



SWTEST

PROBE TODAY, FOR TOMORROW

Reducing Test Costs by Optimizing the Prober Indexing Process

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Reducing Test Costs by Optimizing the Prober Indexing Process

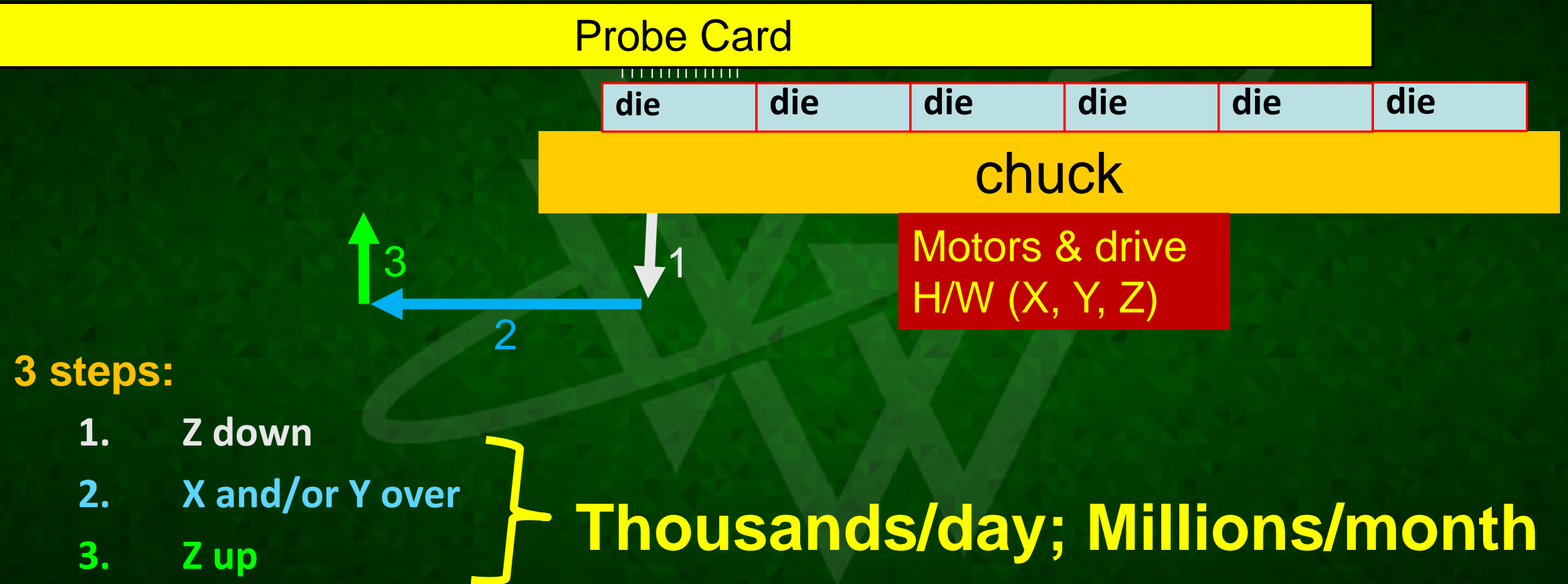
Outline

- Objectives
- Introduction
- Equipment & Procedures
- Results
- Conclusions
- To-do List

Objectives

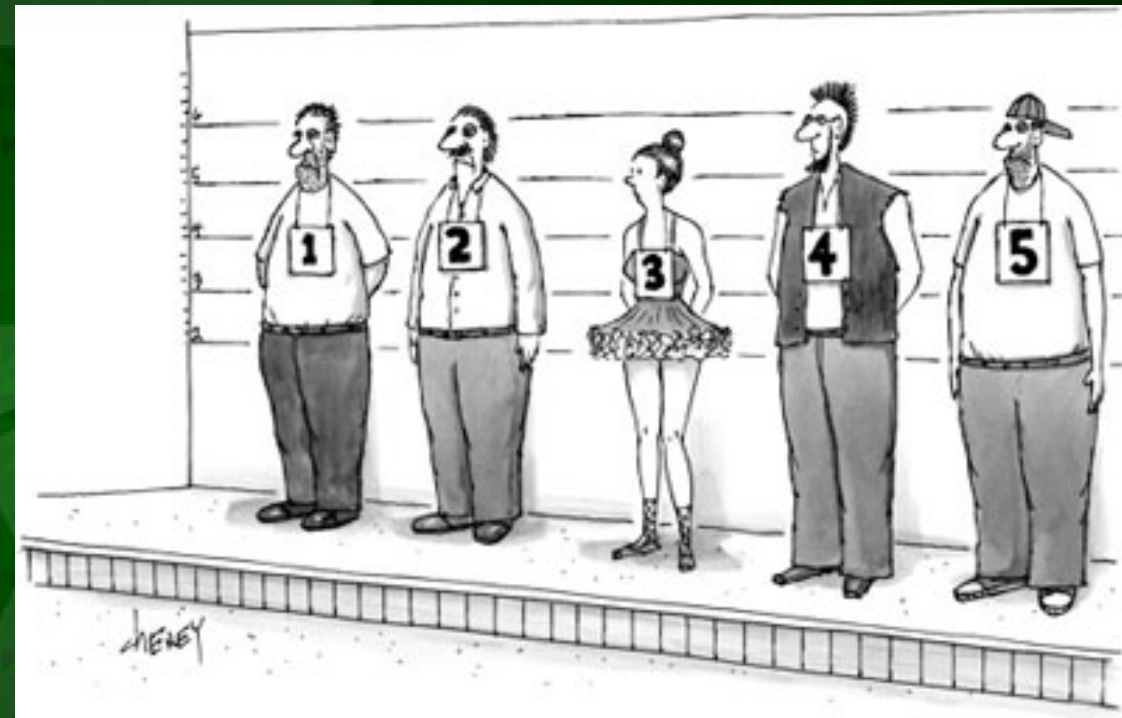
- Develop means to quickly alter prober “recipes”
(Before probe card design)
- Quantify & correlate variables affecting index times →
PREDICTABILITY
- Trim index times & costs

Introduction: prober indexing process



Suspected Variables affecting index time

- **Prober X/Y/Z drive H/W & S/W**
- **Die size & aspect ratio**
- **Index pattern:**
 - X-priority
 - Y-priority
 - Diagonal, vortex, etc.
- **Parallelism: # of sites, configuration, indexing choices**



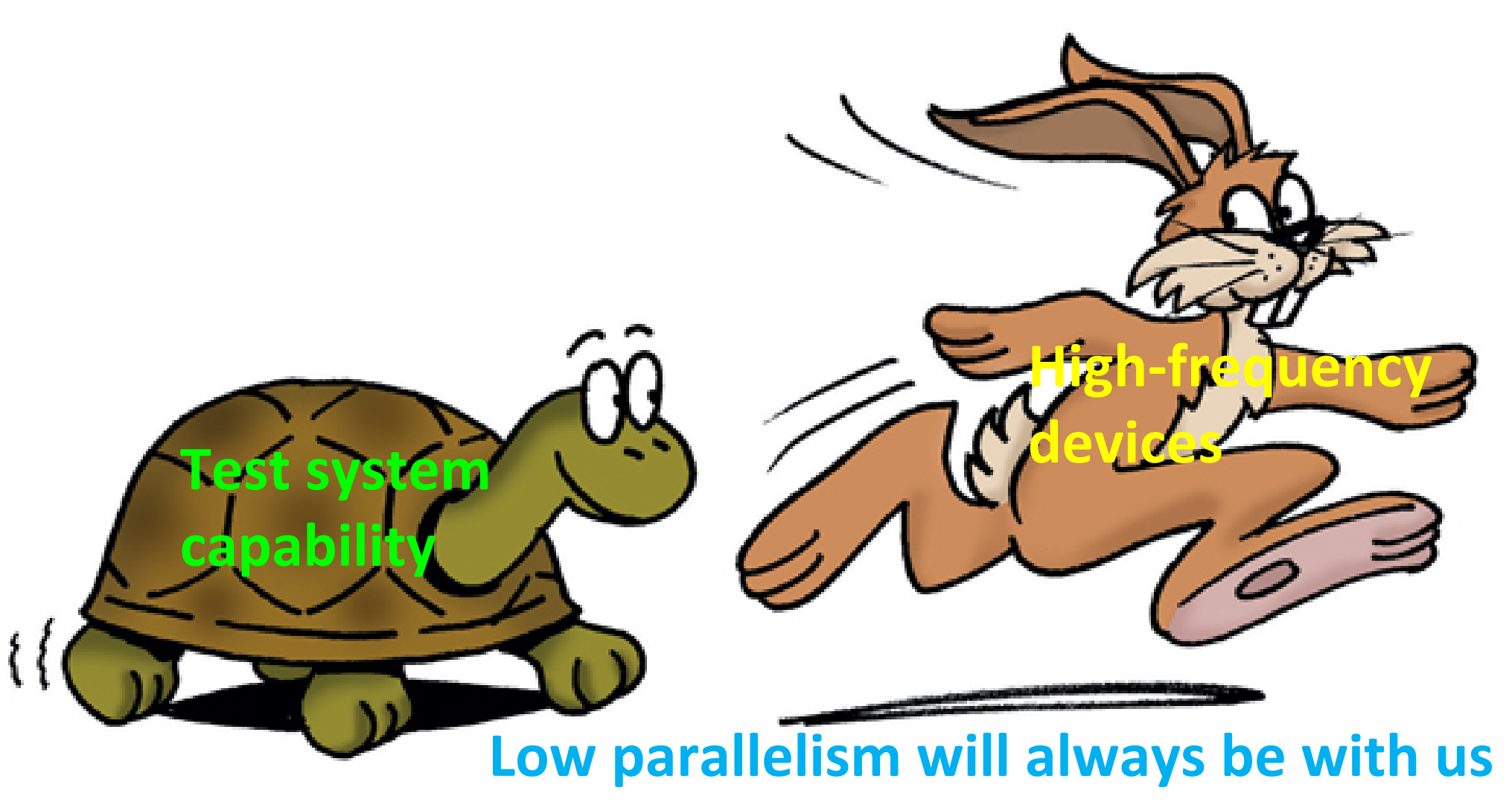
Equipment & Procedures

- 2 probers (300-mm)
- S/W: index instructions (“maps”)
- Maps → prober “recipe” file
- Start timer 1st die; end last die

NOT included:

- test program
- loading/unloading wafer
- wafer/probe alignment (demo mode); no:
 - theta rotation of chuck
 - slight stepping in “off” axis

Fable? The Tester and the Die



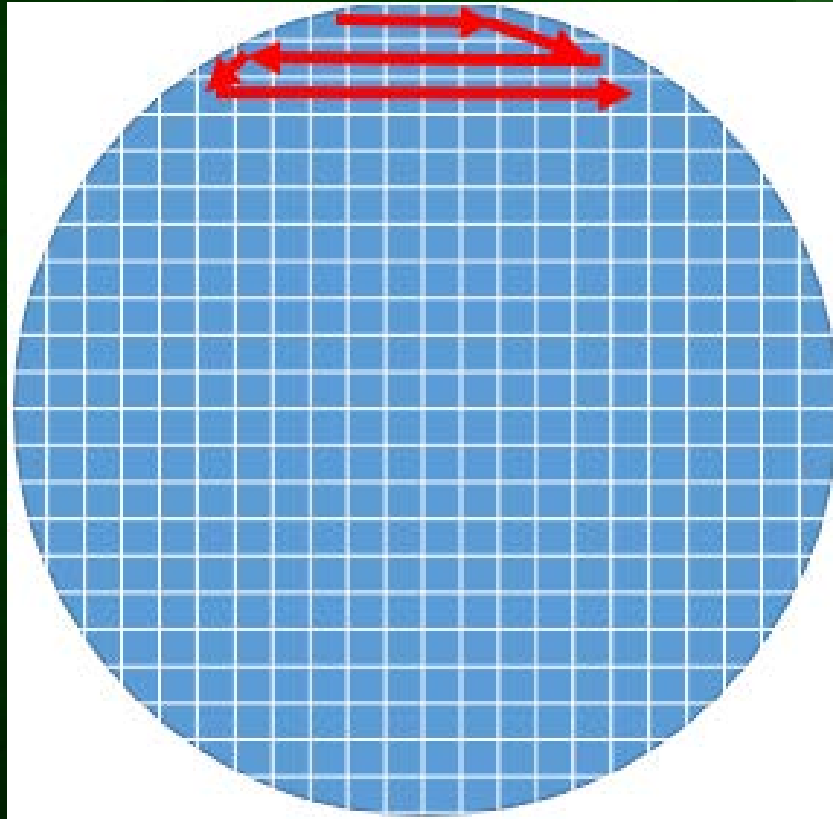
Mostly
X1

Some
X4

Experiment #1: X vs. Y Indexing

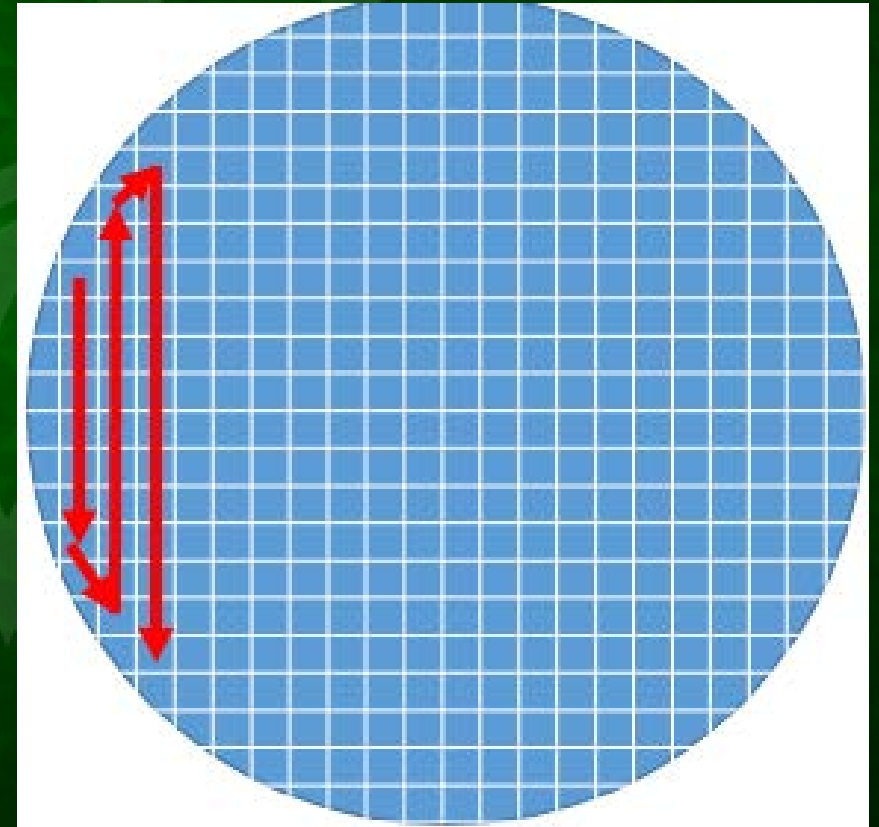
X indexing:

hundreds of X steps;
few Y

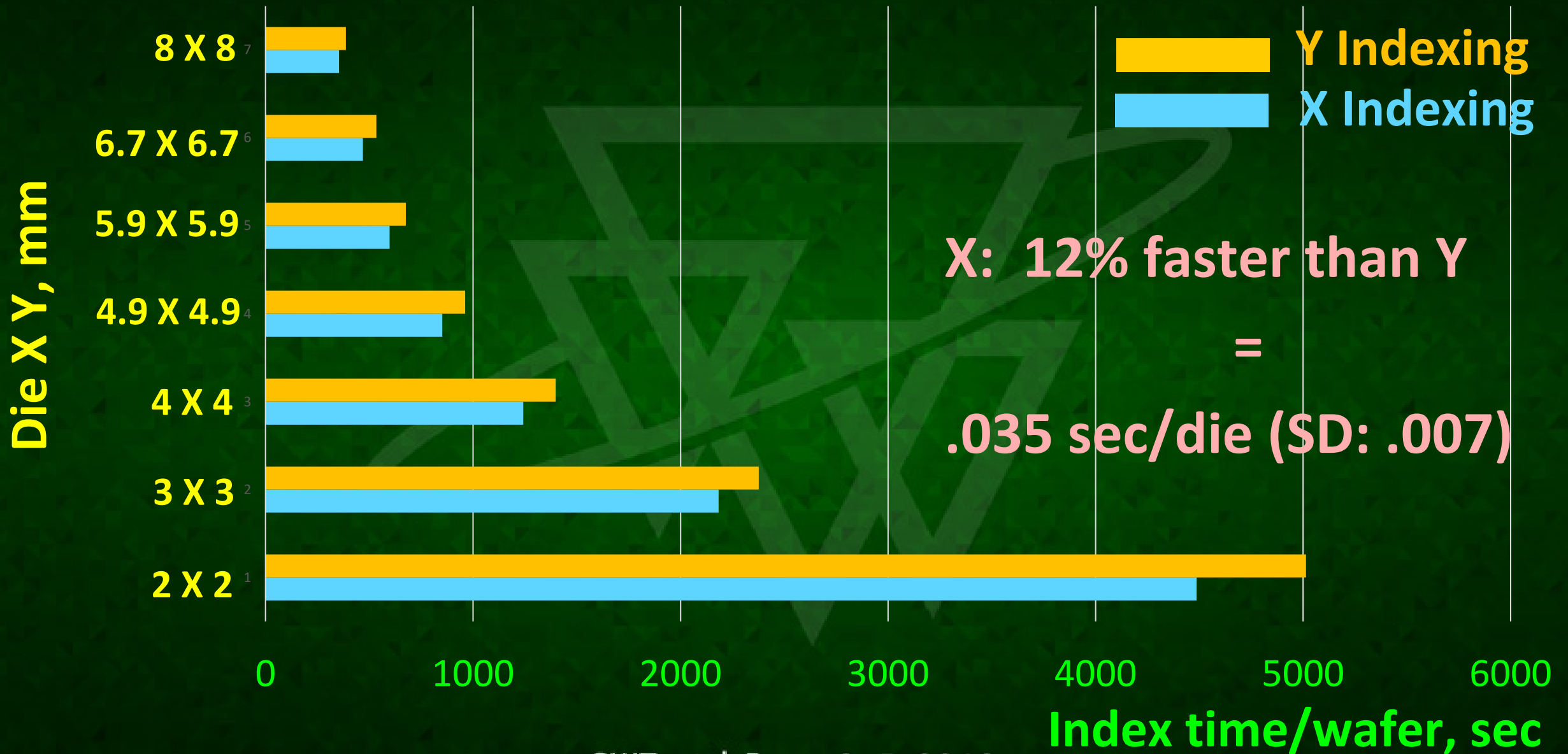


Y indexing:

hundreds of Y steps;
few X



X vs. Y indexing times (square die)



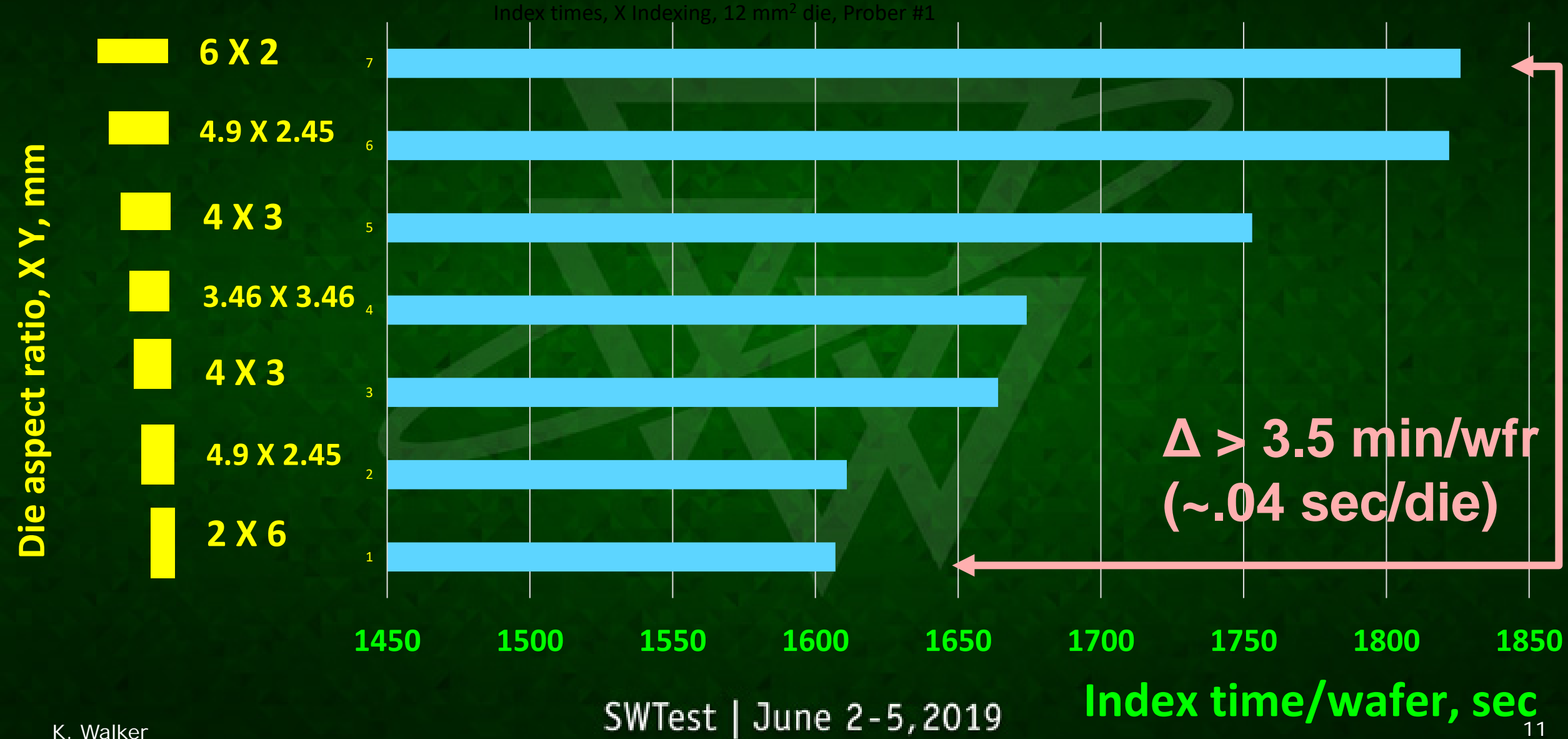
Experiment #2: Die Aspect Ratio (W/L)

Which indexes faster? By how much? Why? Predictably?

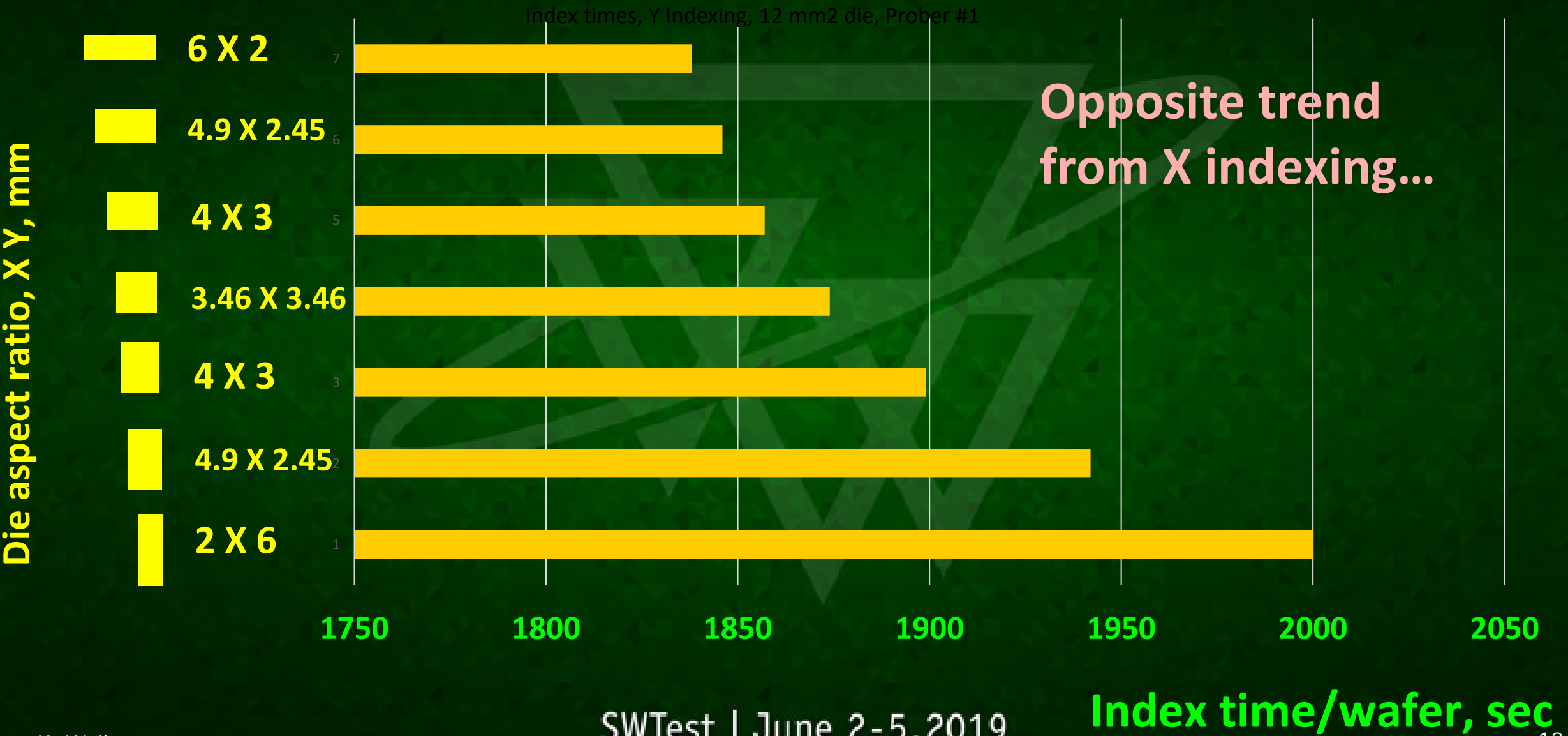


5 different die sizes
≥7 aspect ratios of each

Varying aspect ratios (X indexing)



Aspect ratios (Y indexing)

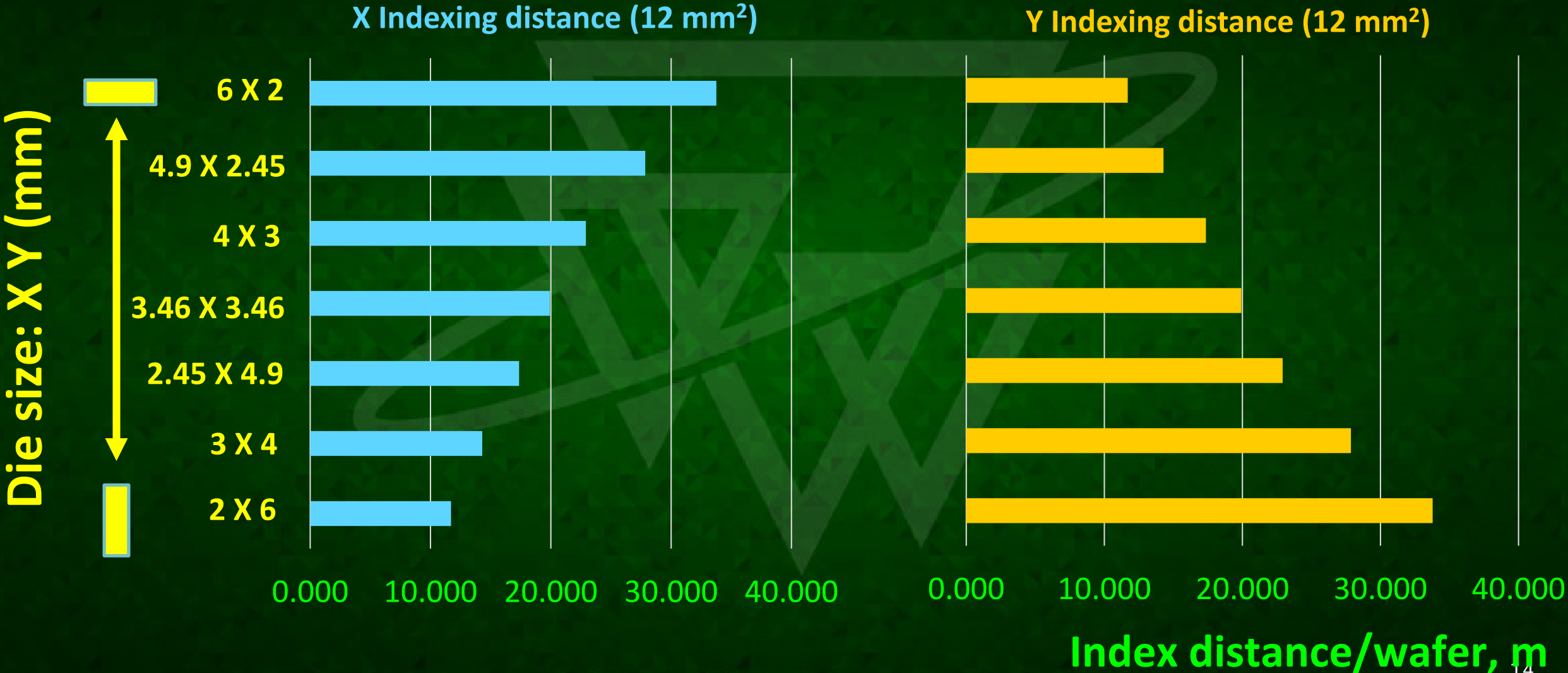


Smaller aspect ratios (W/L) \rightarrow faster X indexing

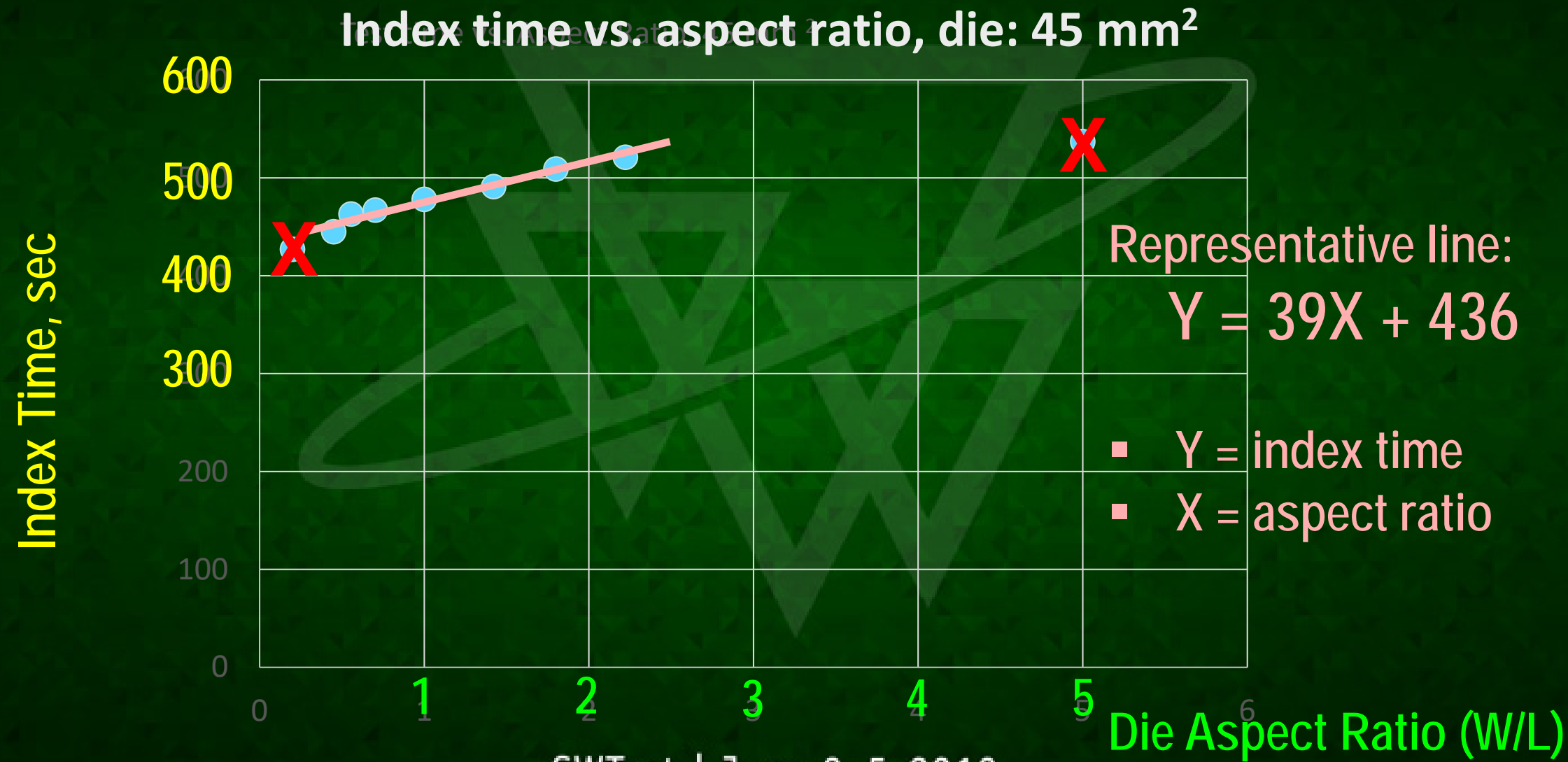
Larger aspect ratios \rightarrow faster Y indexing

WHY??

Indexing Distance (H/W travel)

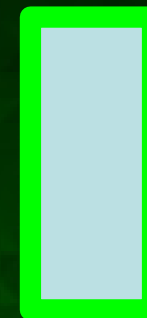
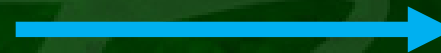


Predictability



Predictability: trivia for your next social event

If we invert aspect ratio (AR),



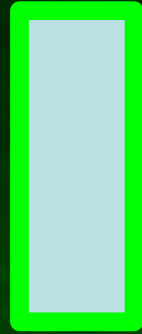
- 2:1 to 1:2 AR, index distance drops ~2:1 (**X indexing**)
- 3:1 \rightarrow 1:3, distance drops ~3:1
- 4:1 \rightarrow 1:4, ~4:1

AND... index distance \rightarrow linear w/ index time – about 1:8.5

Drop distance 1 m \rightarrow ~8.5 sec

Conclusions, Experiment #2

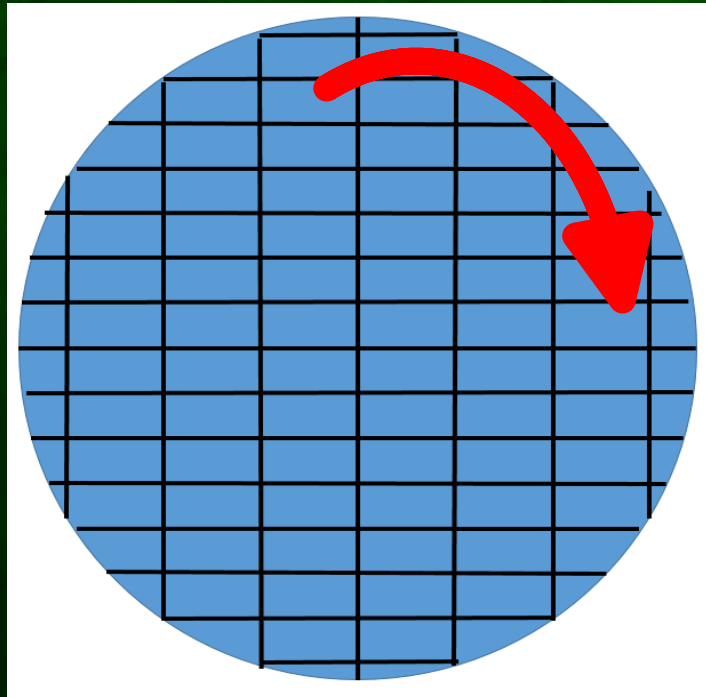
Since this:



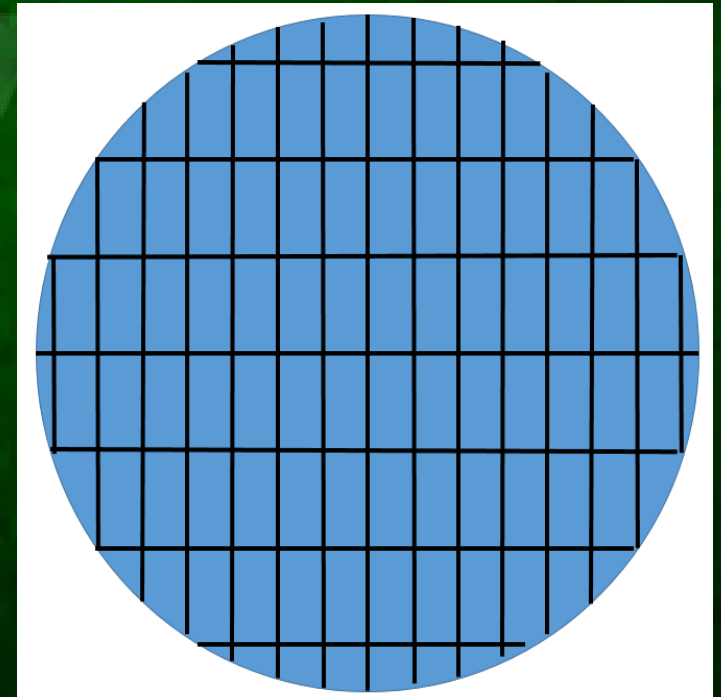
indexes faster than:



...design probe card & lay out (or rotate) wafer...



...to index like this



Can't rotate wafer & probe card...?

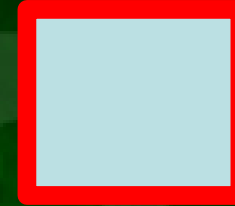
Die aspect (W/L)	Test this way:
< 2	X indexing
~2	X or Y (or Vortex) indexing
> 2	Y indexing

Conclusions, Exp #2

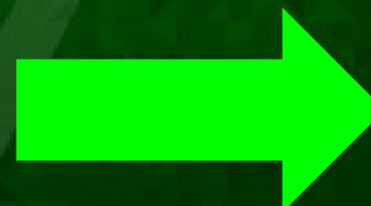
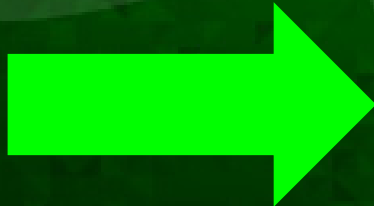
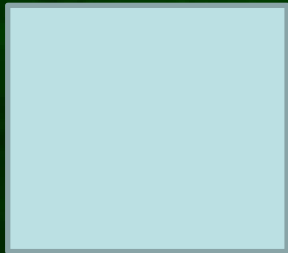
Since this:



indexes faster than:



...design die to be less square?



Experiment #3: Z up/down travel

Probe Card

die

die

die

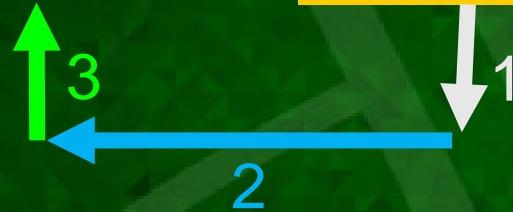
die

die

die

chuck

Motors & drive
H/W (X, Y, Z)



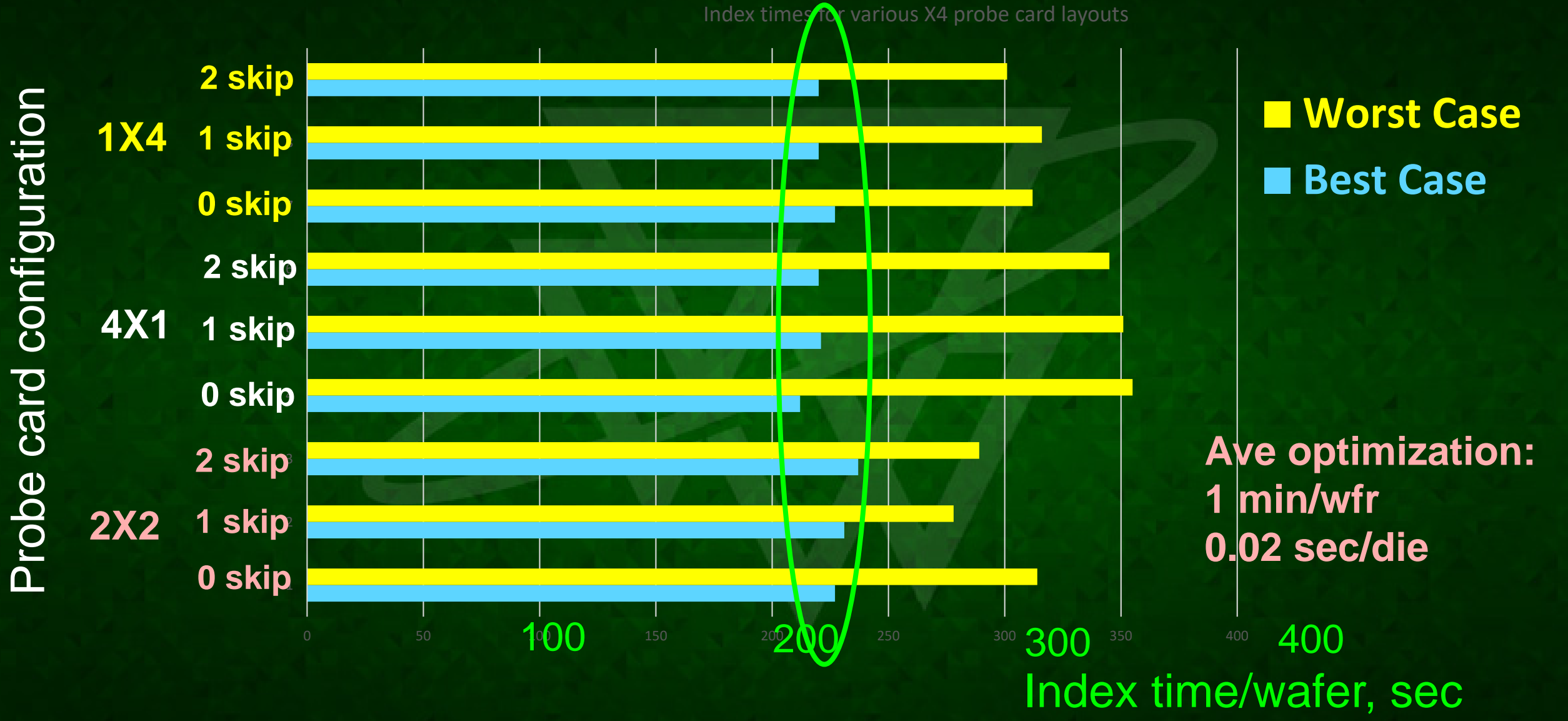
500 um up/down...
...or 250?



Index time by Z up/dn, X indexing



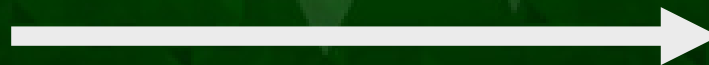
Experiment #4: Multi site (24 mm² die)



Bottom Line (X1 only)

Fastest indexing pattern	0.035 sec/die
Rotate wafer/card, Design die less square	0.040 sec/die
250 um Z up/dn	0.035 sec /die
TOTAL	0.11 sec/die

Run rate: 10MU/yr...
Test cost: \$100-200/hr



Savings:
\$40K/yr

To do...

- More work: X2 & X4
- **Design/Architecture → make die less square?**
- **Test facilities → follow our index maps**
- Wafer/shuttle layout → short die side perpendicular to notch
- **Θ rotation & off-axis micro-stepping? (Work w/ probe card vendors to align more to prober axes?)**



Thank you

