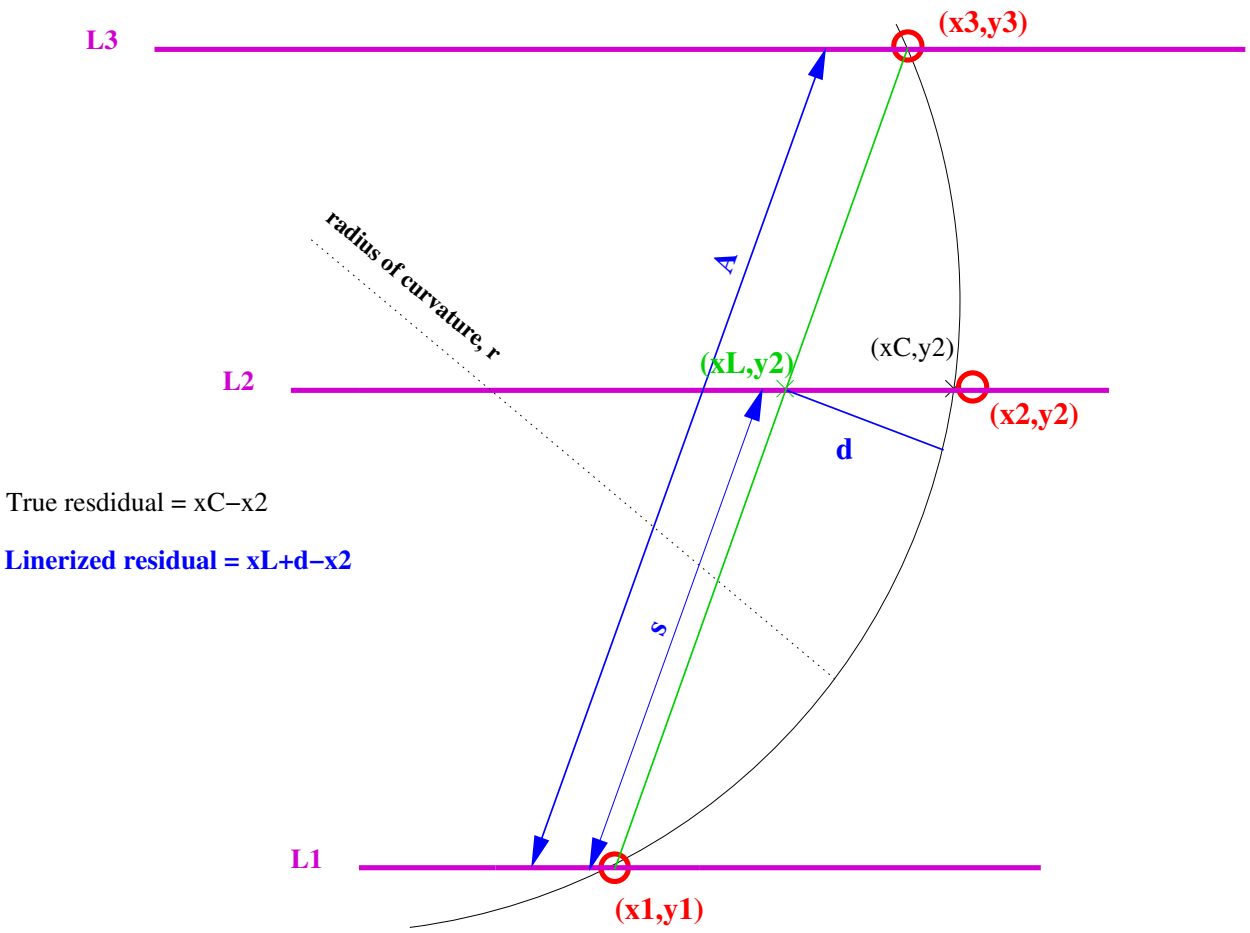
Method for Intrinsic RΦ Resolution

Remove as many external sources of error as possible

- **Assume that intrinsic resolution is gaussian**
- Select High Pt tracks > 15 GeV
- No ISL or L00 allowed in fit
- OIZ tracks with 5 axial, 2 stereo
- Track must go thru only 1 wedge, 1 barrel
- Make telescope with L1+L2+L3
- Throw away track fit and make simple SVX-only fit!

Linerized Circle Passing Thru L1+L3



- Take radius of curvature from OIZ track fit
- Linerized residual is function of weight and can be computed exactly

Residual and Error Computed Track-By-Track

$$\begin{aligned}\delta &= x_{\mathrm{L}} + d - x_2 \\ &= (a + by_2) + d - x_2\end{aligned}$$

$$a = x_1 - y_1\left(\frac{x_3 - x_1}{y_3 - y_1}\right)$$

$$b = \frac{x_3 - x_1}{y_3 - y_1}$$

$$\begin{aligned}d &= r - \frac{1}{2}\sqrt{4r^2 - 4s(A-s)} \\ &\approx \frac{s(A-S)}{2r} \\ &= \frac{\sqrt{[(x_2-x_1)^2 + (y_2-y_1)^2][(x_3-x_2)^2 + (y_3-y_2)^2]}}{2r}\end{aligned}$$

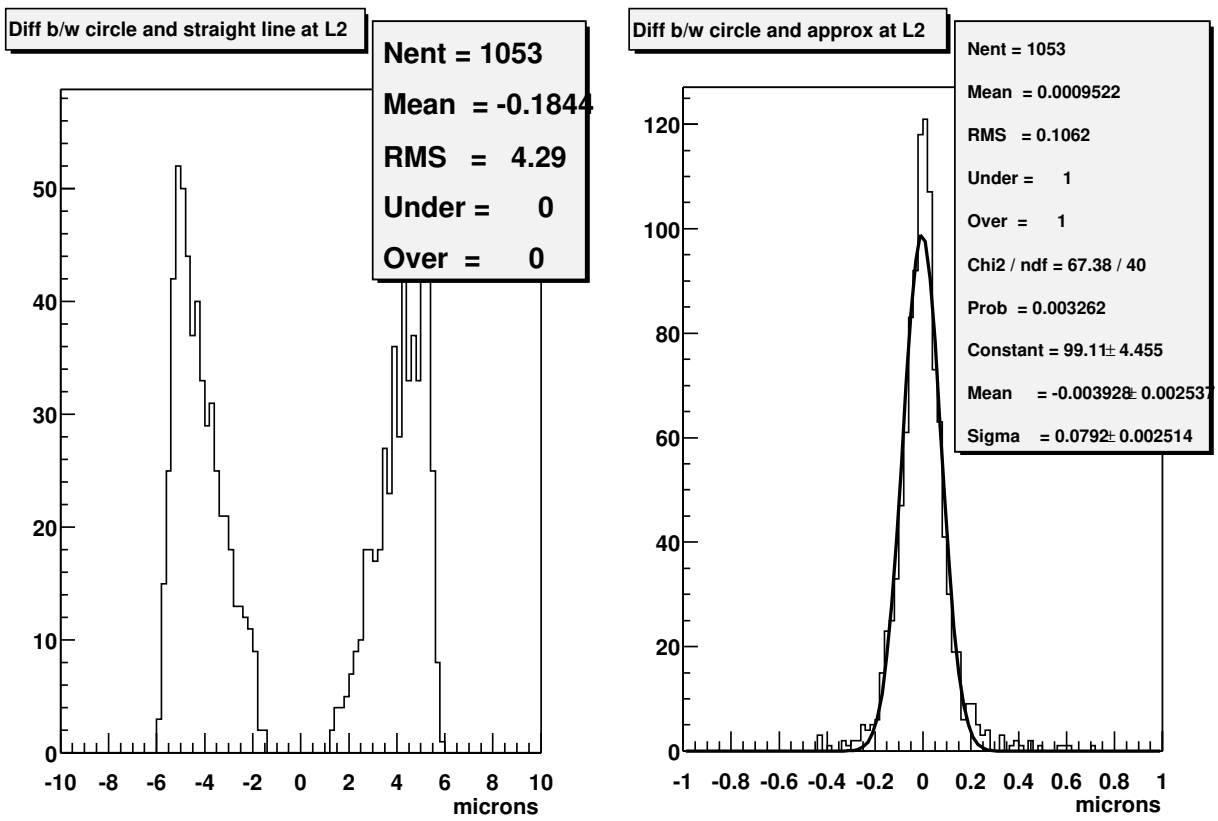
Residual and Error Computed Track-By-Track

σ_{x_i} is function of cluster width

$$\sigma_\delta^2 = [\frac{y_3 - y_2}{y_3 - y_1} - \frac{1}{2r}(x_2 - x_1)\frac{A - s}{s}]^2\sigma_{x_1}^2$$
$$+ [1 + \frac{1}{2r}(\frac{A - s}{s}(x_2 - x_1) - \frac{s}{A - s}(x_3 - x_2))]^2\sigma_{x_2}^2$$
$$+ [\frac{y_2 - y_1}{y_3 - y_1} + \frac{1}{2r}(x_3 - x_2)\frac{s}{A - s}]^2\sigma_{x_3}^2$$

Non-linear terms suppressed by $1/2r \sim 1/8000$ cm for $P_t = 15$ GeV

Linerized Circle Passing Thru L1+L3



- Straight-line good to $\sim 5\mu m$, but biased
- Linerized circle good to $\sim 0.1\mu m$ and unbiased

Unbinned Likelihood Fit

- Residual, $\delta = (a + by_2 + d) - x_2$, for a track
- Error on residiual is function of intrinsic resolution, σ, and geometry of line and circle, $\sigma_\delta(\sigma)^2 = \sigma_{\delta \mathrm{L}}(\sigma)^2 + \sigma_d(\sigma)^2$, where $\sigma^2_{\delta \mathrm{L}}$ is calculated from formula for line.
- Perform unbinned likelihood fit to gaussian for δ/σ

$$L_i = \frac{e^{-\frac{(\delta_i - \mu)^2}{2\sigma_{\delta_i}(\sigma)^2}}}{\sqrt{2\pi}\sigma_{\delta_i}(\sigma)}$$

$$-\ln L = -\sum_i^{N_{\mathrm{track}}} \ln L_i(\sigma)$$

Overall Fitting Strategy

1. Make 2.5σ cut on δ/σ
2. Fit for weight
3. Repeat (1-2) 10 times

Overall Fitting Strategy

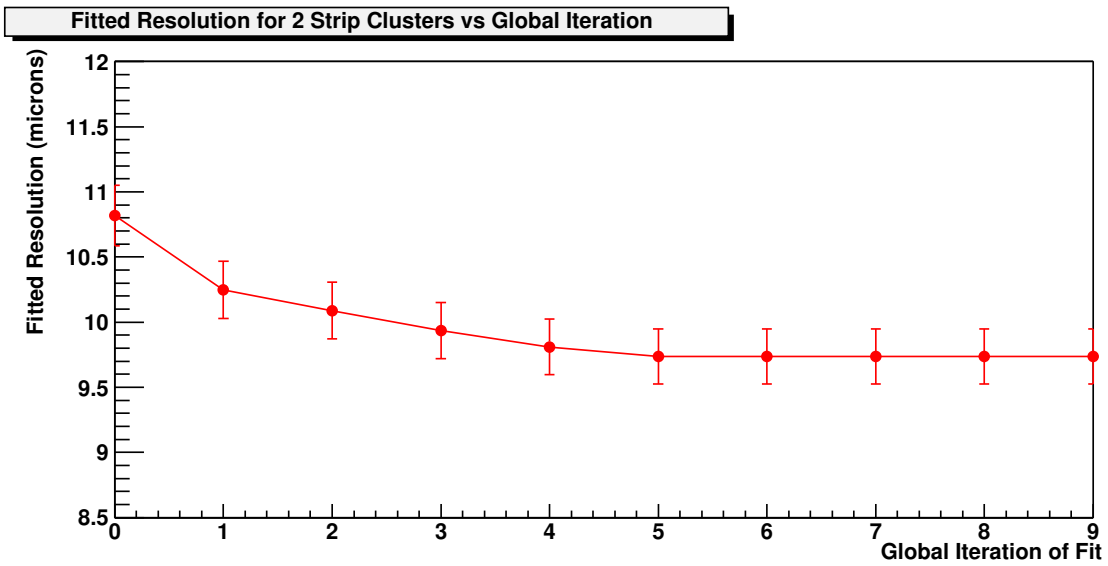
1. Require all hits to be 2-strip clusters. Fit for 2-strip weight

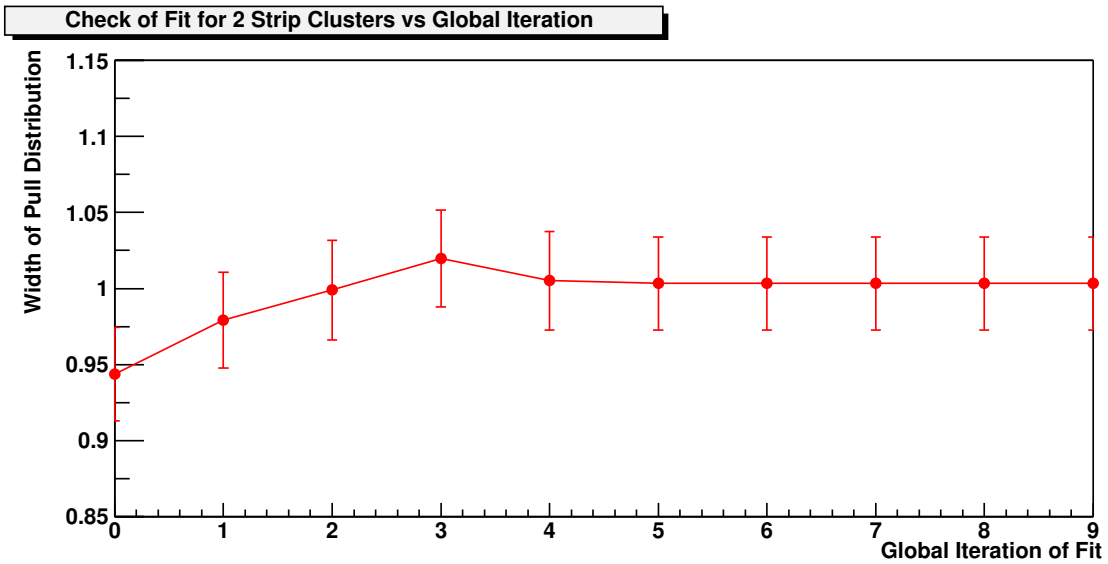
2. Anchor L1 & L3 with 2-strips, fit for 1, 3, 4+ strip clusters leaving 2-strip weight free

3. Verify that 2-strip weights are fit to same value in (2) as compared to the pure 2-strip fit of (1)

4. Fix 2-strip weight, do global fit with no anchors. Try other cross-checks

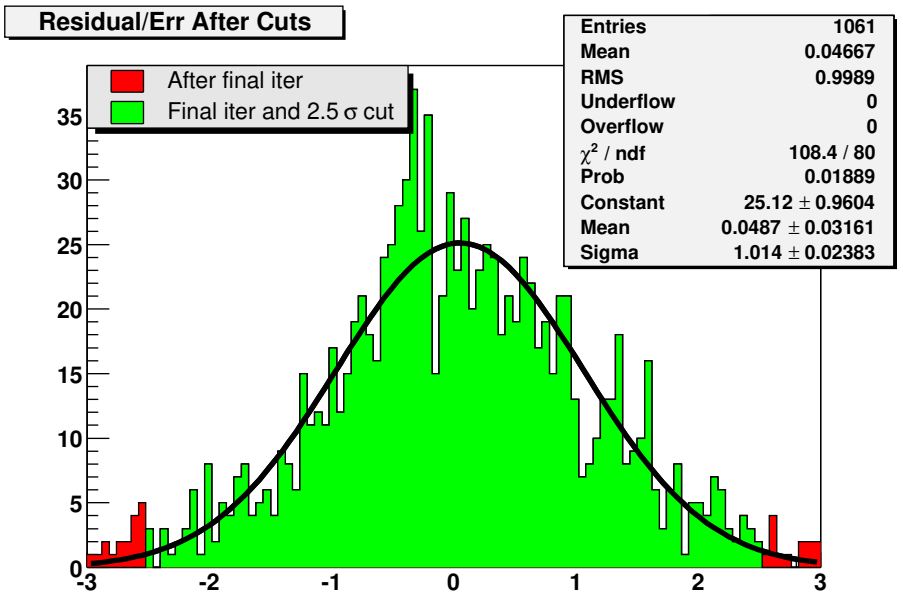
Check Fit at Each Global Iteration

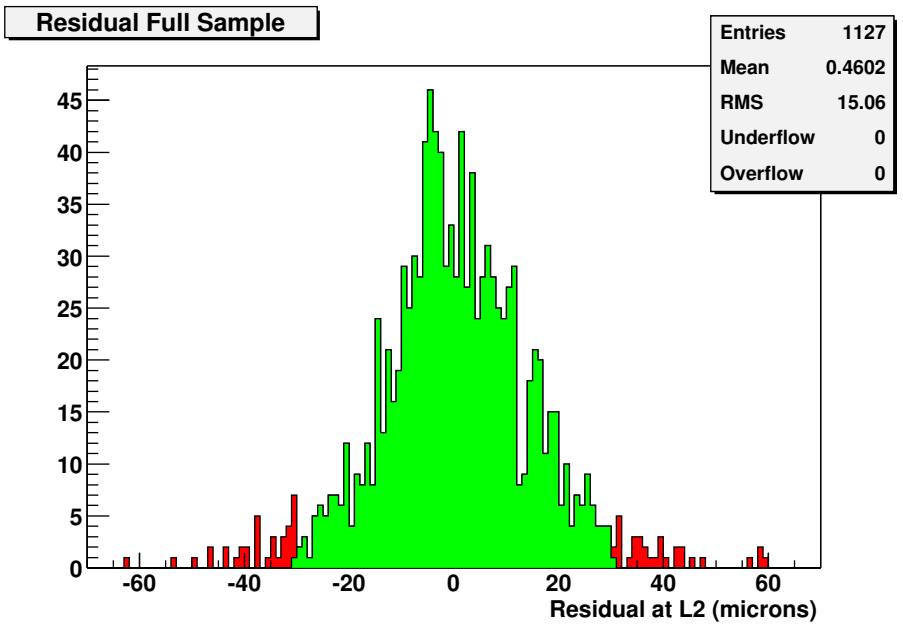




Make 2.5σ cut at each global iteration to remove non-gaussian effects from misalignment, other problems

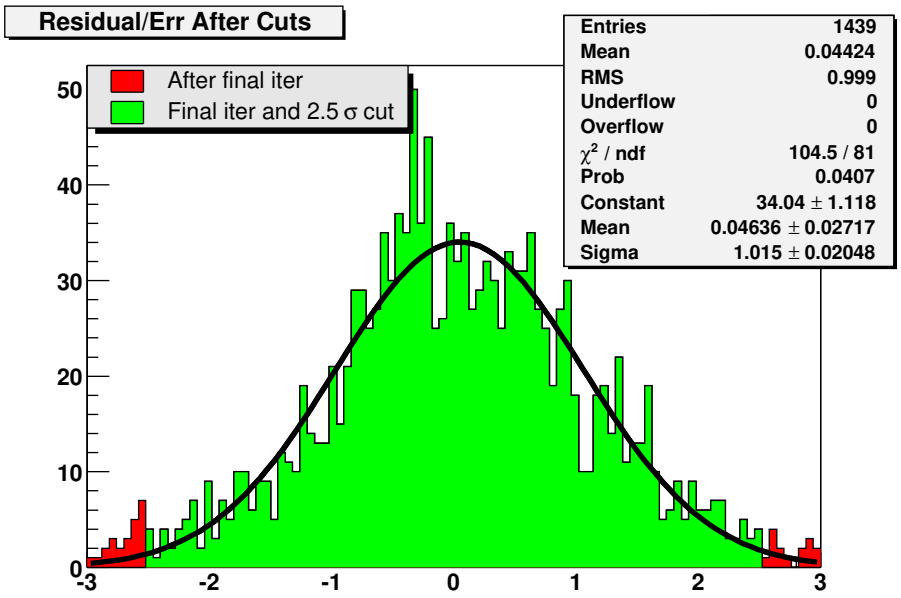
Final Iteration of Fit for 2-strip

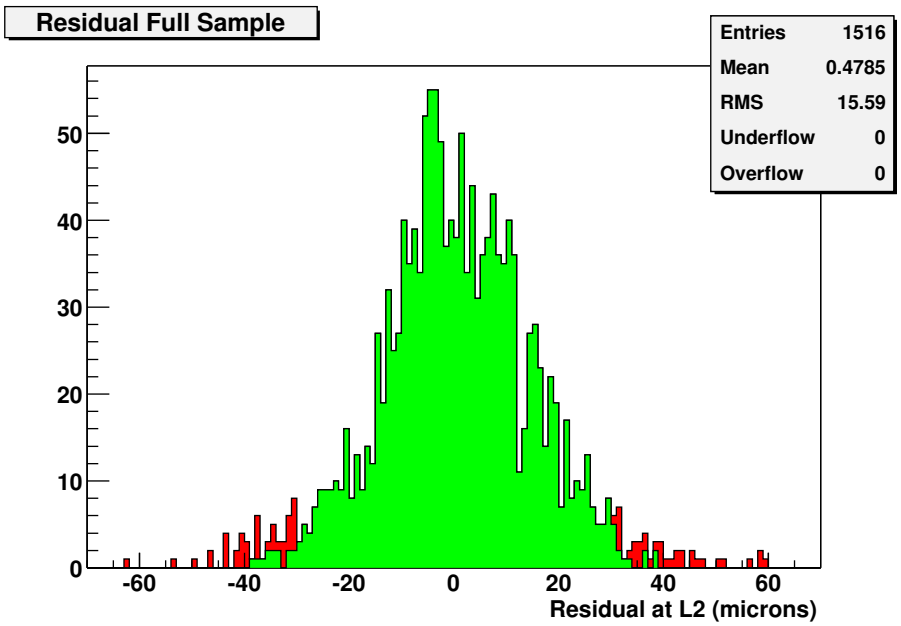




Looks ok

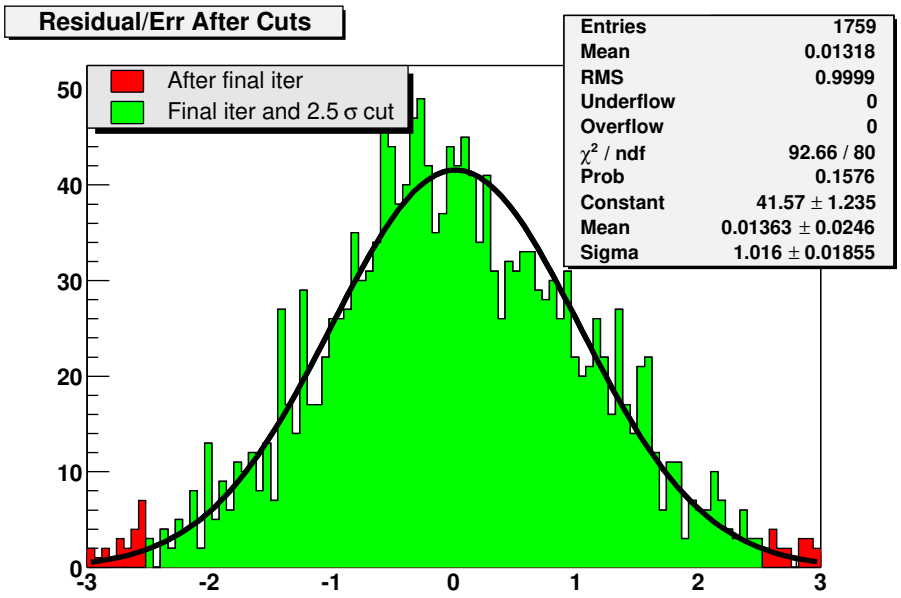
Fit for 1-strip with 2-strip anchor

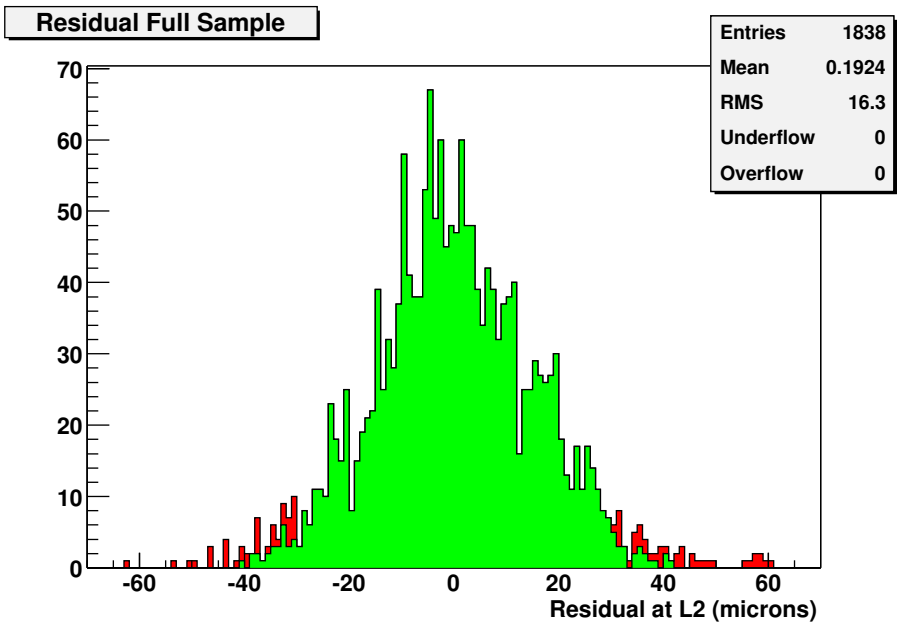




Looks ok

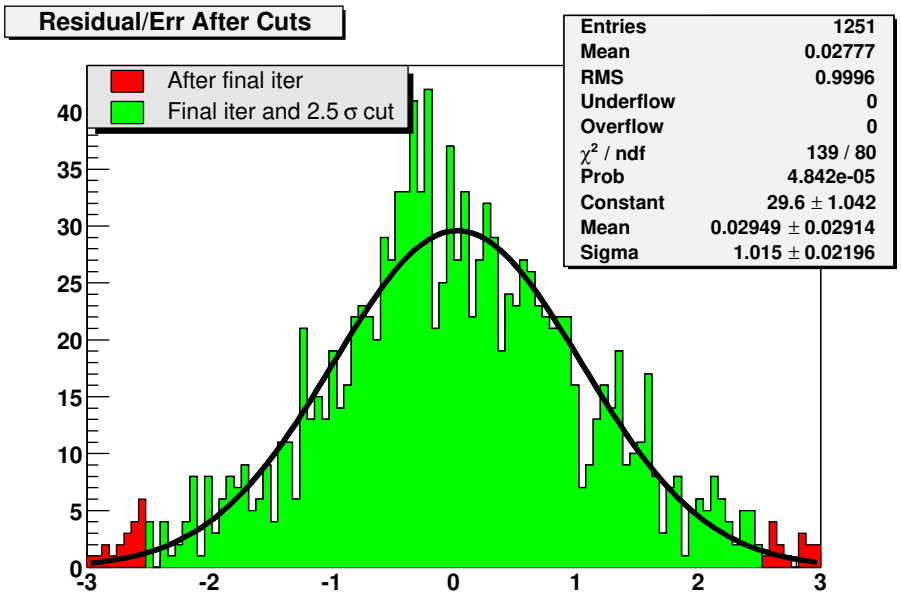
Fit for 3-strip with 2-strip anchor

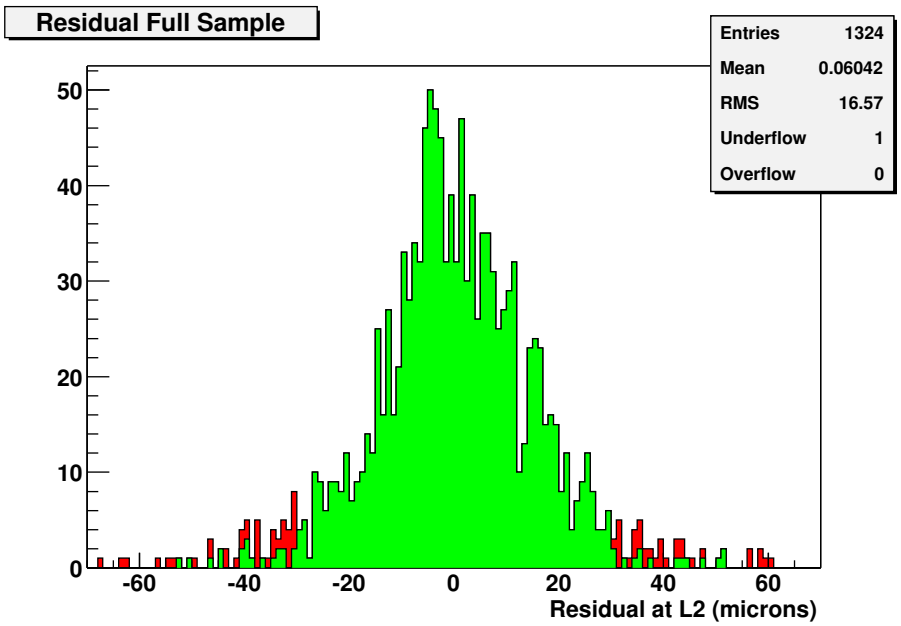




Looks ok

Fit for 4+ strip with 2 strip anchor





Looks ok

Preliminary Results

Cluster Width	Resolution (μm)	Current (μm)
1	13.9 ± 0.6	13
2	9.7 ± 0.2	11
3	15.4 ± 0.5	23
4+	20.1 ± 1.2	23

What's Next?

- Global fit with 2-strip wt fixed gives $\sim$results to within 1 μm
- Need to investigate correlations due to incidence angle
- Mean of gaussian fixed to zero. But see some small offsets
- Ready to turn crank again with new $r - \phi$ alignment
- Need to repeat for 90°, 1.2°, ISL, L00. **VOLUNTEERS?**