Overview of RadiaSoft and our SBIR Phase II Collaboration with BNL on X-ray Optics

David Bruhwiler

radiasoft

1348 Redwood Ave.
Boulder, Colorado 80304
USA

Collaboration Meeting on
"Simulation and Modeling for SR Sources and X-Ray Optics"

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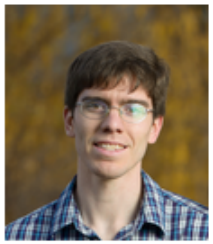
RadiaSoft History

- founded in August, 2013
  - *David Bruhwiler, President and co-founder*
  - *RadiaBeam Technologies, co-founder*
    - hardware company in Santa Monica, CA
    - Salime Boucher, President, sits on Board of Directors
- main office in Boulder, Colorado
- two Phase I SBIR awards in 2014
  - *including X-ray optics collaboration with BNL*
- two Phase II SBIR awards in 2015
  - *including X-ray optics collaboration with BNL*
  - *also, a new Phase I SBIR award*

The RadiaSoft Team

Our president David Bruhwiler has devoted over 25 years to the simulation of experiments and physical systems, including beam and laser-driven plasma accelerators, electron cooling of relativistic heavy ion beams, electron and ion sources, particle tracking and accelerator design and nonlinear dynamical systems. In addition to codeveloping both free and commercial software, and coauthoring more than 30 refereed journal articles, David has managed more than $10M in contracts and grants, and successfully mentored teams of more than 10 scientists, mathematicians and software developers. David is a Fellow of the American Physical Society.



Associate Research Scientist Nathan Cook is an accelerator physicist who has a strong interest in laser driven ion acceleration and related applications in radiation therapy, medical imaging, and accelerator driven systems. He has published papers in peer reviewed journals on the subjects of laser driven ion acceleration, RF acceleration, and ion beam imaging diagnostics, and was an editor of the Pre-Conceptual Design Report for the Ion Rapid Cycling Medical Synchrotron project at Brookhaven National Laboratory. Nathan received his BA in Physics and Mathematics from Williams College and his PhD in Physics from Stony Brook University. His thesis work comprised novel approaches to RF acceleration of carbon ions for a rapid cycling medical synchrotron and laser driven shock acceleration of helium ions from a gas target.

Principal Scientist Rami A. Kishek is also Research Professor at the University of Maryland (UMD), where he leads the UMER facility. He has 20 years' experience in charged particle dynamics and is an expert on space charge effects, computation, and multipactor, where he made groundbreaking contributions to its theoretical modeling. He has published over 190 scientific papers, delivered 50 invited talks, and has over 1000 citations to his work. Rami has chaired several workshops, most recently the 4th Workshop on the Microbunching Instability in FELs (April, 2012). He has advised or co-advised 11 graduate students and guided the research of dozens more graduate, undergraduate and high school students. Rami teaches regularly at UMD and at the US Particle Accelerator School (USPAS). Rami is a Fellow of the American Physical Society and a Senior Member of IEEE. He was awarded the 2015 USPAS Prize for Achievement in Accelerator Science and Technology: "For groundbreaking work on the theory of multipactor discharge, his contributions to the understanding of physics of space-charge-dominated beams and his excellent mentorship of young scientists."

Software Architect Rob Nagler has designed and deployed leading-edge distributed systems for over 30 years. Rob has written extensively about software, including his book on agile development methods, Extreme Perl. Rob started his career in the Distributed Systems Group at Stanford working with Dr. David Cheriton. At Sun Microsystems, he worked with Eric Schmidt in the telecommunications group. He led OLAP development at Olsen & Associates, a pioneer in financial research and analysis. At Tandem Computer's High Performance Research Center, Rob implemented a multi-platform, distributed architecture based on CORBA and used for internet traffic routing for mobile phone networks. Rob holds a BS in Computer Engineering from the University of California, San Diego and an MS in Computer Engineering from Stanford University.

Research Scientist Stephen Webb is an expert in scientific computing and theoretical plasma and beam physics, with an eye towards the theoretical underpinnings of computational algorithms. He has co-authored over twenty conference proceedings and peer-reviewed journal articles covering the fields of intense ion beams, free-electron lasers, and computational plasma and beam physics. Stephen holds a BS in Physics from Georgia Tech and a PhD in Accelerator Physics from Stony Brook University. The Air Force Office of Scientific Research (AFOSR) has awarded Stephen one of its prestigious 2015 Young Investigator Research Program awards. His project "High average power electron beams from a novel compact plasma wakefield accelerator" will develop fundamentally new algorithms and computational tools to enable the accurate simulation of novel ultra-bright electron beams for a wide variety of scientific, industrial and military applications.

Phase II SBIR Project

- Title: "Development of Software Framework for X-Ray Optics Simulation and Modeling"
  - *period of performance: April 5, 2015 through April 4, 2017*
  - *possible no-cost extension to cover final 6 months of post-doc*
- Funding: $500k/year for two years
  - *subcontract to BNL to hire a postdoc*
  - *subcontract to Bivio Software Inc. for software development*
    - Paul Moeller; user interface design and development
  - *DOE has a Phase 2a and 2b extension program*
    - possibility of writing another proposal to extend project for 2 years
- Objectives
  - *make SRW more available to X-ray light source users*
  - *improve the capabilities of SRW*
  - *develop commercial software for cloud-based scientific codes*

RadiaSoft Vision

- world class computational scientists and engineers
  - *near-term: beams, plasma and radiation*
  - *work with and contribute to community codes*
    - SRW (BNL, synchrotron radiation & X-ray optics, cross platform)
    - Genesis (PSI, free electron lasers, cross platform)
    - WARP (LBL, beams and plasmas, Linux)
    - Synergia (Fermilab, beams, Linux)
    - Elegant (ANL, beams, cross platform)
- commitment to open source software
  - *scientific software should be open for inspection*
  - *enables collaborative development with other scientists*
    - eliminates expensive, time-consuming IP discussions
- scientific cloud computing services
  - *market is large & independent of any particular field*
  - *accelerator technology can provide initial users*
    - success will bring significant value to our community

Open Source Cloud Computing for Science

- Containerized computing
  - *open source technologies: Docker, Vagrant, VirtualBox (VM)*
    - Docker/Vagrant enable rapid cloud deployment, no overhead
    - headless VMs on Mac OS and Windows with low overhead
    - eliminates pain of code installation, cross-platform development
  - *archival, reproducibility, instantaneous collaboration*
    - user input files, output files, etc. are saved in the container
    - share the container with a collaborator, students, etc.
- The browser will be the user interface (UI)
  - *possible due to advances in HTML5, CSS and JavaScript*
  - *physics code can run locally, on a server, supercomputer, etc.*
- Seamless legacy
  - *export SRW python script, or IPython Notebook from browser*
  - *the UI will always help users, never restrict what they can do*