HB2014 Summary for Working Group C

Computational Challenges, New Concepts, New Projects

Conveners:

Steven M. Lund	FRIB/MSU
Giuliano Franchetti	GSI
Hiromi Okamoto	U. Hiroshima

Michigan State University,
10-14 November, 2014

Working Group C: Computational Challenges, New Concepts, New Projects
Invited Talks

1st Session, Tuesday:
Computational: Simulation Infrastructure
New Concepts: Scaled Physics Experiments

2nd Session, Tuesday
New Concept: Nonlinear Integrable Optics

3rd Session, Wednesday
Computational Challenges: Long Path Length Simulations / Benchmarking

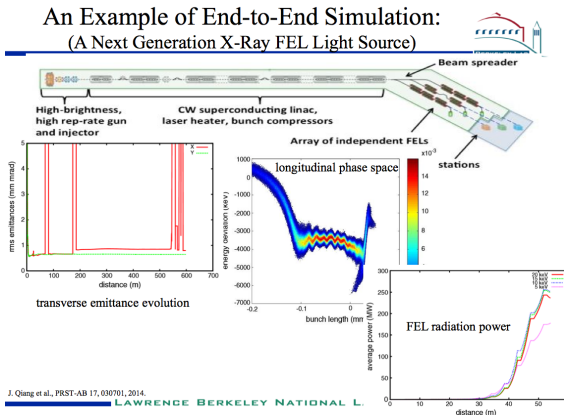
4th Session, Thursday:
New Projects: FFAG, ISIS Upgrade, Beam-Beam, Electron Lenses

Working Group C: Computational Challenges, New Concepts, New Projects
Invited Talks: 1st Session Tuesday
Simulation Infrastructure / Scaled Physics Experiments

Simulation Infrastructure

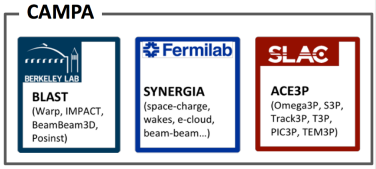
Jean-Luc Vay (LBNL)
Needs and considerations for a consortium of accelerator modeling

Ji Qiang (LBNL)
Development of integrated workflow for end-to-end modeling of accelerators



New initiative:

Consortium for
Advanced
Modeling of
Particle
Accelerators

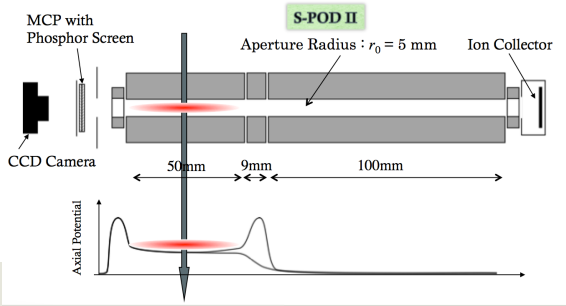


Points of contact:
LBNL: J.-L. Vay, J. Qiang
SLAC: C.-K. Ng, Z. Li
FNAL: J. Amundson, E.G. Stern

Scaled Physics Experiments

Hiromi Okamoto (Hiroshima U.)
Recent results from the S-POD trap systems on the stability of intense hadron beams

Typical Experiment Process



Comments: Simulation Infrastructure / Scaled Physics Experiments

- Code consortiums (CAMPA or other) good cause for community support
  - Needs expanding beyond 3 labs asap. Some funding to start good news.
  - Suggestion that less ambitious focus on advanced tools and improving support of legacy codes might better help the effort take off

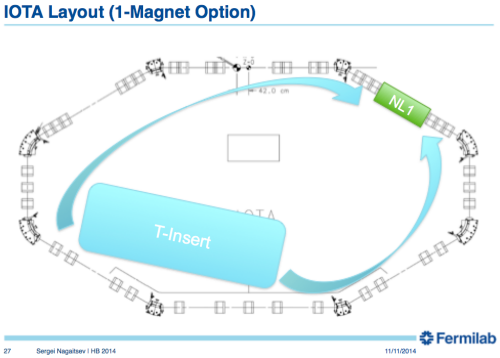
    Report: Los Alamos updating parmela/trace codes
- Sharing/support of benchmarked code tools for broad use is a good cause
  - Leverage effort/funding
  - Increase reliability
- End to end modeling may help support performance claims on large machines to help justify funding
  - Sources?
  - Rings with self-consistent models? Really ready?

- Traps can help clarify idealized physics processes cheaply and effectively train students in accelerator physics
  - Many numerical models also have limitations. But if understanding improves we can more effectively avoid problems in the design of real machines
  - Cheap dedicated beam time with no worries of damage ideal for training
- Hoped for workshop suggestions on expanded physics to explore in traps
  - We should be more active in conveying problems of interest!
- RAL building a Hiroshima U. type trap
  - Good to have more effort: Princeton Plasma Lab program zeroed recently

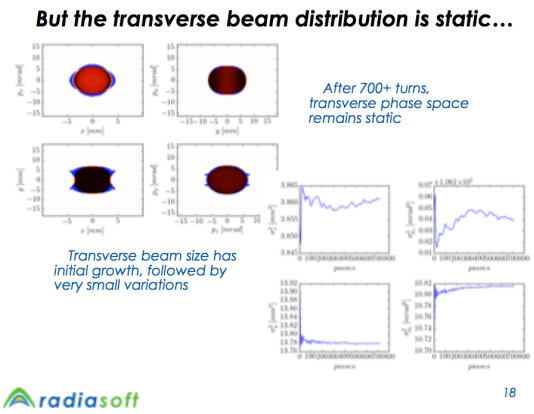
Working Group C: Computational Challenges, New Concepts, New Projects
Invited Talks: 2nd Session, Tuesday
New Concept: Nonlinear Integrable Optics

Nonlinear Integrable Optics (NIO)

Surgei Nagaitsev (FNAL)
The IOTA ring:
present status and plans

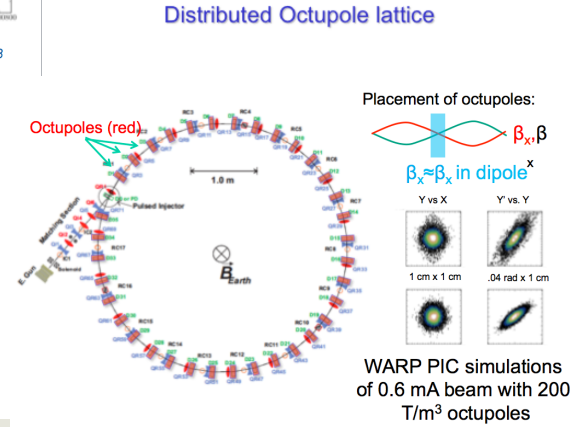


Stephen Webb (Radia-Soft)
Chromatic and space charge effects in nonlinear integrable optics



Scaled Physics Experiments

Rami Kishek (U. Maryland/UMER)
UMER 2.0: Adapting the University of Maryland Electron Ring to explore intermediate space-charge and nonlinear optics for Hadron beam facilities

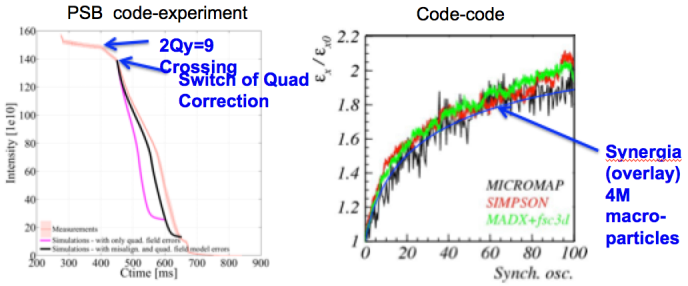


Comments: Nonlinear Integrable Optics

- Appears some in community skeptical of some aspects/promises but generally high support on seeing this effort progress
  - Lot of work to do !
  - Even if fails will increase understanding and excellent for training
- Laser/Plasma effort has much larger funding and likely much farther from practical at present
  - Can we sell effort more?
  - Risk of oversell if does not pan out?
- Some basic things may be missing to really be able to evaluate fairly:
  - Matching: need envelope like equation to know how to launch beam
  - Magnets: idealizations more problematic than linear case or not?
  - Scaling of Magnets: Will they be harder to achieve needs than whatever linear transport system they would improve upon
- Might be helpful to see more left/right type comparisons of equivalent optimized systems to better understand promise
  - Less halo due to mismatch within smaller aperture is compelling
- Experiments progressing slowly. Can we learn what we need to evaluate by theory/ simulation/ or idealized Paul-trap type experiments?
  - Good problem for student training

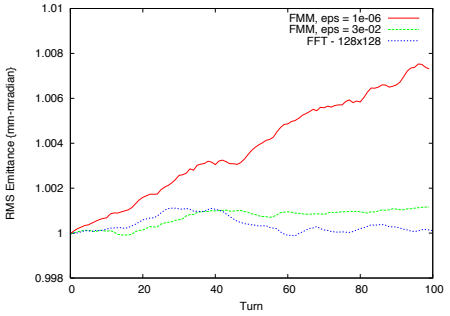
Working Group C: Computational Challenges, New Concepts, New Projects
Invited Talks: 3rd Session, Wednesday
Long Path Length Simulations / Benchmarking

Frank Schmidt (CERN)
Code requirements for long term tracking with space charge

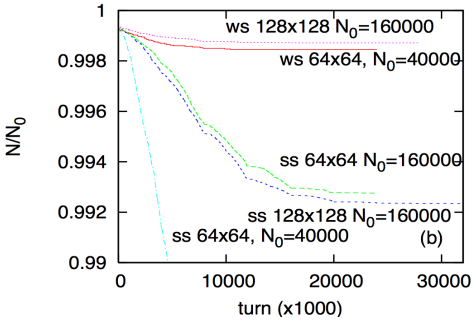


Jeff Holmes (SNS)
Status of PY-ORBIT and noise control in PIC codes

Tests of FFM vs FFT

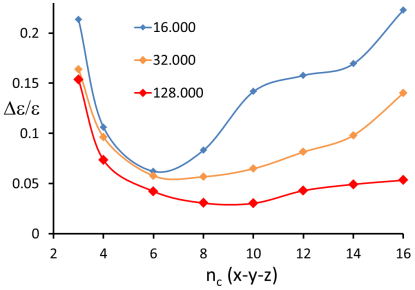


Kazuhito Ohmi (KEK)
Artificial noise in PIC codes and consequences on long term tracking



frozen model

nonfrozen model



From WGB:

Ingo Hofmann (GSI)
Grid Noise and Entropy Growth in PIC Code

Comments: Long Path Length Simulations / Benchmarking

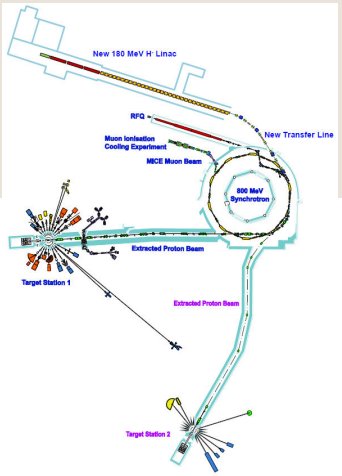
- Benchmarking both code-code and code-experiment are needed
  - GSI effort a good example: should be expanded
  - Need both analytic results to test against, other "verified" codes, and reliable experimental data
  - Difficult but necessary process: must keep in mind needs change with question asked and codes can be misused!
- Much debate on models. Benefits may be derived from examining other developed fields like plasma (must work in effective regime of space-charge domination) and fluid physics
  - Optimal/adequate likely changes strongly on parameters and type problem
  - Knowing extreme limits better may help guide effort: breakdowns often not quantum transitions
  - Keep tests simple: Many appear to explore issues with many effects simultaneously going on. Can be hard to disentangle.
- Enormous path lengths in rings together with difficult scaling in numerical needs for clear convergence poses large challenges
  - Are smoothed models with high detail (Ohmi) a possible way to go?
  - Can theory methods (Hoffman) guide needs if tests are kept simple enough?
  - Much interest in fast multipole methods reported: but conflicting reports of efficacy

    Common issue beyond this case: feel comparisons often limited fairness and winner depends on context

Working Group C: Computational Challenges, New Concepts, New Projects

Invited Talks: 4th Session, Thursday

New Projects

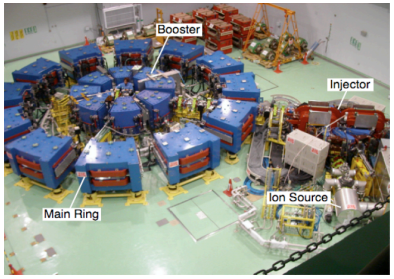


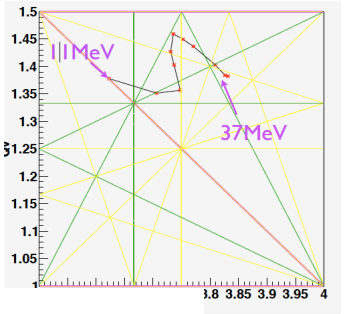
Projects

Dean Adams (STFC/RAL)

Ring Simulation and Beam Dynamics Studies for ISIS Upgrades

0.5 to 10 MW





Suzie Sheehy (RAL)

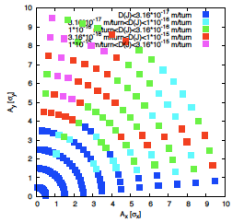
Characterization of a 150 MeV FFAG

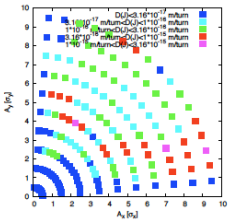
Beam-Beam / Electron Lenses

Christoph Montag (BNL)

Recent results on beam-beam effects in space charge dominated colliding ion beams at RHIC

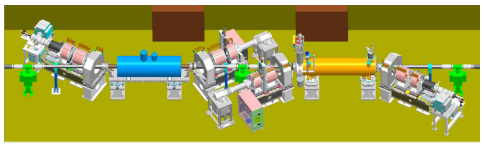
(.09, .08) : (.13, .12) :

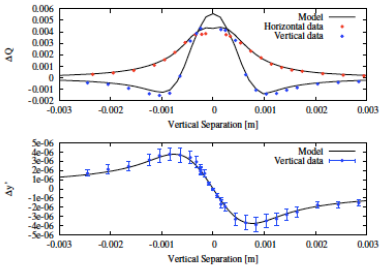




Xiaofeng Gu (BNL)

The physics and use of electron lenses at BNL





Comments: Projects

- Common apparent theme: need reliable code tools to guide facility improvements
  - Detailed support of ISIS intensity upgrades (space-charge in ring)
  - Need to evaluate space-charge effects to support tests of a non-scaling FFAG at RAL: likely to require code enhancements to address challenges
  - Space-charge effects in beam-beam: C. Montag used relatively simple model as guide to identify physics, match old results, and guide improvements
- Complex hardware needed to evaluate beam-beam mitigation via electron lenses is being developed at BNL
- Speakers did a good job highlighting projects not covered in other working groups with impact relating to simulations, intensity, and long-path length issues taken up.
- Conveners original intent of session was to organize overviews of suggested projects not being taken up at present that might get funded via various sources. This was likely too ambitious and we were not able to organize consistently.