Lucretia Developments

PT

SLAC

Remind me – what's Lucretia?

- A Matlab-based toolkit for simulations of beam dynamics in single-pass electron beamlines
  - **Most components are Matlab scripts or functions**
  - **A handful of compiled C functions which run under Matlab ("mexfiles"**
    - Compute intensive activities like tracking
      - Tracks pointlike rays with user-defined charge, not 4-D macroparticles
    - R-matrix calculation, Twiss propagation, lattice verification
      - Share a lot of code with Tracking
- Designed with the ILC in mind
  - **Somewhat useful for other applications – LCLS, XFEL**
  - **Designed from the ground up to be an all-in-one tool for LET studies**
  - **As "bulletproof" as we can make it**
    - Careful memory management
    - Careful error handling
    - Segmentation faults fixed as quickly as possible
    - Runs under Matlab
      - Matlab data (ie, beamline state, etc) preserved even if a fault is detected

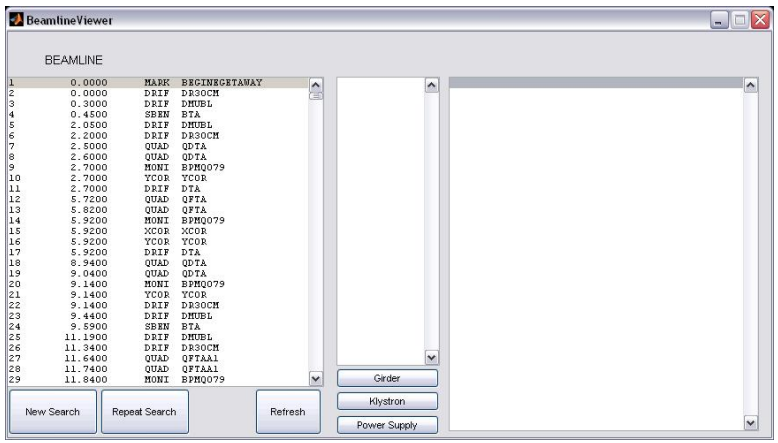
What's in Lucretia?

- Fairly sophisticated beamline representation
  - **Includes power supplies, klystrons, girders with or without movers, short range and long range wakefields, incoherent synchrotron radiation (several methods), crab cavities**
- Beam representation
  - **Multi-bunch representation**
  - **Several pre-defined distributions of rays, and users can define their own**
- Instrumentation
  - **Read-out of "observable" and "non-observable" stuff at each instrument**
  - **Bunch-by-bunch or train-by-train readback**
  - **BPM resolution and electrical offsets**

Other Lucretia Features

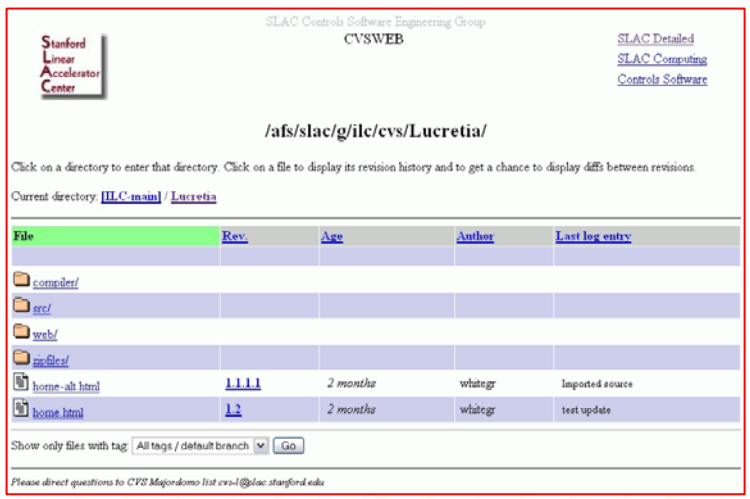
An online manual in the form of a heavily cross-linked website:

http://www.slac.stanford.edu/accel/ilc/codes/Lucretia/



A GUI for studying the beamline data structures

CVS control via a CVSWEB interface



What's Missing?

- At this point, there are two key features which are missing
  - **Insertion devices – wigglers and undulators**
  - **Wraparound elements – IR solenoids around other magnets, quads wrapped around accelerating structures, etc.**
- Plus at least a couple of other potentially useful features
  - **RF kicks from asymmetric couplers**
  - **Crab cavity LOMs (fundamental mode excitation)**
  - **?**

Insertion Devices

- Needed for e- linac
  - **Positron production undulator is seen by the beam which goes to the IP**
    - Helical undulator
- Which features are required?
  - **Optical effects (fringe field focusing)?**
  - **Path length change and/or momentum dependence of path length?**
  - **Mean energy loss?**
  - **Growth in energy spread?**
  - **Emittance growth from ISR?**
- Can this be “dummied up” with lots of tiny sector bends?
  - **Probably hopeless for a ring with an insertion device**
  - **Maybe okay for single-pass beamline**

Wraparound Devices

- An ongoing issue for accelerators in general
- My proposal: add a new FIELDMAP data structure to represent the wraparound element
  - **Zero length field maps with integrated E and B fields in an xy grid**
  - **Cross-referencing between the field maps and the elements they wrap around**
  - **Field maps can have power supplies, girders, movers**
  - **Tracking makes use of Matlab interpolation functions to find best approximation of actual field at each ray's location**

End of Presentation

- Some questions
  - **Do we need the insertion device as a true element type, or can we fake it with a mess of sector bends?**
  - **Is the proposed general design of the FIELDMAP data structure, and its use, sensible?**
  - **Are there other important features which should be incorporated in the near future?**
    - Not all users are necessarily linear collider people!