TNI LOD – Concepts of

DETECTION

What is DETECTION?

Detection is a binary decision – YES or NO.

Can you see it or not?

Was it there or not?

The number associated with that detected analyte does not need to be accurate or precise. It's just a ball park number…

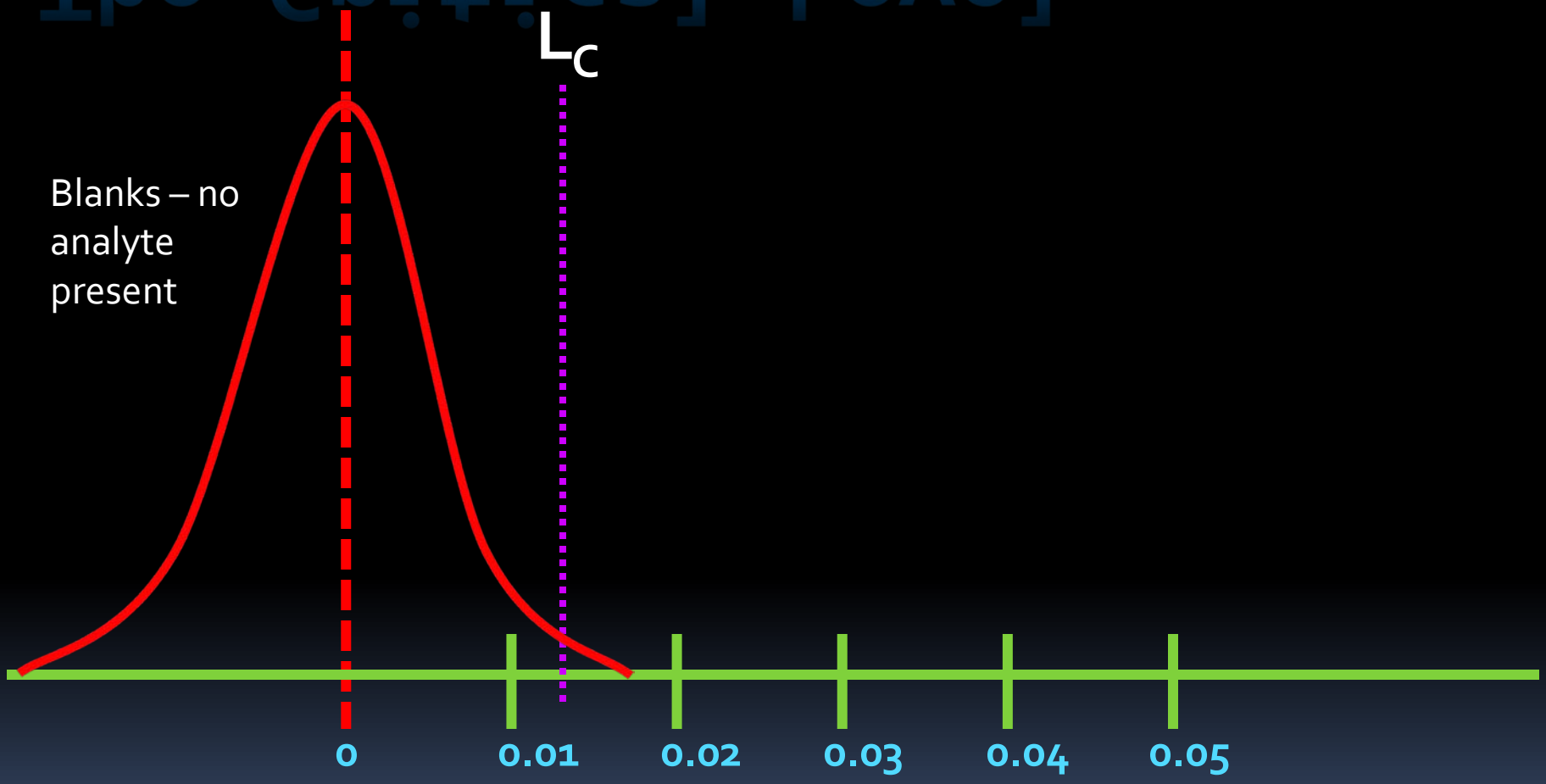

CAT FOUND!!!
BLACK + TAN WITH GREY
-MALE -NO COLLAR
-Not VERY FRIENDLY, I think he might be SCARED.
-Not HOUSE BROKEN EITHER
-Found on SUNSET BLVD.
-If HE is yours Please call
TAXONOMY FAIL

What does detected mean?

The classic definition of "Detected" is from Lloyd Currie.

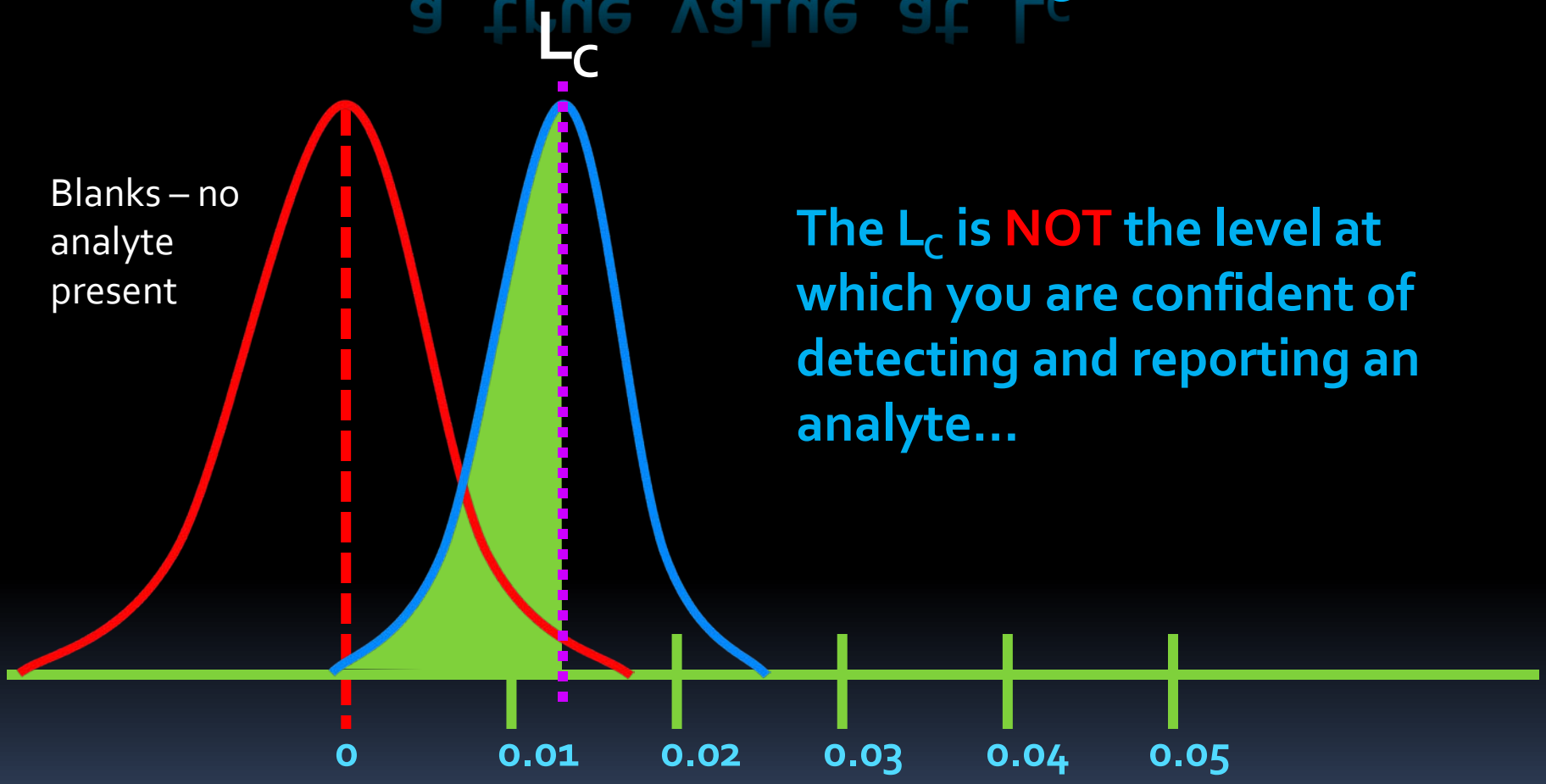
He called the value where you are almost positive your detection is not background the "Critical Level L_C".

The Critical Level



The Critical Level, L_C, is where the detection decision is made, and has an acceptable rate of false positives (<1%)

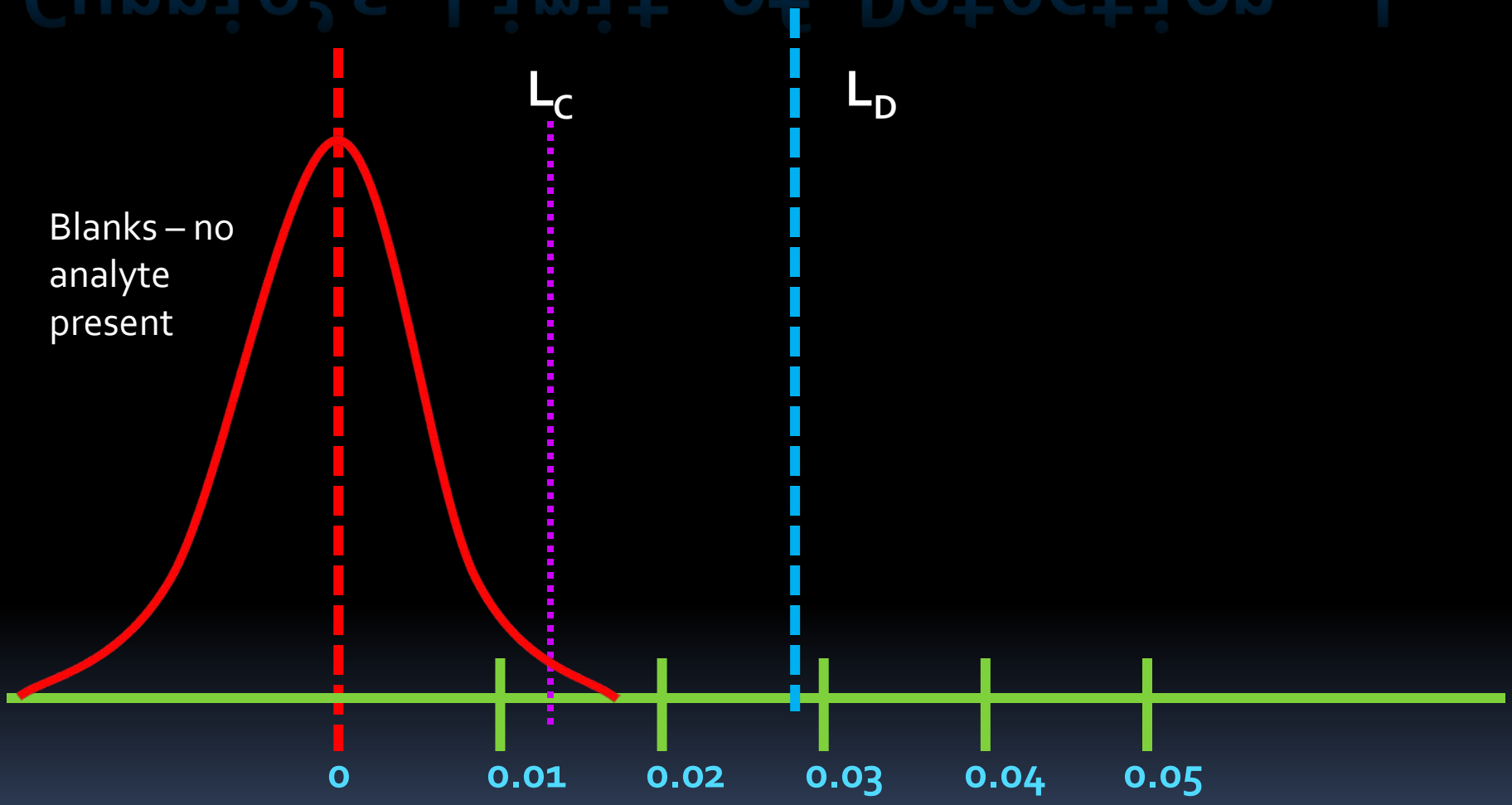
There are lots of false negatives for a true value at L_C



The L_C is NOT the level at which you are confident of detecting and reporting an analyte…

…if you have a true value at the L_C, you'll have up to 50% false negatives!

Currie's Limit of Detection, L_D



The Detection Level, L_D, is where my sample distribution minimally intersects the blank population.

What does detected mean?

In environmental analytical chemistry, there are two basic kinds of detecting…

One where the analyte starts to appear… like in GC

I see it!

What does detected mean?

…and one where your analyte is indistinguishable from background, like ICP… so you don't "detect" this analyte until you are out of the background range.

ICP Detection based on Quantitated Value

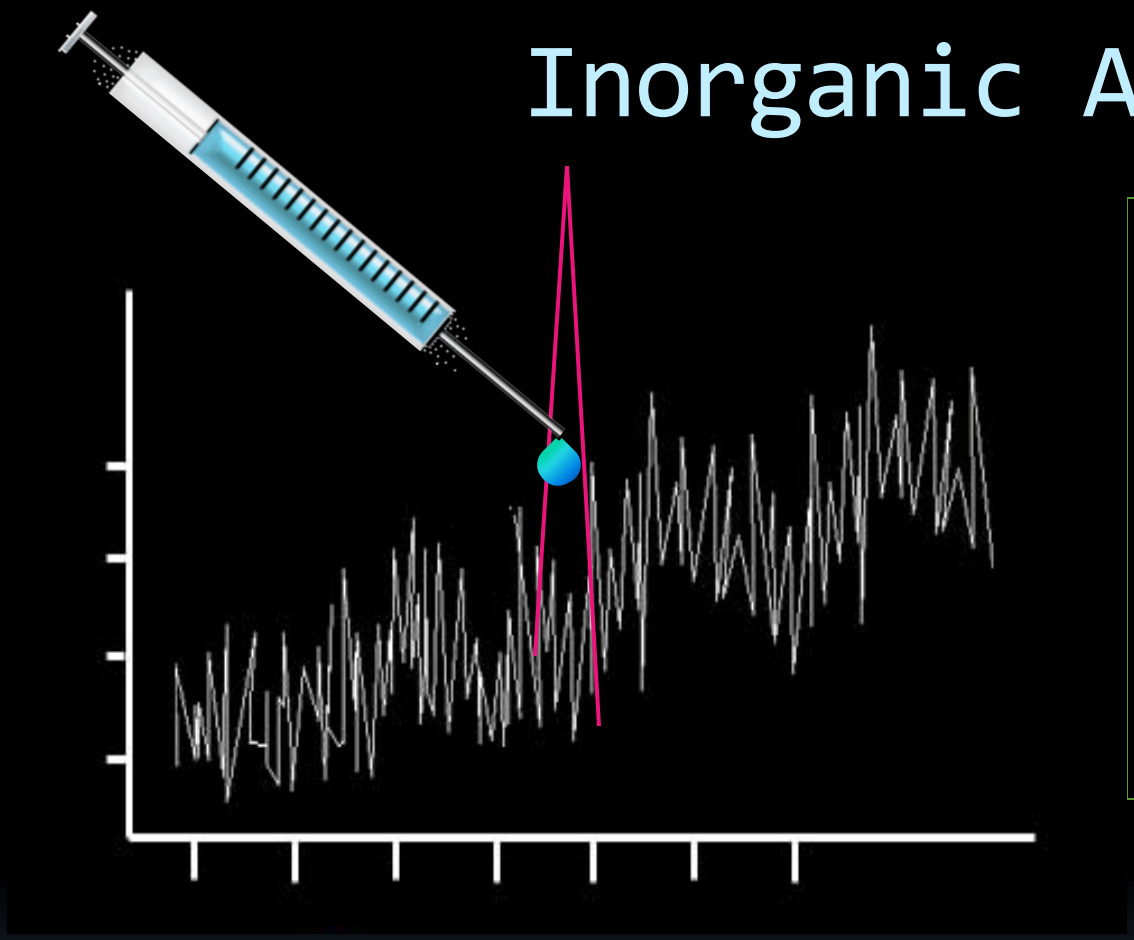
What does detected mean?

GC analyses have noise just like ICP. It is just that the instrument signal cut-off value is set to eliminate the chatter so the report will not be overloaded with non-reportable noise.

If you look below the that threshold, you will see the noise.

My Threshold

Inorganic Analysis…



"Detected"

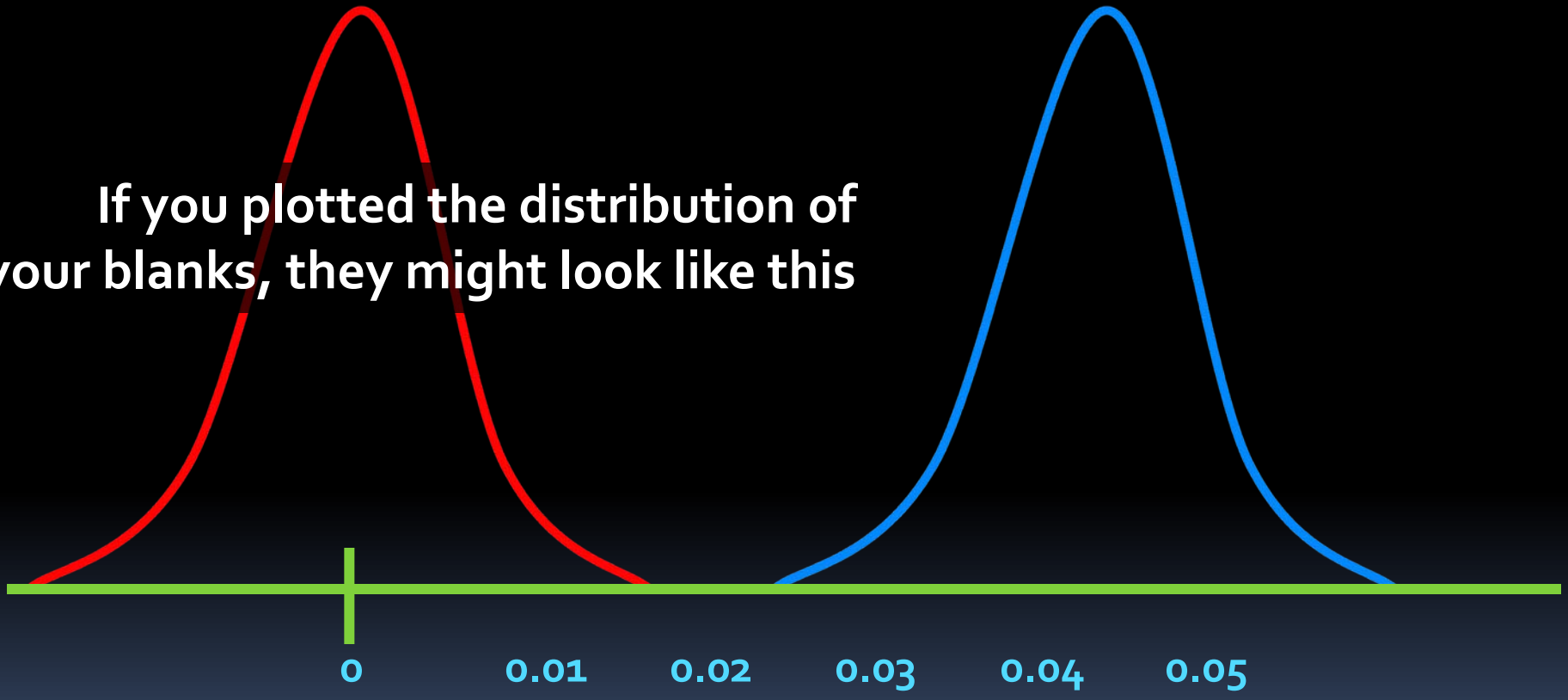
≠

"Any Measurable Signal"

Inorganic analyses like ICP and ICPMS always have signal, be it electronic noise, contamination, interference or carryover.

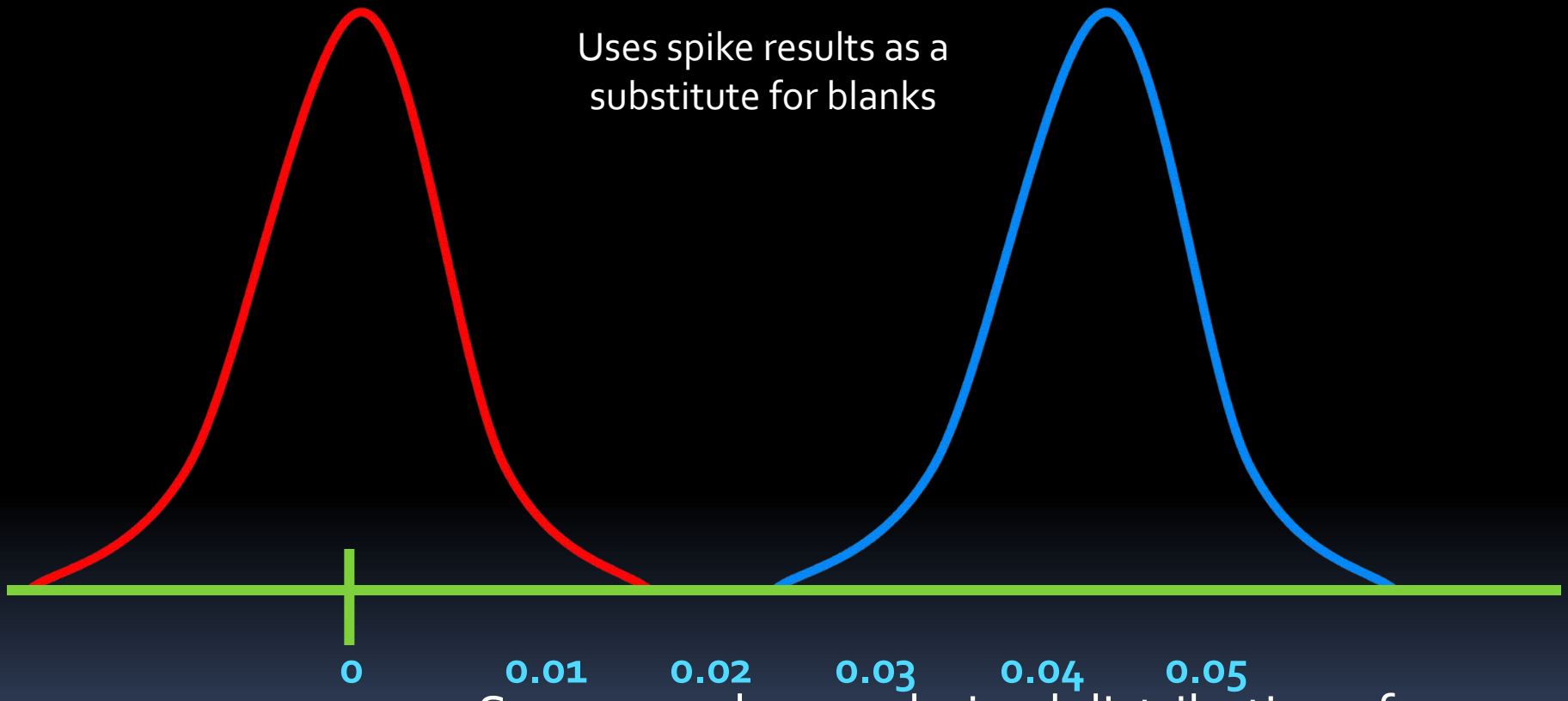
The EPA MDL (40 CFR Part 136)

If you plotted the distribution of your blanks, they might look like this



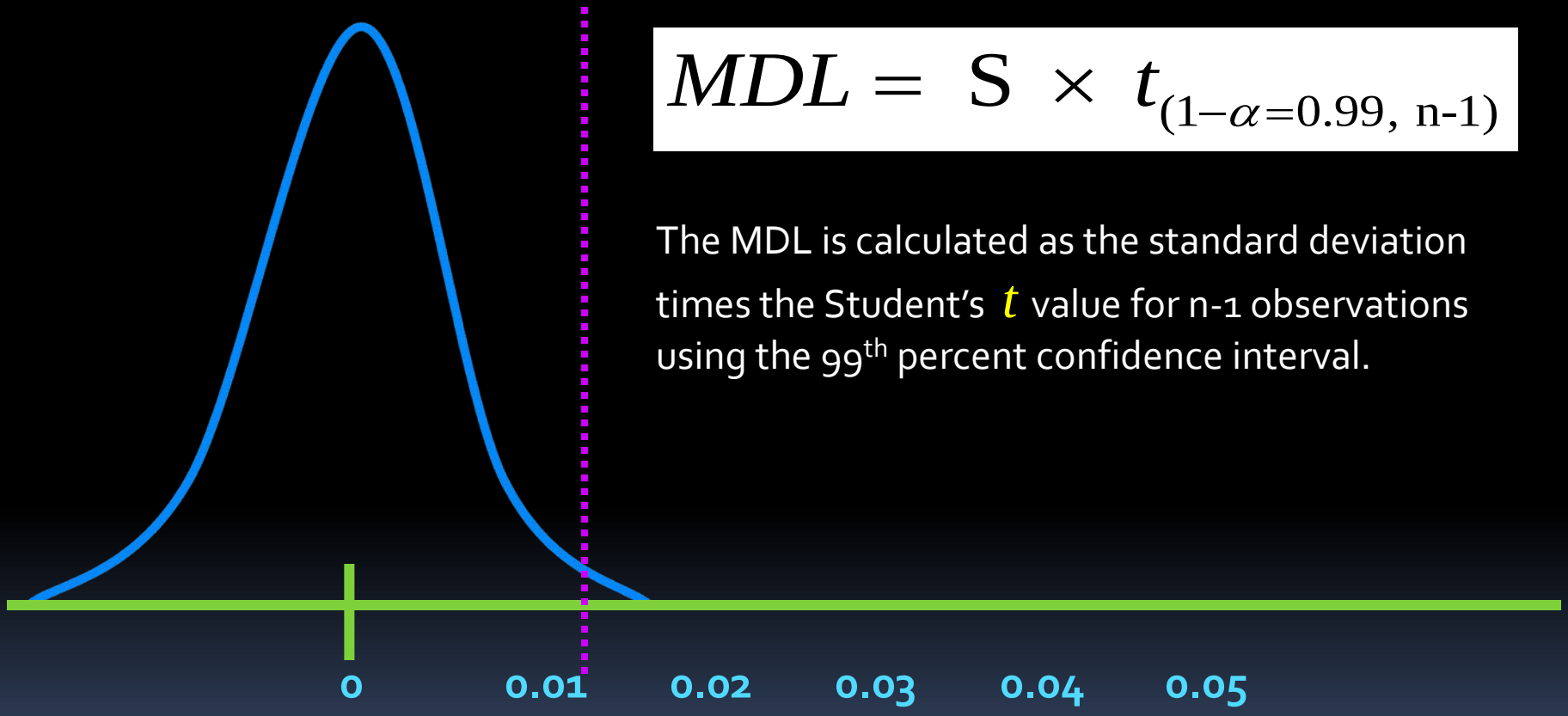
The MDL assumes that if you spike at a low concentration you'll get the same distribution as the blanks.

The EPA MDL (40 CFR Part 136)



So we now have a derived distribution of blank results from the spikes.

The EPA MDL (40 CFR Part 136)

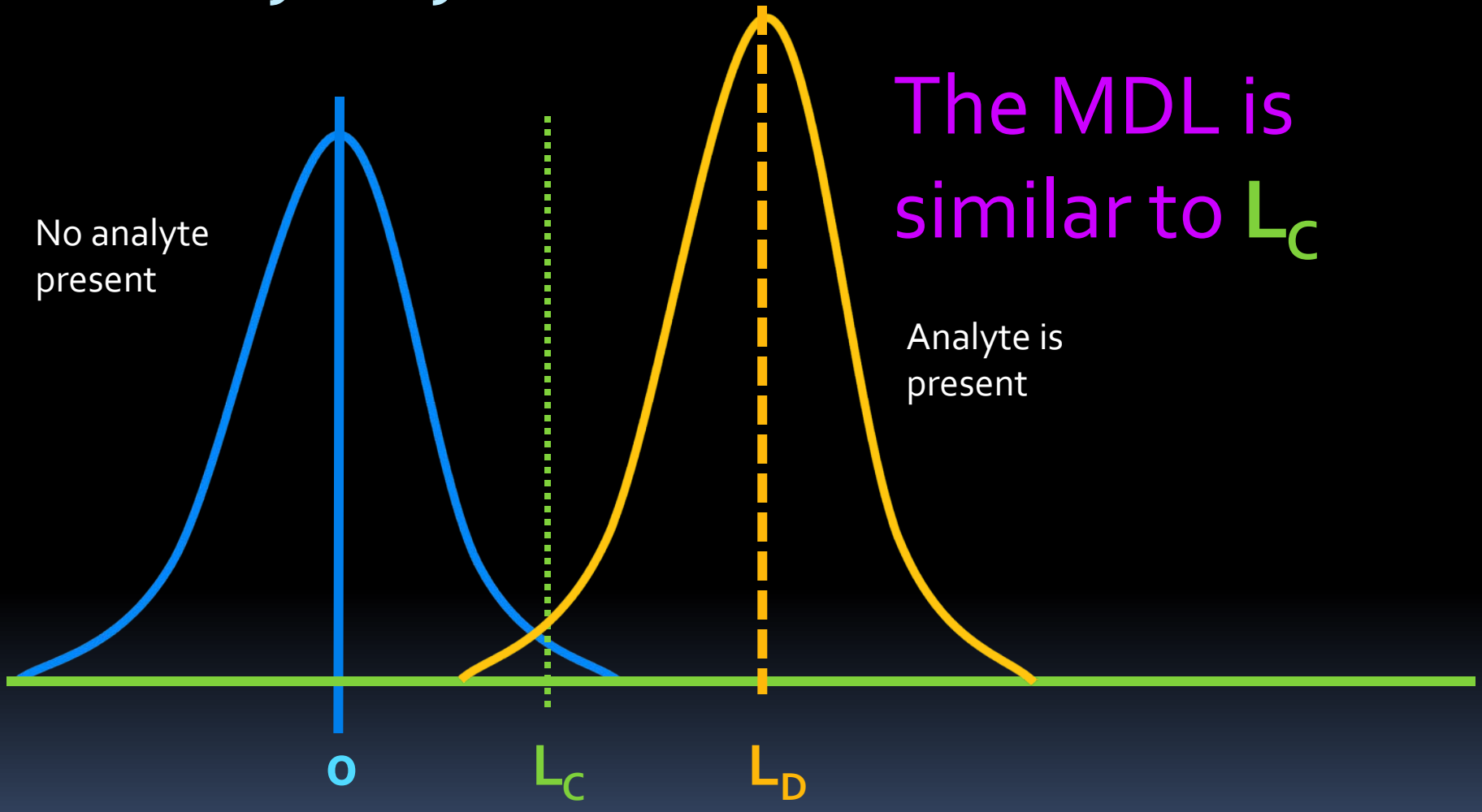


$$MDL = S \times t_{(1-\alpha=0.99,\ n-1)}$$

The MDL is calculated as the standard deviation times the Student's t value for n-1 observations using the 99th percent confidence interval.

Which puts MDL at 1% of the right-tail.

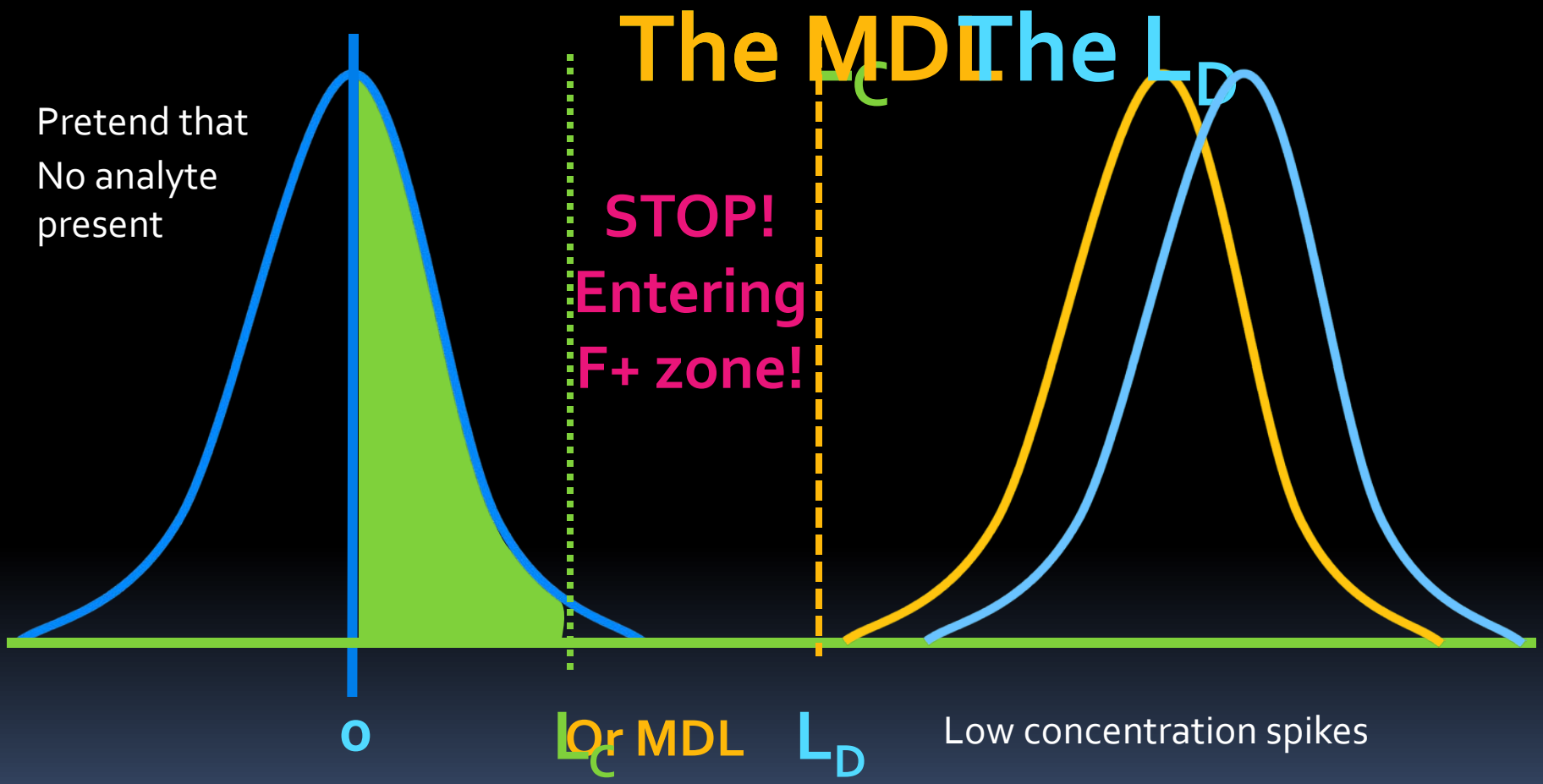
MDL, LC, and Limit of Detection



The MDL is similar to L_C

The MDL is not equivalent to Currie's Limit of Detection, L_D!

L_C, MDL and L_D



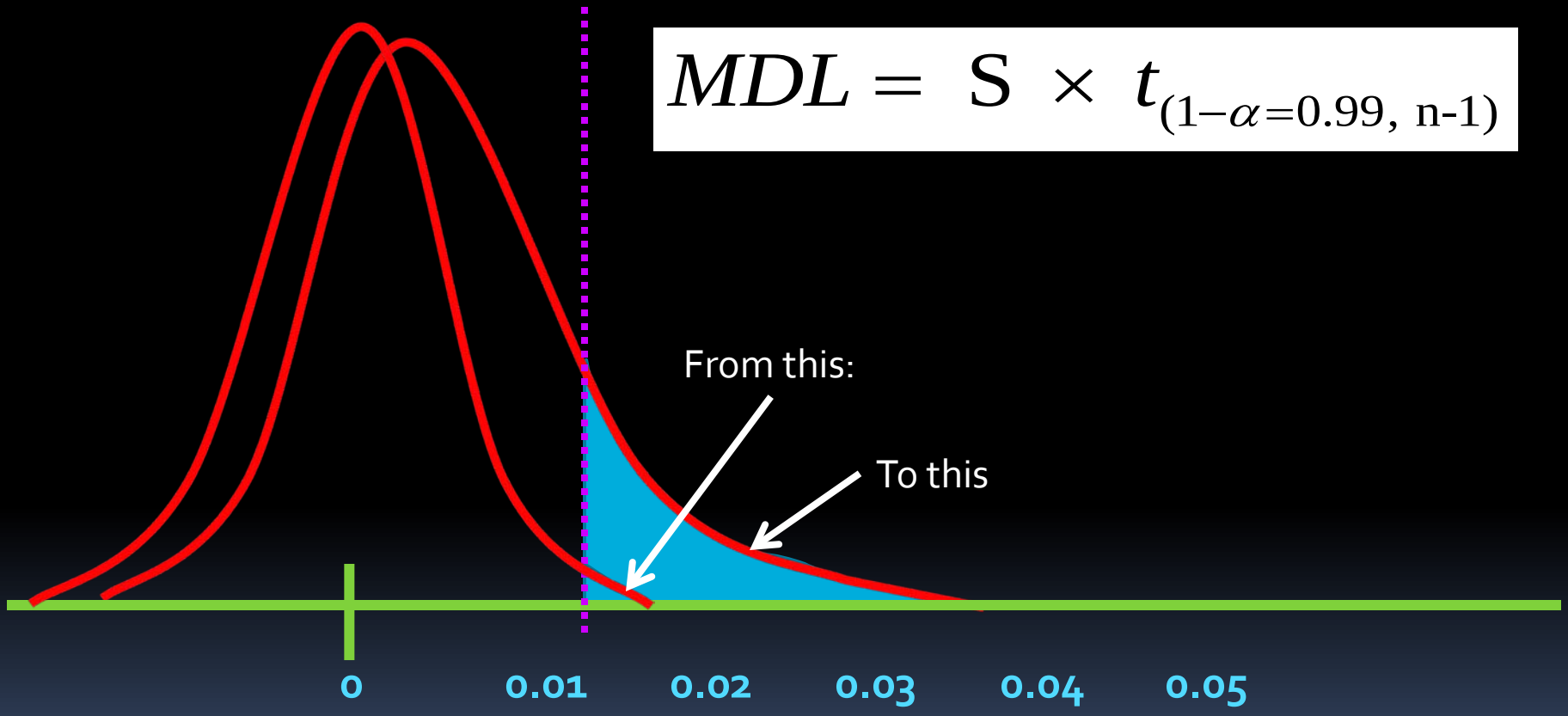
The L_D is where you are really confident that there will be very minimal background interference (False positives) and confident that you will detect the analyte when it is present at the L_D concentration.

The MDL is based on substituting low concentration spikes for blanks.

The L_C is dependent on the background.

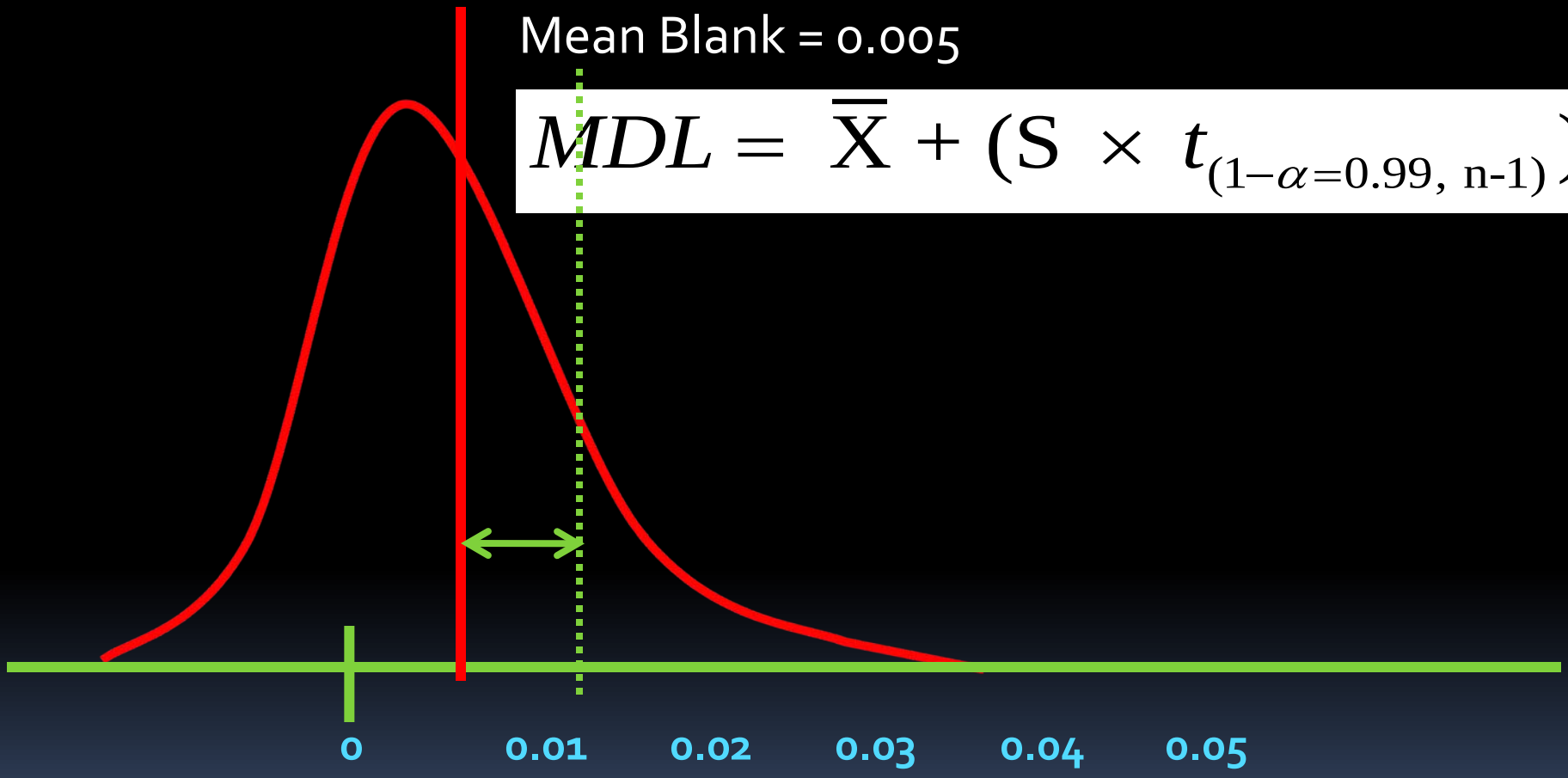
The EPA MDL (40 CFR Part 136)

$$MDL = S \times t_{(1-\alpha=0.99,\ n-1)}$$



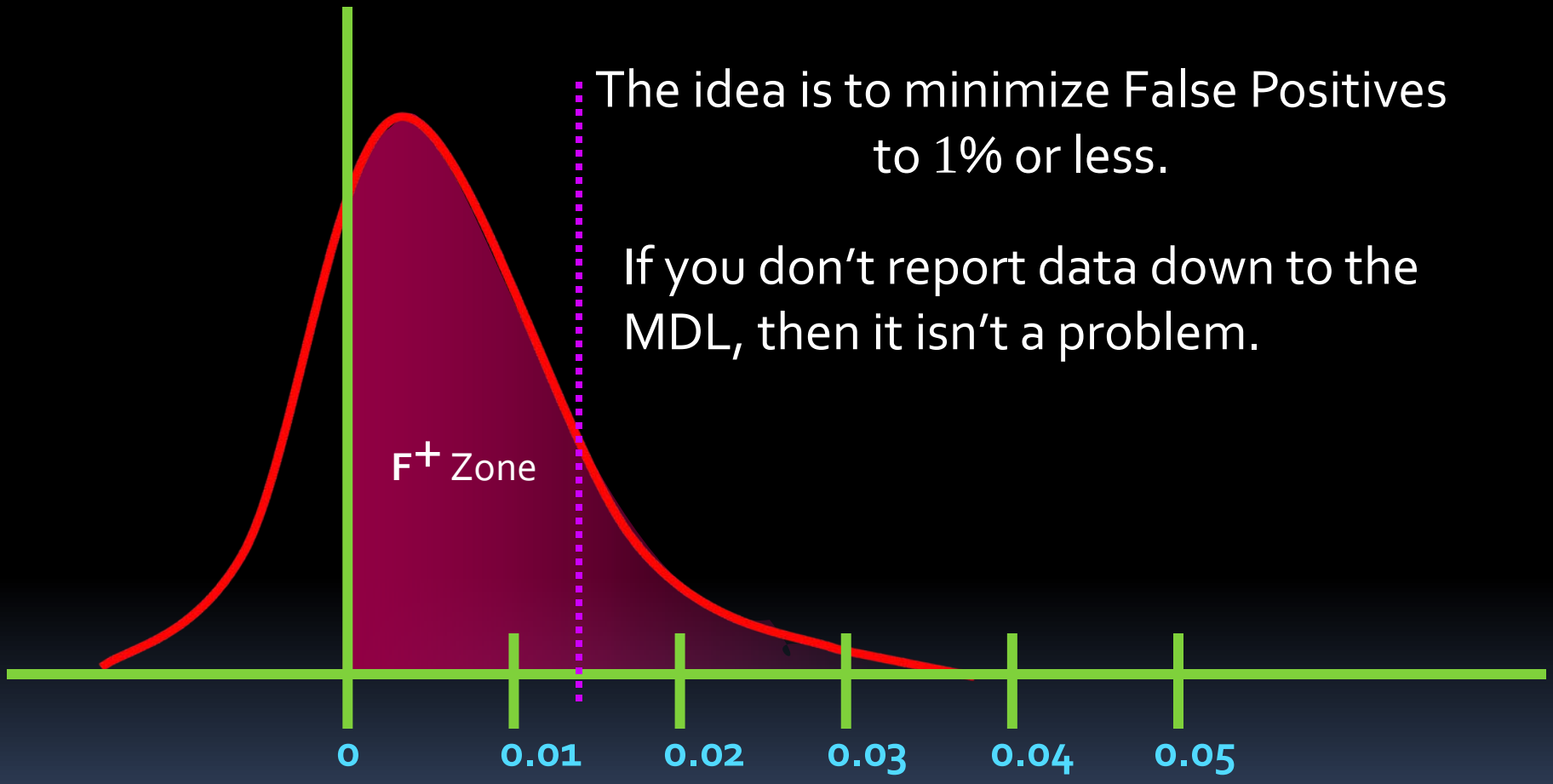
If your blanks have a positive bias (frequent detections), centering the spike distribution on zero can underestimate the MDL significantly.

The EPA MDL (40 CFR Part 136)



One recommendation to minimize this type of error is to offset the MDL by the mean blank population.

The EPA MDL (40 CFR Part 136)

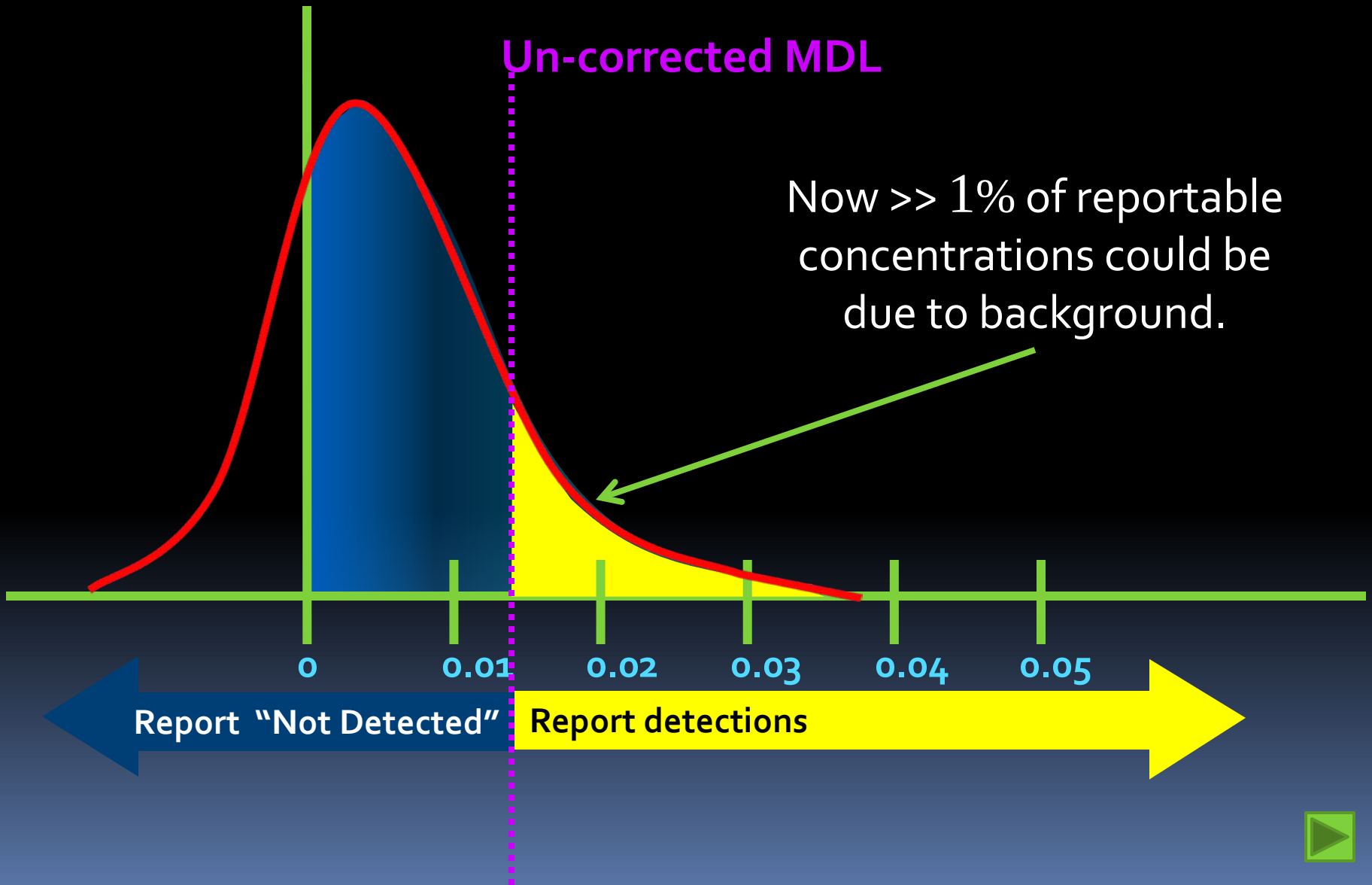


The idea is to minimize False Positives to 1% or less.

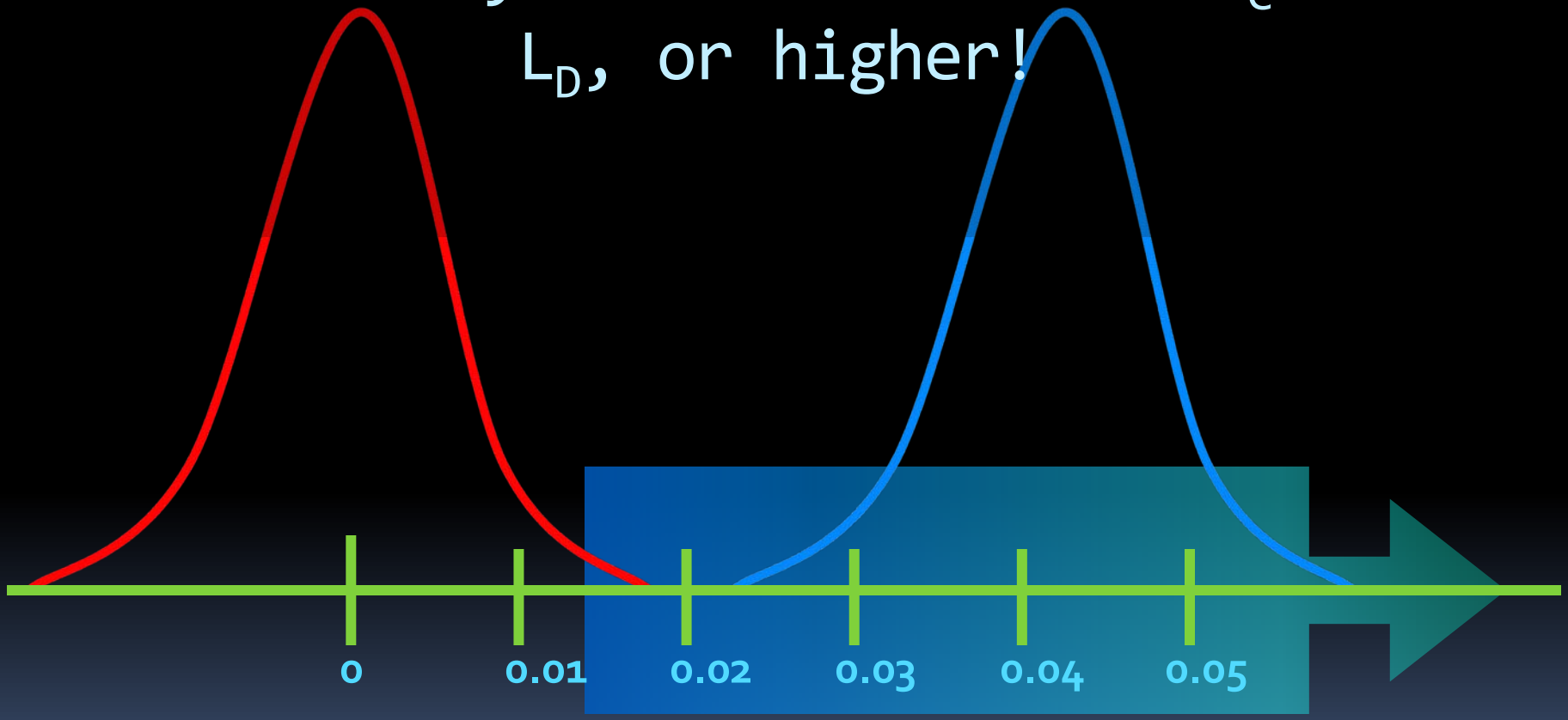
If you don't report data down to the MDL, then it isn't a problem.

What tolerance does your customer have for false positives? The common value chosen is <1%.

The EPA MDL (40 CFR Part 136)



The TNI LOD does not require limits for F+ or F- rates. The TNI LOD can be set anywhere between the L_C and L_D, or higher!



It is up to you to define your LOD, and what it represents.

end