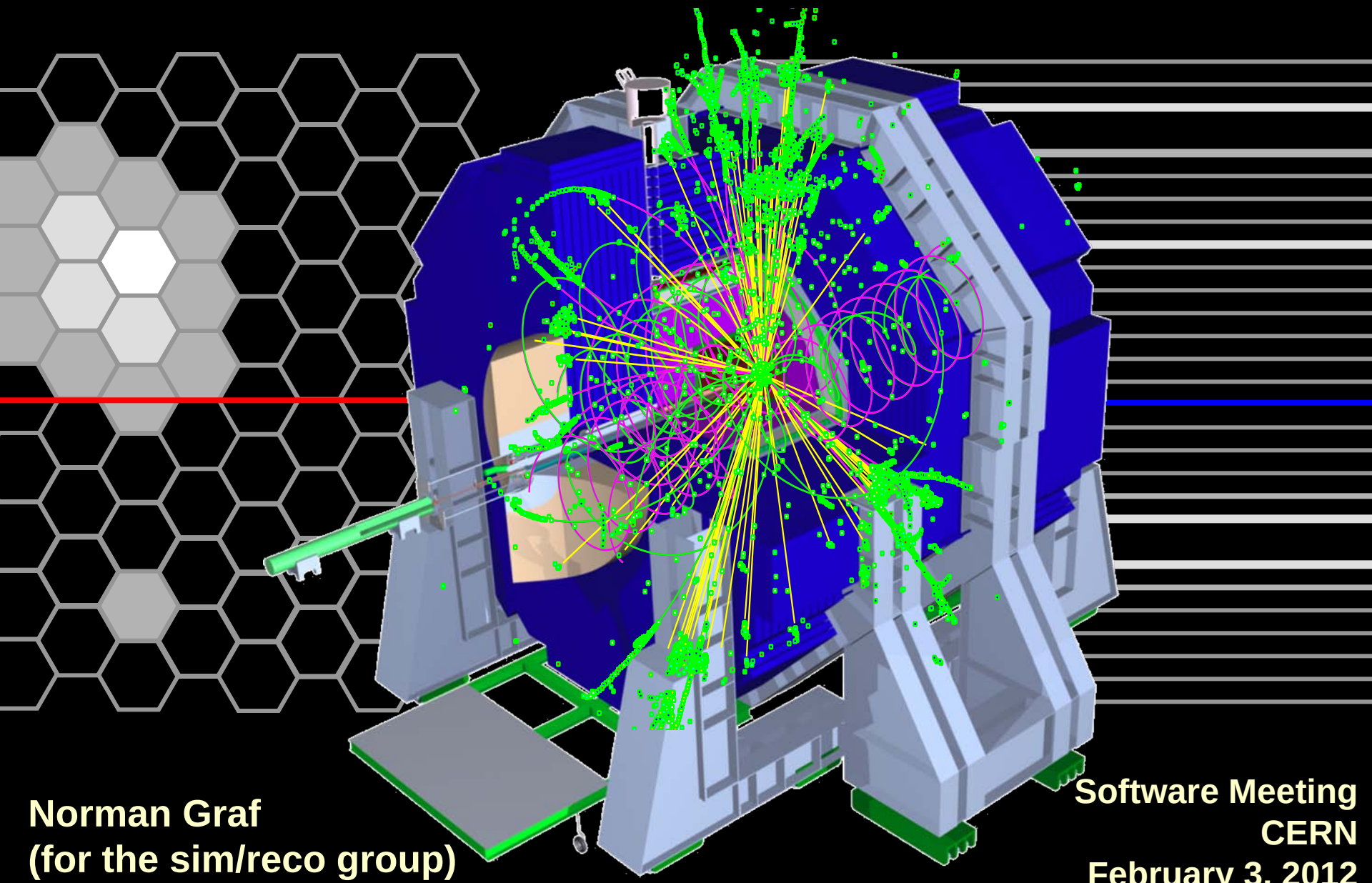
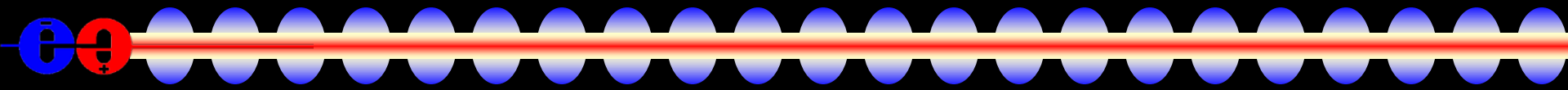
SiD:Tracking



Norman Graf
(for the sim/reco group)

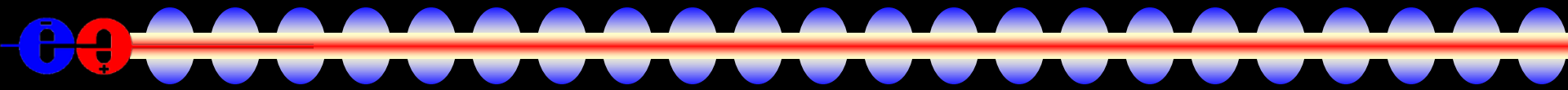
Software Meeting
CERN
February 3, 2012

org.lcsim Tracking I



- TrackerHit classes will make use of new LCIO classes which support 1D and 2D hits on planar surfaces.
- Track will incorporate new TrackState classes.
- Improvements in silicon pixel response simulations.
- Incorporate non-prompt tracking into the standard reconstruction and used for V finding?
- Implementing track finding based on 3D hits.

org.lcsim Tracking II



- Work ongoing to implement existing Kalman Filter code into standard reconstruction stream.
  - Extrapolator will be used to calculate TrackStates at Calorimeter face and at the dca to the IP.
  - Should resolve existing deficiencies in track fits.
- Work ongoing to improve overall tracking simulations, lower priority but also useful to other end users.
  - Effects of field map will be investigated.
  - Runge-Kutta stepper code being adapted.

PixSim (N. Sinev, UO)

http://www.slac.stanford.edu/~sinev/pixsim_doc/pixsim_help.html

Allows very detailed descriptions of charge carrier movement, e.g. list of collecting, absorbing and reflecting regions, properties of silicon (doping, mobility, diffusion length and so on), electric and magnetic fields (including TCAD maps).
Use of lookup tables leads to faster simulation.

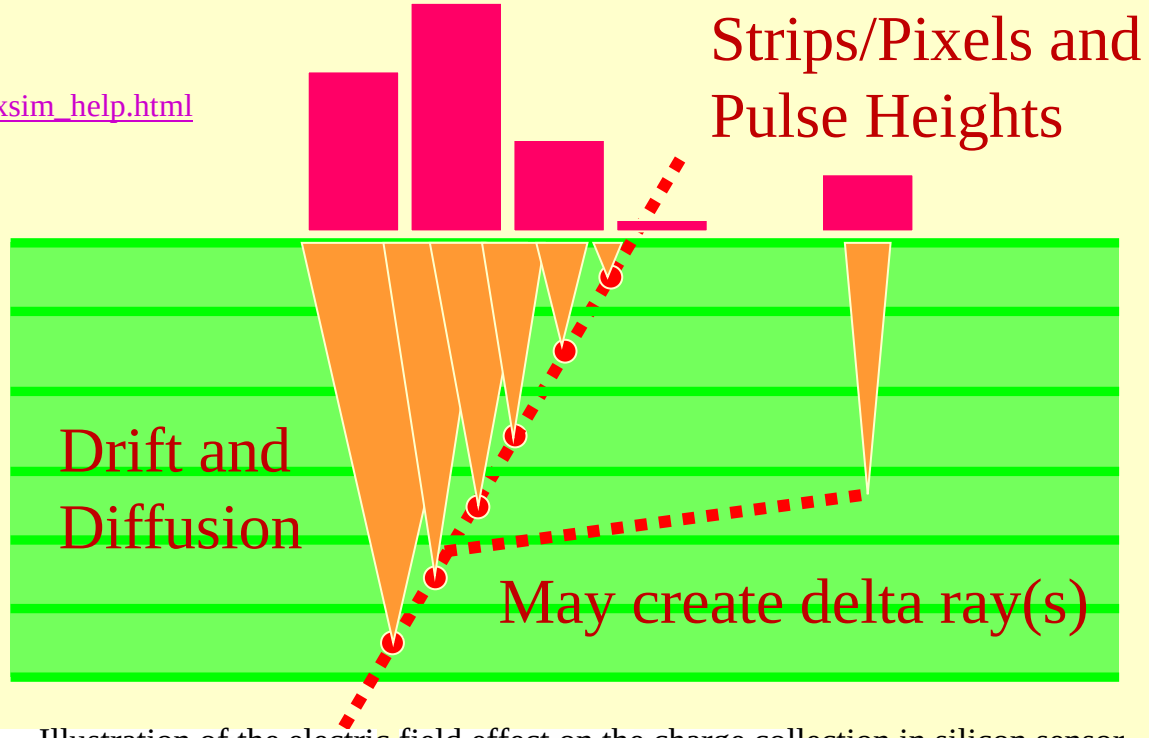
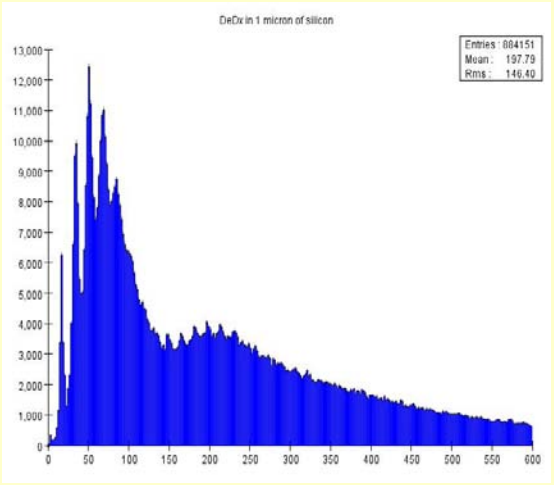
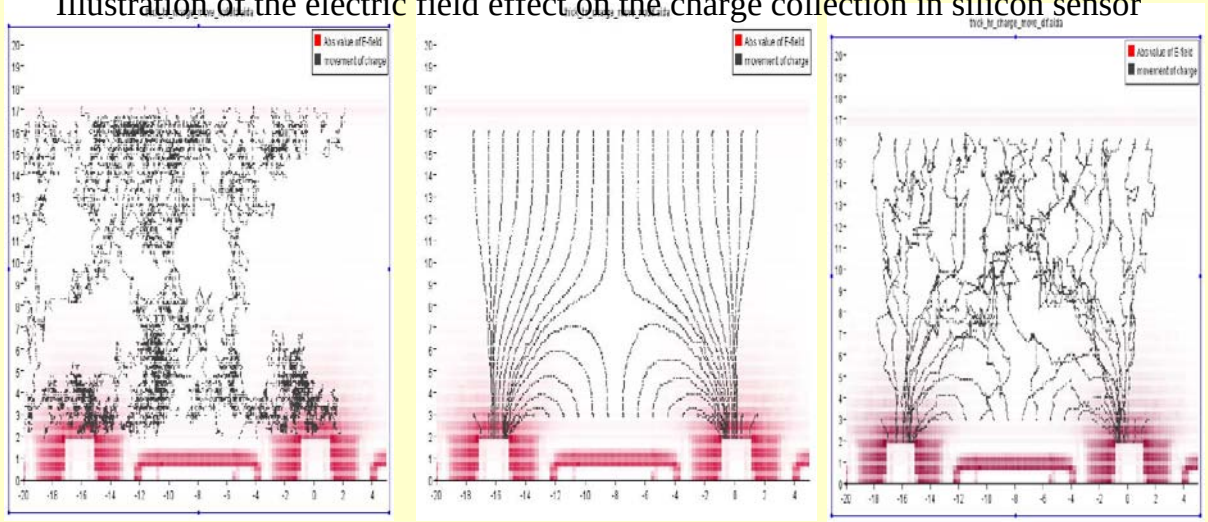


Illustration of the electric field effect on the charge collection in silicon sensor

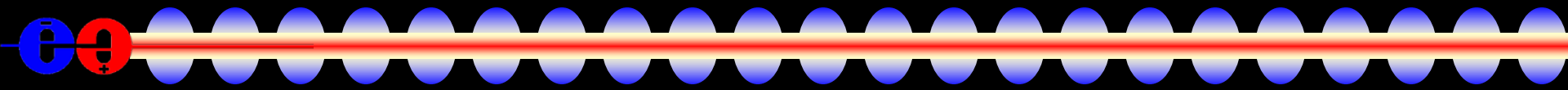


Example energy loss distribution for 1μm Si



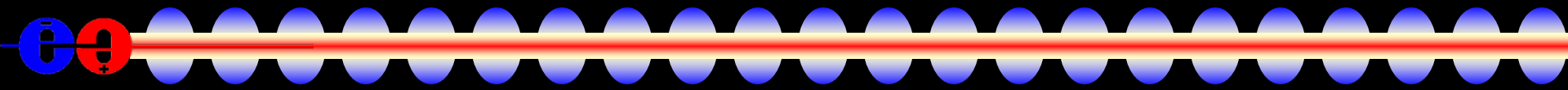
On the left, only diffusion is simulated,
in the middle charge is moving only by electric forces,
and the right picture shows how it moved in our simulations

Track Finding: ftf



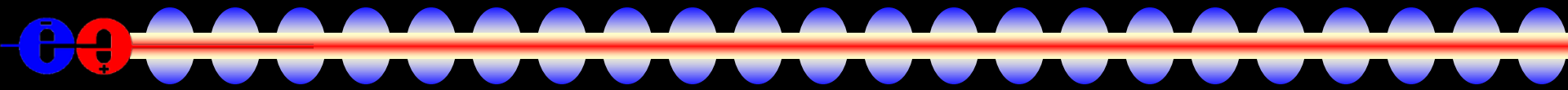
- Using a conformal mapping technique
  - Maps curved trajectories onto straight lines
  - Simple link-and-tree type of following approach associates hits.
  - Once enough hits are linked, do a simple helix fit
    - circle in r-phi
    - straight line in s-z
    - simple iteration to make commensurate
  - Use these track parameters to predict track into regions with only 1-D measurements & pick up hits.
  - Outside-in, inside-out, cross-detector: completely flexible as long as concept of *layer* exists.
  - Simple fit serves as input to final Kalman fitter.

Track Fitting: trf



- Provides complete infrastructure to define a tracking detector based on surfaces
- Native support for 1D, 2D and 3D hits
- Propagators (analytic as well as RK)
- Interactors (Eloss & MCS)
- Kalman Filter Fitter

Moving Forward



- pixsim provides an extremely capable silicon response simulation package.
- trf toolkit contains a well-tested detector model, track & hit classes and Kalman filter fitting code which accounts for energy loss and MCS.
- ftf toolkit provides a fast, efficient, pattern recognition package based on a conformal mapping of hits on topological layers.
- All available from lcd cvs repository.