measure the wake produced by four Gaussian laser pulses. The current progress depicts the interaction of 4 laser pulses of 3 ps FWHM, separated peak-to-peak by 18 ps, each of normalized vector potential $a_0 \sim 0.7$. Results confirm previous discourse (*,**) and show, for a given laser profile, a band pass like structure of choices for plasma density grouped around the so called single pulse resonant condition, $\omega_p = n/t_fwhm$.
Footnotes	* Umstadter, D., et al, Phys. Rev. Lett. 72, 1224 ** Umstadter, D., et al, Phys. Rev. E 51, 3484
Funding Agency	
Type of Presentation	Poster
Main Classification	O3 Linear Colliders, Lepton Accelerators and New Acceleration Techniques
Sub Classification	A20 Plasma Wakefield Acceleration

ID: 3436 - THPS009 Coherent Electron Cooling Demonstration Experiment	
Presenter	Vladimir N. Litvinenko (BNL, Upton, Long Island, New York)
Authors	Vladimir N. Litvinenko, Sergey Belomestnykh, Johan Bengtsson, Ilan Ben-Zvi, Alexei V. Fedotov, Yue Hao, Dmitry Kayran, George Mahler, Wuzheng Meng, Triveni Rao, Thomas Roser, Brian Sheehy, Roberto Than, Joseph Tuozzolo, Gang Wang, Vitaly Yakimenko (BNL, Upton, Long Island, New York), Mikhail Anatolyevich Kholopov, Pavel Vobly (BINP SB RAS, Novosibirsk), Andrew Hutton, Geoffrey Arthur Krafft, Matt Poelker, Robert Rimmer (JLAB, Newport News, Virginia), George I. Bell, David Leslie Bruhwiler, Vahid Houston Ranjbar, Brian T. Schwartz (Tech-X, Boulder, Colorado)
Abstract	Coherent electron cooling (CEC) is considered to be one of potential candidates capable of cooling high-energy, high-intensity hadron beams to very small emittances. It also has a potential to significantly boost luminosity of high-energy hadron-hadron and electron-hadron colliders. In a CEC system, a perturbation of the electron density caused by a hadron is amplified and fed back to the hadrons to reduce the energy spread and the emittance of the beam. Following the funding decision by DoE office of Nuclear Physics, we are designing and building coherent electron cooler for a proof-of-principle experiment at RHIC to cool 40 GeV heavy ion beam. In this paper, we describe the layout of the CeC installed into IP2 interaction region at RHIC. We present the design of the CeC cooler and results of preliminary simulations.
Funding Agency	
Type of Presentation	Poster
Main Classification	O4 Hadron Accelerators
Sub Classification	A11 Beam Cooling

ID: 3782 - THPS097 Space Radiation Mimicking and Electronics Testing with Laser-Plasma-Accelerators	
Presenter	Bernhard Hidding (HHU, Duesseldorf)
Authors	Bernhard Hidding, Thomas Koenigstein, Georg Pretzler, Oswald Willi (HHU, Duesseldorf), Kazuhisa Nakajima (KEK, Ibaraki), David Leslie Bruhwiler (Tech-X, Boulder, Colorado), James Rosenzweig (UCLA, Los Angeles, California)
Abstract	Testing and certifying the radiation sensitivity of electronics onboard of space vessels and satellites can take up to 1/3 of the total budgets for space missions. This field has enormous scientific and economic importance, but has never been considered until recently* to be a potential application area for laser-plasma-accelerators (LPAs). This is remarkable, since radiation in space is extremely multi-faceted, which is paralleled by the versatility of the output of LPAs. Electrons, protons, and x-rays are among the most important kinds of radiation encountered in space—all of which is well-known to be producible with LPAs. Furthermore, the flux spectra of space radiation often follows exponential or power-law distributions, which is the inherent domain of LPAs. The flux of so called "killer" electrons in the radiation belts, where many satellites are stationed, for example, have exponential energy distribution, which to date could not be mimicked with conventional approaches by the testing community. We show first results on space radiation mimicking and electronics testing with LPAs and the technology knowledge transfer to space entities.
Footnotes	* B. Hidding, T. Königstein, O. Willi, J.B. Rosenzweig, K. Nakajima, G. Pretzler, "Laser-plasma-accelerators—A novel, versatile tool for space radiation studies", NIM A 636(1), (2011) 31-40.
Funding Agency	This work has been supported by the Strategischer Forschungsfonds, Heinrich-Heine-University Düsseldorf, by the DFG SFB TR18, and by the European Space Agency under Contract No. 4000102854.
Type of Presentation	Poster
Main Classification	O8 Applications of Accelerators, Technology Transfer and Industrial Relations
Sub Classification	U04 Security