DC Alignment

Analysis Meeting, April 18

- Goal: Align the CLAS drift chambers by finding the appropriate "offsets" to minimize the residuals of straight track (B=0) data.

$$\chi^2 = \Sigma_{tracks}\Sigma_{hits}\frac{(|D_{track,hit}| - |D_{hit}|)^2}{(\sigma_{track,hit}^2 + \sigma_{hit}^2)}$$

where

- $D_{track,hit}$ = DOCA (Distance Of Closest Approach) to the wire of the fitted track (also known as FITDOCA),

- D_{hit} = calculated DOCA from x vs t function (also known as CAL-CDOCA),

- $\sigma_{track,hit}$ = uncertainty in track position,

- σ_{hit} = time–based resolution of the hit.

CLAS-NOTE 2002-010, S. A. Marrow & M. D. Mestayer

- run 2467 was an engineering run taken with no magnetic field: /volatile/clas12/data/rg-a/calibration/recooked/out_clas_002467*

- General procedure
  - Develop method to implement shifts and rotations
  - Calculate χ^2 from fitted tracks
  - Implement some shift/rotation and run reconstruction
  - Recalculate χ^2

- Ultimately we want to fit the residuals as a function of the shifts/rotations instead of guessing shifts/rotations and checking the results

- Data table added to ccdb (geometry/dc/alignment) to define shifts and rotations for reconstruction

```
[ifarm1401.jlab.org> ccdb -i

+--------------------------+
  CCDB shell v.1.05
  CLAS12 JLab
+--------------------------+

Interactive mode
print help to get help
print quit or q to exit
print !<command> to execute shell command

Login as    : 'thayward'
Connect to : 'mysql://clas12reader@clasdb.jlab.org/clas12'
Variation  : 'default'
Deflt. run : '0'
[/> cat geometry/dc/alignment
```

| region	sector	component	dx	dy	dz	dtheta_x	dtheta_y	dtheta_z
int	int	int	double	double	double	double	double	double
1	1	0	1.0	0	0	0	0	0
1	2	0	0	0	0	0	0	0
1	3	0	0	0	0	0	0	0
1	4	0	0	0	0	0	0	0
1	5	0	0	0	0	0	0	0
1	6	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0
2	3	0	0	0	0	0	0	0
2	4	0	0	0	0	0	0	0
2	5	0	0	0	0	0	0	0
2	6	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0
3	2	0	0	0	0	0	0	0
3	3	0	0	0	0	0	0	0
3	4	0	0	0	0	0	0	0
3	5	0	0	0	0	0	0	0
3	6	0	0	0	0	0	0	0

```json
{
    "bank": "TimeBasedTrkg::TBHits",
    "group": 20631,
    "info": "reconstructed hits using DC timing information",
    "items": [
        {"name":"id",            "id":1, "type":"int16",  "info":"id of the hit"},
        {"name":"status",        "id":2, "type":"int16",  "info":"id of the hit"},
        {"name":"sector",        "id":3, "type":"int8",   "info":"DC sector"},
        {"name":"superlayer",    "id":4, "type":"int8",   "info":"DC superlayer (1...6)"},
        {"name":"layer",         "id":5, "type":"int8",   "info":"DC layer in superlayer (1...6)"},
        {"name":"wire",          "id":6, "type":"int16",  "info":"wire id of DC"},
        {"name":"TDC",           "id":7, "type":"int32",  "info":"raw time of the hit"},
        {"name":"doca",          "id":8,  "type":"float", "info":"doca of the hit calculated from TDC (in cm)"},
        {"name":"docaError",     "id":9,  "type":"float", "info":"uncertainty on doca of the hit calculated from TDC
        {"name":"trkDoca",       "id":10, "type":"float", "info":"track doca of the hit (in cm)"},
        {"name":"timeResidual",  "id":11, "type":"float", "info":"time residual of the hit (in cm)"},
        {"name":"LR",            "id":12, "type":"int8",  "info":"Left/Right ambiguity of the hit"},
        {"name":"X",             "id":13, "type":"float", "info":"wire x-coordinate  in tilted-sector"},
        {"name":"Z",             "id":14, "type":"float", "info":"wire z-coordinate  in tilted-sector"},
        {"name":"B",             "id":15, "type":"float", "info":"B-field intensity at hit position in tilted-sector
        {"name":"TProp",         "id":16, "type":"float", "info":"t propagation along the wire (ns)"},
        {"name":"TFlight",       "id":17, "type":"float", "info":"time of flight correction (ns)"},
        {"name":"T0",            "id":18, "type":"float", "info":"T0 (ns)"},
        {"name":"TStart",        "id":19, "type":"float", "info":"event start time used (ns)"},
        {"name":"clusterID",     "id":20, "type":"int16", "info":"ID of associated cluster"},
        {"name":"trkID",         "id":21, "type":"int8",  "info":"ID of associated track"}
    ]
},
```
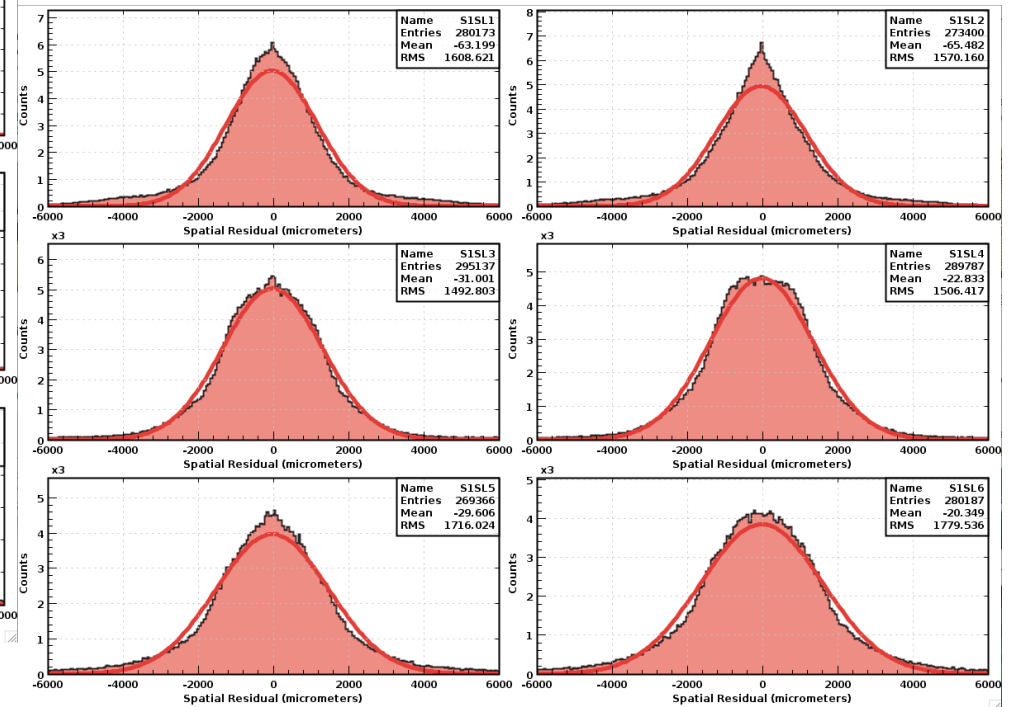
$$\text{residual} = \text{LR}(\text{doca} - \text{trkDoca})$$

- **Preliminary** analysis routine written with CLAS12 coatjava package to calculate residuals as a function of sector, superlayer and track angle:
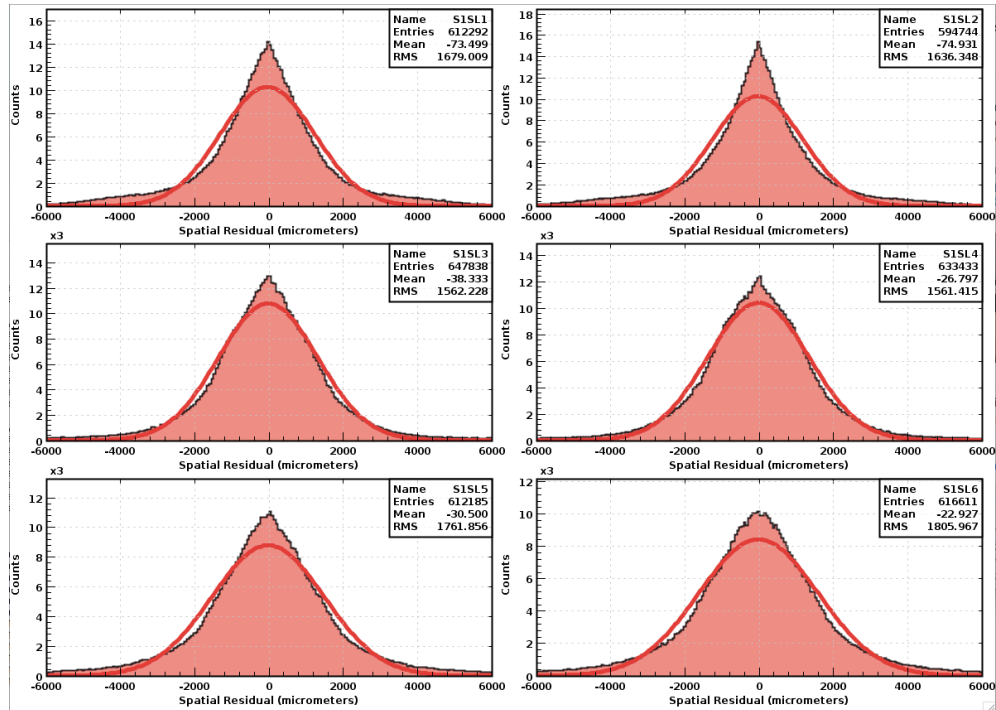
Sector 1, 0 < θ < 90 degrees

Sector 1, 8 < θ 20 < degrees

- Next steps: implement method for shifting the geometry and look for changes in the residuals.

- Develop method for fitting residuals as a function of shifts/rotations.