Si strip analysis

Outline

Change fitting method (more simple)

Resolution estimation

>Fitting using 3 sensors

Rough estimation

>Fitting using 5 sensors

Resolution and error estimation

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Old fitting method

- 2-dimentional linear fit.

$$x(z) = az + b$$

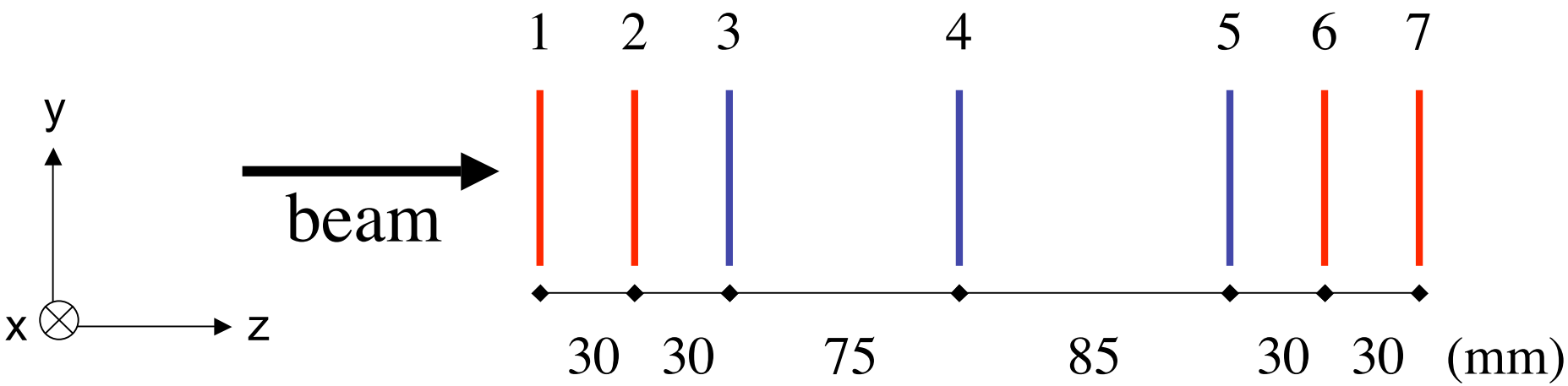
$$y(z) = cz + d \text{ (change u to y first)}$$

minimize $$S \equiv \sum_i \left[\frac{(X_i - X(Z_i))^2}{\sigma_x^2} + \frac{(Y_i - Y(Z_i))^2}{\sigma_y^2} \right]$$

red : 250 um

blue : 400 um

Geometry

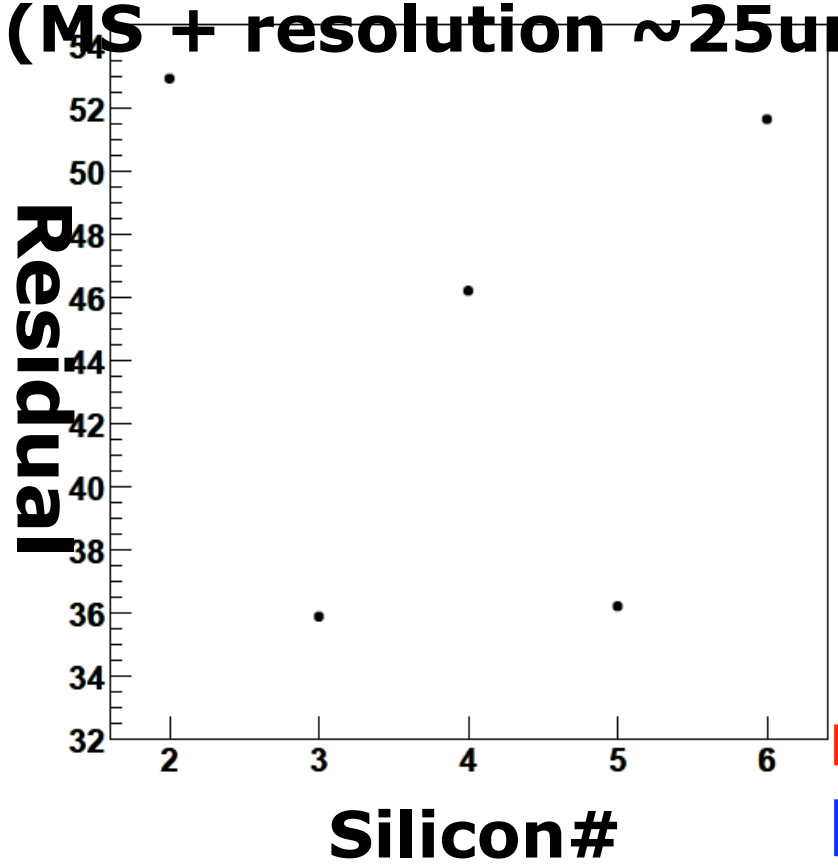


Residual x → Experimental data were reproduced by the simulation with a intrinsic resolution

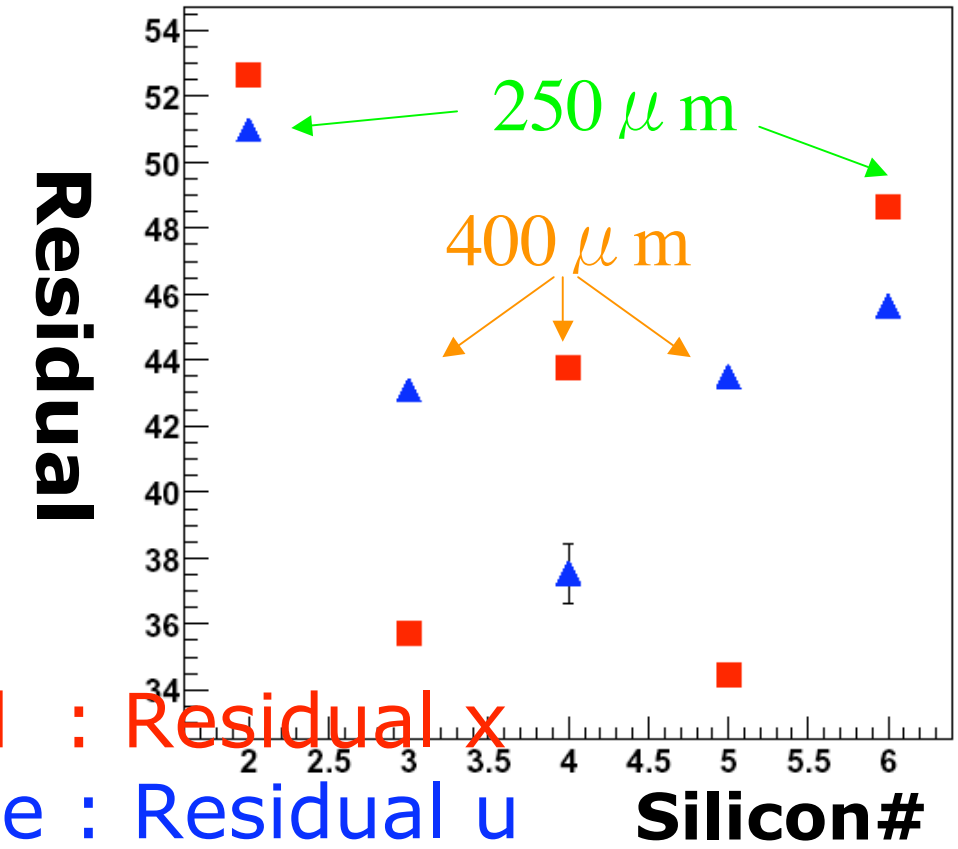
Residual u → different response compare with residual-x and simulation.

Sim.

(MS + resolution ~25um)



Exp.



red : Residual x

blue : Residual u

New fitting (more simple)

- Fit x and u separately (1-dimensinal fit).

  → minimize $$S \equiv \sum_i \left[\frac{(X_i - X(Z_i))^2}{\sigma_x^2} \right]$$

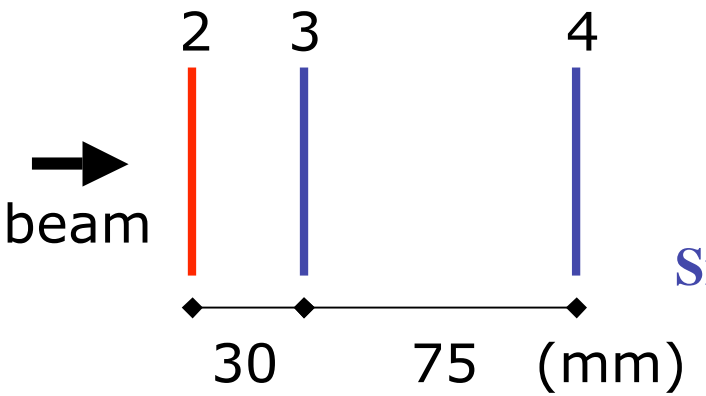
- not convert to y information. (fit using u info. directly)

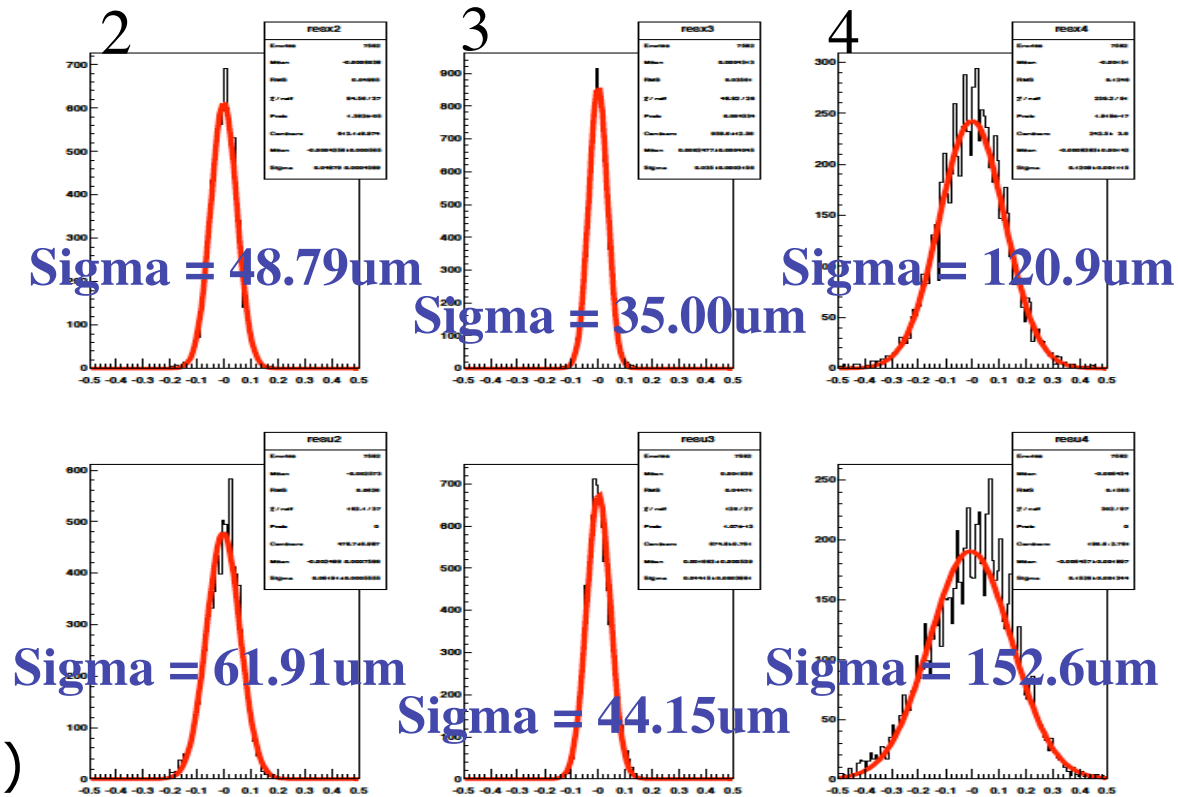
First, try to fit using 3 sensors

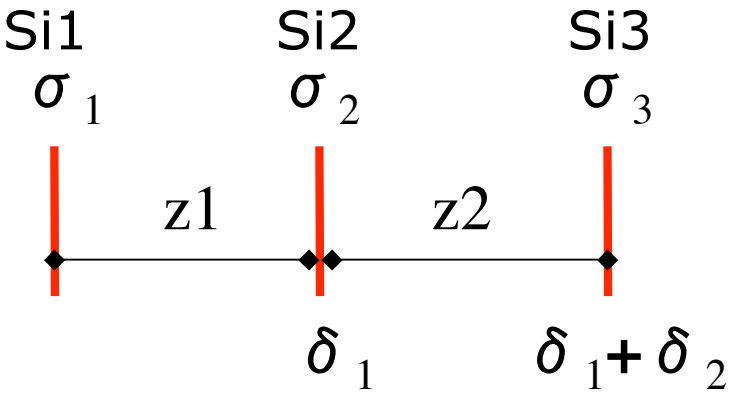
Residual Exp.

For example,
Sensor 2,3,4

red : 250 um
blue : 400 um







- $\sigma_1, \sigma_2, \sigma_3$: intrinsic resolution.
- δ_1, δ_2 : multiple scattering from Si1 or Si2. (calculate by multiple scattering equation)
- And define R1 R2 R3, these are residual (observed)

We obtain following 3 equations about each residual.

$$(1)\cdots(\Delta R_1)^2 = \Delta_{1MS}^2 \left(\frac{z_1}{z_2}\right)^2 \Delta_{2MS}^2 = \Delta_1^2 + \left(\frac{z_1 + z_2}{z_2}\right)^2 \Delta_2^2 + \left(\frac{z_1}{z_2}\right)^2 \Delta_3^2$$

$$(2)\cdots(\Delta R_2)^2 = \left(\frac{z_2}{z_1 + z_2}\right)^2 \Delta_{1MS}^2 \left(\frac{z_1}{z_1 + z_2}\right)^2 \Delta_{2MS}^2 = \left(\frac{z_2}{z_1 + z_2}\right)^2 \Delta_1^2 + \Delta_2^2 + \left(\frac{z_1}{z_1 + z_2}\right) \Delta_3^2$$

$$(3)\cdots(\Delta R_3)^2 = \left(\frac{z_2}{z_1}\right)^2 \Delta_{1MS}^2 = \Delta_{2MS}^2 = \left(\frac{z_2}{z_1}\right)^2 \Delta_1^2 + \left(\frac{z_1 + z_2}{z_1}\right)^2 \Delta_2^2 + \Delta_3^2$$

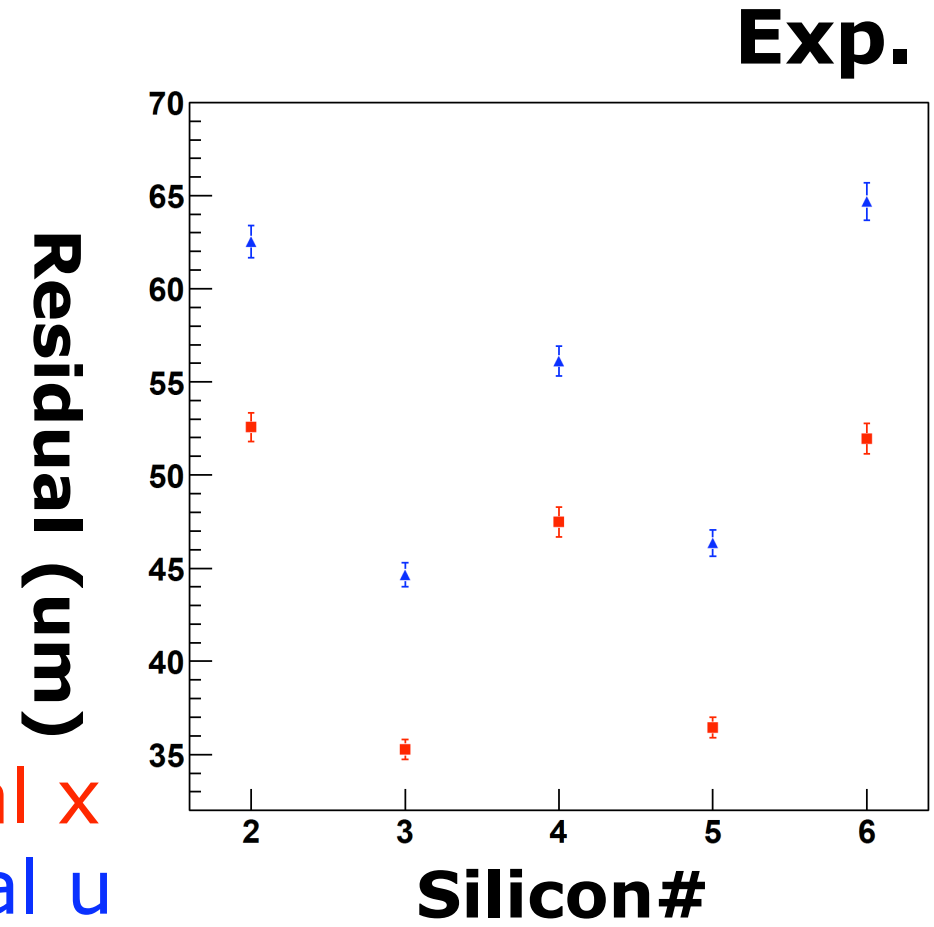
If assume $\Delta_1 = \Delta_2 = \Delta_3 (\equiv \Delta)$, we can calculate this resolution.

-> (1) x:25.57 (2) x:25.63 (3) x:25.24

3 values are same and ~25(um) It is reasonable!

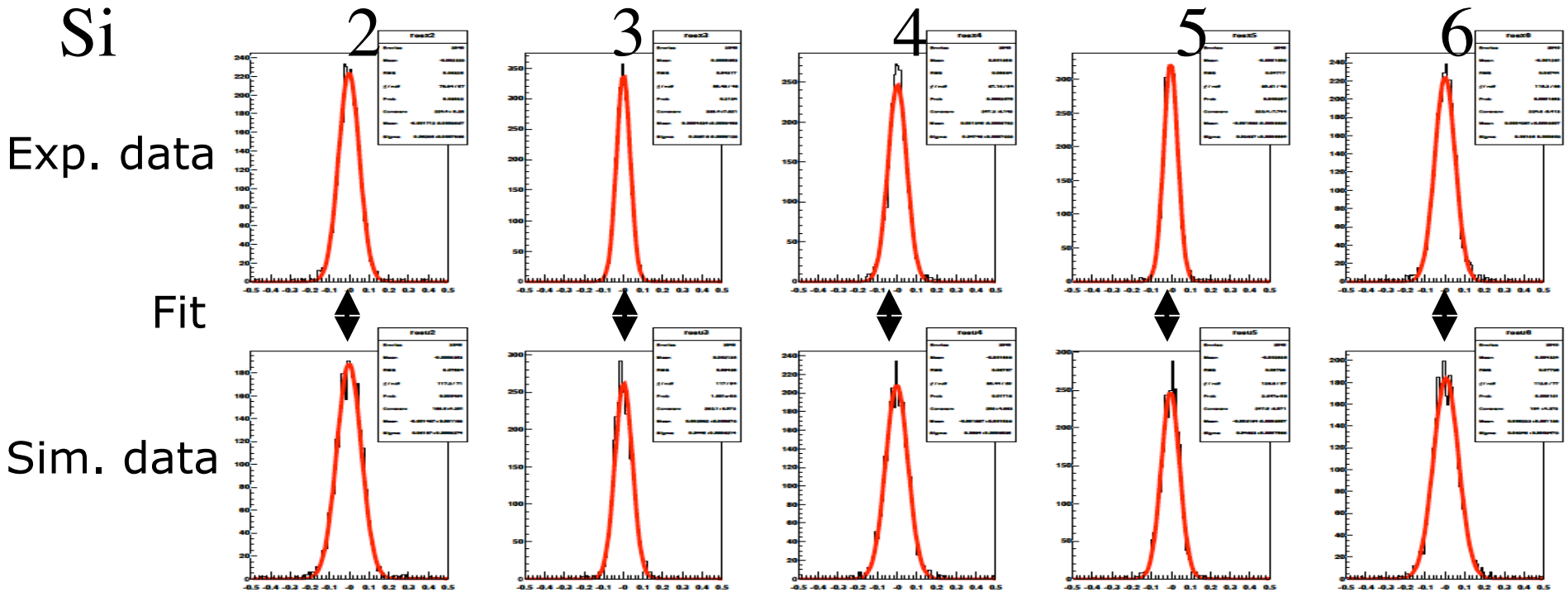
Fitting using 5 sensors

Both residuals are same response as simulation.
(MS + Intrinsic resolution).
But u residual is worse than x.



red : Residual x
blue : Residual u

Error estimation



* Each histogram has 100 bin

Fit histogram(exp. data) and histogram(sim. data) changing intrinsic resolution. (scanning minimum chi^2 defining as following)

resolution -> when chi^2 minimum.

Error -> when chi^2 minimum +- 1

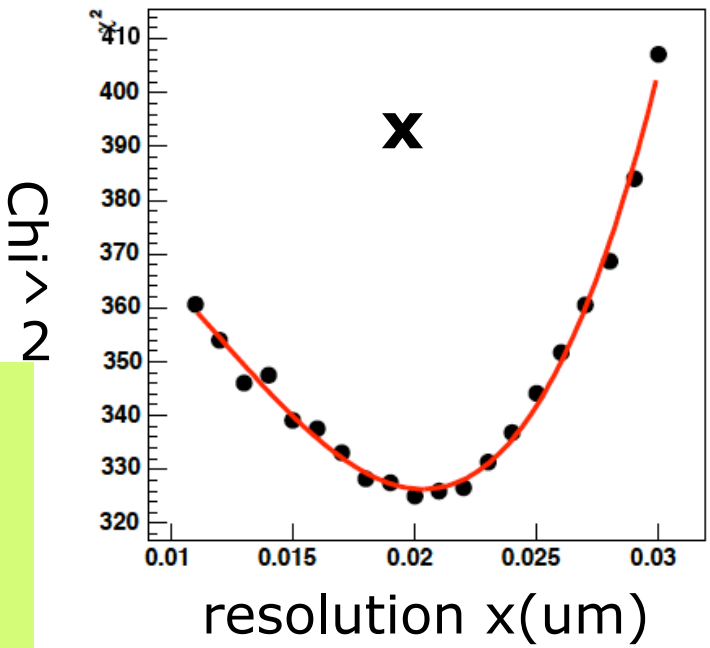
$$\chi^2 = \sum_{i=2}^{6} \sum_{j=1}^{100} \frac{\left[N_{ij}(\exp.) - N_{ij}(sim.)\right]^2}{N_{ij}(\exp.)}$$

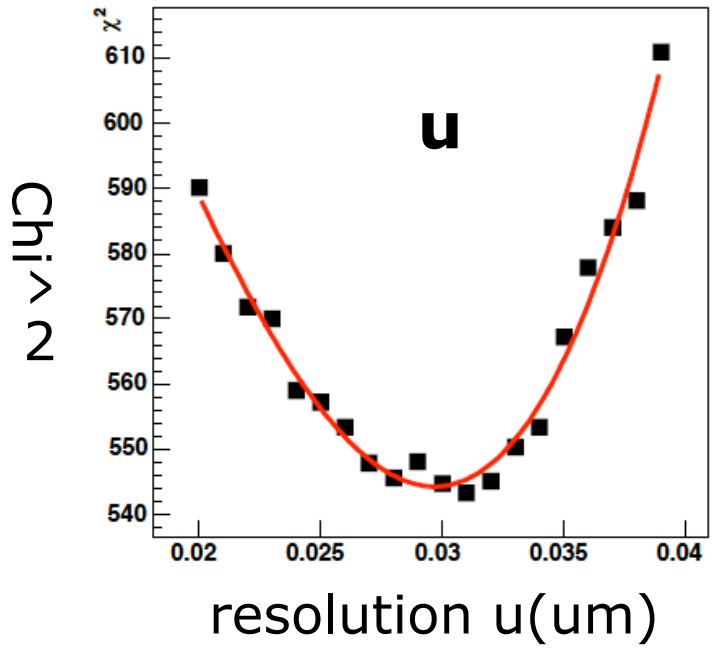
Resolution

For ex. Si 2

dof ~ 300

Exp.
~ 3000 evts
Sim.
~500000 evts
par earch point





Obtain 20~23 um for Resolution-x; (except for Si4)
-> under studying
Resolution-u is worse than resolution-x
-> under studying

	X(um)	U(um)
Si2	20.34 ± 1.26	29.68 ± 1.26
Si3	23.27 ± 0.65	31.20 ± 0.69
Si4	11.46 ± 2.39	27.87 ± 1.37
Si5	23.59 ± 0.68	31.98 ± 0.79
Si6	22.88 ± 1.12	30.87 ± 1.37

Summary

- Fitting using 3 sensors
  - Assuming these sensors are same resolution, we obtain ~25 (um) for x.
- Fitting using 5 sensors
  - Residual-x and residual-u are reproduced by the simulation with a intrinsic resolution.
  - Resolution-x : 20~23 (um)
  - Resolution-u : 28~32 (um)

Under studying

Not well known

- Si4 resolution-x is strange (too good).
  - simulation parameters are not proper?
  - programming?

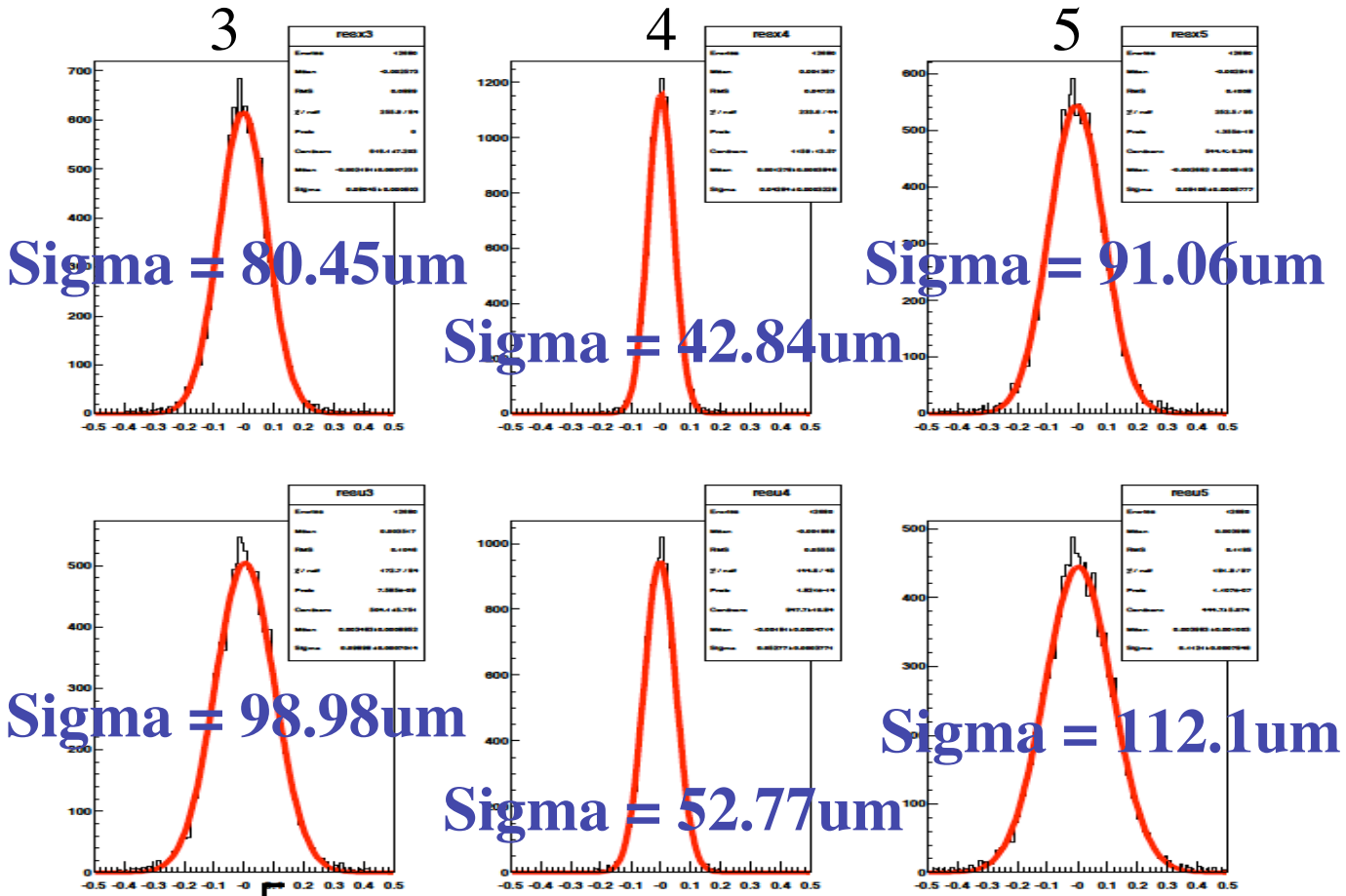
    -> to be done until core week.
- Resolution-u is worse than resolution-x

  -> should reconsider programming

  -> will reexamine electronics

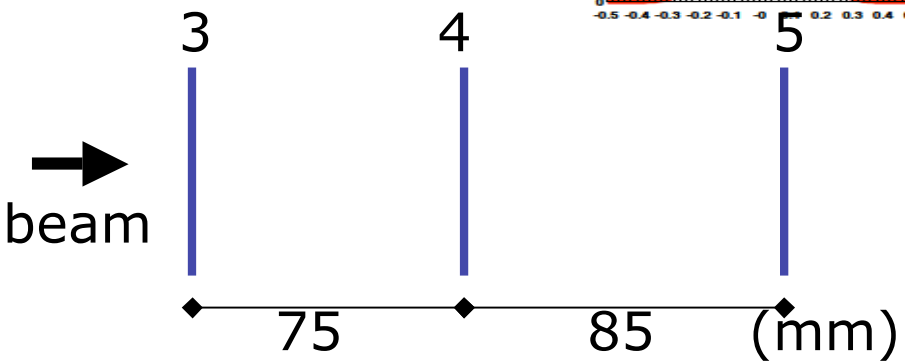
  ..

Back up 1 : 3 fit (Si 345)



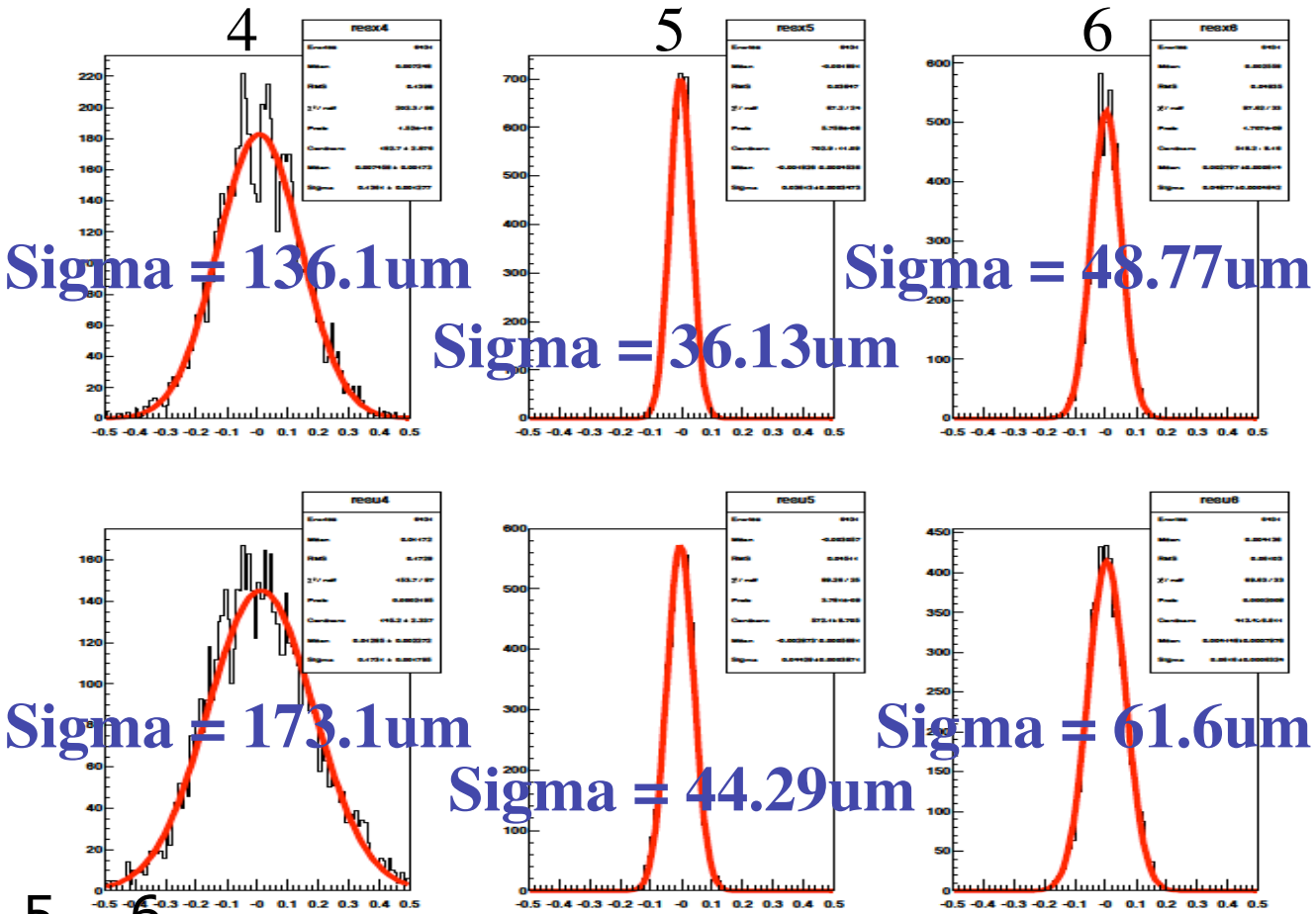
red : 250 um

blue : 400 um



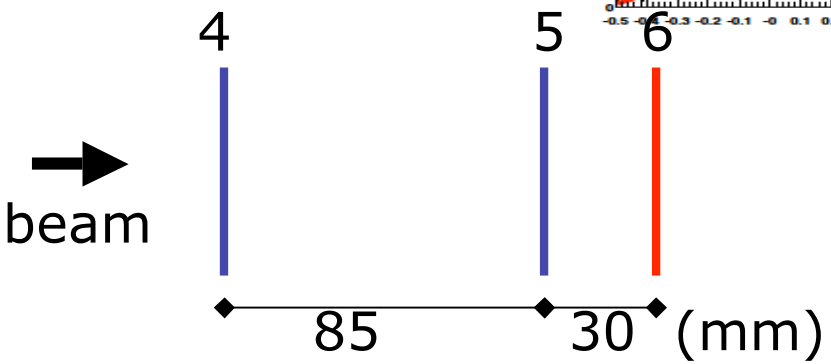
(1) x:~26.62 (um)
(2) x:~26.73 (um)
(3) x:~26.73 (um)

Back up 2 : 3 fit (Si 456)



red : 250 um

blue : 400 um

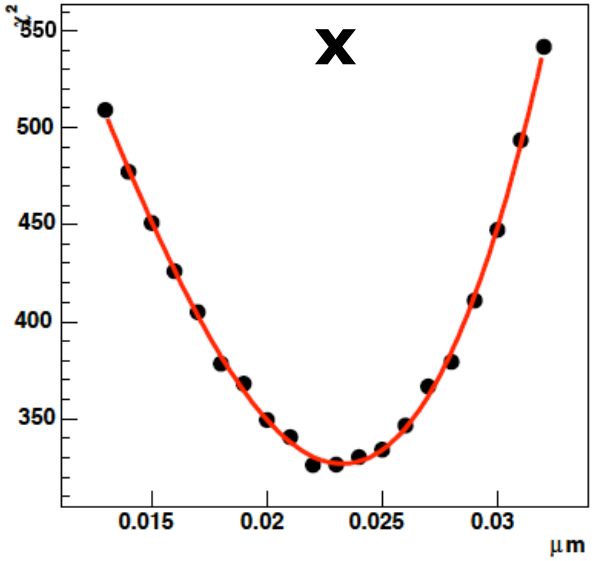


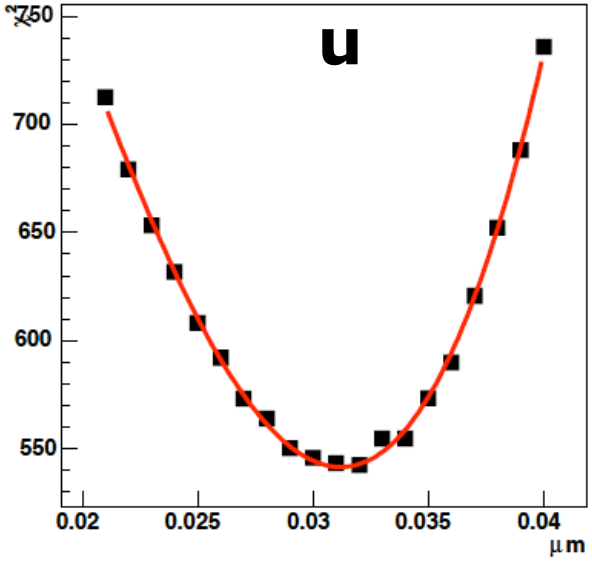
(1) x:~25.19 (um)
(2) x:~25.74 (um)
(3) x:~25.64 (um)

Chi^2 Si3 Si4

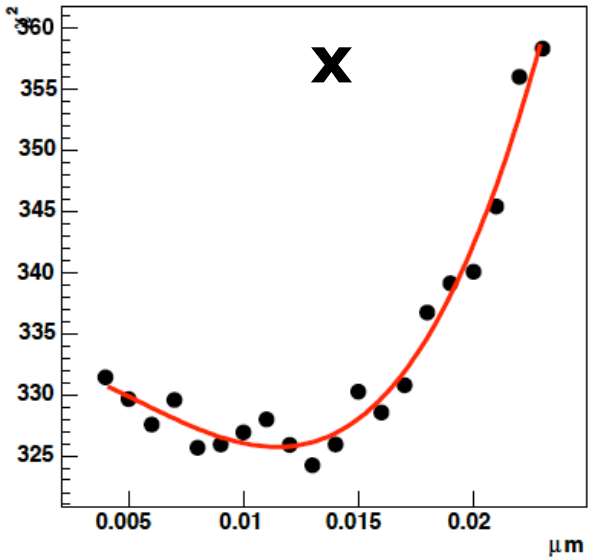
Vertical axis : chi^2 Horizontal axis : resolution

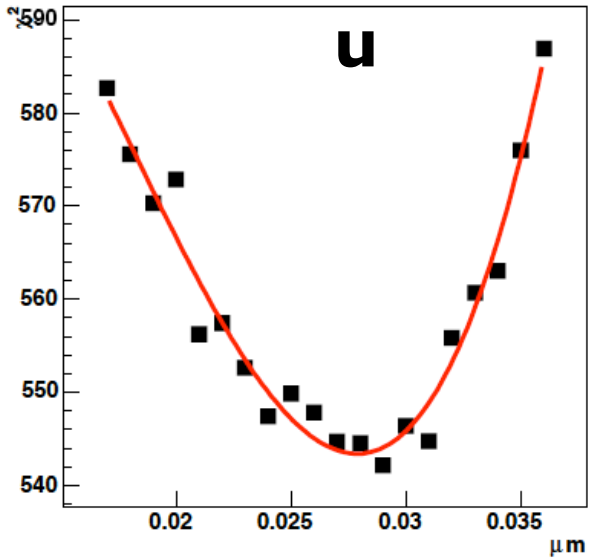
Si3





Si4

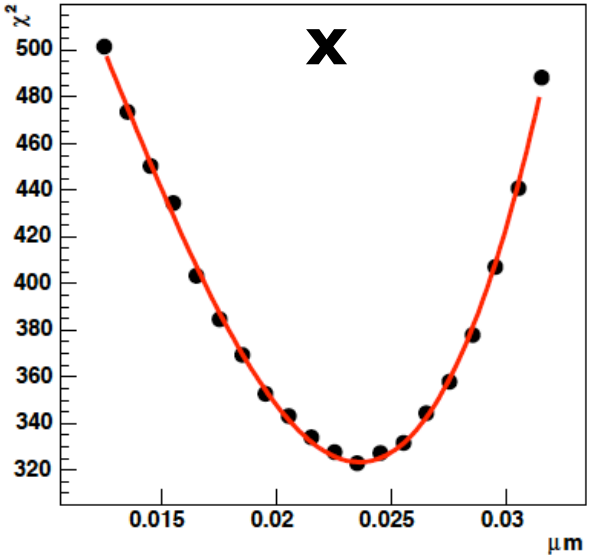


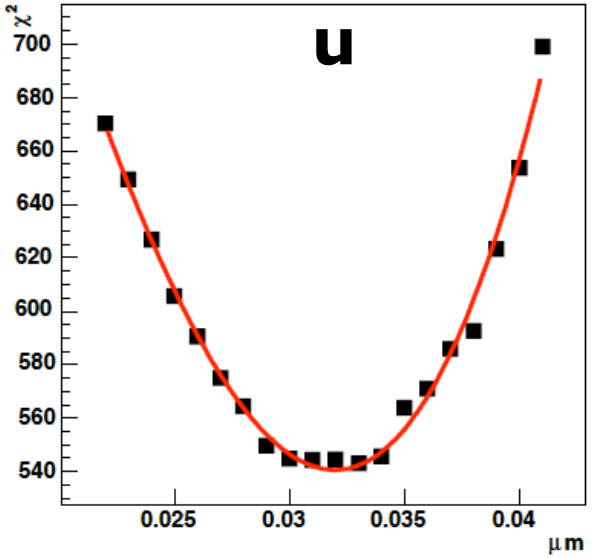
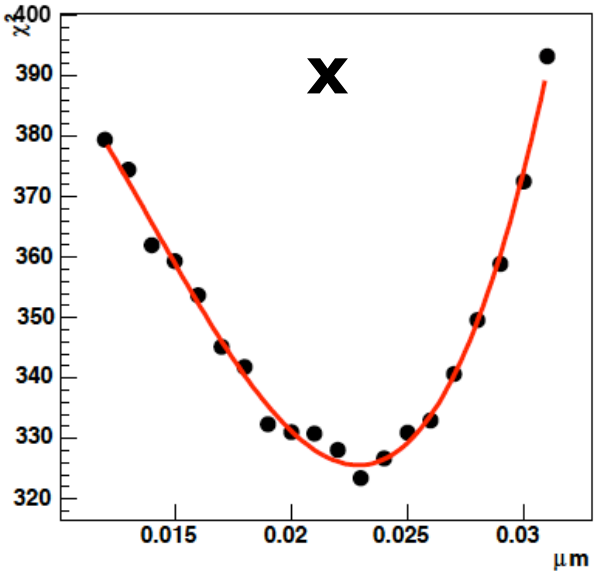
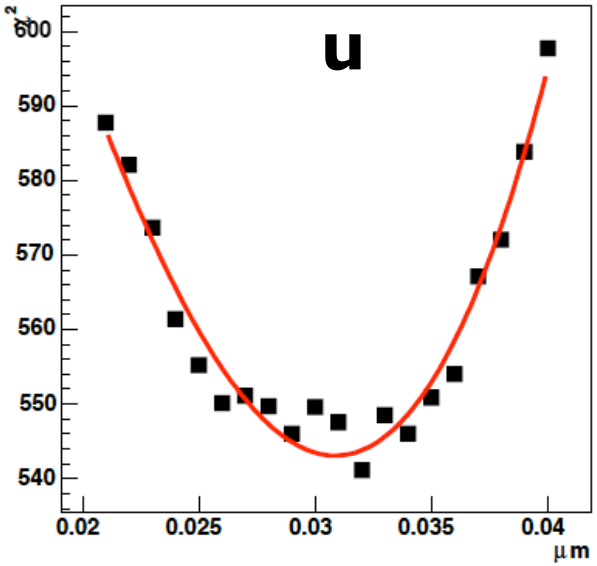


Chi^2 Si5 Si6

Vertical axis : chi^2 Horizontal axis : resolution

Si5





Si6