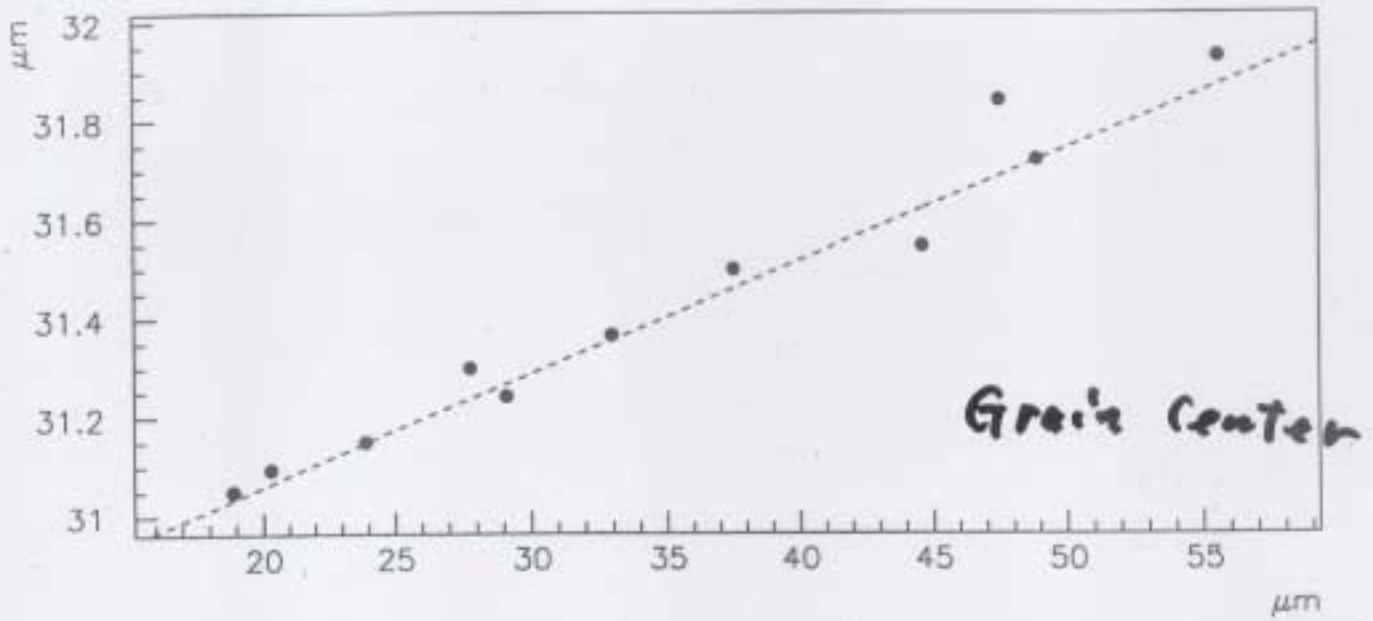


Intrinsic position resolution
of nuclear emulsion.

nagoya - univ.

A. Ariga.

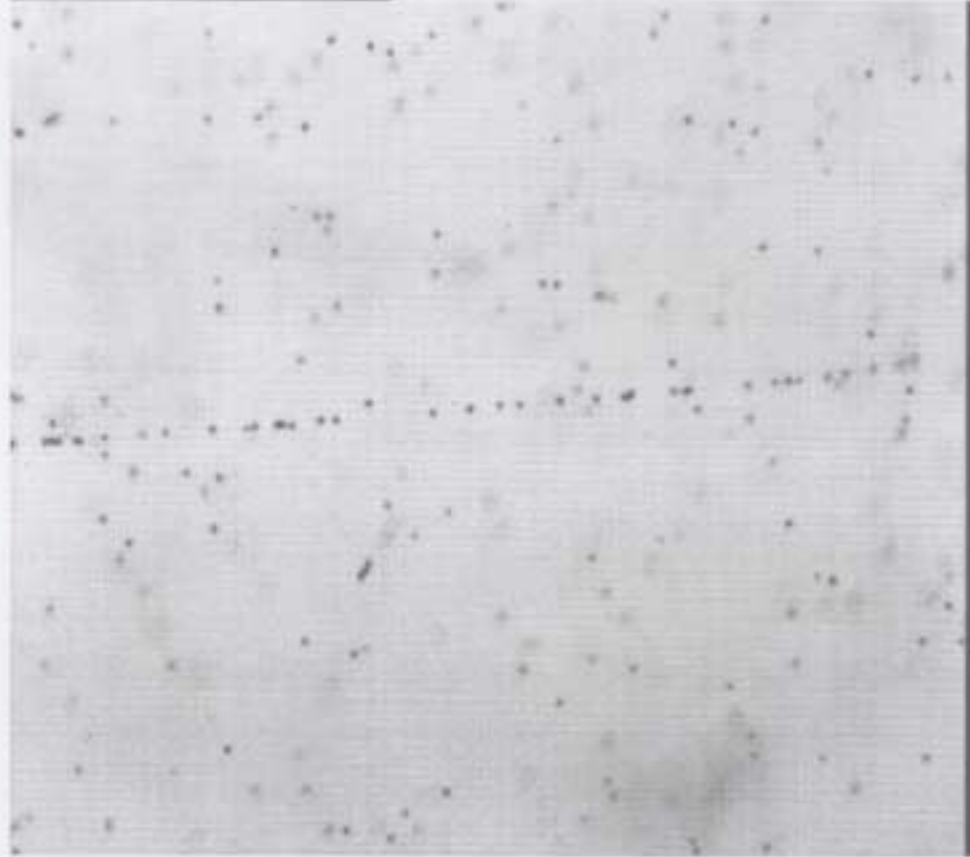


Grain Deviation from
Minimum Square fitting Line.

→ position resolution

How to measure.

- take Images by CCD camera.
- take Grain Center.
- Calculate the deviation:
for Opera film.



62 μm



82 μm .

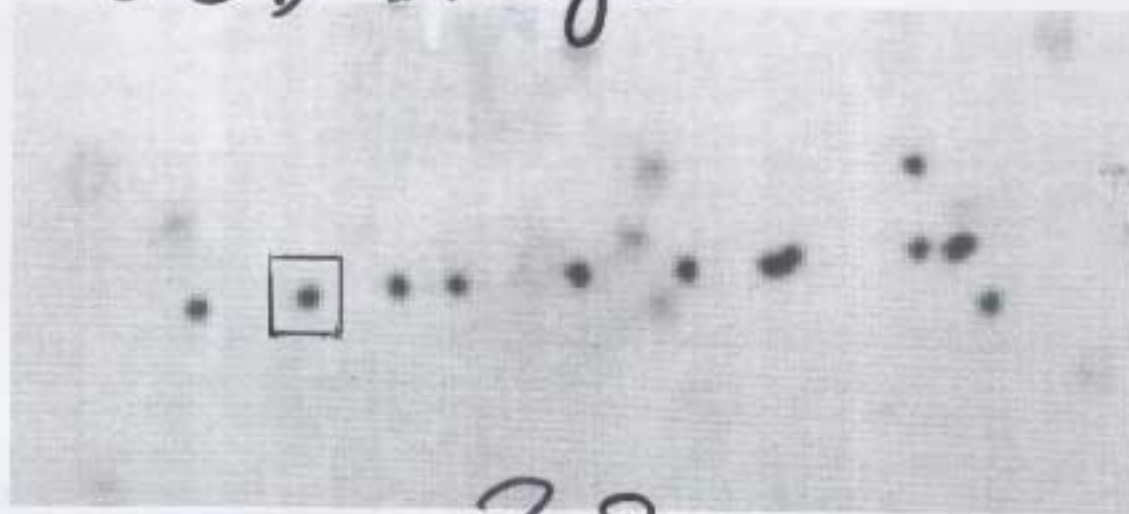
CCD camera 512x485
pixel

Objective Lens X100

N.A = 1.30

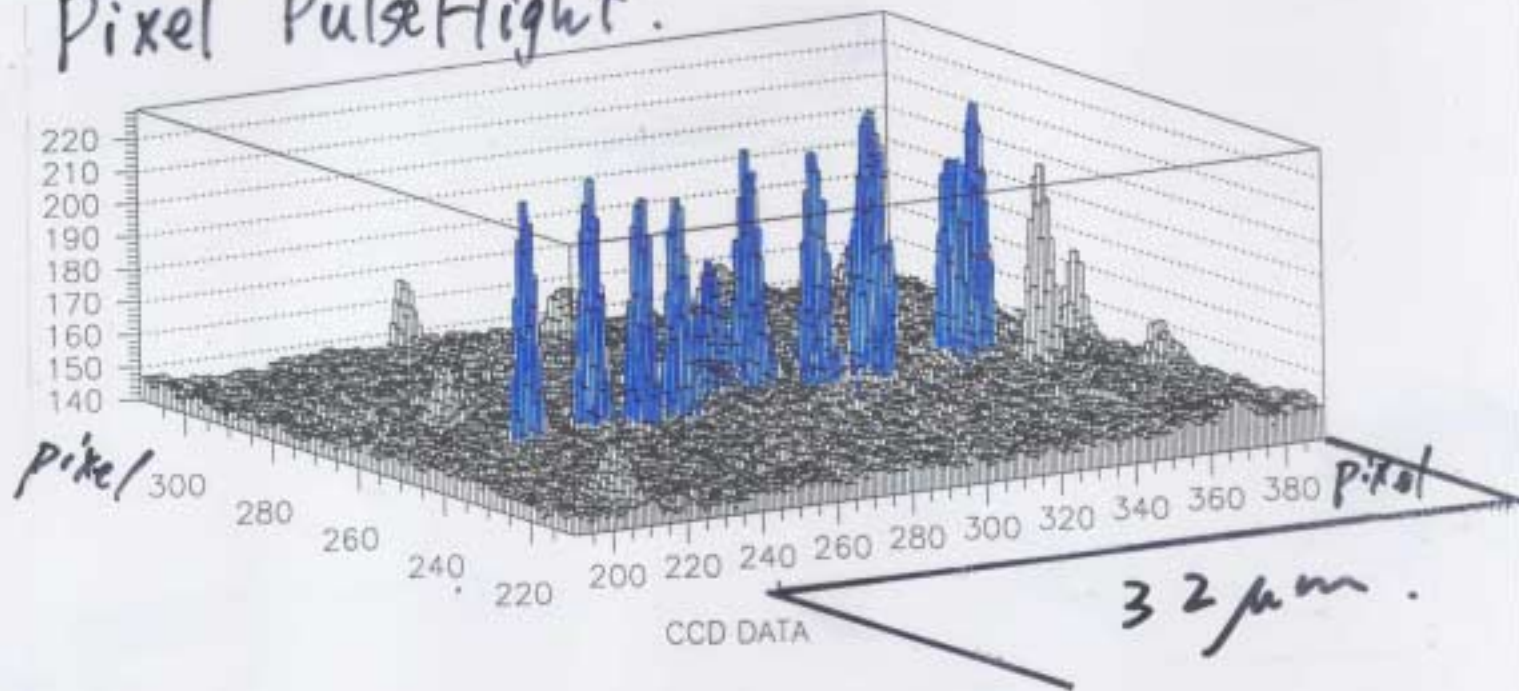
Green light
with oil.

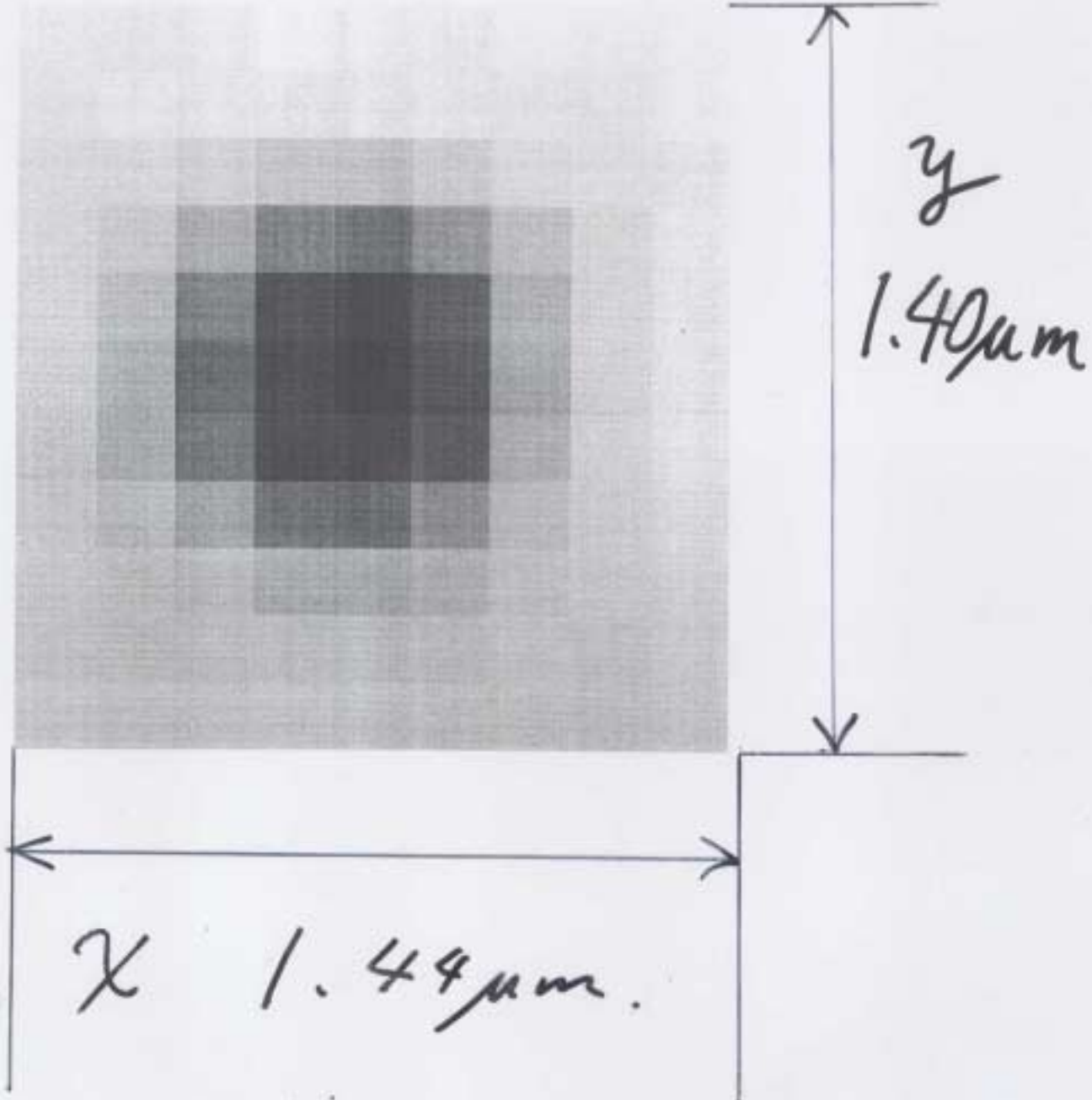
CCD Image



32 μm

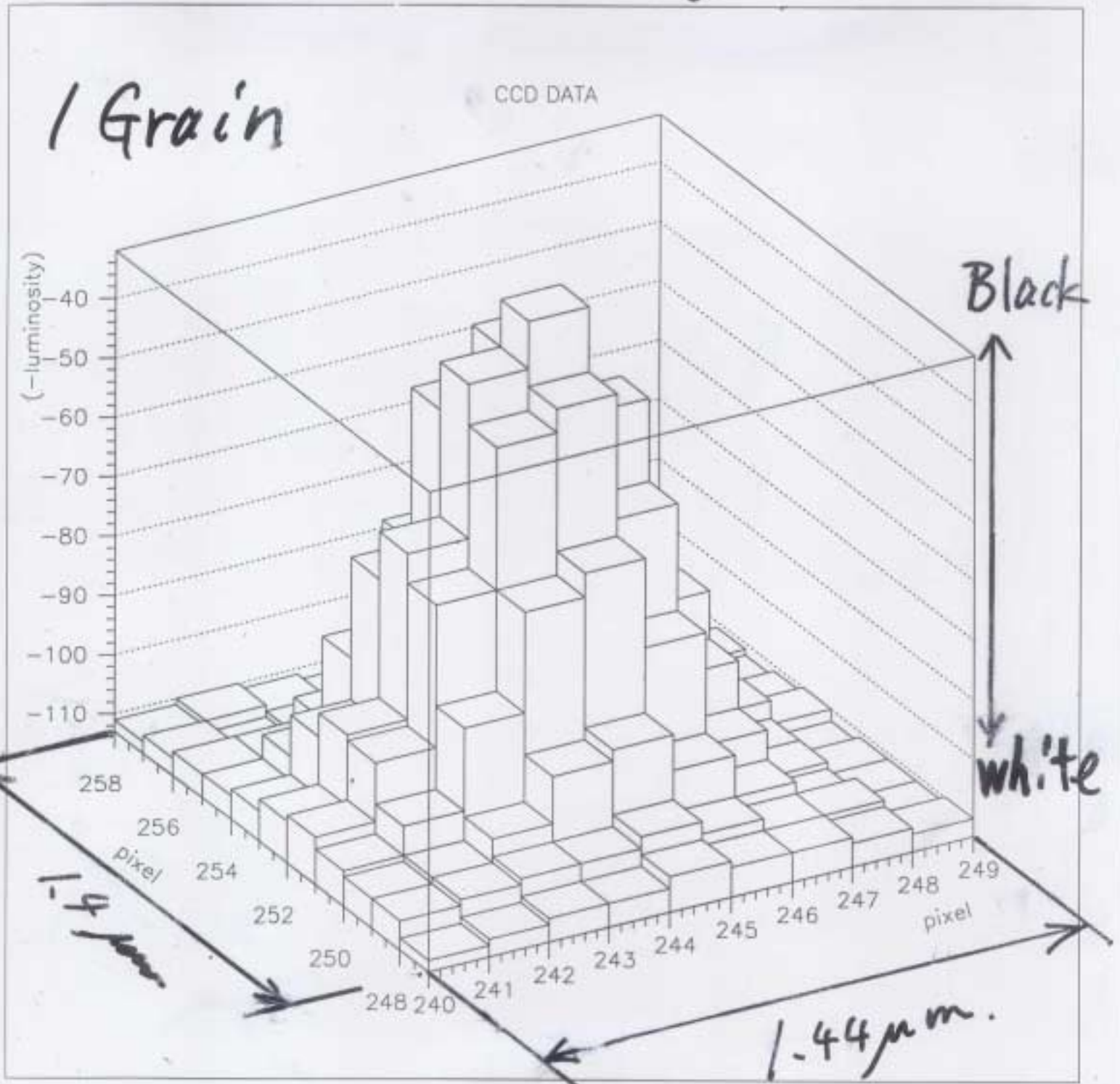
Pixel Pulse Height.





Pixel size $x \approx 0.160 \mu\text{m}$
 $y \approx 0.128 \mu\text{m}$.

Pixel Puls Height.



Procedure to take Grain Center.

the same way as Center of Gravity.

$W_i = (\text{Pixel Puls Hight})_i - (\text{Background})$

$$X = \frac{\sum W_i X_i}{\sum W_i}$$

Background \approx mean pulse Hight around the grain

the repeatability of this way.

$$\sigma \approx 5 \mu\text{m}.$$

Where is the Center?



Grain is an example
of filaments
by electron microscope.

practically In using Light microscope.
the information is limited.

- Blackness or Lightness
- Color
- Size.

the Grain Center have meaning at first
when that is related to track. time.



in this area
Optical distortion
 $\sim \sigma$ (Grain Center)

Calculation of deviation.

used track $10 \text{ GeV } \pi^-$

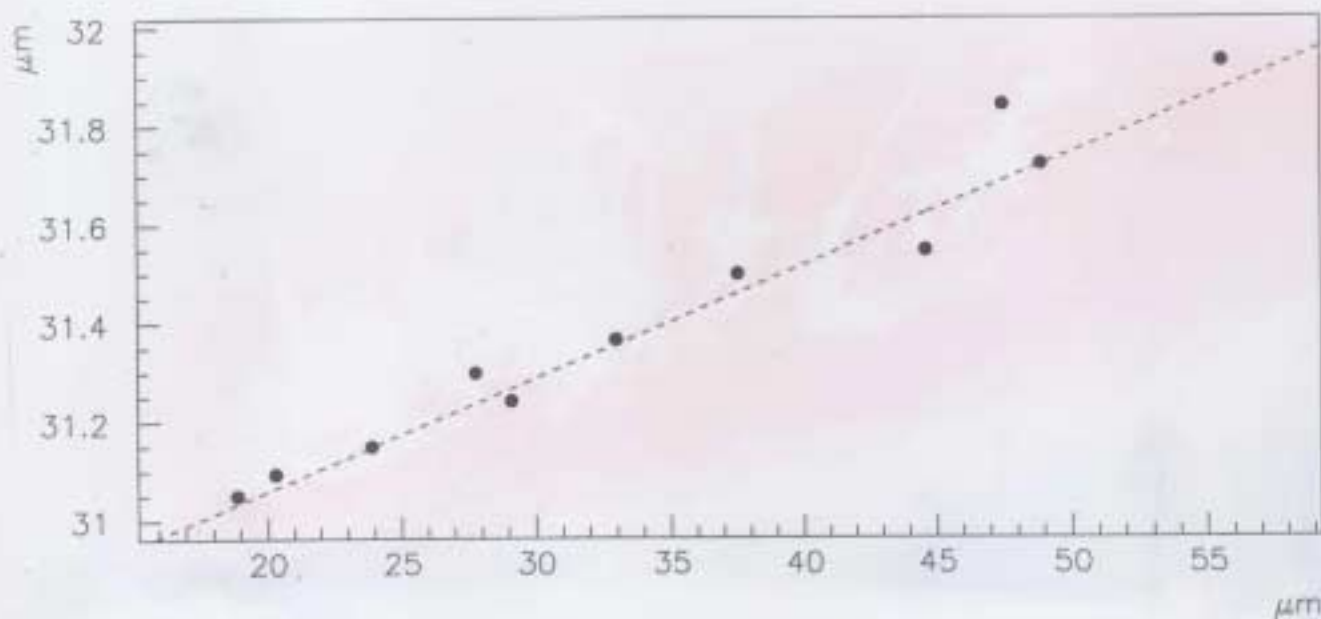
mean number of Grain $40 \mu\text{m}$ 13.7 (GD 34)

total 100 tracks $(50+50)$
 1366 Grain 4 mm

Local distortion and Optical distortion
are not corrected.

I followed 2 tracks for the length 2 mm .

40 μm . OPER SU20D



Select track.

fit by minimum square Line

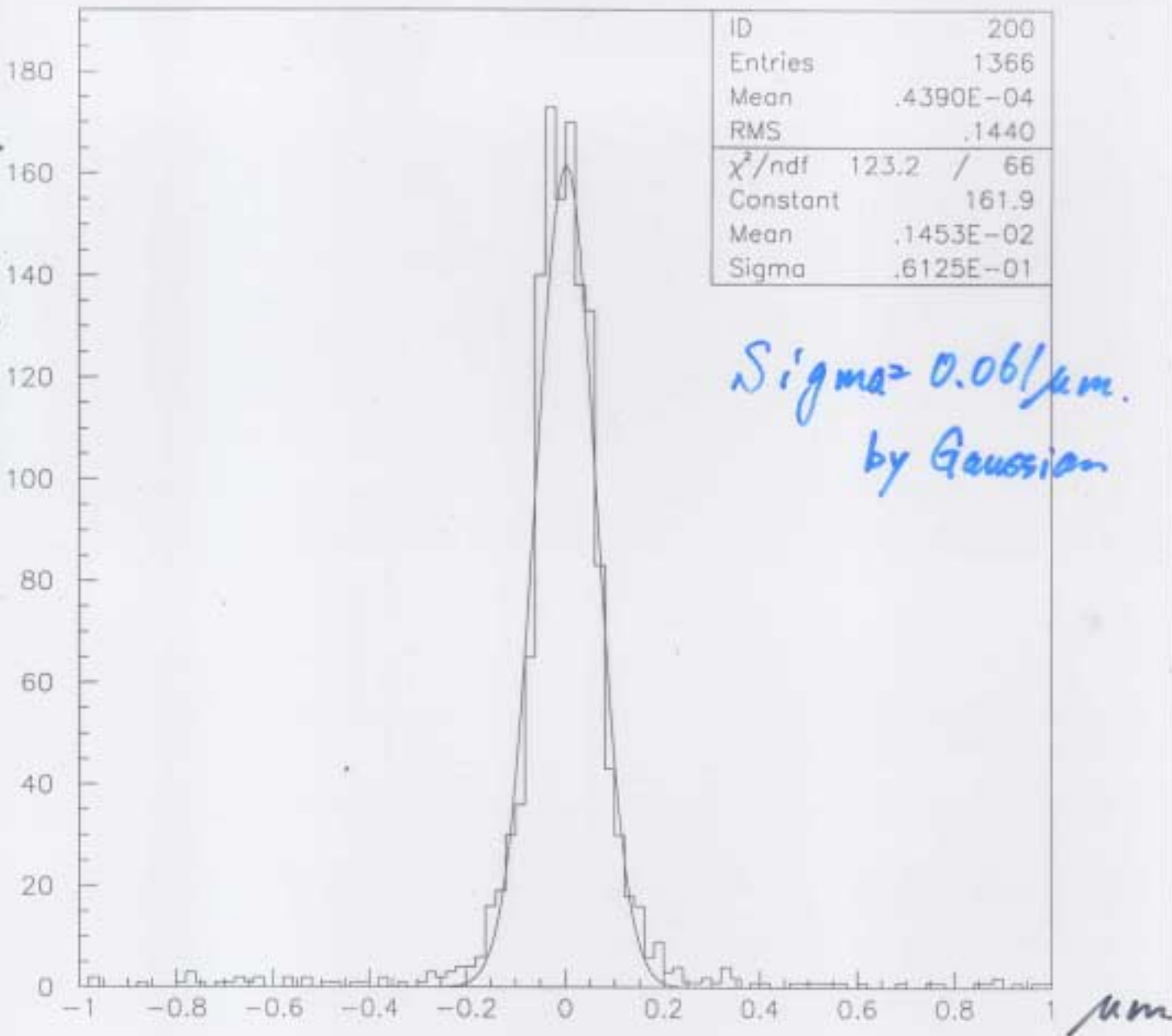
pick up Grain.

① distance from the best fit Line.
< $1.0 \mu\text{m}$.

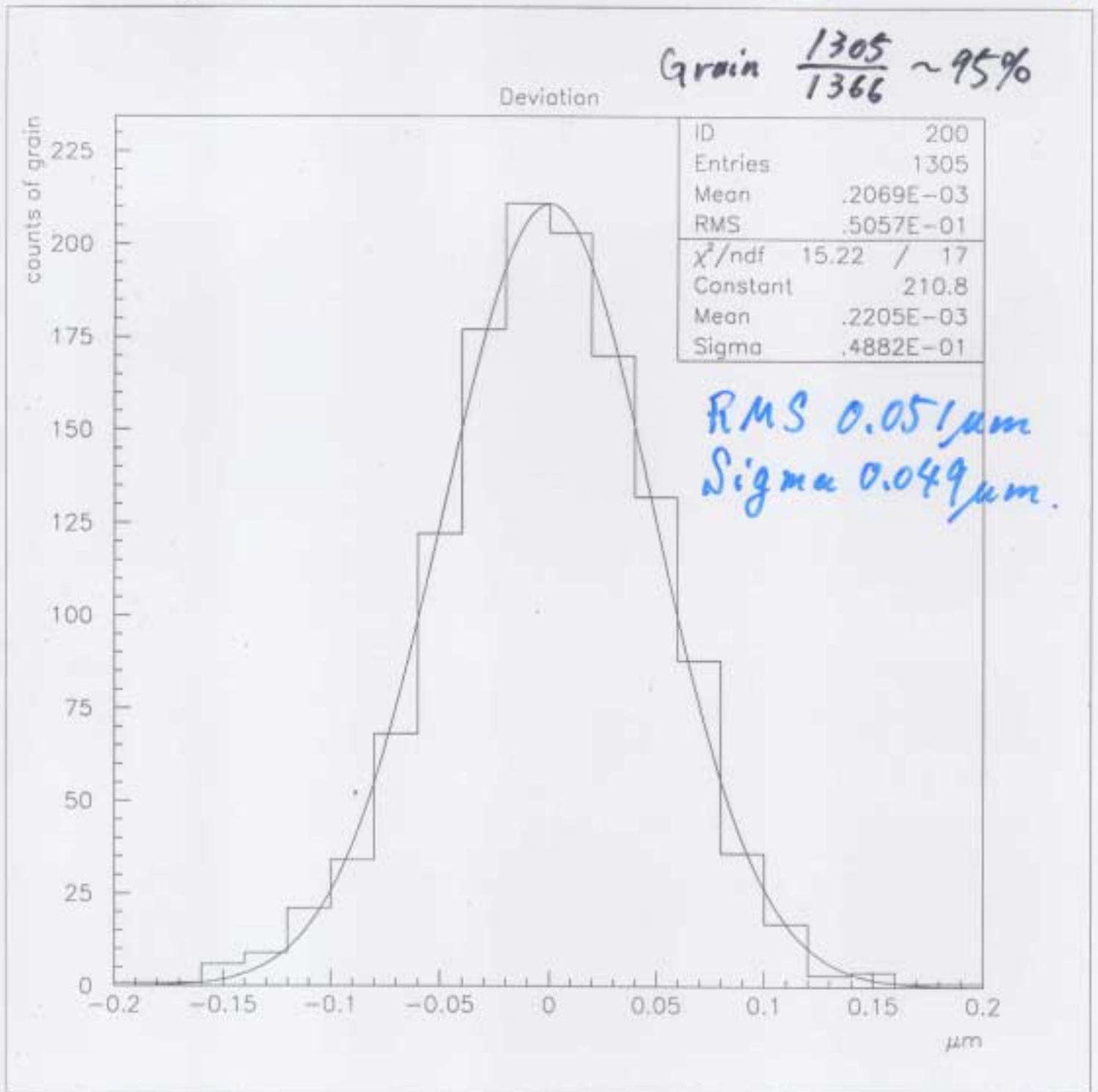
② do rejection and fitting again and again
to distance < 3σ of ①.
for each tracks.

distance from best fit line $< \underline{1.0 \mu\text{m}}$.

counts of Grain.



distance < 0.183 μm (out of 11)



This also contains fog and rock on electron.

Application.

Base Angle measurement
by 2 Grain.

$$\Delta\theta = \frac{\sqrt{2}\sigma}{Z}$$

for Opera.

$$\Delta\theta = \frac{\sqrt{2} \cdot 0.049}{200} \approx 0.35 \text{ m}$$



Low energy electron rejection.

High energy partial Low energy electron



Emulsion
layer

the Deviation $\sigma \sim 0.089$ $\sigma > 0.049$.

Summary

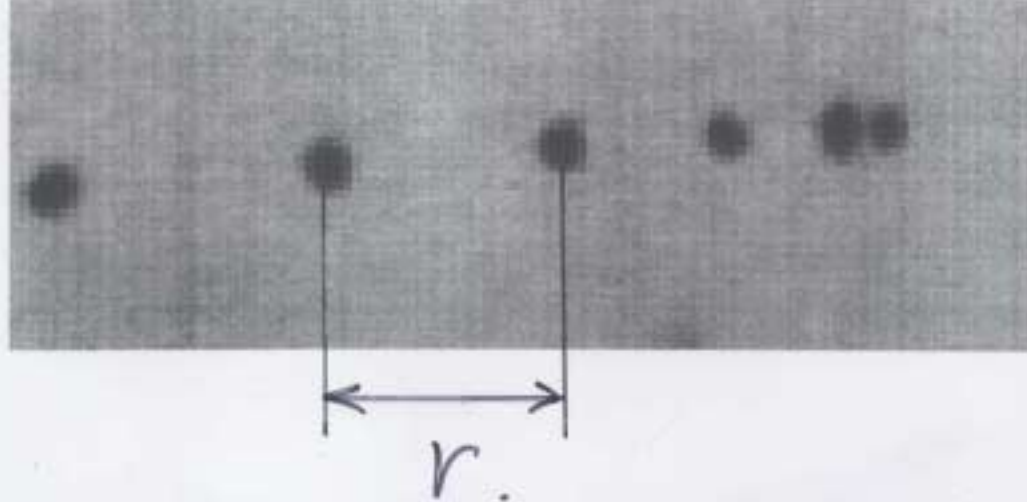
- Intrinsic position resolution of emulsion film.

$$D \approx 0.049 \mu\text{m} \quad (49 \text{ nm})$$

- This measurement was done on Video Sig

That means it is possible to

achieve the resolution in Automatic Analysis.



to measure the distance
between Grains again and again,
the repeatability is

$$\sigma \sim 5 \text{ nm.}$$

(moving stage little by little.
100 times.

Distance between 2 Grains

