



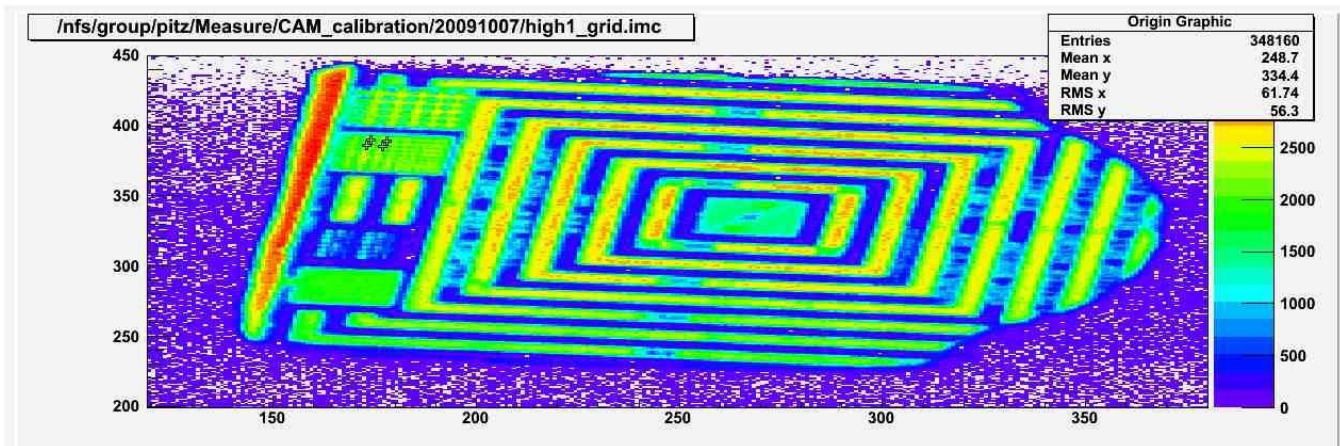
Grid Calibration for the cameras

Xiaohui Wang



Outlines:

- Rotate a original graphic to find the minimal square.
- Calibrate the grid without rotation.



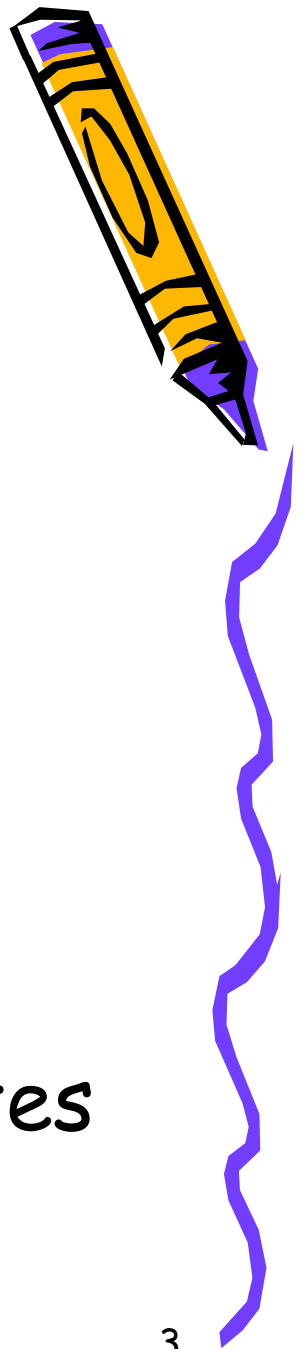
2010-2-18

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2

With Rotation

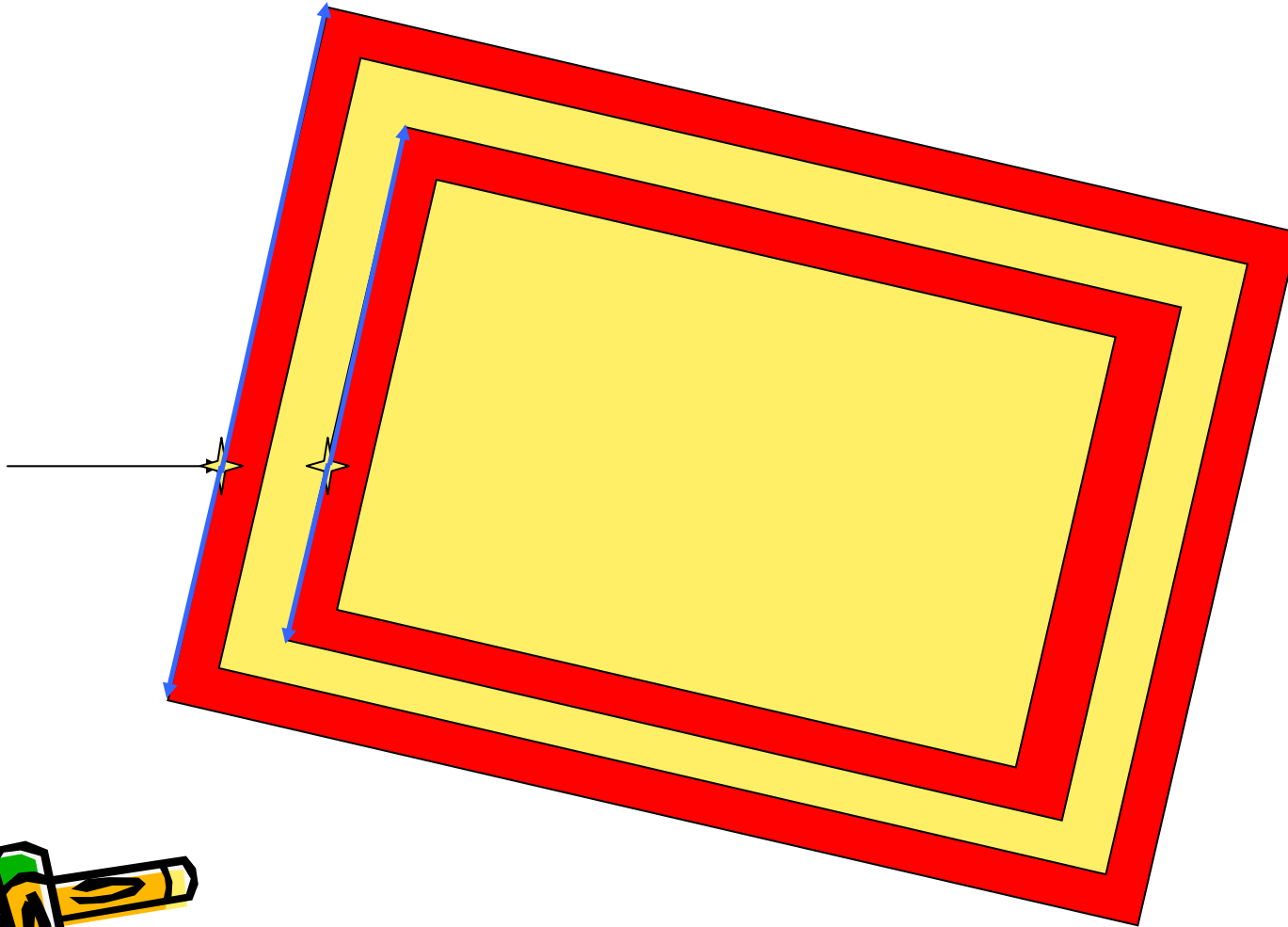
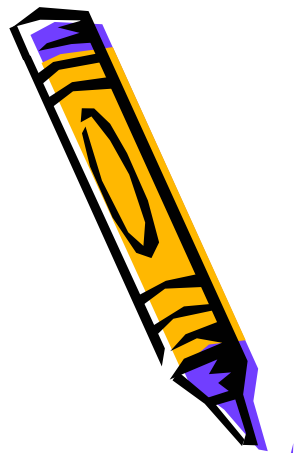
- To tri-value the original graphic
- To find the boundary
- To find the edge point
- To rotate the tri-valued graphic
- To fix the rotated graphic
- To find the minimal square in the rotated graphic
- To rotate back to original coordinates



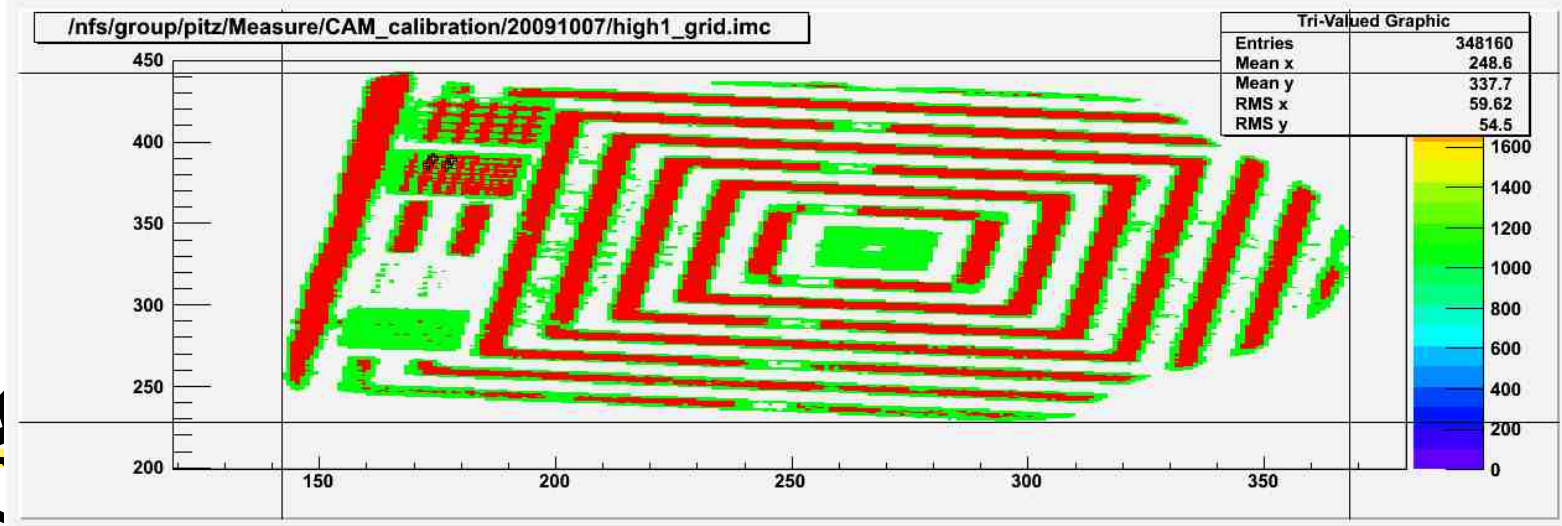
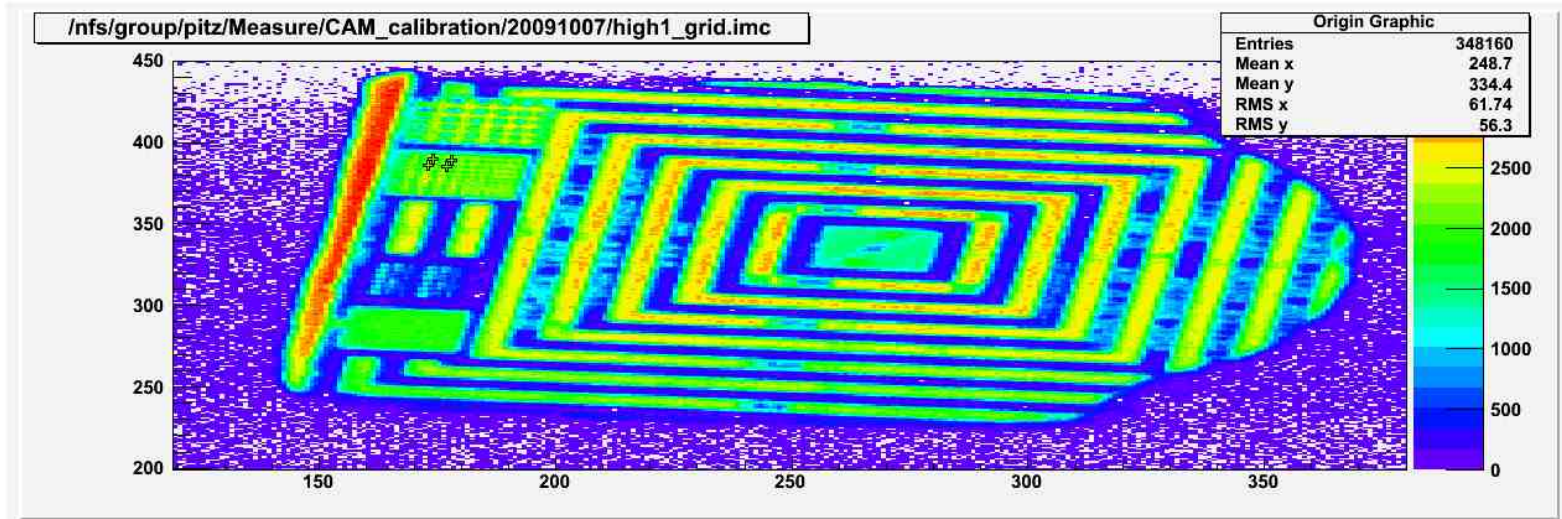
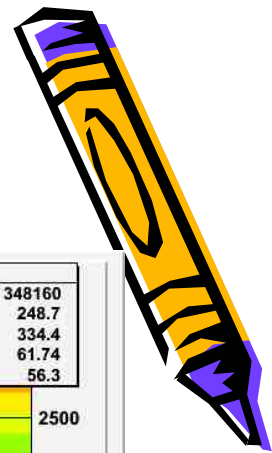
- Program Path:
/doocs/data/resolution/./resoluMeter
- Original Graphic Path:
/nfs/group/pitz/Measure/CAM_calibration/20091007/high1_grid.imc
- Tri-value threshold
30% of max. pixel value; 60% of max. pixel value;
- Ycut Mode
30% of (max. coord. – min. coord.) + min. coord.
50% of (max. coord. – min. coord.) + min. coord.
70% of (max. coord. – min. coord.) + min. coord.



Ycut Mode

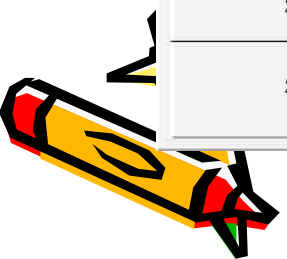


Tri-valued Graphic

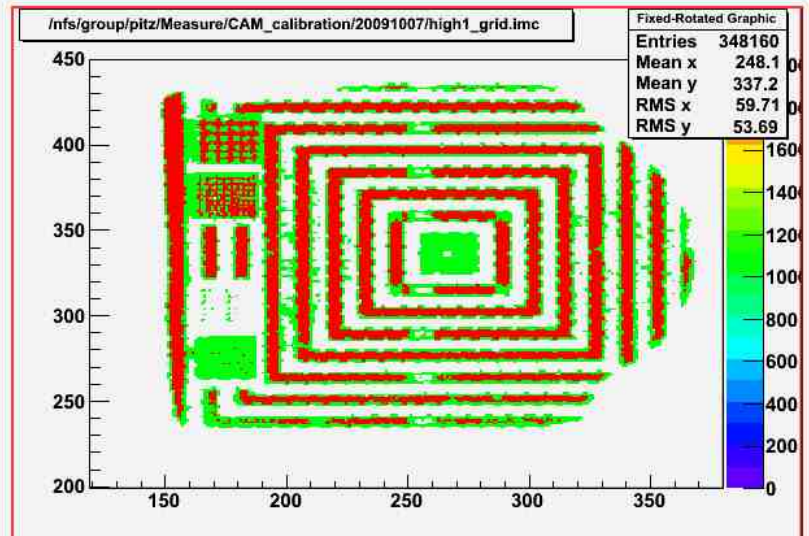
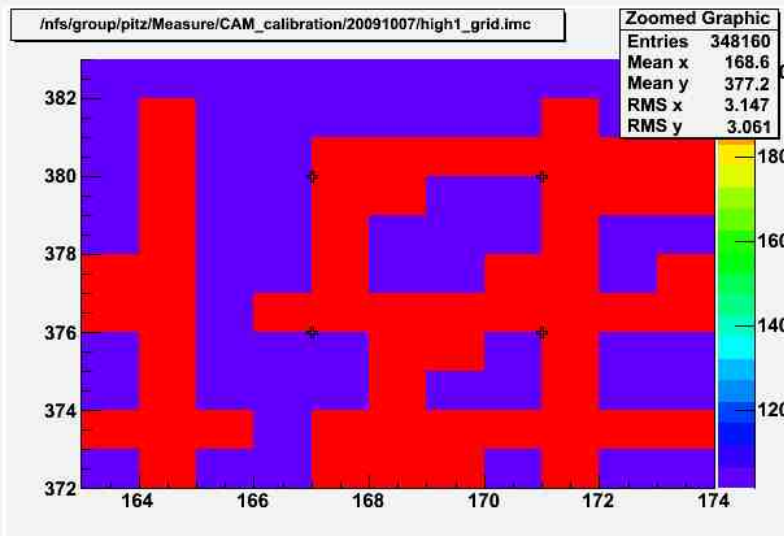
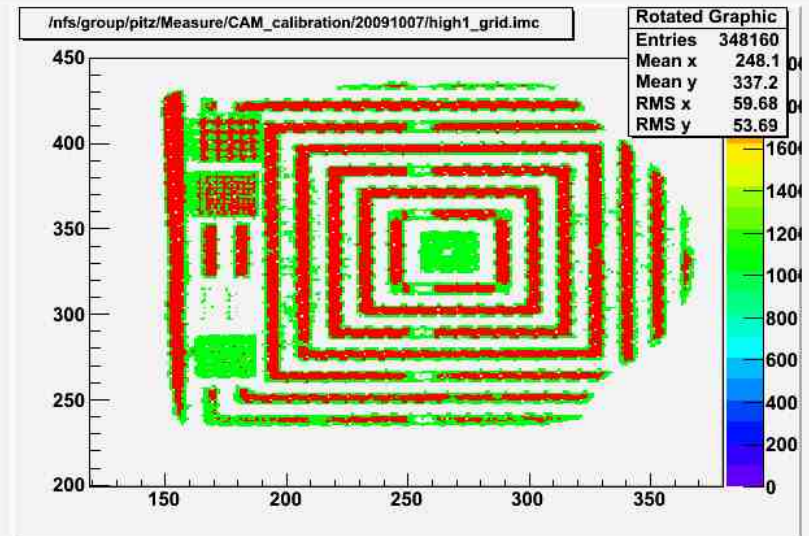
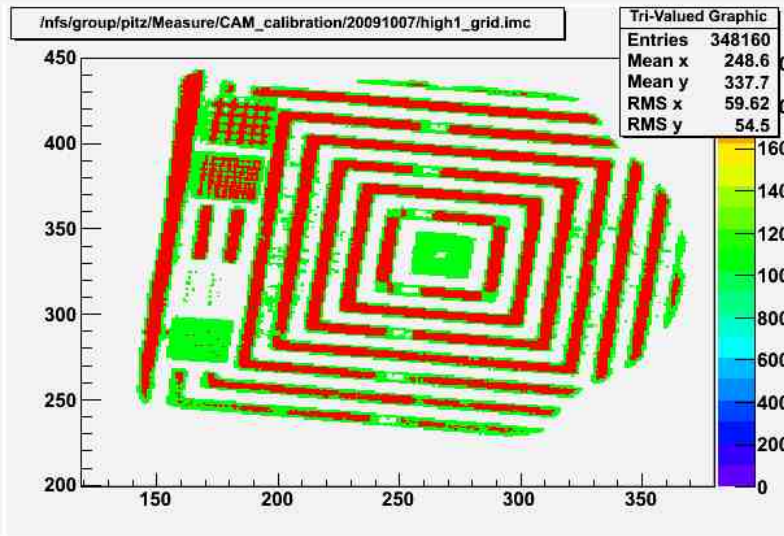
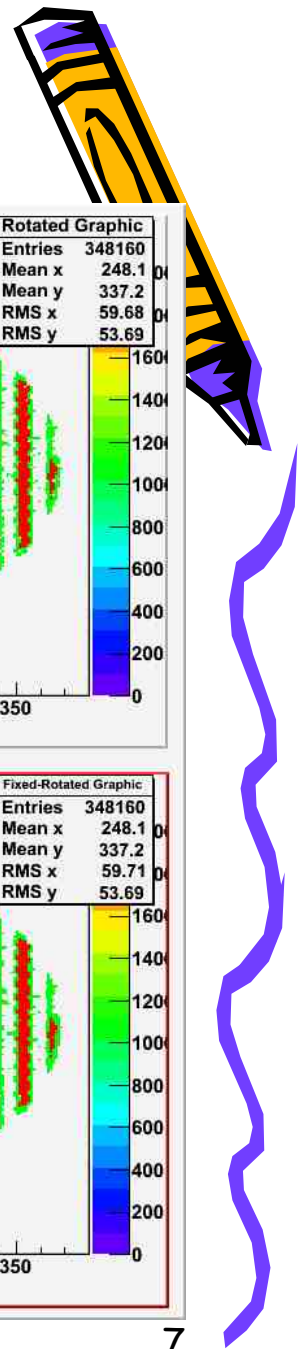


2010-2-18

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Rotated Graphic

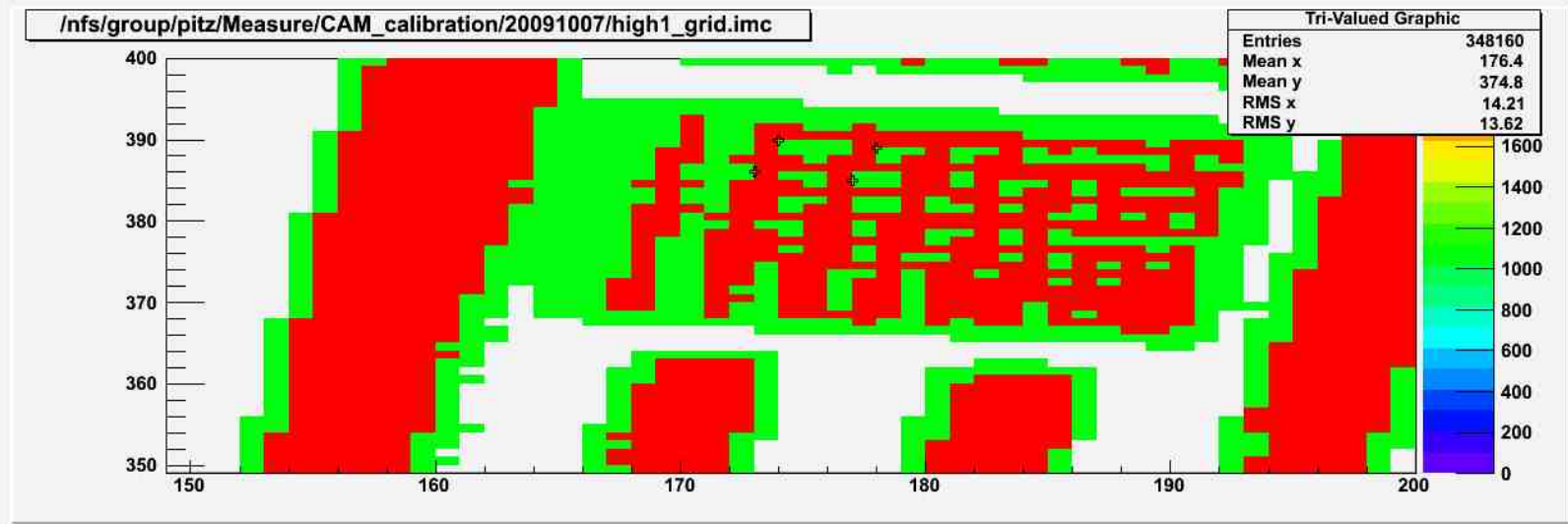
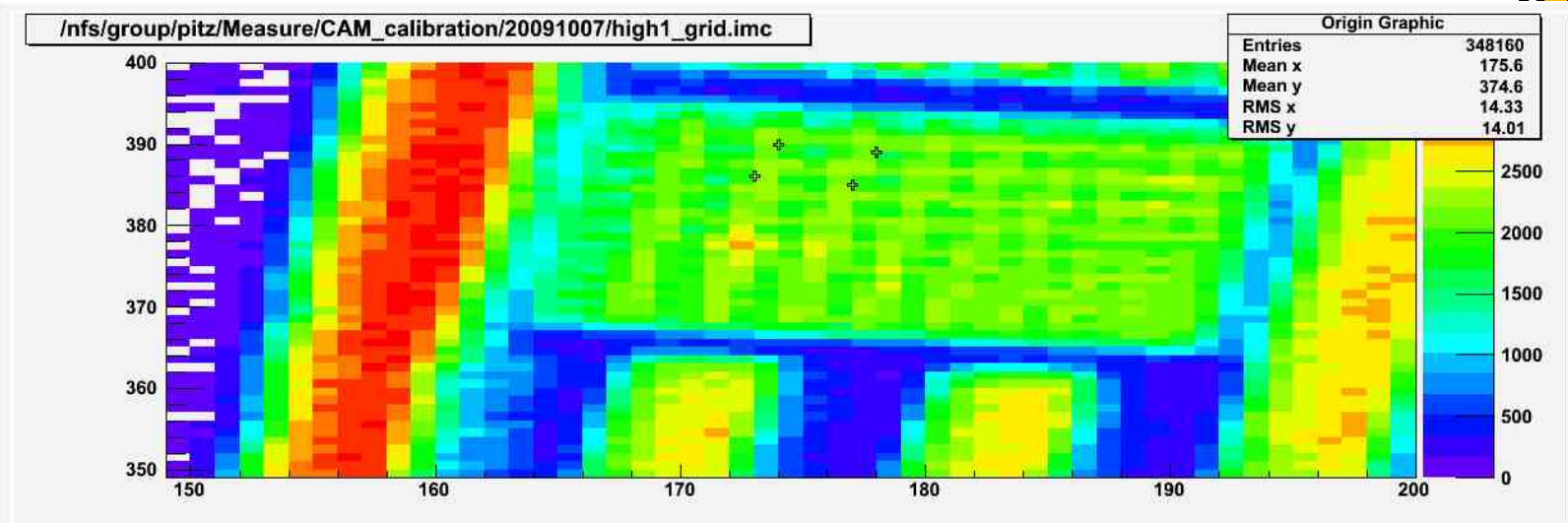
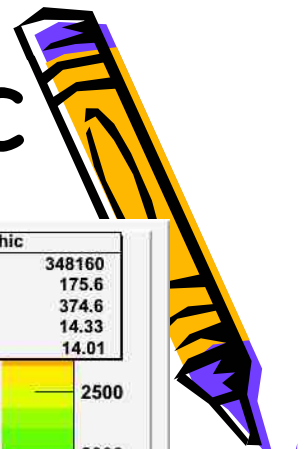


2010-2-18

PITZ PPS

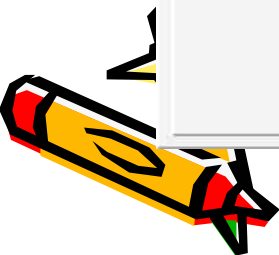


Zoomed Original Graphic



2010-2-18

PITZ PPS



- Program Path:

/doocs/data/resolution/resolution1./resoluMeter

- Original Graphic Path:

/nfs/group/pitz/Measure/CAM_calibration/20090826/H1S4/grid250.imc

- Tri-value threshold

50% of max. pixel value; 80% of max. pixel value;

- Ycut Mode

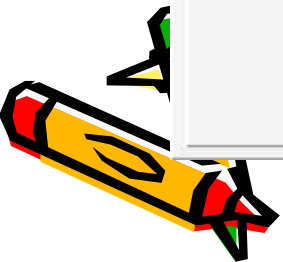
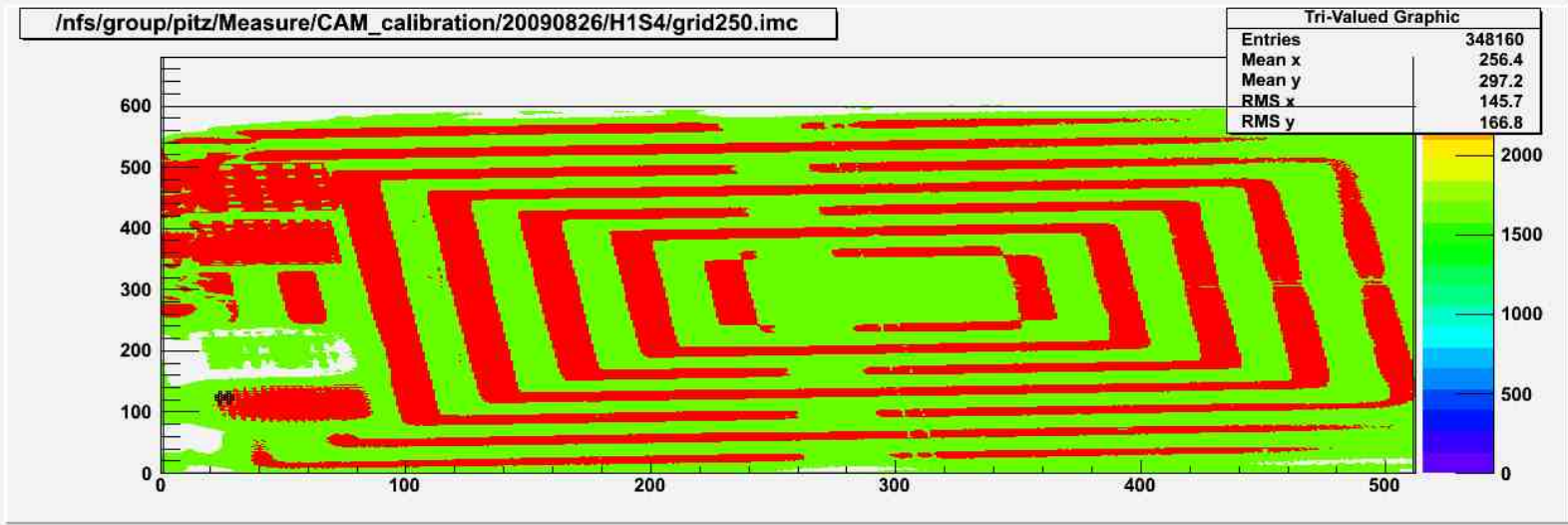
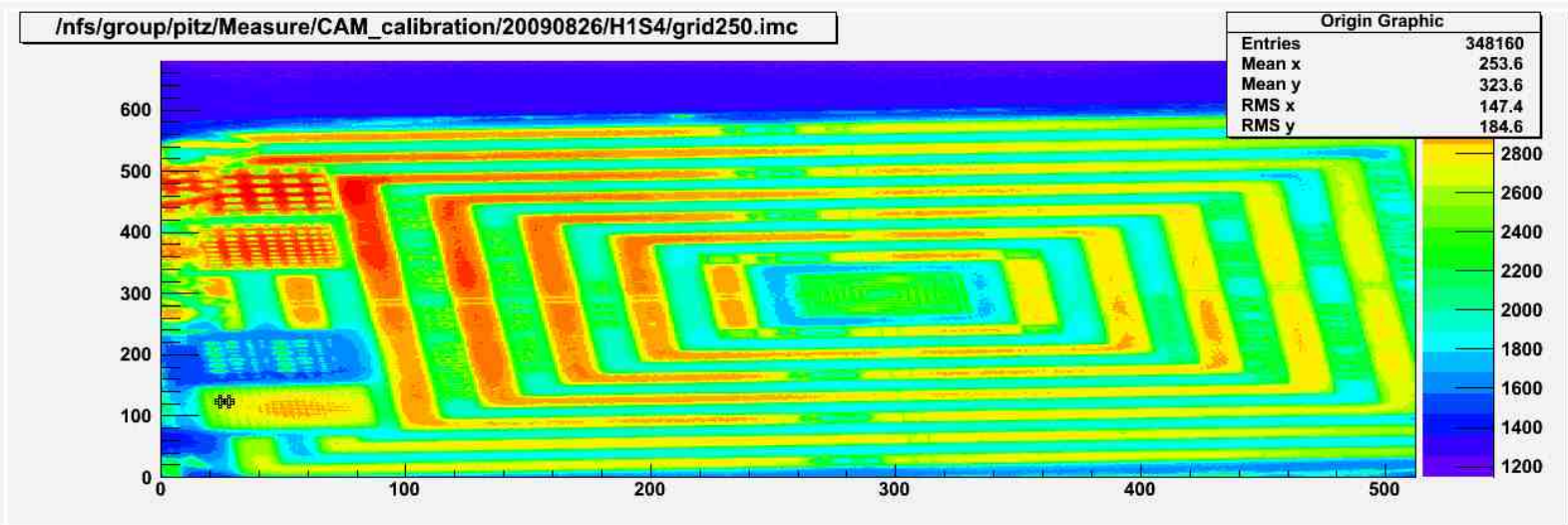
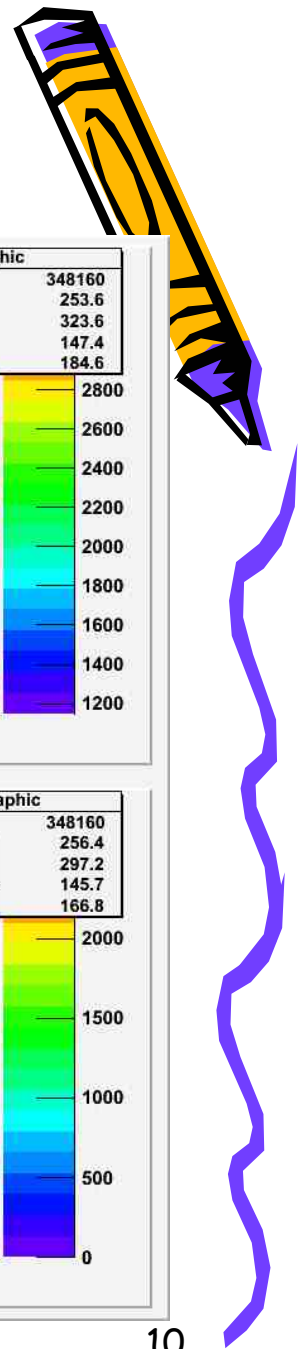
40% of (max. coord. – min. coord.) + min. coord.

50% of (max. coord. – min. coord.) + min. coord.

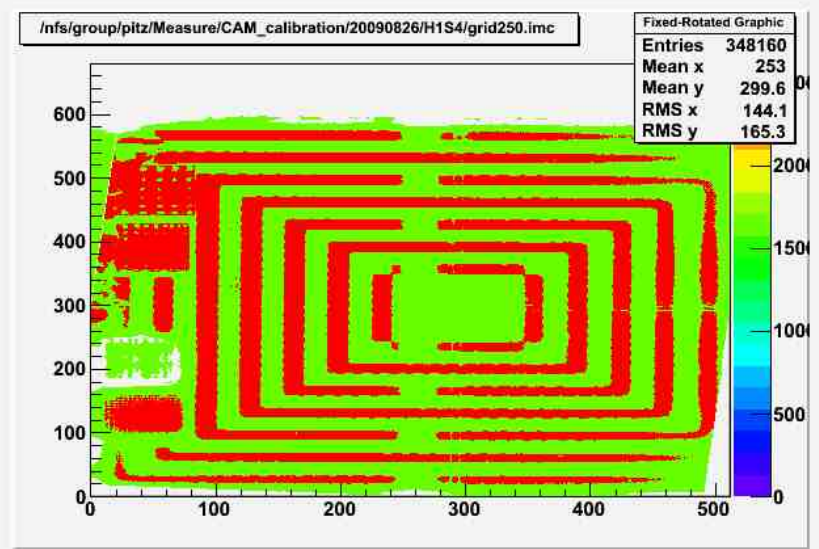
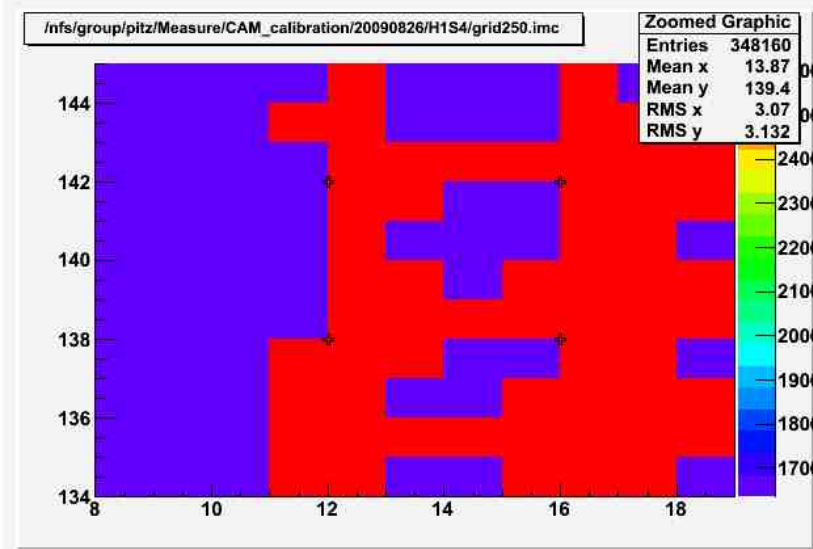
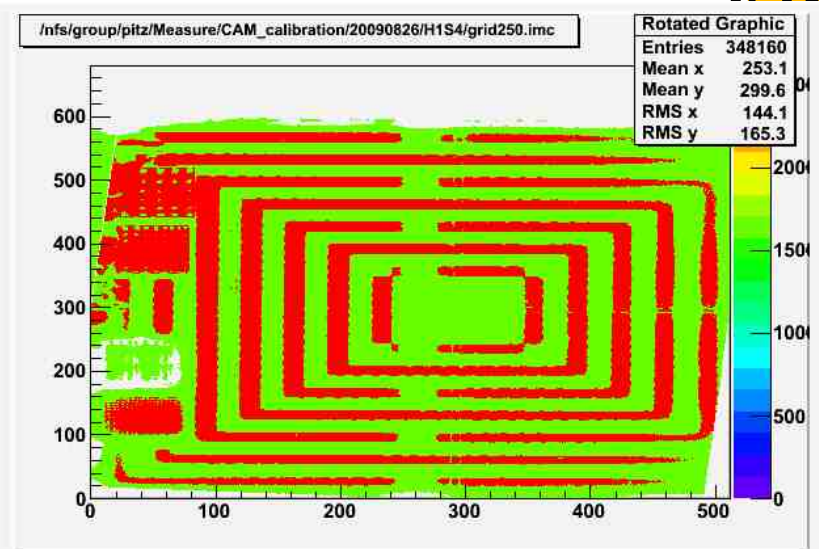
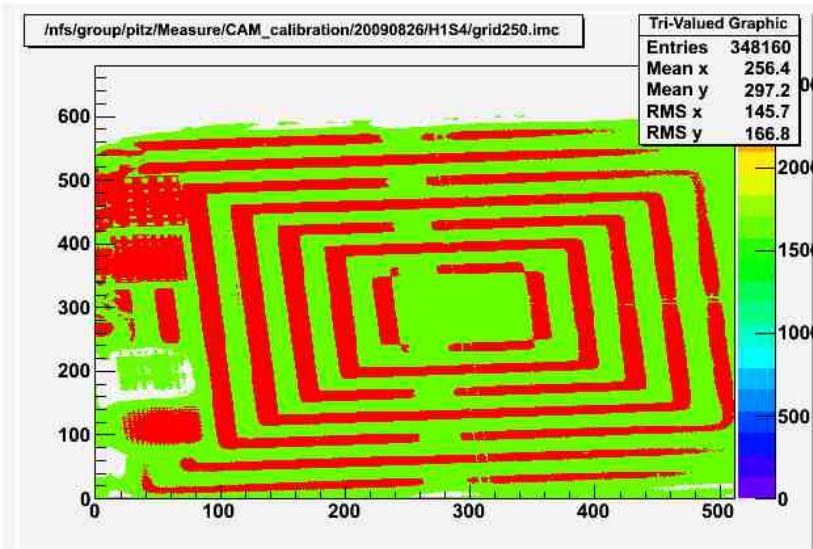
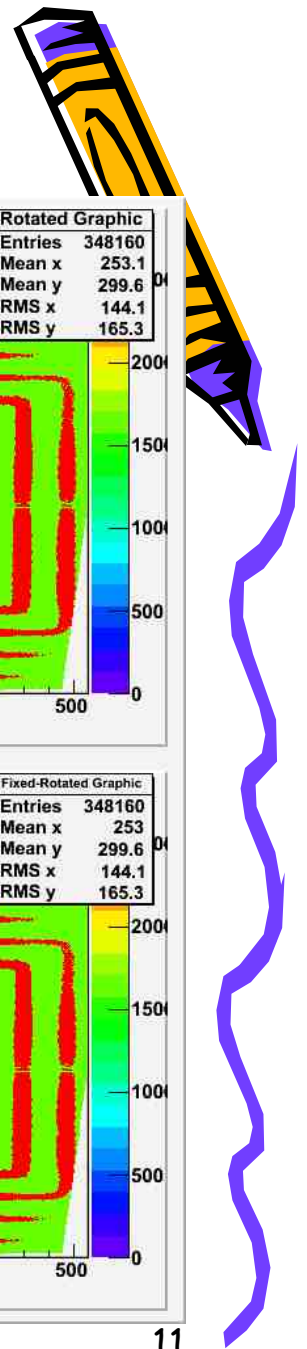
60% of (max. coord. – min. coord.) + min. coord.



Tri-valued Graphic



Rotated Graphic



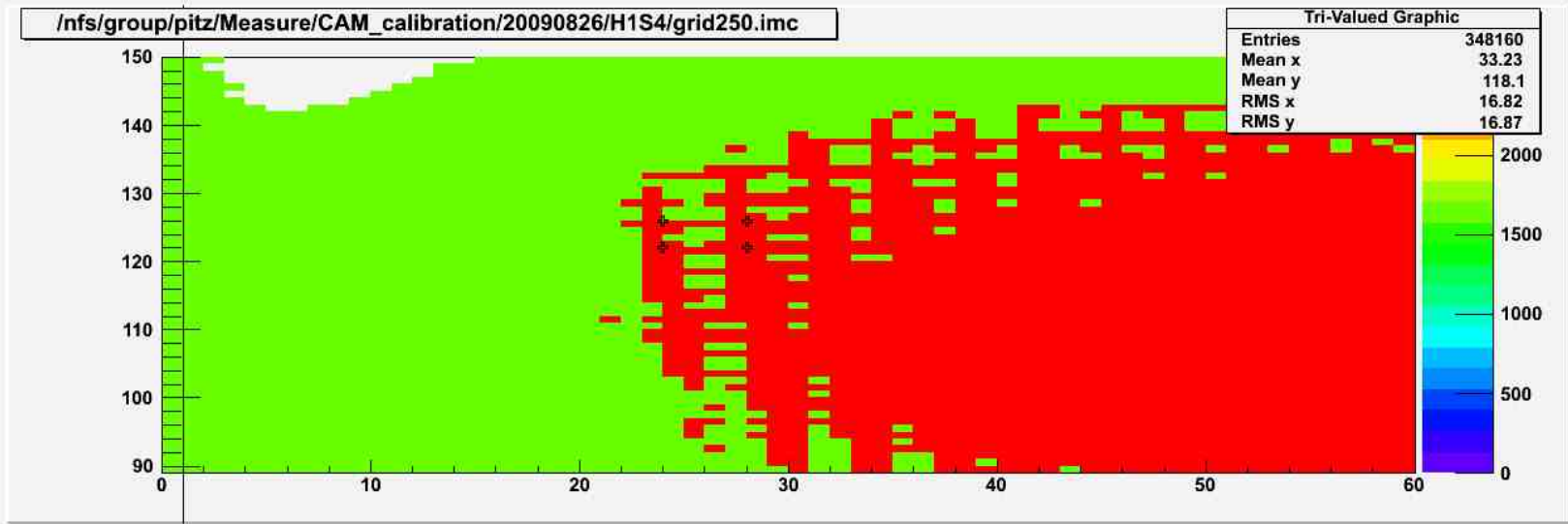
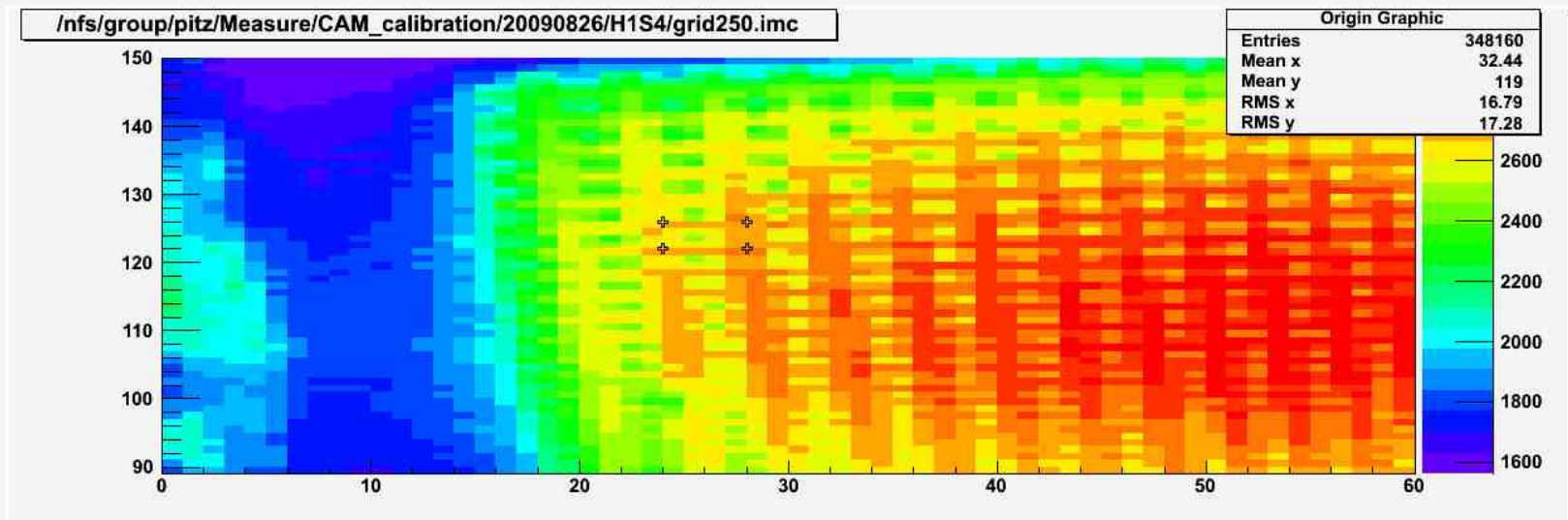
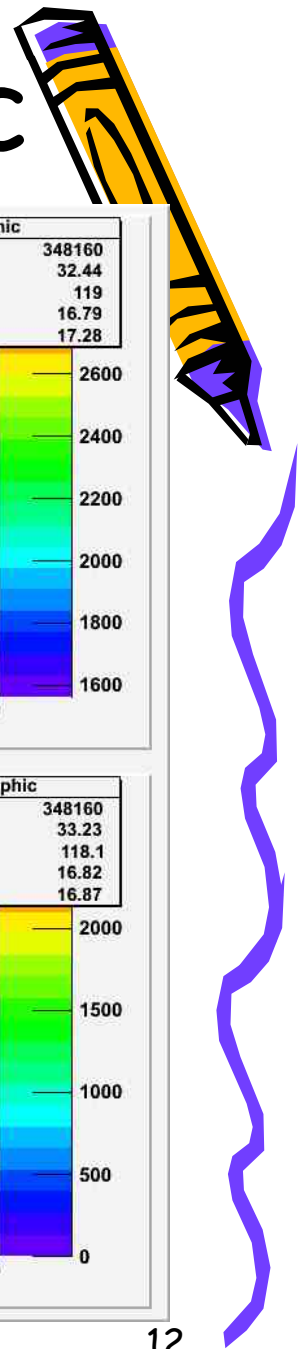
2010-2-18

PITZ PPS

11



Zoomed Original Graphic



2010-2-18

PITZ PPS

12



Problems in Rotation Method

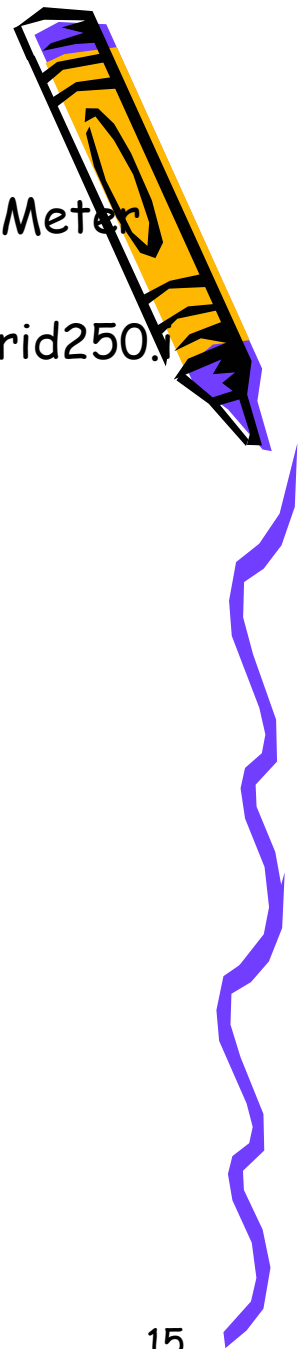
- Data type of pixel positions is Long, but after the rotation, the coordinates will be changed to Double type. When forcing the coordinates to long type, some pixels will be missed.
- When rotating back, the minimal square may not be a square anymore. At most 1-2 pixels distorted.



Without Rotation

- To tri-value the original graphic
- To find the boundary
- To find the edge point
- To trace edge point, finding the edges
- To calculate rotated angle and length
- To find which line the edges should be
- To calculate how many pixels in one mm or how many μm for one pixel

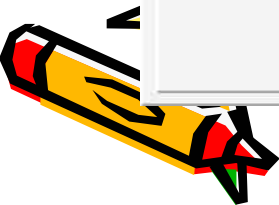
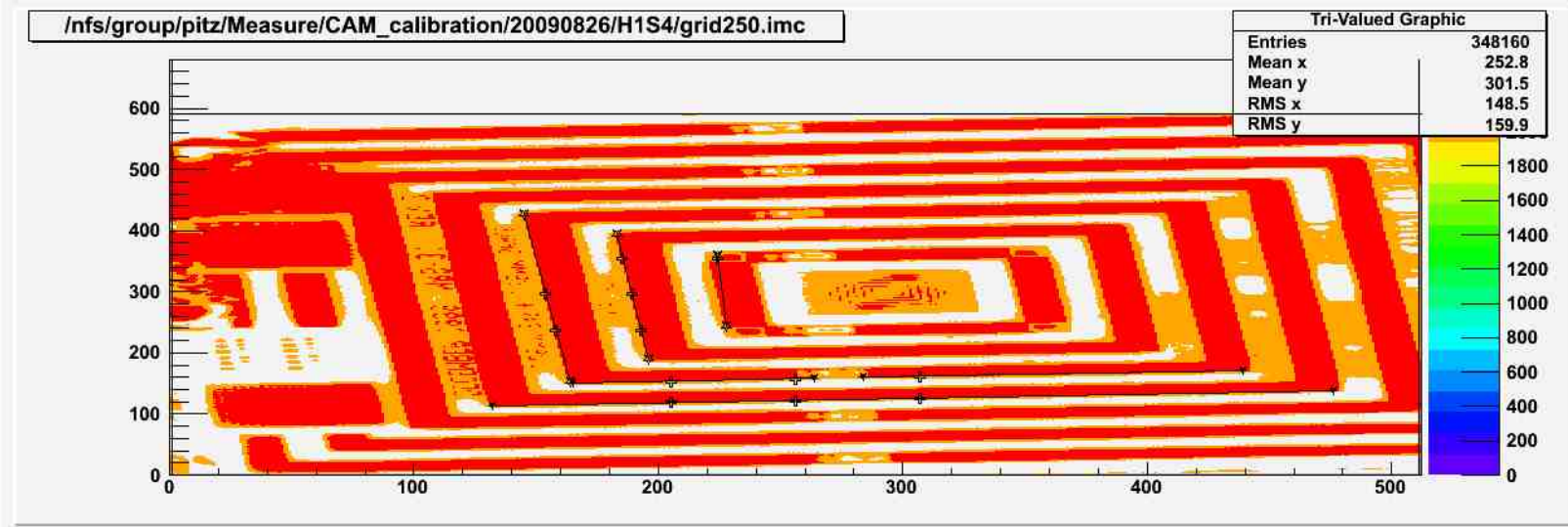
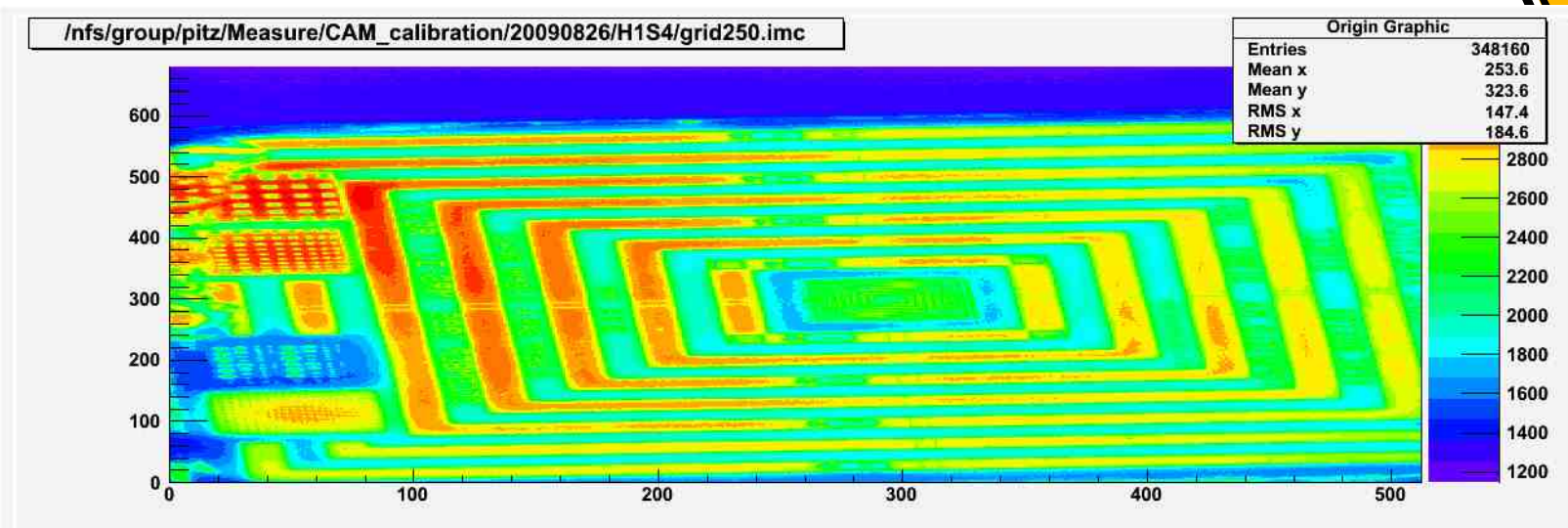
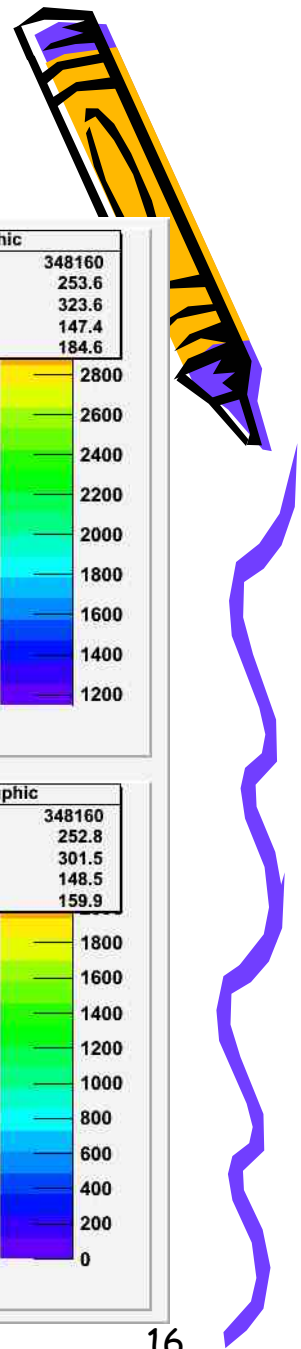




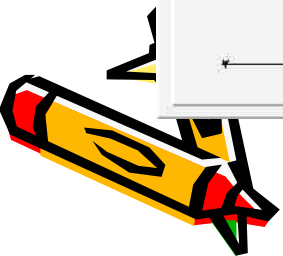
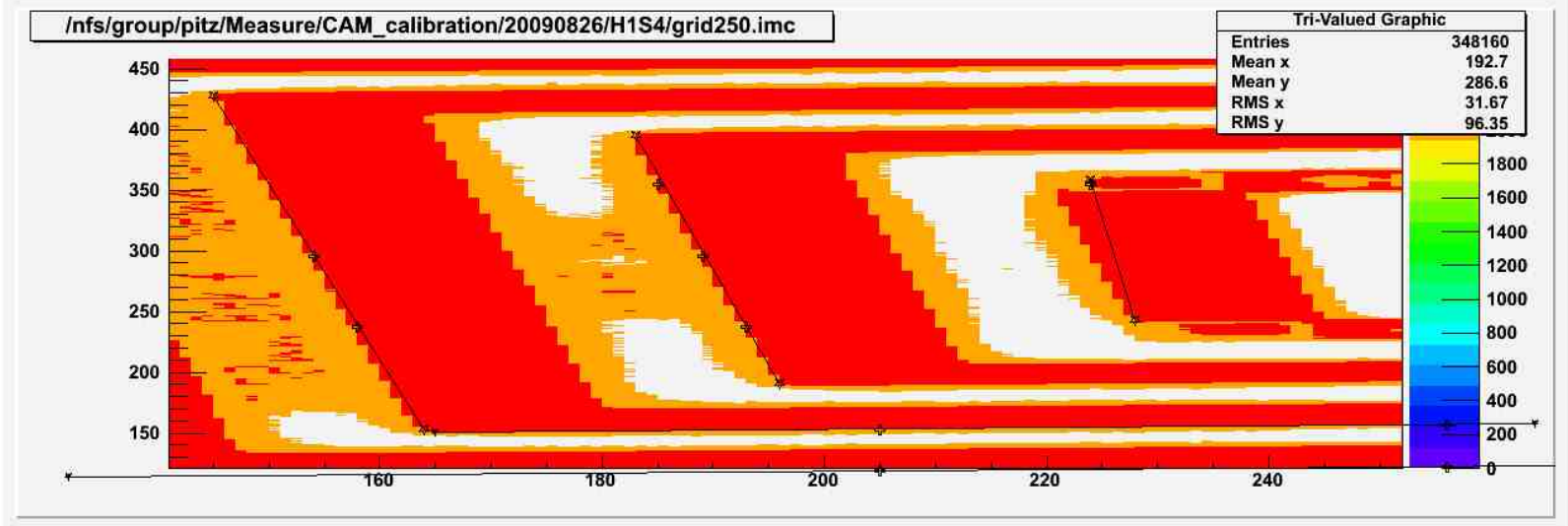
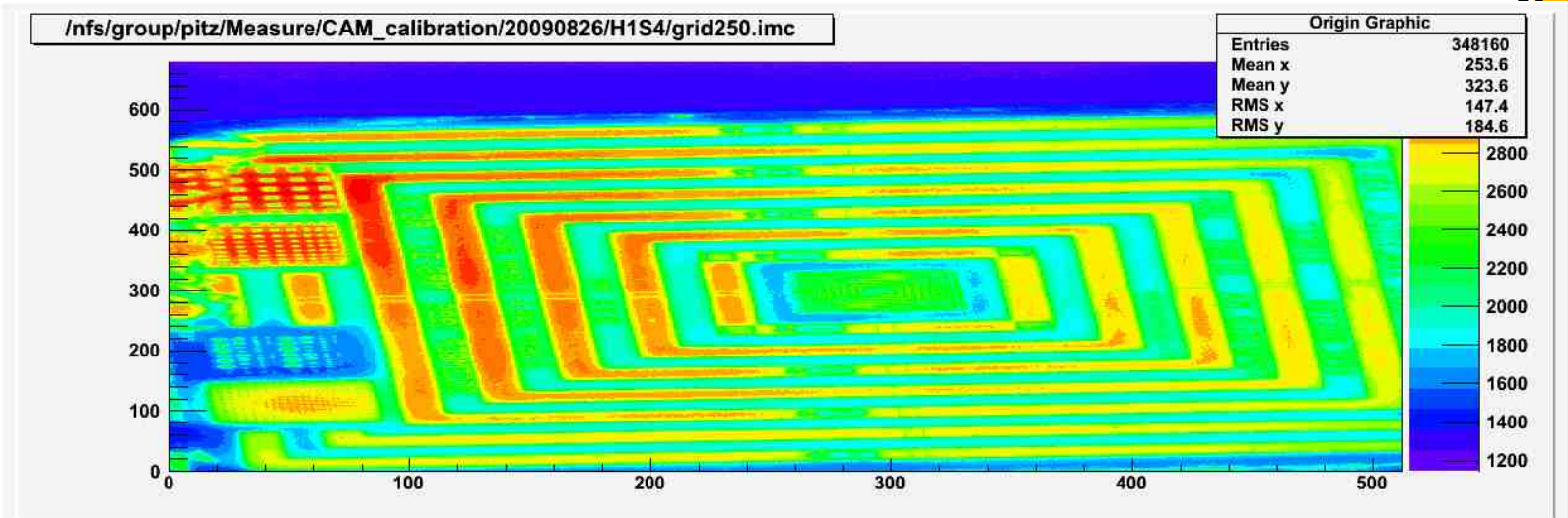
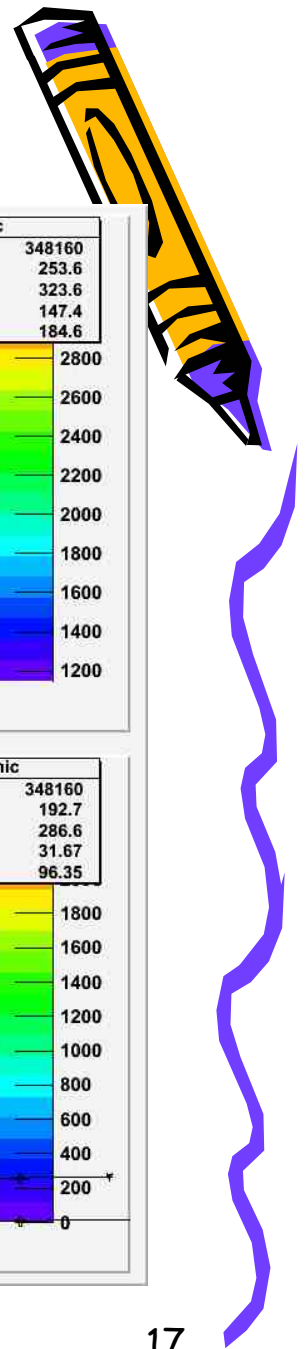
- Program Path: /doocs/data/resolution/resolution2/./resoluMeter
- Original Graphic Path:
/nfs/group/pitz/Measure/CAM_calibration/20090826/H1S4/grid250.
mc
- Tri-value threshold
 - 40% of (max. pixel value – min. pixel value) + min. pixel value;
 - 60% of (max. pixel value – min. pixel value) + min. pixel value;
- Ycut Mode
 - 40% of (max. vert. coord. – min. vert. coord.) + min. vert. coord.
 - 50% of (max. vert. coord. – min. vert. coord.) + min. vert. coord.
 - 60% of (max. vert. coord. – min. vert. coord.) + min. vert. coord.
- Xcut Mode
 - 40% of (max. hor. coord. – min. hor. coord.) + min. hor. coord.
 - 50% of (max. hor. coord. – min. hor. coord.) + min. hor. coord.
 - 60% of (max. hor. coord. – min. hor. coord.) + min. hor. coord.



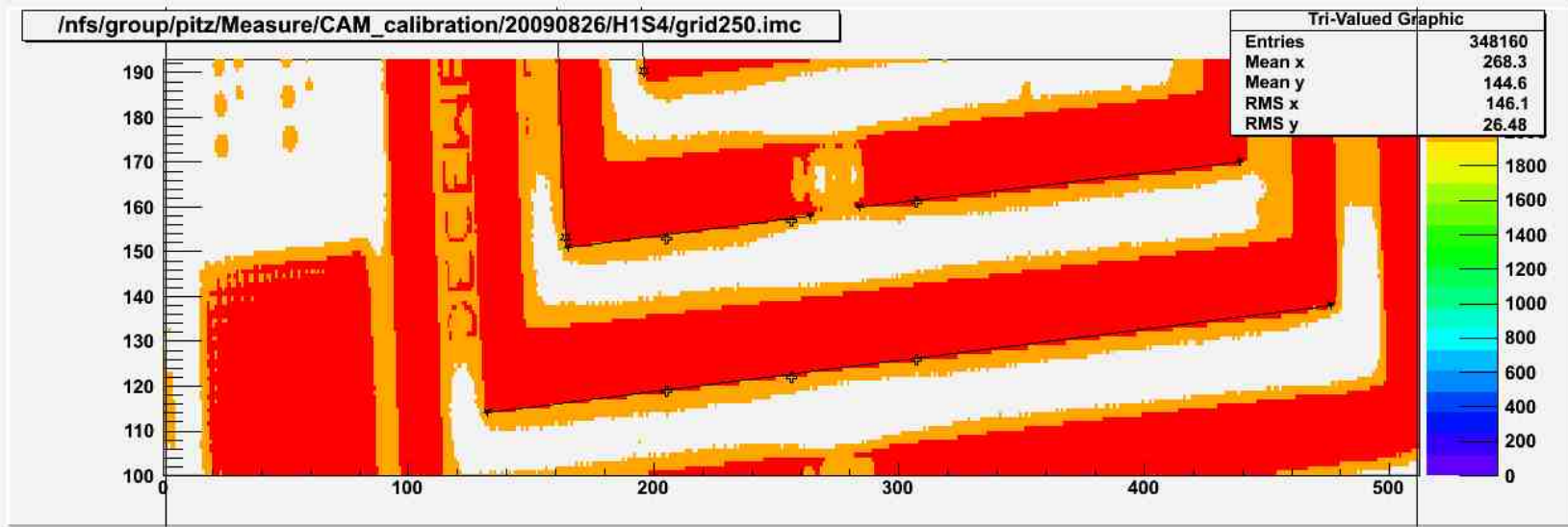
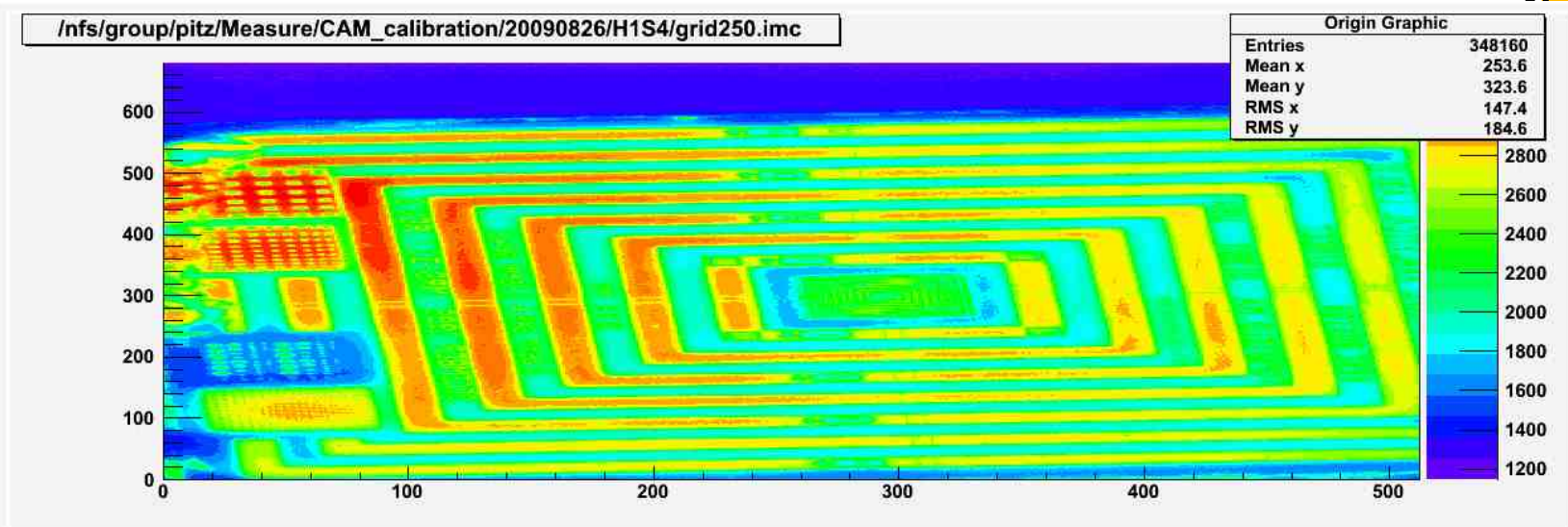
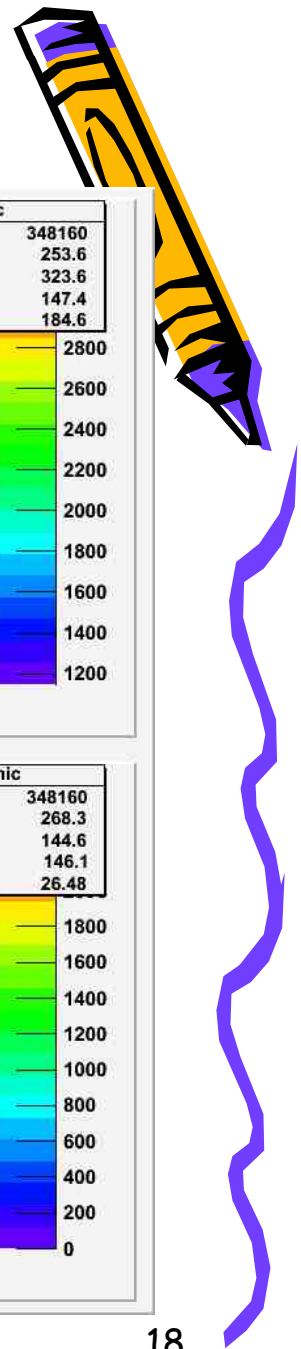
Tri-valued Graphic



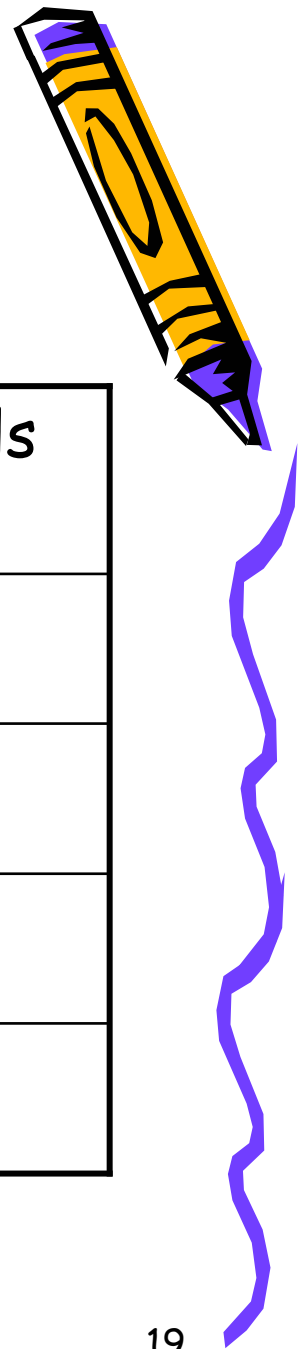
Ycut Mode



Xcut Mode



Resolutions of different lines

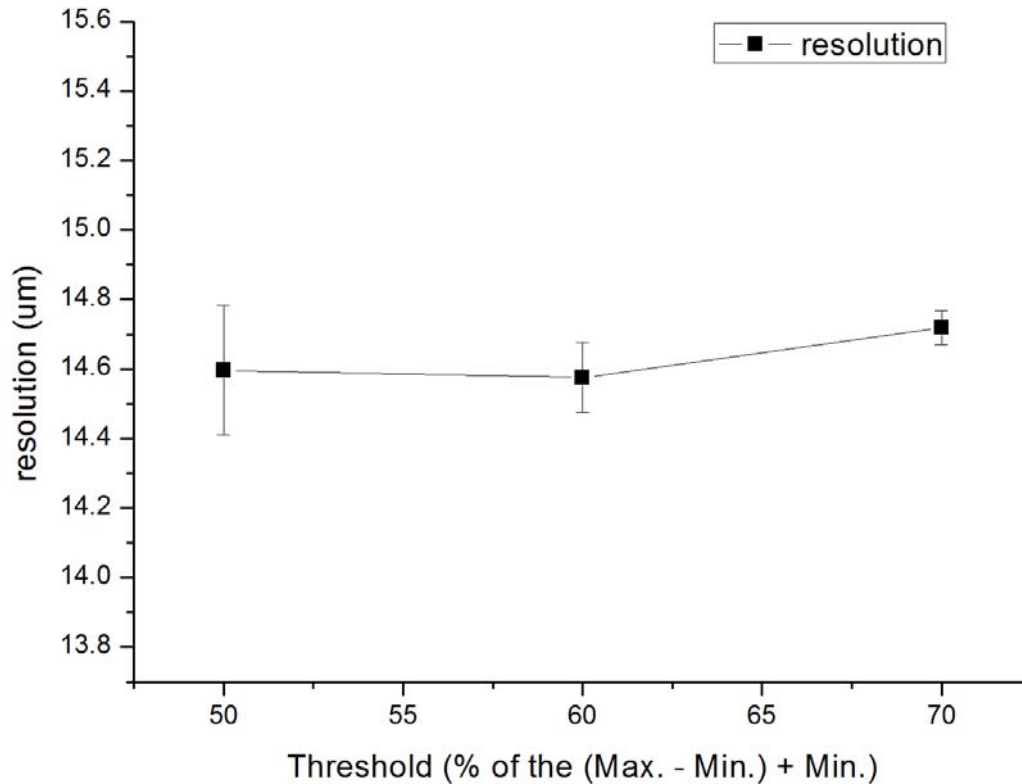


Line No. from the center	Resolution (um)	No. of pixels per mm
3rd in Xcut Mode	14.5636	68.6645
4th in Xcut Mode	14.4996	68.9672
2nd in Ycut Mode	14.6761	68.1379
3rd in Ycut Mode	14.5636	68.6645

Average resolution is 14.5757 um



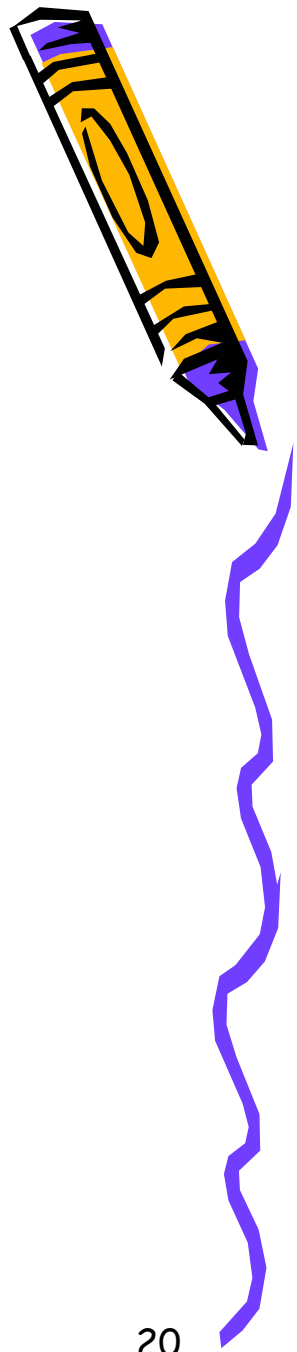
Threshold vs. resolution



2010-2-18

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20



Problems in Without Rotation Method

- When tracing the edge points, some gaps or characters are in the graphic
- Thresholds for the tri-value progress





Thank you for your attention!

