Alignment of the Silicon Vertex Tracker (SVT)

• Track-based alignment of SVT requires fitting many parameters:
  \[ N_{\text{sectors}} \times N_{\text{layers}} \times N_{\text{trans}} \times N_{\text{rot}} = 66 \times 2 \times 3 \times 2 = 792 \]

• Program millepede does linear least squares with many parameters.
  o Uses matrix form of least squares method and divide the elements into two classes.
     Global parameters – the geometry misalignments. Same in all events.
     Local – individual track fit parameters. Change event-to-event.
  o Calculate first partial derivatives of the fit residuals with respect to the local (i.e. fit) parameters and global parameters (geometry misalignments).
  o Manipulate the linear least squares matrix to isolate the global parameters (geometry) and invert the results to obtain the solution.

• Apply millepede to a ‘simple’ example – Type 1 tracks.
  o Only horizontal sectors – easier to understand.
  o Use real cosmic rays.
  o Fixed layer 4 in millepede fit to SVT residual.
  o Good agreement between millepede misalignment and residuals.
  o Fit residual and resolution improve.
  o Analysis chain for full event set complete – testing millepede now.

• Ideal Geometry Validation and Testing.
  o Corrected differences between engineering drawings and ideal geometry – 100 \( \mu \text{m} \) down to 3 \( \mu \text{m} \).
  o Developing API for reconstruction – completed one for gemc.
  o Platt (Surrey masters), Johnston (ANL postdoc).
Geometry of the Silicon Vertex Tracker (SVT)

- Ideal Geometry Validation and Testing
  - Calculate ideal fiducial location on each module.
  - Observed significant difference with engineering drawings - up to 100 µm. Now reduced to < 3 µm.
  - Ideal geometry defined by engineering drawings.
  - Used by simulation and reconstruction codes.

- Geometry package
  - Common Java utility for gemc and reconstruction.
  - Detailed reproduction from engineering drawings.
  - Full inventory of material in SVT for gemc.
  - CLAS-NOTE nearly done.
  - Charles Platt - new Surrey masters student.
  - Sereres Johnston – ANL postdoc.