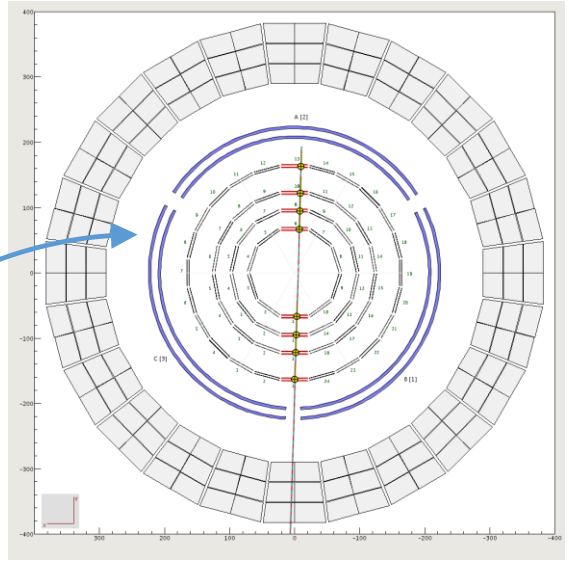
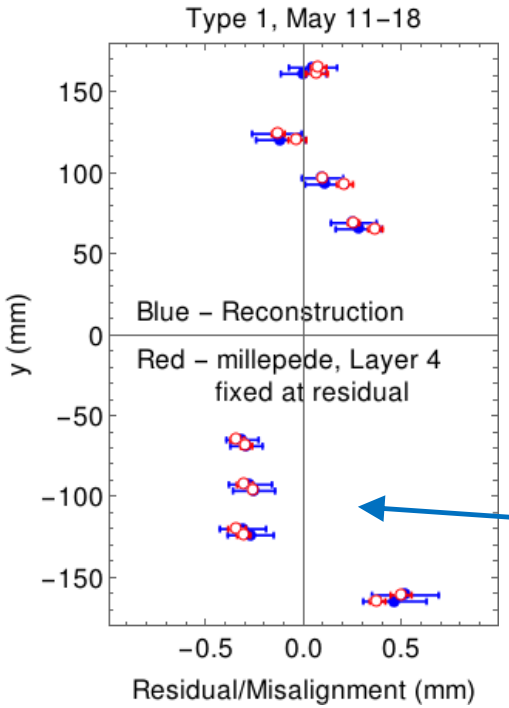
Alignment of the Silicon Vertex Tracker (SVT)

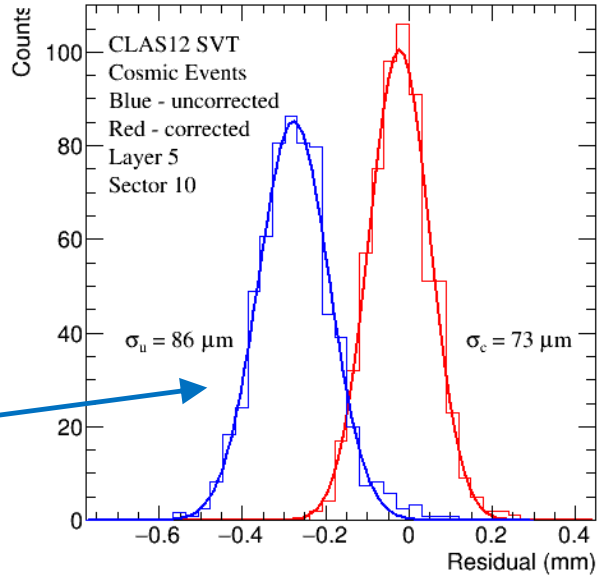
- Track-based alignment of SVT requires fitting many parameters: $N_{sectors}$ x N_{layers} x N_{trans} x N_{rot} = 66 x 2 x 3 x 2 = 792
- Program **millepede** does linear least squares with many parameters.
  - Uses matrix form of least squares method and divide the elements into two classes.
    - Global parameters – the geometry misalignments. Same in all events.
    - Local – individual track fit parameters. Change event-to-event.
  - Calculate first partial derivatives of the fit residuals with respect to the local (i.e. fit) parameters and global parameters (geometry misalignments).
  - Manipulate the linear least squares matrix to isolate the global parameters (geometry) and invert the results to obtain the solution.



Type 1 tracks – sensors are horizontal.

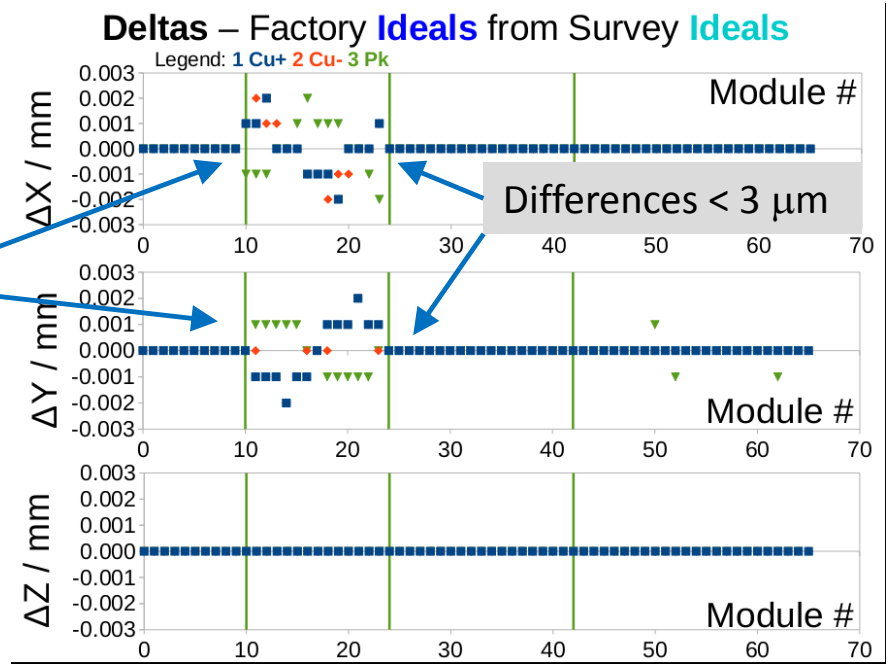


- Apply to a 'simple' example – Type 1 tracks.
  - Use gemc cosmics for testing and validation.
  - Shift layers 1-2 (Region 1) by 2-500 microns in *x*.
  - millepede reproduces all shifts.
- Apply to Type-1 cosmic ray sample from SVT.
  - 5.9M events collected May 11-18.
  - Fixed layer 4 in millipede fit to SVT residual.
  - Good agreement between millipede mis-alignment and residuals.
  - Fit residual and resolution improve.
- Code for Type 2 events now being tested.

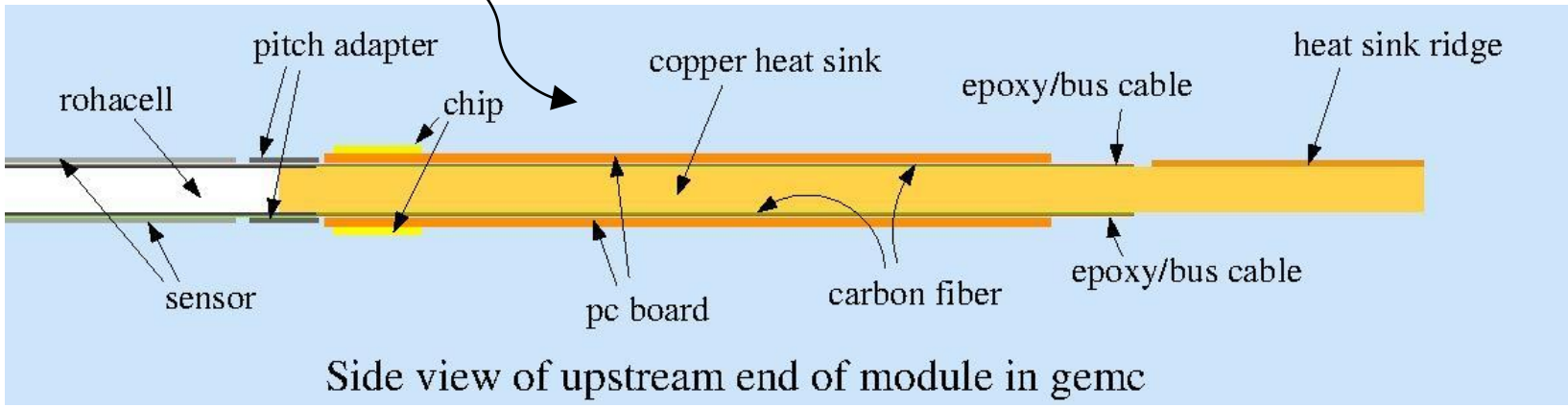


Geometry of the Silicon Vertex Tracker (SVT)

- 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 < 3µm
  - 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 near completion.
  - Charles Platt - new Surrey masters student.
  - Sereres Johnston – ANL postdoc.



Side view of upstream end of module in gemc