# BCAL Status:
# Apparent Laser Curvature

Kevan Hashemi

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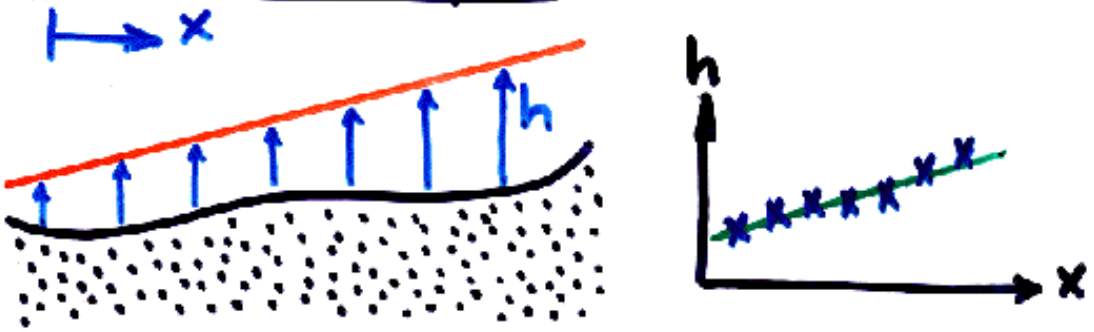
ATLAS Week

(BCAL=
Boston Ccd And Laser instrument)

## BCAL Principle




- Laser defines a straight line
- Measure height above table (plus a fixed offset)
- Residuals from a straight line fit give table curvature

## BCAL Practice

- Locus of measured laser centroid is not straight
- Asymmetry in intensity profile

+

Threshold in calculation

=

Apparent Laser Curvature

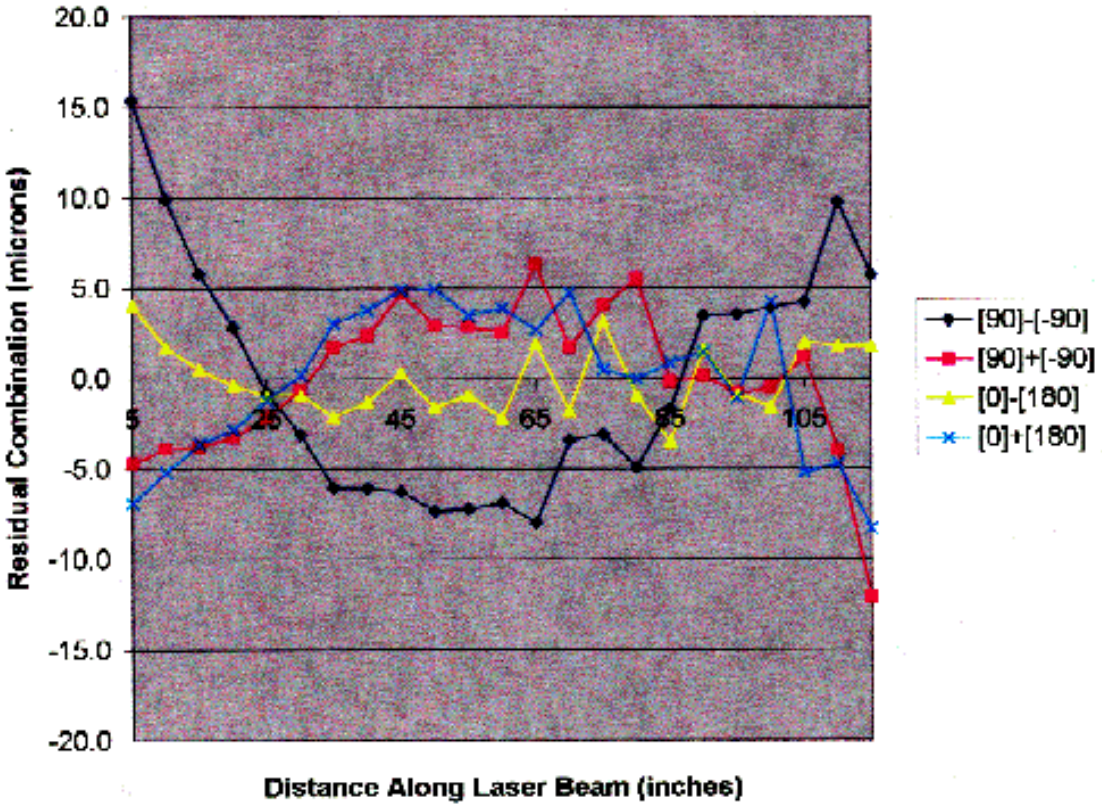
# Apparent Laser Curvature

- We can observe the apparent laser curvature by measuring a flat table
- Or we can measure any table, rotate laser 180°, and repeat. The difference is 2 x laser curve.

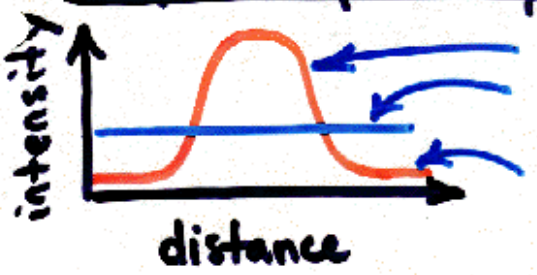
- Full measurement by repeating at 0°, 90°, 180°, -90°

[0°] - [180°] = 2 x vertical laser curve
[0°] + [180°] = 2 x table curve
[90°] - [-90°] = 2 x horizontal laser curve
[90°] + [-90°] = 2x table curve

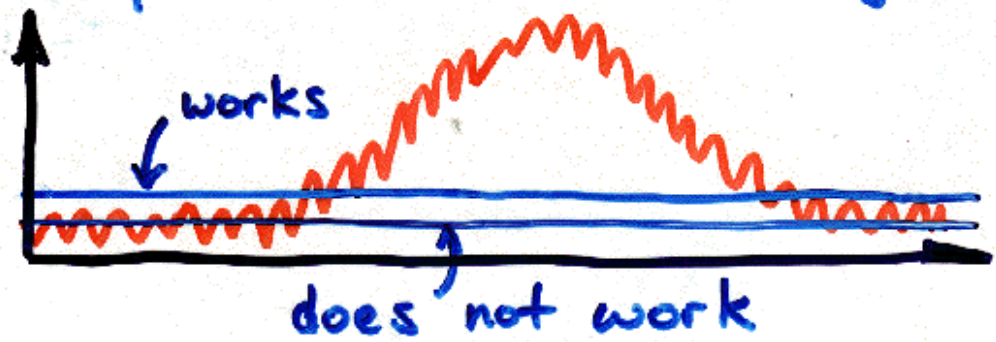
- Note: Should get
  [0°] + [180°] = [90°] + [-90°]

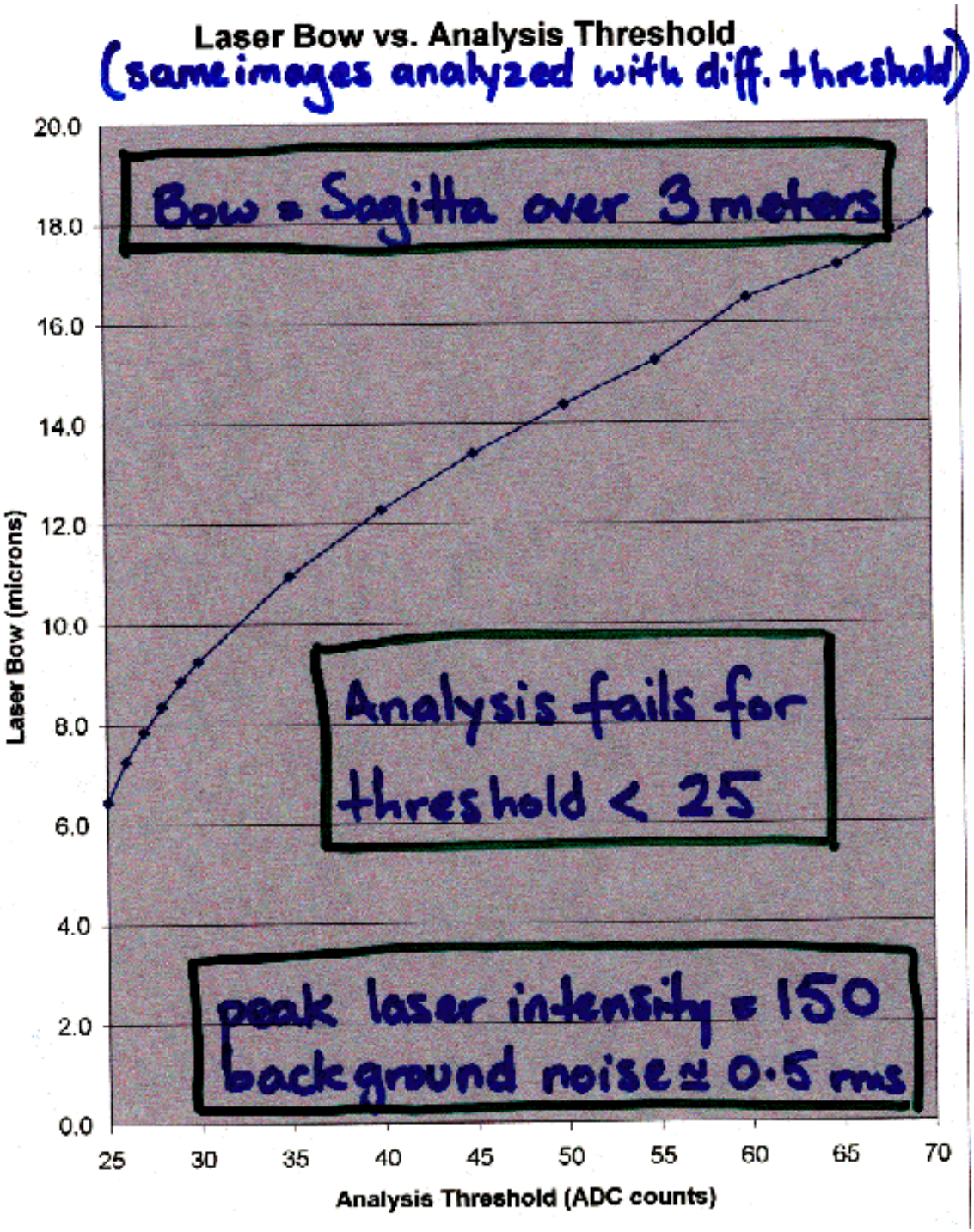

20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Residual Combination (microns)
5
25
45
65
85
105
Distance Along Laser Beam (inches)
[90]-[-90]
[90]+[-90]
[0]-[180]
[0]+[180]

# Effect of Analysis Threshold




- calculation of centroid position uses only pixels above threshold
- asymmetry in profile makes centroid threshold-dependent
- in theory, get true centroid with threshold = background
- in practice, BACKGROUND NOISE forces threshold > background




Laser Bow vs. Analysis Threshold
(same images analyzed with diff. threshold)
Bow = Sagitta over 3 meters
Analysis fails for threshold < 25
peak laser intensity = 150
background noise ≈ 0.5 rms
Laser Bow (microns)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
25
30
35
40
45
50
55
60
65
70
Analysis Threshold (ADC counts)

## Conclusion

1.5 mm gaussian laser beam
+ 15 m single-mode fiber
+ laser on low power
+ laser not temperature-controlled
+ analysis threshold just > background
+ 3-meter distance

= apparent laser bow ~ 10 μm

Observe: bow can rotate and change size during the course of a day

Propose: neutralize effect by keeping bow parallel to table

Propose: neutralize effect by repeating all measurements with laser rotated 180°