LumiCal Si impact position

- Impact position analysis method
- Testbeam study

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https://indico.ihep.ac.cn/event/11953/

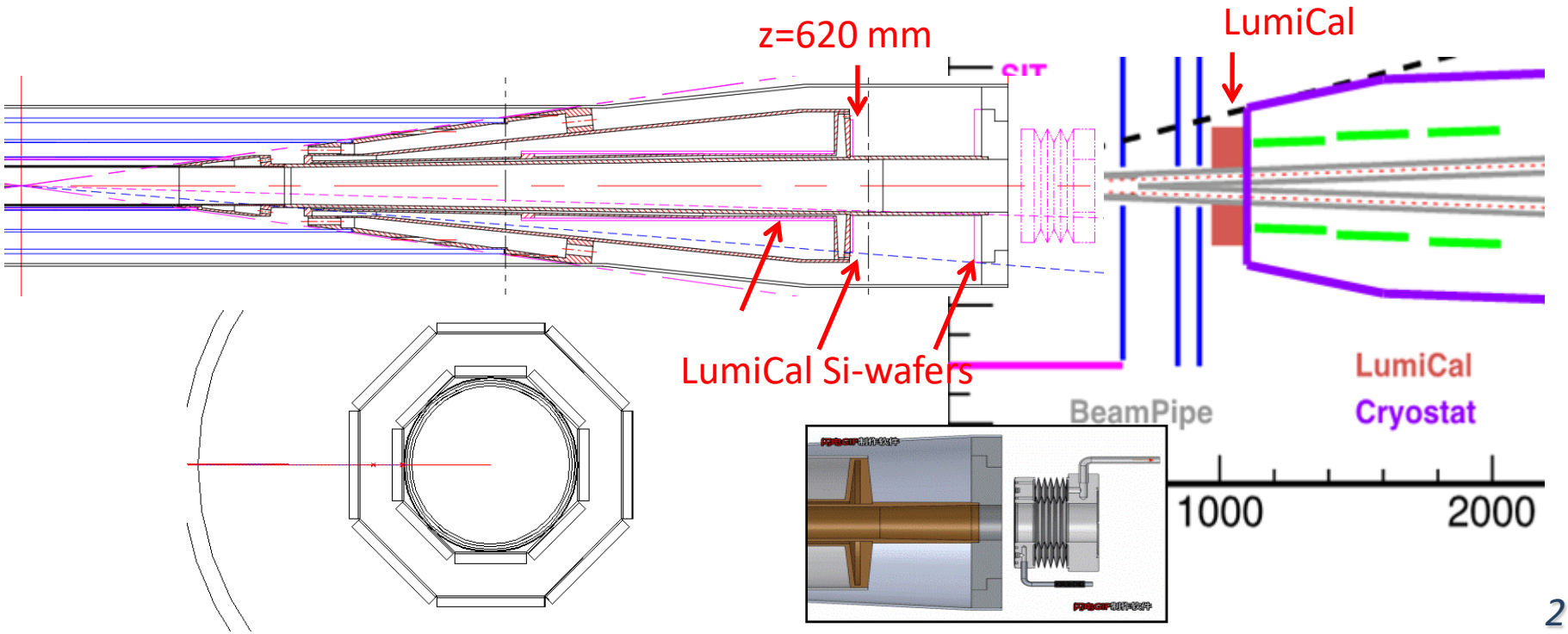
LumiCal Si wafers in Vertex volume

Wafer surrounding beampipe || z-axis

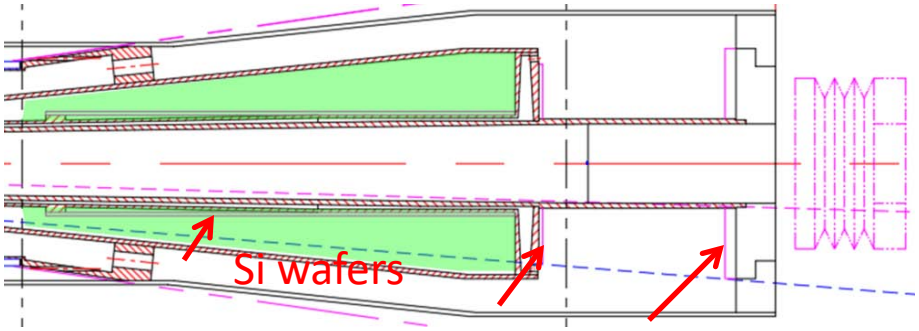
→ Most simple layout

→ Least distance to Al-pipe, least multiple-scattering

→ 1 µm/tanθ scaling for resolution = 25 µm @30 mRad for $\delta L/L=10^{-4}$



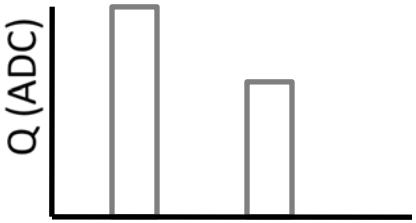
Si wafer signal

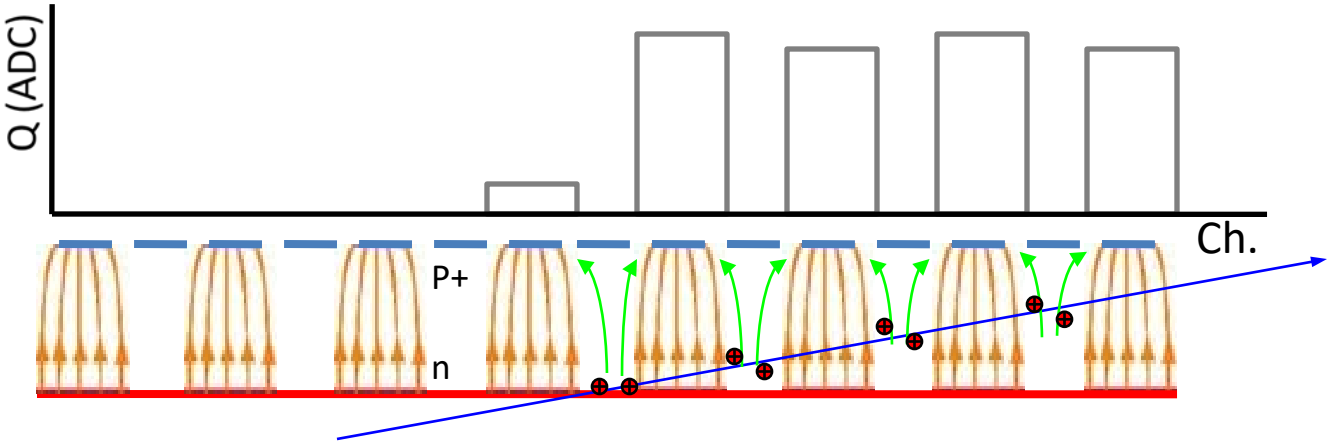


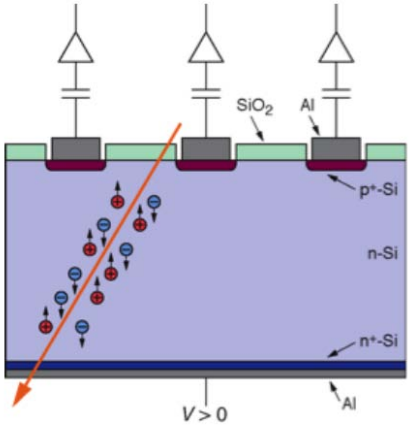
Charged particle traversing Si wafer
→ Creates ionization h+,e- pairs, 25k pairs/300µm
→ Charges drift to p+ electrodes
→ Between strips, charges drift to nearest strip

Traversing at low angle,
→ const. Q_c to continuous strips
→ Precision by measuring entrance positio
beginning strip Q is a fraction of Q_c

Common applications
Track of perp. Incidence
Q shared by a few strips



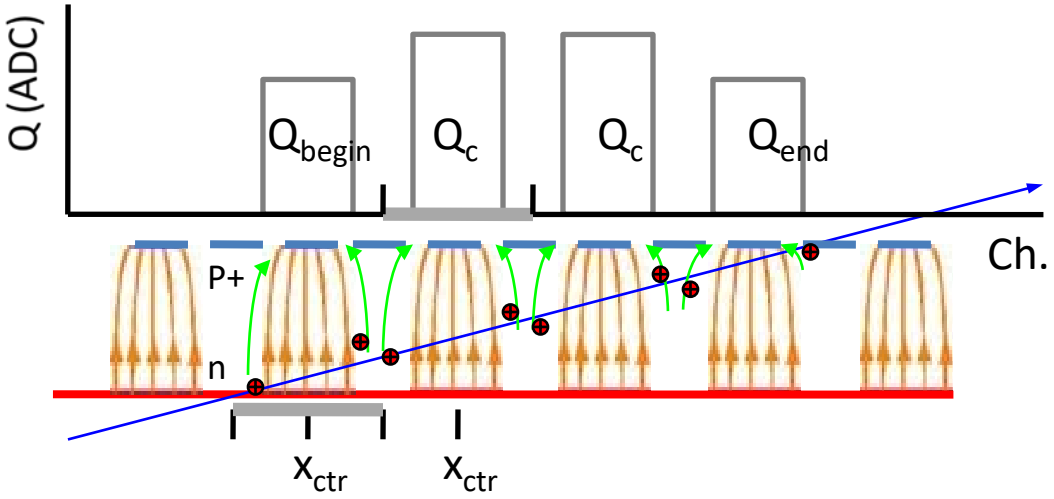




Precision for impact position

Low angle traversing

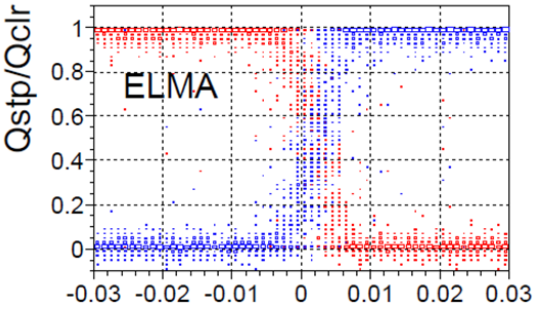
- Q strip range = $x_{ctr} \pm$ pitch/2
- Q_c = track full span, crossing strip Q-collection range
- Q_{strip} = track span/ full span

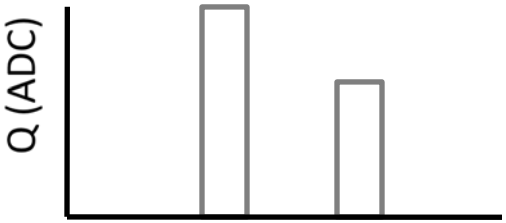


Normal incidence

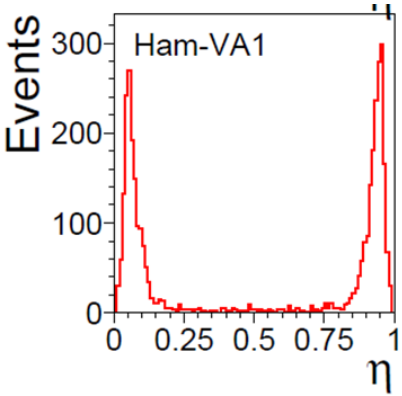
Charge Sharing by adjacent strips

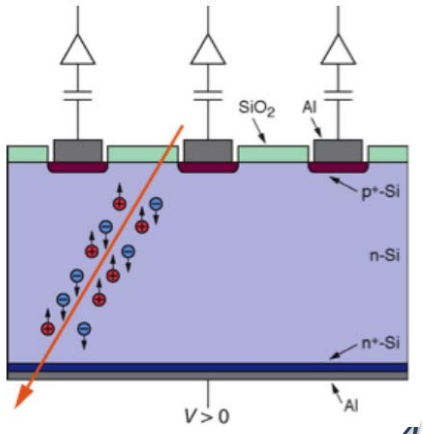
Q_{sum} = Q(~300 µm)





$$\eta = \frac{Q_r}{Q_r + Q_l}$$





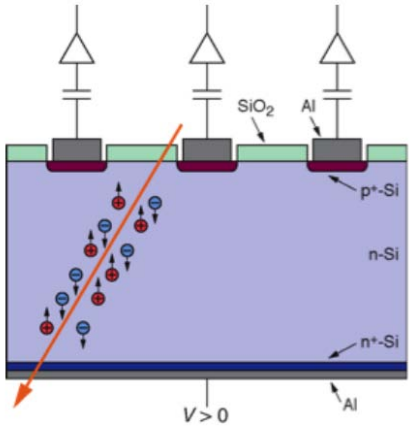
Precision for normal incidence

- Q sharing by track left/right strips
- Event distrib. is flat in the gap, η is NOT parameterize η function, x=x(η)

σ_x ~ pitch/10

Test beam purpose

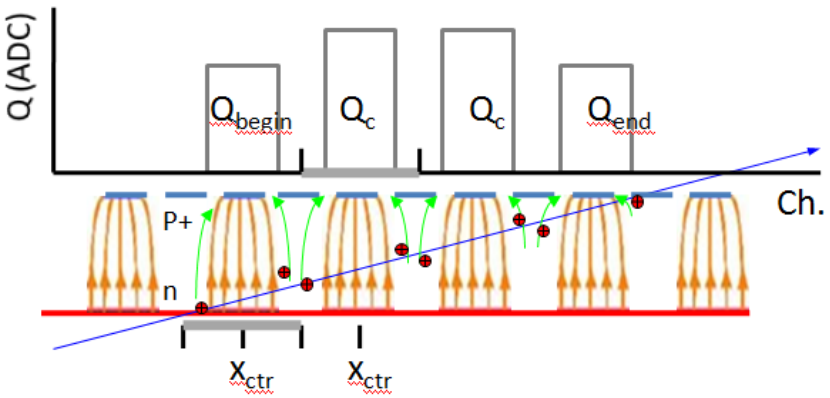
- Small angle tracking with Si wafer
  is **NOT** heard of
- Si strip PN field lines deviates in Magnetic field
  ➔ charge sharing, η is **NOT** symmetric
- Multiple scattering
  mock-up beampipe M.S. GEANT calibration



Test beam plan using strip detector

1 **Normal incident:**
  charge sharing vs position resolution
  Magnetic field effect to eta

2 **Small angle traversing**
  position resolution by Q vs track span
  Mag. Field effect, shift of X_{ctr}



Summary

- Testbeam with electrons
  normal/small angles to Si strip wafer:
  ➔ prove Si wafer surrounding beampipe is feasible
  1. position reconstruction method for small angle tracks
  2. Mult.Scattering to impact position resolution and field effect

- Application in LumiCal
  1. use noise hits (e.g. beam-gas) normal to Si
     to calibrate η and field effect
  2. measure electrons from IP, with long span tracks,
     precision on entrance position i.e. theta from IP, is
     THE MOST critical