Measuring & correcting ion distortions with photoelectrons

D. Karlen
University of Victoria & TRIUMF

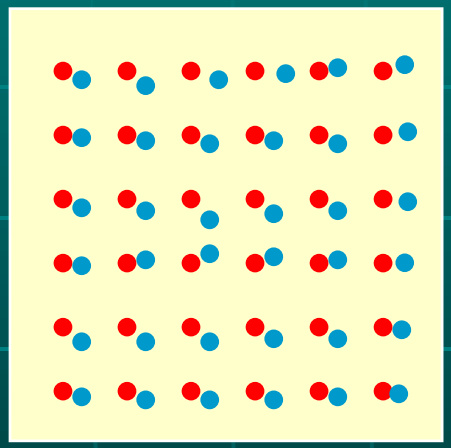
June 2, 2007

Basic ideas – for discussion

- A controlled and reproducible pattern of photo-electrons can be used to understand and monitor distortions due to positive ions (see my earlier presentation for general concept, proof of principle)
  - the first step would be to understand electron transport in absence of positive ion effects
    - magnetic field on – no beam – photoelectron events
  - with beam – are the photo-electron images modifed?
    - compare centroids relative to no beam locations

Correcting ion distortions

- A matrix of images will give a field of displacements for electrons that travel the full distance across the TPC



  - interpolate for displacements between – apply to tracks near central cathode
    - investigate z dependance with other tracks

Time variation to distortions

- Should positive ions be seen to shift images, the effect will depend on the ion structure within the TPC – and therefore depend on the time wrt to the start of the bunch train
  - The UV flash could be made at different times relative to the bunch train (during the bunch train) to quantify the time variation
    - UV flashes overlapping physics events: these are easily removed, since all photoelectron signals occur at a common time

Impact on physics data

- To limit the disruption to physics analysis, either
  - veto events containing TPC hits from photoelectrons (<< 1% of BX, since laser can only fire on several Hz level), or
  - limit amount of area for photo-electron sources, or
  - flash only selected areas of the TPC where the ion effect is important (such as innermost layers)

Tests with prototypes

- At DESY test beam, operate the TPC in cosmic mode along with high intensity electron beams (to produce constant in time but spatially non-uniform ion density)
  - prove that “crooked cosmics” can be corrected
  - then introduce time variable ionization
- Tests with ionization with similar beam structure as ILC would provide a better proof of principle that ion effects, if present, can be corrected
  - FNAL test beam will attempt to mimic the ILC beam structure

Summary

- Photoelectron calibration/monitor tool may be an essential tool to deal with ion effects, if they turn out to be significant
  - important to test this in the LP1 prototype