



# U.S. Particle Accelerator School

Education in Beam Physics and Accelerator Technology

## *Simulations of Beam and Plasma Systems*

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Sponsoring University: Old Dominion University

Hampton, Virginia – January 15-26, 2018

## Collaborations

Jean-Luc Vay, Rémi Lehe

Lawrence Berkeley National Laboratory

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U.S. DEPARTMENT OF  
**ENERGY**

Office of Science



EXASCALE  
COMPUTING  
PROJECT



# Particle accelerators are essential tools in modern life

## Medicine



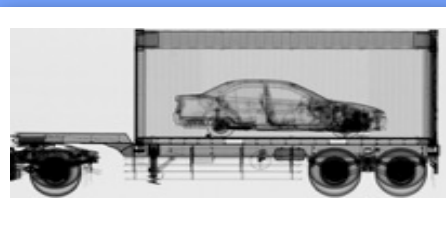
- ~9000 medical accelerators in operation worldwide
- 10's of millions of patients treated/yr
- 50 medical isotopes, routinely produced with accelerators

## Industry



- ~20,000 industrial accelerators in use
  - Semiconductor manufacturing
  - cross-linking/polymerization
  - Sterilization/ irradiation
  - Welding/cutting
- Annual value of all products that use accel. Tech.: \$500B

## National Security



- Cargo scanning
- Active interrogation
- Stockpile stewardship: materials characterization, radiography, support of non-proliferation

## Discovery Science



- ~30% of Nobel Prizes in Physics since 1939 enabled by accelerators
- 4 of last 14 Nobel Prizes in Chemistry for research utilizing accelerator facilities

***Opportunity for much bigger impact by reducing size and cost.***



# Problem: size & cost often a limiting factor

## Example 1: Proton Therapy Center



### New Rochester Mayo Clinic Proton Therapy Center

- 4 chambers
- \$188M



120-ton gantry directs proton beam  
to appropriate spot on patient  
by rotating around a three-story  
chamber.



<http://finance-commerce.com/2014/03/status-report-mayo-proton-therapy-facility/#ixzz43DJgnIIA>  
<http://blogs.mprnews.org/statewide/2014/03/mayos-proton-beam-facility-on-track-for-2015-opening/>

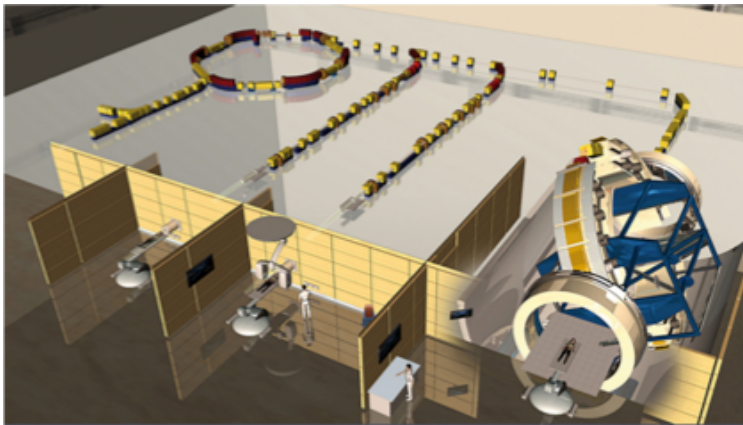


# Problem: size & cost often a limiting factor

## Example 2: Carbon Therapy Center

Heidelberg Proton & Carbon Therapy Center

- 2 scans chambers
- one  $4\pi$  chamber
- €119M



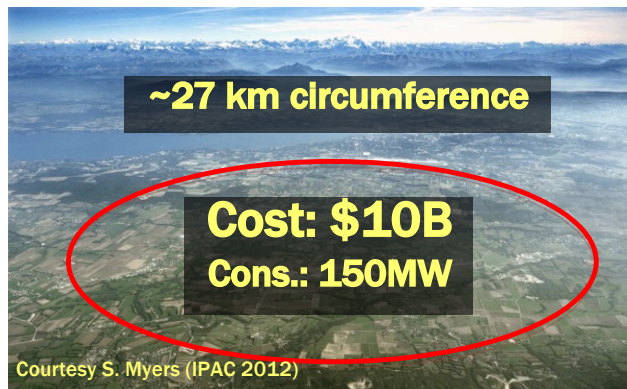
<http://medicalphysicsweb.org/cws/article/research/51684>  
<https://www.klinikum.uni-heidelberg.de/About-us.124447.0.html?&L=1>



# Problem: size & cost often a limiting factor

## Example 3: High-Energy Physics collider

### CERN LHC



### Future colliders?

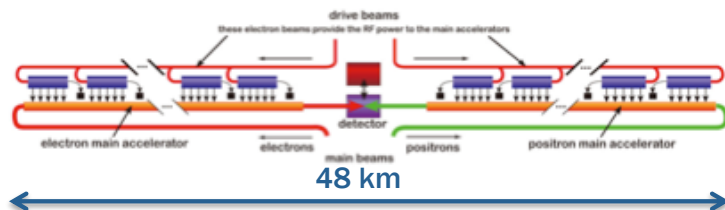
### ILC



Cost: \$8B-\$20B?

Cons.: 230MW

### CLIC



Cost: \$?B

Cons.: 415MW

### FCC





NATURE | NEWS: Q&A

## CERN's next director-general on the LHC and her hopes for international particle physics

Fabiola Gianotti talks to *Nature* ahead of taking the helm at Europe's particle-physics laboratory on 1 January.

Elizabeth Gibney

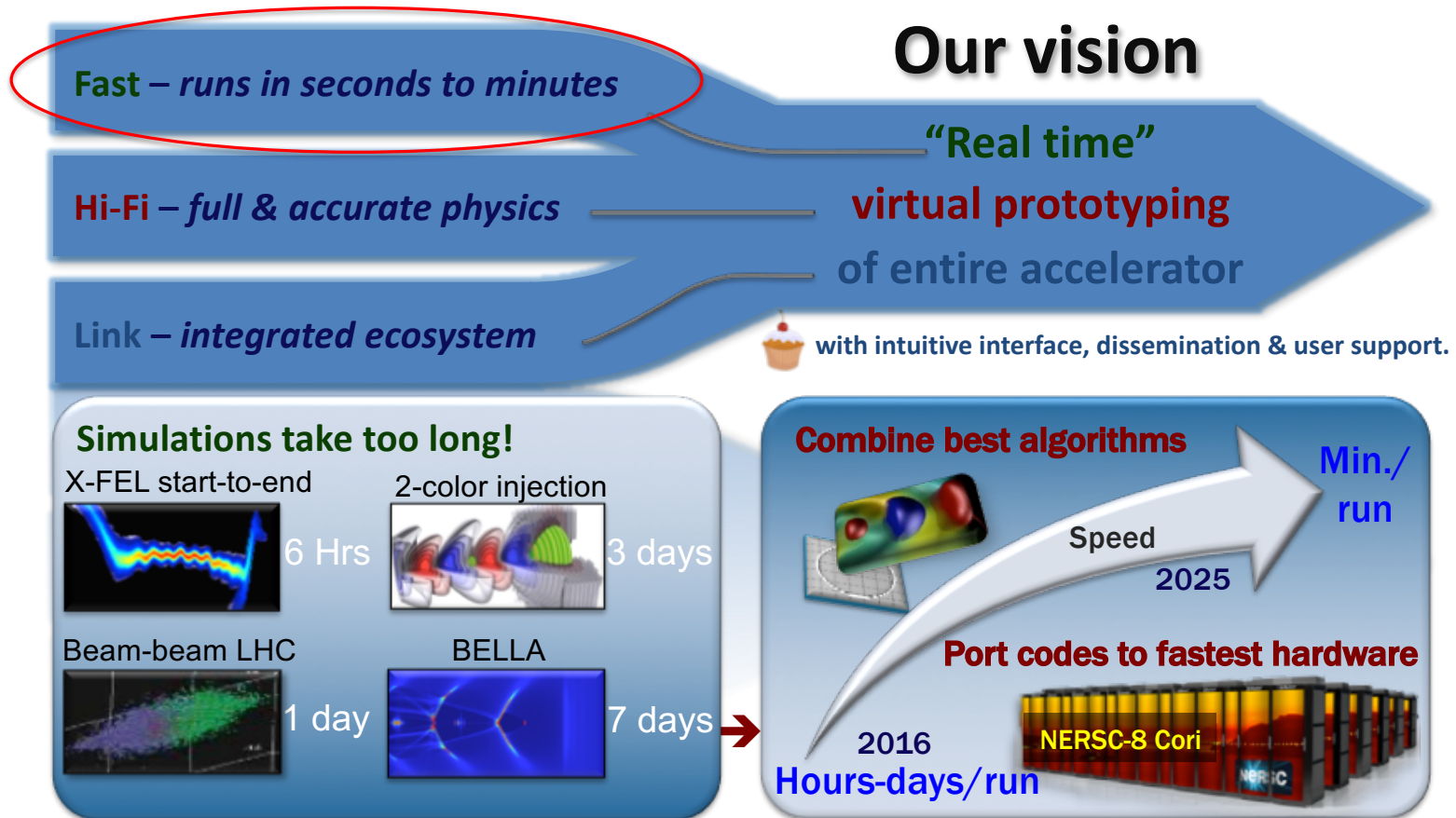
22 December 2015

**Some people think that future governments will be unwilling to fund larger and more expensive facilities. Do you think a collider bigger than the LHC will ever be built? And will it depend on the LHC finding something new?**

The outstanding questions in physics are important and complex and difficult, and they require the deployment of all the approaches the discipline has developed, from high-energy colliders to precision experiments and cosmic surveys. High-energy accelerators have been our most powerful tools of exploration in particle physics, so we cannot abandon them. What we have to do is push the research and development in accelerator technology, so that we will be able to reach higher energy with compact accelerators.

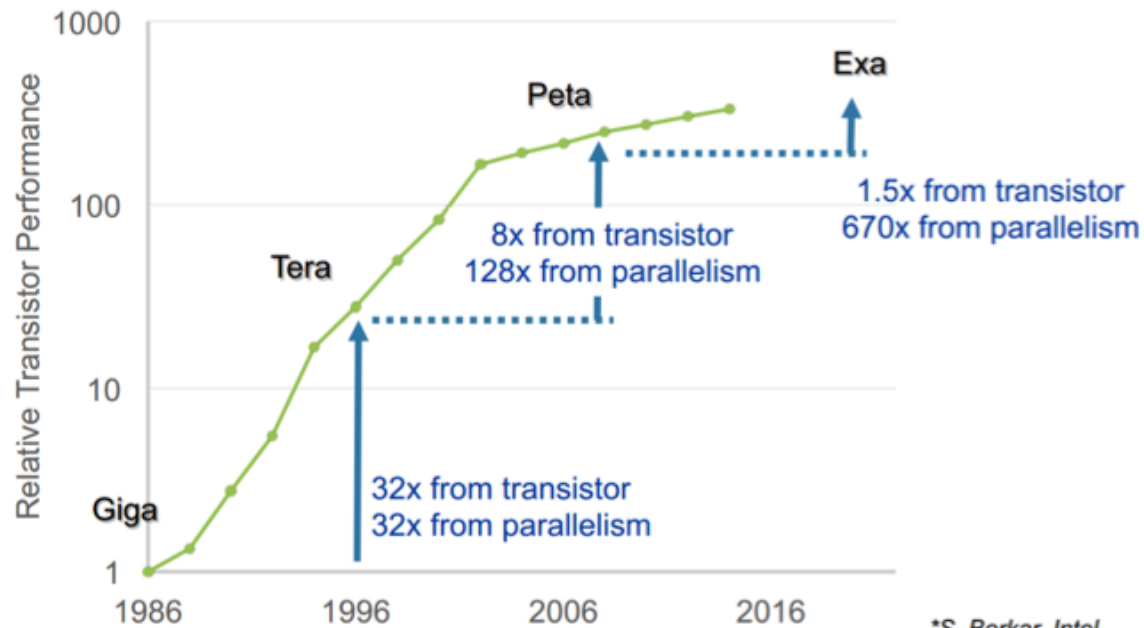
***Computer modeling has unique role to play!***

# The next generation of accelerators needs the next generation of modeling tools



# Speedup not from transistors speed anymore, need to increase parallelism

## From Giga to Exa, via Tera & Peta\*



\*S. Borkar, Intel

### Performance from parallelism

Basic Energy Sciences Advisory Committee Briefing 2.11.2016



13 Exascale Computing Project



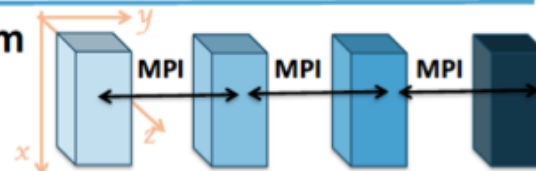


# Emerging supercomputing architectures require restructuration with “multi-level parallelism”

## To run effectively on future systems



- **Manage Domain Parallelism**
  - independent program units; explicit
- **Increase Thread Parallelism**
  - independent execution units within the program; generally explicit
- **Exploit Data Parallelism**
  - Same operation on multiple elements
- **Improve data locality**
  - Cache blocking; Use on-package memory

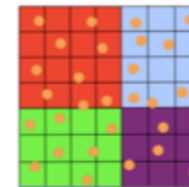


```

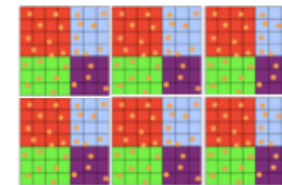
|--> DO I = 1, N
|      R(I) = B(I) + A(I)
|--> ENDDO
    
```

## Particle-In-Cell

Domain decomposition



Threading + tiling



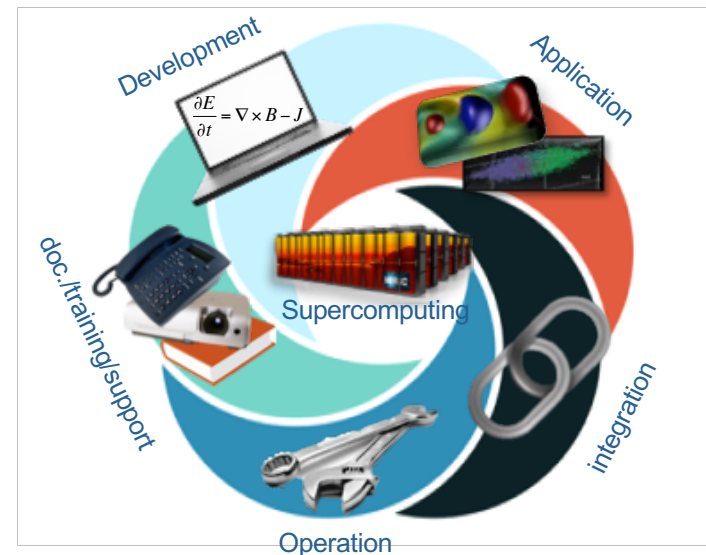
Vectorization, ...

# Supporting community calls for large efforts

## Community HPC hardware needs community HPC software

### needs:

- Development
- Application
- Integration of multiphysics modules
- Operation
- Doc./training/support
- On laptop/desktop to supercomputers



**How is the community doing?**



# Beam dynamics codes

Beam Dynamics Codes:

Codes section from Accelerator Handbook (A. Chao, 2013)

(Below, PIC refers to codes with particle-in-cell space-charge capability.)

Code	URL or Contact	Description/Comments
ASTRA	<a href="http://tesla.desy.de/~meykopff">tesla.desy.de/~meykopff</a>	3D parallel, general charged particle beams incl. space charge
AT	<a href="http://sourceforge.net/projects/atcollab/">sourceforge.net/projects/atcollab/</a>	Accelerator Toolbox
BETACOOOL	<a href="http://betacool.jinr.ru">betacool.jinr.ru</a>	Long term beam dynamics: ECOOL, IBS, internal target
Bmad, Tao	<a href="http://www.lns.cornell.edu/~dcs/bmad/">www.lns.cornell.edu/~dcs/bmad/</a>	General purpose toolbox library + driver program
COSY INFINITY	<a href="http://www.cosyinfinity.org">www.cosyinfinity.org</a>	Arbitrary-order beam optics code
CSRTrack	<a href="http://www.desy.de/xfel-beam/csrtrack">www.desy.de/xfel-beam/csrtrack</a>	3D parallel PIC; includes CSR; mainly for e <sup>-</sup> dynamics
Elegant/SDDS suite	<a href="http://aps.anl.gov/elegant.html">aps.anl.gov/elegant.html</a>	parallel; track, optimize; errors; wakes; CSR
ESME	<a href="http://www-ap.fnal.gov/ESME">www-ap.fnal.gov/ESME</a>	Longitudinal tracking in rings
HOMDYN	<a href="mailto:Massimo.Ferrario@LNF.INFN.IT">Massimo.Ferrario@LNF.INFN.IT</a>	Envelope equations, analytic space charge and wake fields
IMPACT code suite	<a href="http://amac.lbl.gov">amac.lbl.gov</a>	3D parallel multi-charge PIC for linacs and rings
LAACG code suite	<a href="http://laacg.lanl.gov">laacg.lanl.gov</a>	Includes PARMILA, PARMELA, PARMTEQ, TRACE2D/3D
LiTrack	<a href="http://www.slac.stanford.edu/~emma/">www.slac.stanford.edu/~emma/</a>	Longitudinal linac dynamics; wakes; GUI-based; error studies
LOCO	<a href="mailto:safranek@slac.stanford.edu">safranek@slac.stanford.edu</a>	Analysis of optics of storage rings; runs under matlab
LUCRETIA	<a href="http://www.slac.stanford.edu/accel/ilc/codes">www.slac.stanford.edu/accel/ilc/codes</a>	Matlab-based toolbox for simulation of single-pass e <sup>-</sup> systems
MaryLie	<a href="http://www.physics.umd.edu/dsat">www.physics.umd.edu/dsat</a>	Lie algebraic code for maps, orbits, moments, fitting, analysis
MaryLie/IMPACT	<a href="http://amac.lbl.gov">amac.lbl.gov</a>	3D parallel PIC; MaryLie optics + IMPACT space charge
MAD-X	<a href="http://mad.web.cern.ch/mad">mad.web.cern.ch/mad</a>	General purpose beam optics
MERLIN	<a href="http://www.desy.de/~merlin">www.desy.de/~merlin</a>	C++ class library for charged particle accelerator simulation
OPAL	<a href="http://amas.web.psi.ch">amas.web.psi.ch</a>	3D parallel PIC; cyclotrons, FFAGs, linacs; particle-matter int.
ORBIT	<a href="mailto:jzh@ornl.gov">jzh@ornl.gov</a>	Collective beam dynamics in rings and transport lines
PATH	<a href="mailto:Alessandra.Lombardi@cern.ch">Alessandra.Lombardi@cern.ch</a>	3D PIC; linacs and transfer lines; matching and error studies
SAD	<a href="http://acc-physics.kek.jp/SAD/sad.html">acc-physics.kek.jp/SAD/sad.html</a>	Design, simulation, online modeling & control
SIMBAD	<a href="http://agsrhichome.bnl.gov/People/luccio">agsrhichome.bnl.gov/People/luccio</a>	3D parallel PIC; mainly for hadron synchrotrons, storage rings
SIXTRACK	<a href="http://frs.home.cern.ch/frs/">frs.home.cern.ch/frs/</a>	Single particle optics; long term tracking in LHC
STRUCT	<a href="http://www-ap.fnal.gov/users/drozhdin">www-ap.fnal.gov/users/drozhdin</a>	Long term tracking w/ emphasis on collimators
Synergia	<a href="https://compacc.fnal.gov/projects">https://compacc.fnal.gov/projects</a>	3d parallel PIC; space charge, nonlinear tracking and wakes
TESLA	<a href="mailto:lyyang@bnl.gov">lyyang@bnl.gov</a>	Parallel; tracking; analysis; optimization
TRACK	<a href="http://www.phy.anl.gov/atlas/TRACK">www.phy.anl.gov/atlas/TRACK</a>	3D parallel PIC; mainly for ion or electron linacs
LIBTRACY	<a href="http://libtracy.sourceforge.net/">libtracy.sourceforge.net/</a>	Library for beam dynamics simulation
TREDI	<a href="http://www.tredi.enea.it">www.tredi.enea.it</a>	3D parallel PIC; point-to-point Lienard-Wiechert
UAL	<a href="http://code.google.com/p/uual/">code.google.com/p/uual/</a>	Unified Accelerator Libraries
WARP	<a href="mailto:DPGrote@lbl.gov">DPGrote@lbl.gov</a>	3D parallel ES and EM PIC with accelerator models
ZGOUBI	<a href="http://sourceforge.net/projects/zgoubi/">sourceforge.net/projects/zgoubi/</a>	Magnetic optics; spin; sync radiation; in-flight decay



# Beam/plasma codes

Table 1. List of simulation PIC codes for the modeling of plasma accelerators.

Code	Type	Website/reference	Availability/license
ALaDyn/PICCANTE	EM-PIC 3D	<a href="http://aladyn.github.io/piccante">http://aladyn.github.io/piccante</a>	Open/GPLv3+
Architect	EM-PIC RZ	<a href="https://github.com/albz/Architect">https://github.com/albz/Architect</a>	Open/GPL
Calder	EM-PIC 3D	<a href="http://iopscience.iop.org/article/10.1088/0029-5515/43/7/317">http://iopscience.iop.org/article/10.1088/0029-5515/43/7/317</a>	Collaborators/Proprietary
Calder-Circ	EM-PIC RZ <sup>+</sup>	<a href="http://dx.doi.org/10.1016/j.jcp.2008.11.017">http://dx.doi.org/10.1016/j.jcp.2008.11.017</a>	Upon Request/Proprietary
CHIMERA	EM-PIC RZ <sup>+</sup>	<a href="https://github.com/hightower8083/chimera">https://github.com/hightower8083/chimera</a>	Open/GPLv3
ELMIS	EM-PIC 3D	<a href="http://www.diva-portal.org/smash/record.jsf?pid=diva2%3A681092&amp;dswid=-8610">http://www.diva-portal.org/smash/record.jsf?pid=diva2%3A681092&amp;dswid=-8610</a>	Collaborators/Proprietary
EPOCH	EM-PIC 3D	<a href="http://www.ccpp.ac.uk/codes.html">http://www.ccpp.ac.uk/codes.html</a>	Collaborators/GPL
FBPIC	EM-PIC RZ <sup>+</sup>	<a href="https://fbpic.github.io">https://fbpic.github.io</a>	Open/modified BSD
HiPACE	QS-PIC 3D	<a href="http://dx.doi.org/10.1088/0741-3335/56/8/084012">http://dx.doi.org/10.1088/0741-3335/56/8/084012</a>	Collaborators/Proprietary
INF&RNO	QS/EM-PIC RZ	<a href="http://dx.doi.org/10.1063/1.3520323">http://dx.doi.org/10.1063/1.3520323</a>	Collaborators/Proprietary
LCODE	QS-PIC RZ	<a href="http://www.inp.nsk.su/~lotov/lcode">http://www.inp.nsk.su/~lotov/lcode</a>	Open/None
LSP	EM-PIC 3D/RZ	<a href="http://www.lspsuite.com/LSP/index.html">http://www.lspsuite.com/LSP/index.html</a>	Commercial/Proprietary
MAGIC	EM-PIC 3D	<a href="http://www.mrcwdc.com/magic/index.html">http://www.mrcwdc.com/magic/index.html</a>	Commercial/Proprietary
Osiris	EM-PIC 3D/RZ <sup>+</sup>	<a href="http://picksc.idre.ucla.edu/software/software-production-codes/osiris">http://picksc.idre.ucla.edu/software/software-production-codes/osiris</a>	Collaborators/Proprietary
PHOTON-PLASMA	EM-PIC 3D	<a href="https://bitbucket.org/thaugboelle/ppcode">https://bitbucket.org/thaugboelle/ppcode</a>	Open/GPLv2
PICADOR	EM-PIC 3D	<a href="http://hpc-education.unn.ru/en/research/overview/laser-plasma">http://hpc-education.unn.ru/en/research/overview/laser-plasma</a>	Collaborators/Proprietary
PICongGPU	EM-PIC 3D	<a href="http://picongpu.hzdr.de">http://picongpu.hzdr.de</a>	Open/GPLv3+
PICLS	EM-PIC 3D	<a href="http://dx.doi.org/10.1016/j.jcp.2008.03.043">http://dx.doi.org/10.1016/j.jcp.2008.03.043</a>	Collaborators/Proprietary
PSC	EM-PIC 3D	<a href="http://www.sciencedirect.com/science/article/pii/S0021999116301413">http://www.sciencedirect.com/science/article/pii/S0021999116301413</a>	Open/GPLv3
QuickPIC	QS-PIC 3D	<a href="http://picksc.idre.ucla.edu/software/software-production-codes/quickpic">http://picksc.idre.ucla.edu/software/software-production-codes/quickpic</a>	Collaborators/Proprietary
REMP	EM-PIC 3D	<a href="http://dx.doi.org/10.1016/S0010-4655(00)00228-9">http://dx.doi.org/10.1016/S0010-4655(00)00228-9</a>	Collaborators/Proprietary
Smilei	EM-PIC 2D	<a href="http://www.maisondelasimulation.fr/projects/Smilei/html/licence.html">http://www.maisondelasimulation.fr/projects/Smilei/html/licence.html</a>	Open/CeCILL
TurboWave	EM-PIC 3D/RZ	<a href="http://dx.doi.org/10.1109/27.893300">http://dx.doi.org/10.1109/27.893300</a>	Collaborators/Proprietary
UPIC-EMMA	EM-PIC 3D	<a href="http://picksc.idre.ucla.edu/software/software-production-codes/upic-emma">http://picksc.idre.ucla.edu/software/software-production-codes/upic-emma</a>	Collaborators/Proprietary
VLPL	EM/QS-PIC 3D	<a href="http://www.tp1.hhu.de/~pukhov/">http://www.tp1.hhu.de/~pukhov/</a>	Collaborators/Proprietary
VPIC	EM-PIC 3D	<a href="http://github.com/losalamos/vpic">http://github.com/losalamos/vpic</a>	Open/BSD clause-3 license
VSim (Vorpal)	EM-PIC 3D	<a href="https://txcorp.com/vsim">https://txcorp.com/vsim</a>	Commercial/Proprietary
Wake	QS-PIC RZ	<a href="http://dx.doi.org/10.1063/1.872134">http://dx.doi.org/10.1063/1.872134</a>	Collaborators/Proprietary
Warp	EM-PIC 3D/RZ <sup>+</sup>	<a href="http://warp.lbl.gov">http://warp.lbl.gov</a>	Open/modified BSD

EM = electromagnetic; QS = quasistatic; PIC = particle-in-cell; 3D = three-dimensional; RZ = axisymmetric; RZ<sup>+</sup> = axisymmetric with azimuthal Fourier decomposition.



## Need of solutions for non-disruptive coordination

### Significant investments into existing pool of codes:

- essential to **minimize disruptions** to developers and users,
- while **enabling interoperability** and **expandability**.

### Challenges:

#### Technical

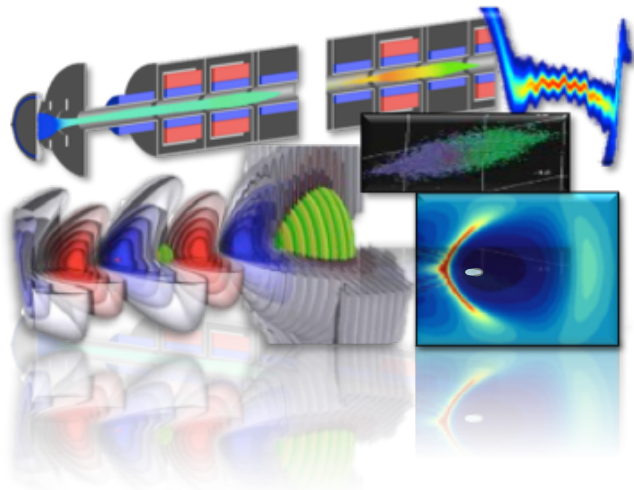
- programming languages
- data formats, parallelism
- code architectures
- open vs proprietary sources
- keep creativity

#### Human

- changing habits is hard
- different visions
- recognition
- distance
- corporatism/rivalry
- (re)build trust



# LBNL codes assembled in “BLAST” simulation toolset



## Advanced simulation toolset:

(For conventional & advanced concept accelerators)

- **Multi-physics frameworks:** IMPACT, Warp, WarpX.
- **Specialized codes:** BeamBeam3D, CSR3D, FBPIC, HiPACE, INF&RNO, POSINST.
- **Libraries:** PICSAR.

## Wide set of physics & components:

- beams, plasmas, lasers, structures, beam-beam, e<sup>-</sup> clouds, ...
- linacs, rings, injectors, traps, ...

## Keeping up at the forefront of computing:

- **novel algorithms:** boosted frame, particle pushers, etc.
- SciDAC, INCITE, NESAP, DOE Exascale.

\*Most codes open source, available at [blast.lbl.gov](http://blast.lbl.gov) or upon request.



# PICSAR created as part of NERSC Exascale Applications Program (NESAP)

## NESAP Codes

Advanced Scientific Computing Research		Basic Energy Sciences	
Almgren (LBNL)	BoxLib	Kent (ORNL)	Quantum Espresso
Trebotich (LBNL)	Chombo-crunch	Deslippe (NERSC)	BerkeleyGW
		Chelikowsky (UT)	PARSEC
		Bylaska (PNNL)	NWChem
		Newman (LBNL)	EMGeo
High Energy Physics		Biological and Environmental Research	
Vay (LBNL)	WARP & IMPACT	Smith (ORNL)	Gromacs
Toussaint(Arizona)	MILC	Yelick (LBNL)	Meraculous
Habib (ANL)	HACC	Ringler (LANL)	MPAS-O
		Johansen (LBNL)	ACME
		Dennis (NCAR)	CESM
Nuclear Physics			
Maris (Iowa)			
Joo (JLAB)			
Christ/Kars (Columbia/)			

Mathieu Lobet



Ex-NESAP postdoc  
(now at CEA, Saclay, France)

Henri Vincenti

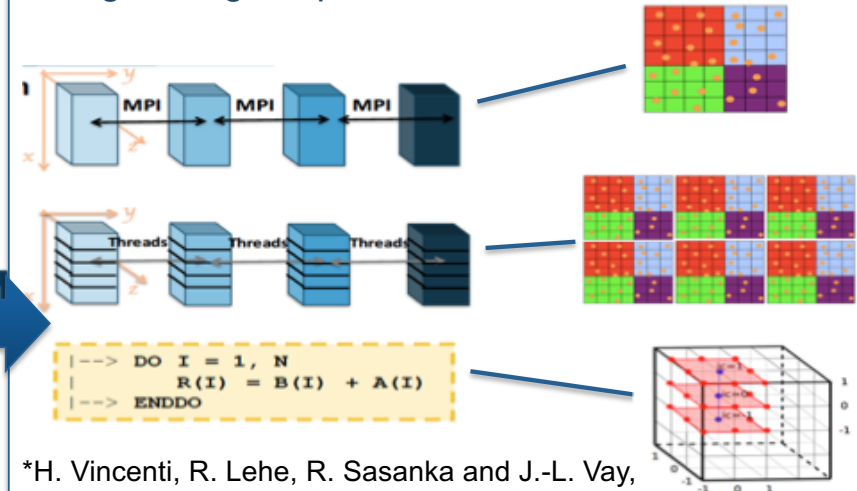


Marie Curie postdoc fellowship  
(now at CEA, Saclay, France)

NERSC

Warp EM-PIC kernel extracted  
→ Particle-In-Cell Scalable Architecture  
Resources (PICSAR) library + miniapp

Optimized with new vectorization algo.\* +  
tiling/sorting + OpenMP + MPI



\*H. Vincenti, R. Lehe, R. Sasanka and J.-L. Vay,  
*Comp. Phys. Comm.*, 210, 145-154 (2017).

**PICSAR is now open source:** <https://picsar.net>

Used in Warp, WarpX & SMILEI.

Now developed within DOE ECP project and CEA Saclay.

## U.S. DOE Exascale Computing Project (ECP)

- As part of the National Strategic Computing initiative, ECP was established to accelerate delivery of a **capable exascale** computing system that integrates hardware and software capability to deliver approximately 50 times more performance than today's 20-petaflops machines on mission critical applications.
  - DOE is a lead agency within NSCI, along with DoD and NSF
  - Deployment agencies: NASA, FBI, NIH, DHS, NOAA
- ECP's work encompasses
  - applications,
  - system software,
  - hardware technologies and architectures, and
  - workforce development to meet scientific and national security mission needs.

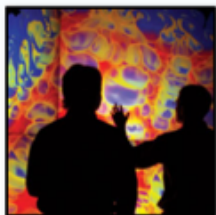




# Capable Exascale System Applications Will Deliver Broad Coverage of 6 Strategic Pillars

## National security

Stockpile stewardship



## Energy security

Turbine wind plant efficiency

Design and commercialization of SMRs

Nuclear fission and fusion reactor materials design

Subsurface use for carbon capture, petro extraction, waste disposal

High-efficiency, low-emission combustion engine and gas turbine design

Carbon capture and sequestration scaleup

Biofuel catalyst design

## Economic security

Additive manufacturing of qualifiable metal parts

Urban planning

Reliable and efficient planning of the power grid

Seismic hazard risk assessment



## Scientific discovery

Cosmological probe of the standard model of particle physics

Validate fundamental laws of nature

Plasma wakefield accelerator design

Light source-enabled analysis of protein and molecular structure and design

Find, predict, and control materials and properties

Predict and control stable ITER operational performance

Demystify origin of chemical elements

## Earth system

Accurate regional impact assessments in Earth system models

Stress-resistant crop analysis and catalytic conversion of biomass-derived alcohols

Metagenomics for analysis of biogeochemical cycles, climate change, environmental remediation

## Health care

Accelerate and translate cancer research



# Plasma-based acceleration has the potential to make accelerators small (again), and cut cost dramatically



**Tens of plasma accelerator stages needed for a 1 TeV  $e^-e^+$  collider.**

**BUT: simulations in 2-D can take days for 1 stage (even at insufficient resolution for collider beam quality).**

**→ Full 3-D modeling of tens of stages intractable without Exascale computing.**

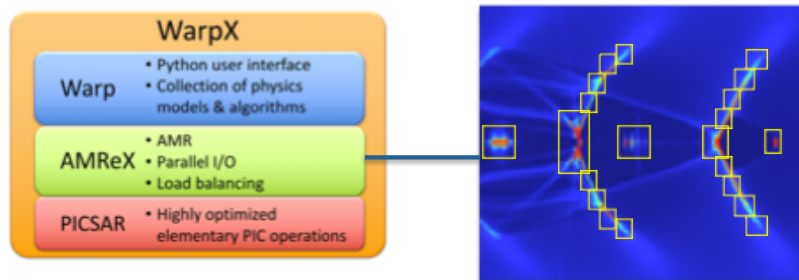


# ECP Project WarpX: “Exascale Modeling of Advanced Particle Accelerators”

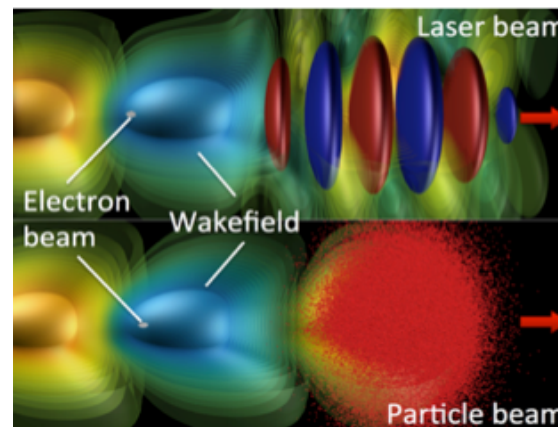
**Goal (4 years):** Convergence study in 3-D of 10 consecutive multi-GeV stages in linear and bubble regime, for laser- & beam-driven plasma accelerators.

**How:** → Combination of most advanced algorithms

→ Coupling of Warp+AMReX+PICSAR



→ Port to emerging architectures (Intel KNL, GPU, ...)



**Team:** LBNL ATAP (accelerators) + LBNL CRD (computing science) + SLAC + LLNL

**Ultimate goal: enable modeling of 100 stages by 2025 for 1 TeV collider design!**



# WarpX team

Time on WarpX varies between 5% to 80%

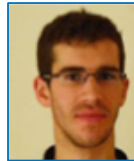
## Main topics

**LBL ATAP**

Jean-Luc Vay (PI)



Rémi Lehe



Jaehong Park



Robert Ryne



Olga Shapoval



Maxence Thevenet



Management  
Algorithms  
Optimization  
Visualization & I/O  
LWFA

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Wei-qun Zhang



AMR  
MPI, OpenMP  
Visualization & I/O

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Lixin Ge



Cho Ng



Oleksiy Kononenko



Optimization  
Visualization  
PWFA

**LLNL**

David Grote (coPI)



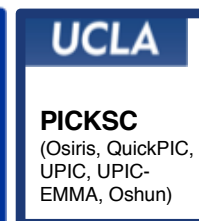
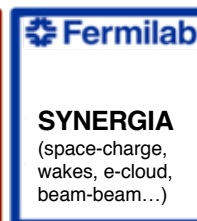
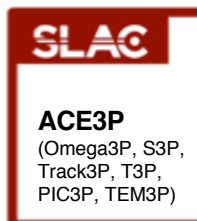
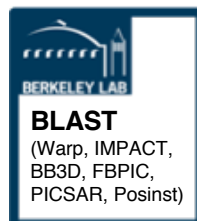
Python interface



## Consortium for accelerator modeling provides the foundations for community software

# Consortium for Advanced Modeling of Particle Accelerators

### CAMPA



Points of contact:  
LBNL: J.-L. Vay  
SLAC: C.-K. Ng  
FNAL: J. Amundson  
UCLA: W. Mori

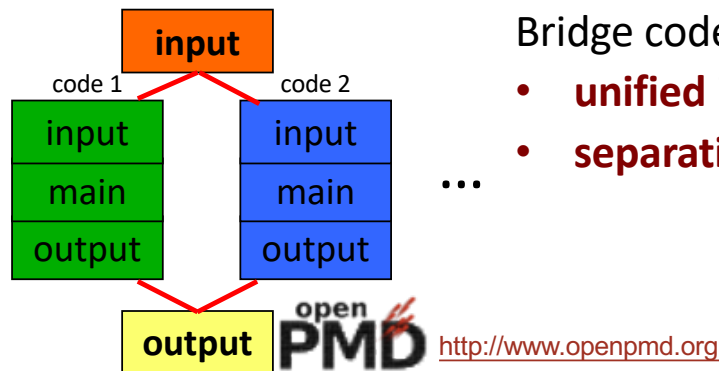
### Activities:

- Coordination/integration of codes & modules, user interfaces and data formats.
- Maintenance, dissemination, support & training.
- High Performance Computing (not covered by SciDAC/ECP).



# Common input/output standards to ease usage of multiple codes

- Currently, each code has own input script & output format
  - user needs 1 input script/code & different data reader or software



Bridge codes to enable:

- **unified** input/output interface
  - **separation** of description/resolution/analysis
- ...

- In the process of defining standard for common input
  - translate to individual code “language”
  - **PICMI**: Particle-In-Cell Modeling Interface
  - **AMI**: Accelerator Modeling Interface (aim to compatibility with MAD8/MAD-X)



# OpenPMD: a common data standard for particles & meshes



Initiated and led by Axel Huebl (HZDR, Germany)



Common output data standard

Adopted by several PIC codes use HDF5:

- Warp
- PIconGPU
- FBPIC

Fully open-source

Hosted on Github: <https://github.com/openPMD>

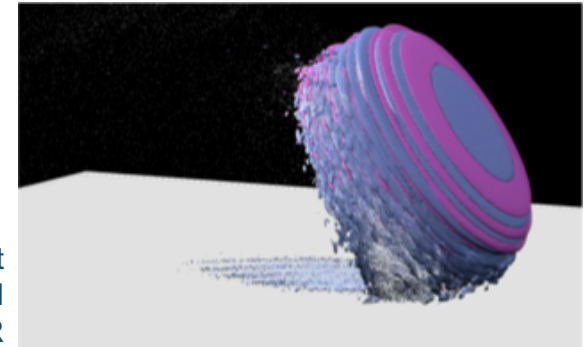
Implementation in progress in a number of other codes (QuickPIC, ...).

C++ & FORTRAN reader/writer in development.

Accelerator extension in development.



Open-source plugins for visualization with Matplotlib, VisIt, yt



3D viz with VisIt  
Simulation by G. Blaizot  
with Warp+PICSAR

Open-source tools for interactive analysis in Jupyter

OpenPMD-Notebook  
Developed by R. Lehe

# Radiasoft Sirepo: a cloud computing framework solution

- Open source, <https://github.com/radiasoft/sirepo>
- Freely available in open beta, <https://sirepo.com>
- Growing number of codes
  - X-ray optics: SRW, Shadow
  - Particle accelerators:
    - **Elegant**
    - **Warp (special cases)**
    - **more on the way**
- Growing number of users
  - independent servers at
    - **BNL/NSLS-II**
    - **LBNL/ALS**
    - **PSI/ETH Zurich**
  - about 100 users visit the open beta site

The screenshot displays the Sirepo web interface for the 'elegant' simulation engine. The main window is titled 'Beamline Report - BL14' and shows a 3D visualization of the beamline layout with various elements represented by colored blocks and lines. A scale bar indicates 1m. Below the report is the 'Beamline Editor - BL14', which features a 'drag and drop elements here to define the beamline' area with a library of elements including 'BL', 'Chic1Drift', 'K1', 'K2', 'K3', 'K4', 'K5', 'K6', 'K7', 'K8', 'K9', 'K10', 'K11', 'K12', 'K13', 'K14', 'K15', 'K16', 'K17', 'K18', 'K19', 'K20', 'K21', 'K22', 'K23', 'K24', 'K25', 'K26', 'K27', 'K28', 'K29', 'K30', 'K31', 'K32', 'K33', 'K34', 'K35', 'K36', 'K37', 'K38', 'K39', 'K40', 'K41', 'K42', 'K43', 'K44', 'K45', 'K46', 'K47', 'K48', 'K49', 'K50', 'K51', 'K52', 'K53', 'K54', 'K55', 'K56', 'K57', 'K58', 'K59', 'K60', 'K61', 'K62', 'K63', 'K64', 'K65', 'K66', 'K67', 'K68', 'K69', 'K70', 'K71', 'K72', 'K73', 'K74', 'K75', 'K76', 'K77', 'K78', 'K79', 'K80', 'K81', 'K82', 'K83', 'K84', 'K85', 'K86', 'K87', 'K88', 'K89', 'K90', 'K91', 'K92', 'K93', 'K94', 'K95', 'K96', 'K97', 'K98', 'K99', 'K100', 'K101', 'K102', 'K103', 'K104', 'K105', 'K106', 'K107', 'K108', 'K109', 'K110', 'K111', 'K112', 'K113', 'K114', 'K115', 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'K991', 'K992', 'K993', 'K994', 'K995', 'K996', 'K997', 'K998', 'K999', 'K1000'. The right sidebar shows a table of beamlines and a list of beamline elements.

Name	Description	Elements	Start-End	Length	Bend
BL	(H.F.)	49	21.26m	21.99m	0.0°
BL12	(BL_W5,Chic1,Chic1Drift,Chic12,Chic12	67	26.87m	27.26m	0.0°
BL13	(BL12,specline)	73	28.75m	29.41m	20.0°

Name	Description	Length	Bend
CHARGE			
C	total=1e-12		
CLEAN			
CT	deltalimit=100,limit=100,xlimit=100,ylimit=100,yplimit=0.25,yplimit		
DRIF			
Chic1Drift		100.0mm	
Chic12		670.0mm	
Chic12Drift		30.00mm	
Chic12		845.0mm	
Chic12		80.00mm	





# Summary

- Computer modeling can play a key role in the development of more compact & cheaper accelerators
- Increasing complexity of computer architectures and codes calls for collaborations
- Efforts are underway for non-disruptive solutions toward increased collaborative code developments





## BLAST Workshop 2018 (7-9 May, LBNL, Berkeley, California, US)

7-9 May 2018  
59  
US/Pacific timezone

Workshop informations: [conferences.lbl.gov/e/BLAST-2018](http://conferences.lbl.gov/e/BLAST-2018)

Overview

BLAST

Timetable

Contribution List

Author List

Registration

Support: Ms. Lucky  
Cortez

✉ [LCortez2@lbl.gov](mailto:LCortez2@lbl.gov)

☎ 510.486.4144

The Accelerator Modeling Program at Lawrence Berkeley National Laboratory is pleased to announce the first workshop on the Berkeley Lab Accelerator Simulation Toolkit ([blast.lbl.gov](http://blast.lbl.gov)), to be held on May 7-9, 2018.

- Intro to codes (IMPACT, WARP, BB3D, CSR3D, FBPIC, POSINST).
- Hands-on sessions
- Flash talks from users on experience with codes
- Ample time for group and one-on-one discussions

### Goals:

- Foster a community of users & developers of BLAST codes
- Share users experiences & highlights
- Introduce new users to code & existing users to latest features
- Discuss ideas & needs from the users community
- Plan & prioritize future code features & developments



The venue will be Shyh Wang Hall (Building 59), home of the U.S. Department of Energy National Energy Research Supercomputer Center ([nersc.gov](http://nersc.gov)) at Lawrence Berkeley National Laboratory, overlooking San Francisco Bay.

A visit of the supercomputer rooms is scheduled.

