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MD PACKAGING INC.

IAOM Presentation

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Contamination Threats to Food Supply Chain

Food supply chain from source to consumer

Major sources of contamination

Chemical

Biological

Physical

Contamination threats exist in each step of the food chain

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What Drives Food Safety Today?

- Corporate brand protection
  - Foreign objects are impossible to eliminate
  - Rework, scrap or recalls can be very costly
  - Use of a PI may be a requirement to export
  - Problems can cost millions of $

- Retailer policies and mandates
  - Many retailers have enhanced policies
  - Most will perform audits
  - X-ray may even be a condition to do business

Walmart

COSTCO WHOLESALE

TESCO

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Food Safety (continued)

- Compliance with industry standards
  - FDA HACCP (Hazard Analysis and Critical Control Points)
  - GFSI (Global Food Safety Initiative)
  - ISO (International Standards Organization)
  - BRC (British Retail Consortium)
  - Many industry specific standards for meat, bakery, dairy, seafood and other products

- US Food Safety Modernization Act (FSMA)
  - First major update to US law in 30 years
  - Increased requirements in many areas including planning, reporting, traceability, importation, supplier verification
  - New regulations are being written and applied now

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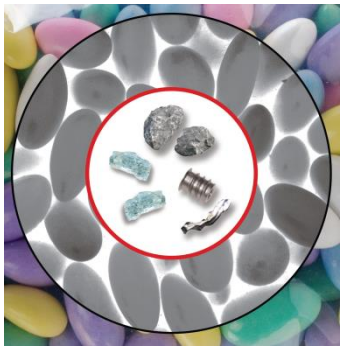
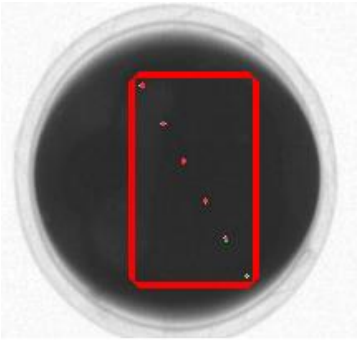
Why Food Safety is More Important Today Than Ever

- Incidents and recalls are very public
  - Mass, easy communication via the internet
  - Consumers are more educated and concerned

- Detection systems more capable and less costly
  - Metal detection sensitivity constantly improving
  - X-ray systems can find more types of objects
  - Systems are very easy to use and own



- Heading toward zero tolerance
  - 3-5 mm was OK, now 0.8mm can be detected
  - Recognition that all hazards must be detected, they can never be eliminated completely



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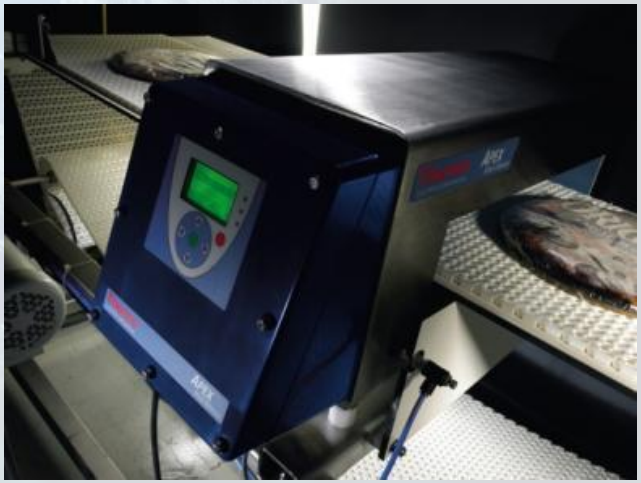
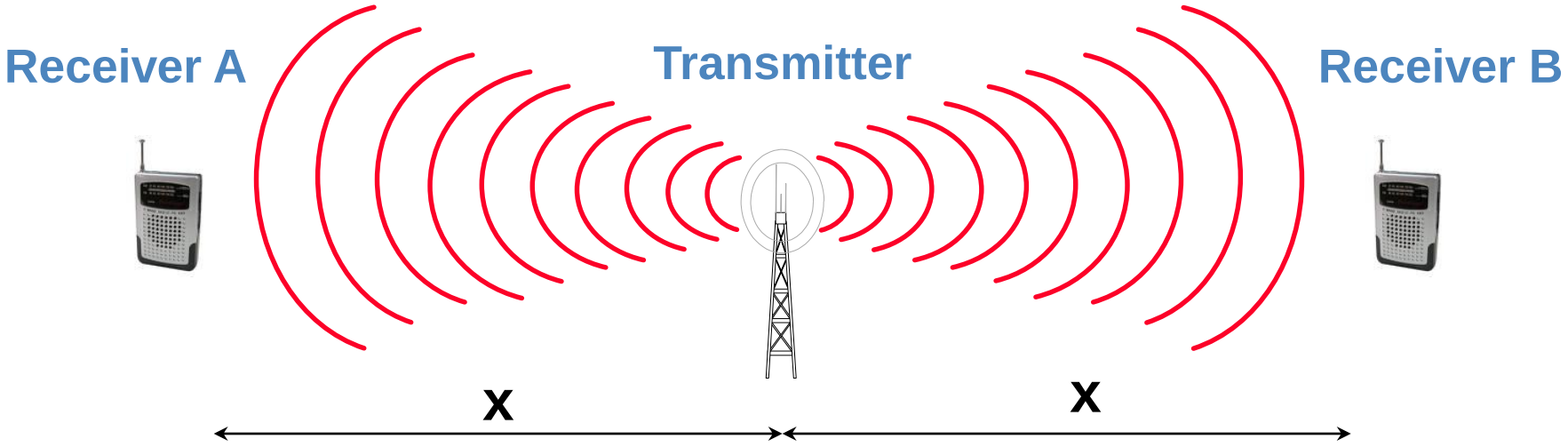
Metal Detection Theory of Operation



The Basic Principle of Metal Detection

- A transmitter sends out a signal
- Two receivers at equal distances from the transmitter receive the signals
- The signals from the receivers are subtracted and the result is zero - a balanced condition



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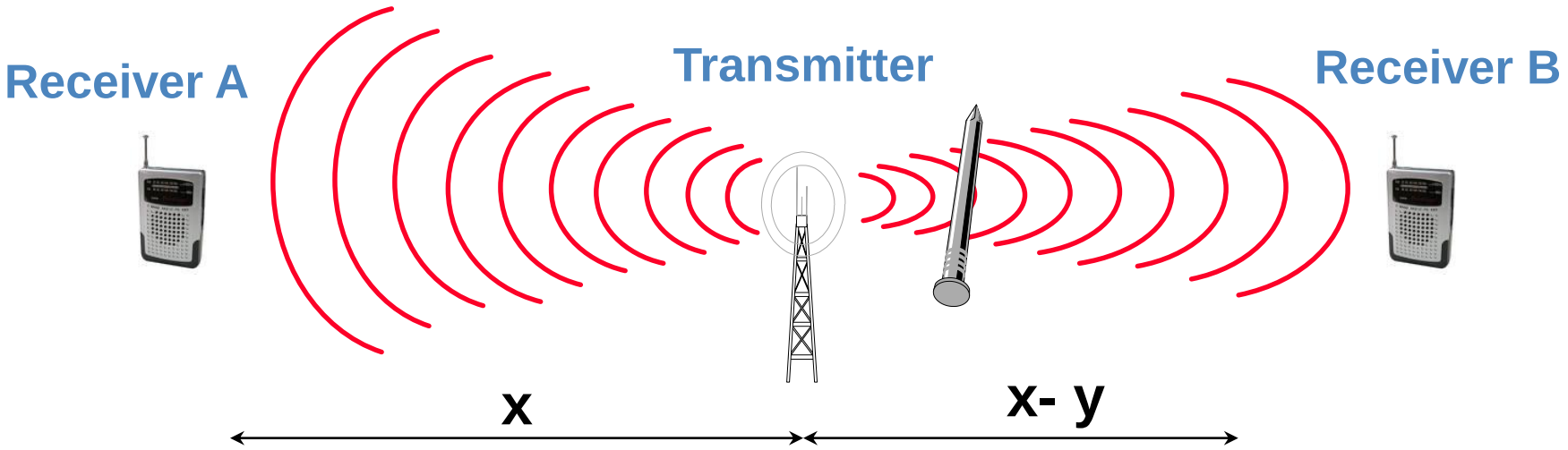
What Happens When Metal is Present

- Metal objects between the coils “unbalance” the system and thus metal may be detected
- A digital signal processor analyzes the signals to find the metal and ignore the product



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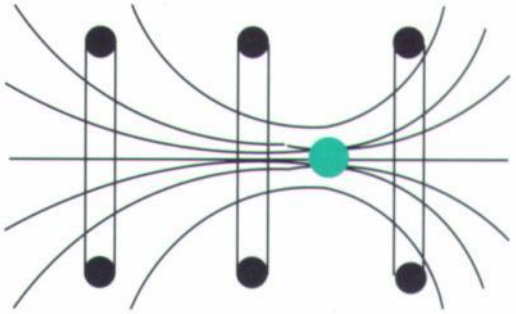
Metal Can Have Two Effects

Magnetic Effect

MAGNETIC METAL PRESENT

FIELD DISTORTED INDUCED

VOLTAGE INCREASED

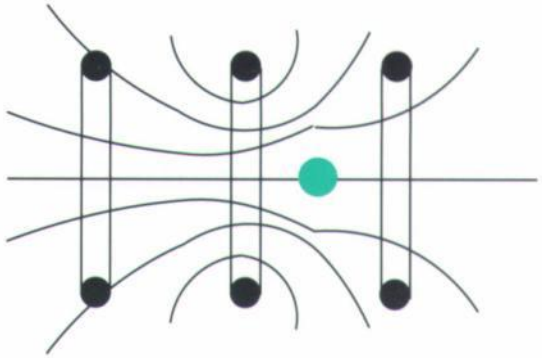


Conductive Effect

NON MAGNETIC METAL PRESENT

FIELD DISTORTED INDUCED

VOLTAGE DECREASED



In the APEX Magnetic = X and Conductive = R

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Metal Types (red indicates metal in test cards)

- **Ferrous** – Iron and mild steel
  Ferrous metals contain both magnetic and conductive properties
  Easiest to detect

- **Magnetic stainless steel** – 400 series
  Contains both magnetic and conductive properties
  Easier to detect

- **Non-ferrous** – Aluminum, copper, tin, lead, brass and silver
  Non-ferrous metals are conductive, but not magnetic
  Slightly more difficult to detect

- **Non-magnetic stainless steel** – 304 and 316 series
  Poor conductive and no magnetic properties
  Most difficult to detect

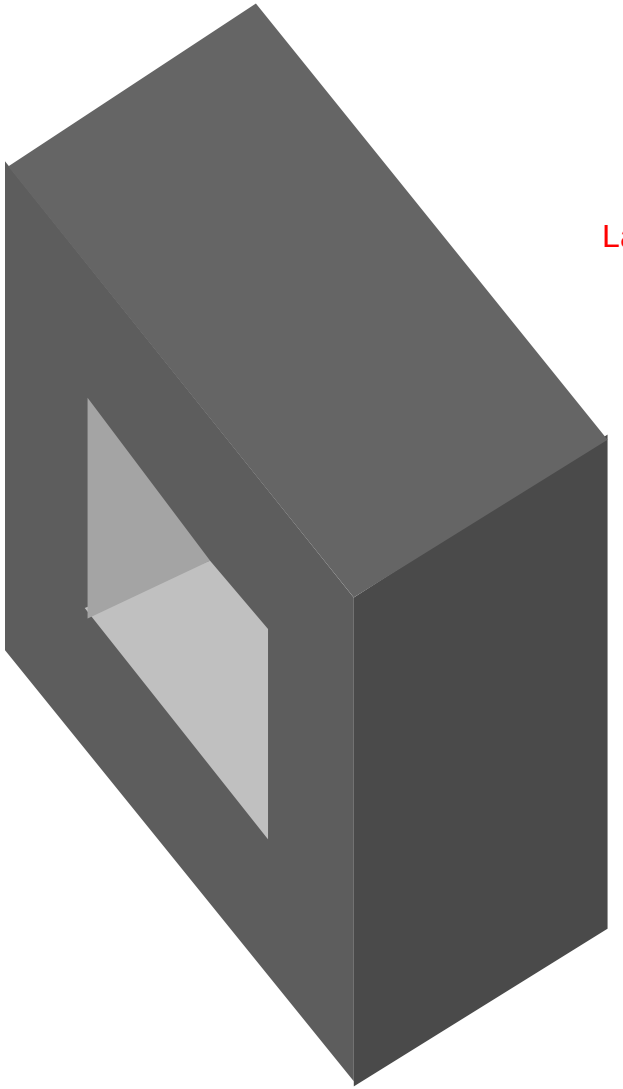
Wire Detection Fundamentals

Ferrous

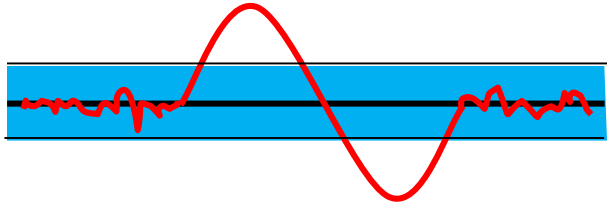
Ferrous

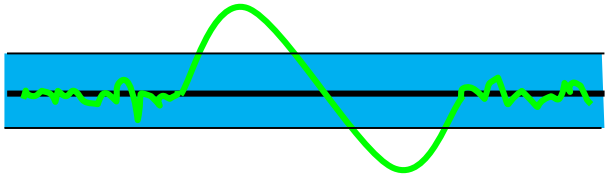
Non-Ferrous

Non-Ferrous



Largest signal due to amplification of the magnetic signal





Largest signal due to size of eddy current created

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Metal Detector Frequency Selection By Product

- 50 Khz – Large, wet (conductive) products such as gallons of salad dressing or blocks of fresh meat.
- 100 & 150 Khz – Small to medium size, conductive products like 5 lb. tubs of tuna or packs of fresh poultry.
- 200 Khz – Small to medium size, somewhat conductive products such as bags of salad mix or loaves of bread.
- 300 Khz – Any very dry or hard frozen product such as bags of sugar or ground beef below 20° F.
- 900 Khz – Pharmaceutical applications such as pills or capsules using small metal detector aperture sizes.

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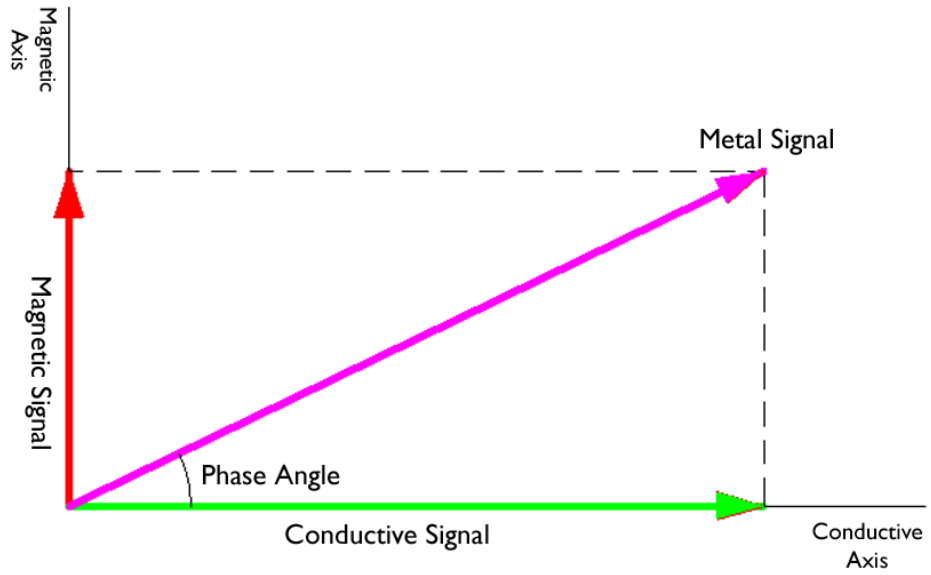
What is Phase Angle?

- All real contaminants have a combination of both magnetic and conductive effects
- The ratio of the two effects can be measured by the phase angle of the out of balance voltage
- Some products have phase angles. The product must be ignored, the metal must be detected.



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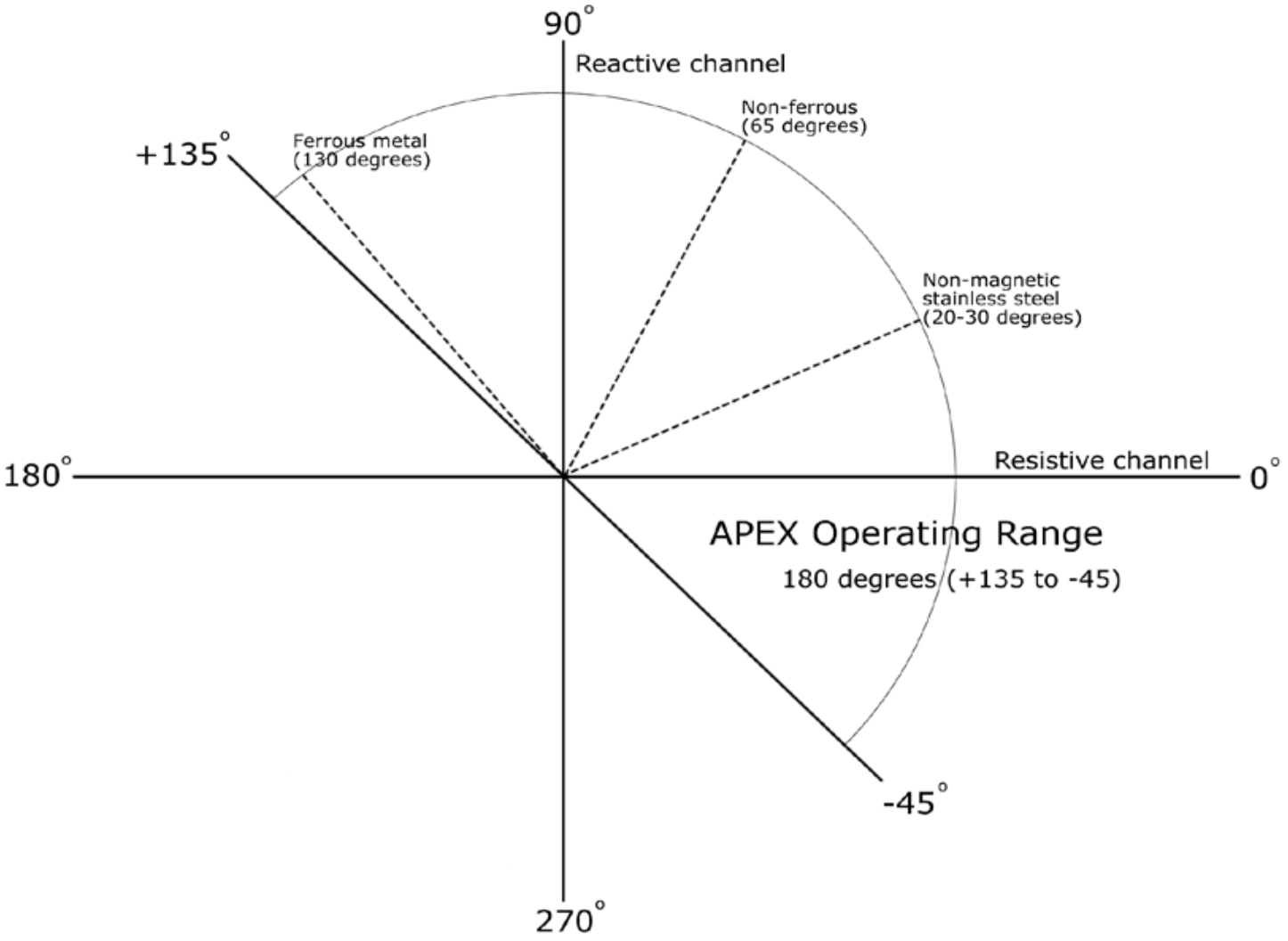
Phase Range and Metal Phases



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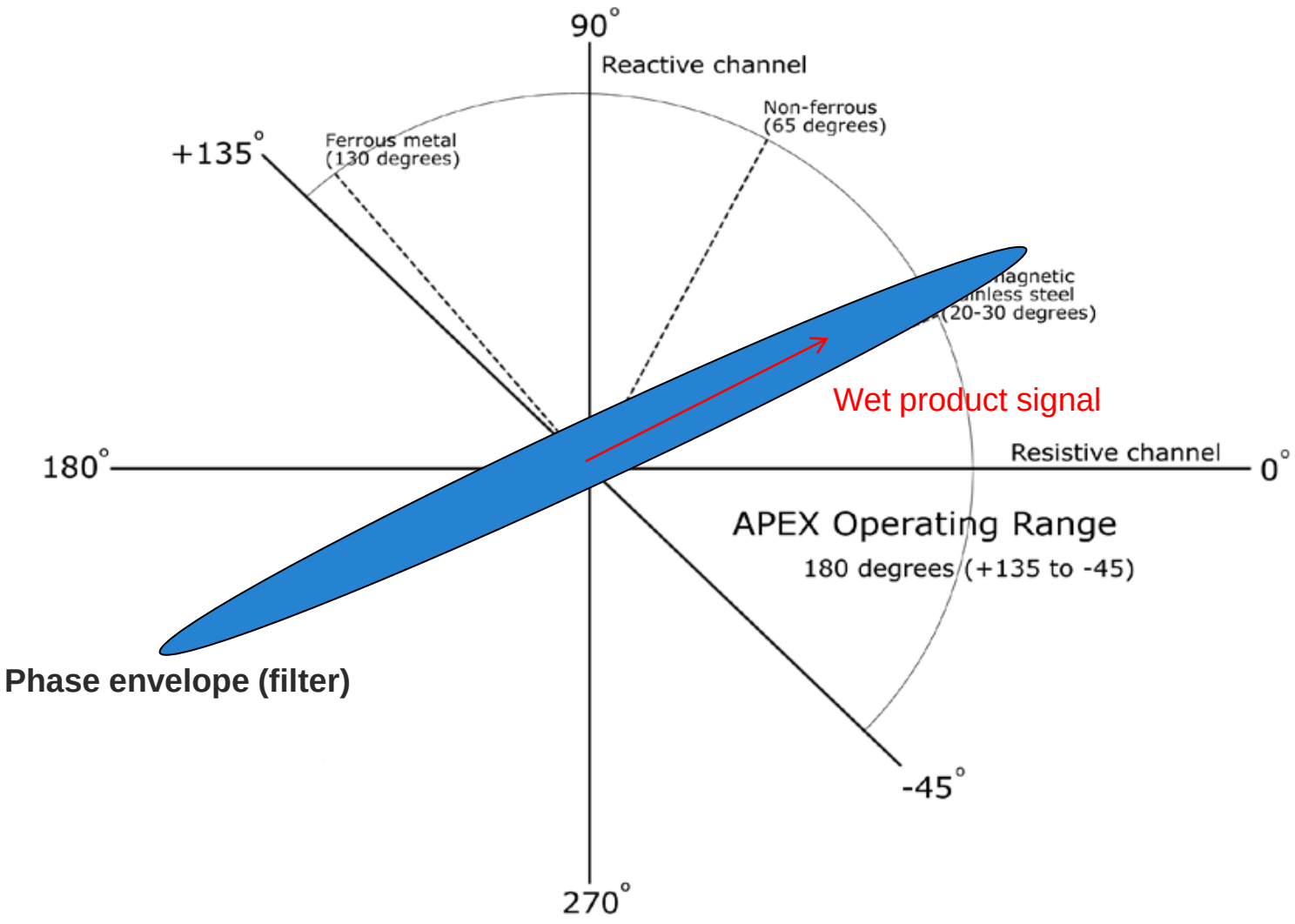
Phasing Out a Product



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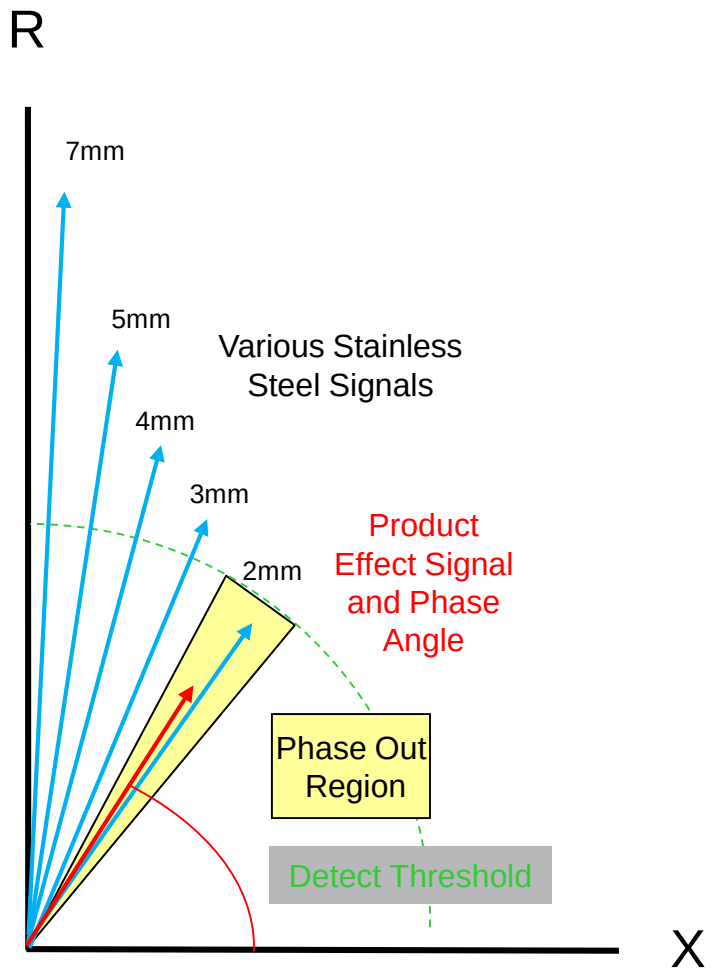
How Traditional Phasing Works in Detail

- The PEAK Product X and R signals are learned (shown in red)
- The ratio of these peaks is used to generate a phase out angle or “ignore” region (shown in yellow)
- The magnitude of the product peaks is used to set detect level (shown in green)
- As the metal type or size changes it may result in a condition where the metal is “phased out” and missed
- Phase tracking and operating frequency changes move this problem around but do not eliminate it



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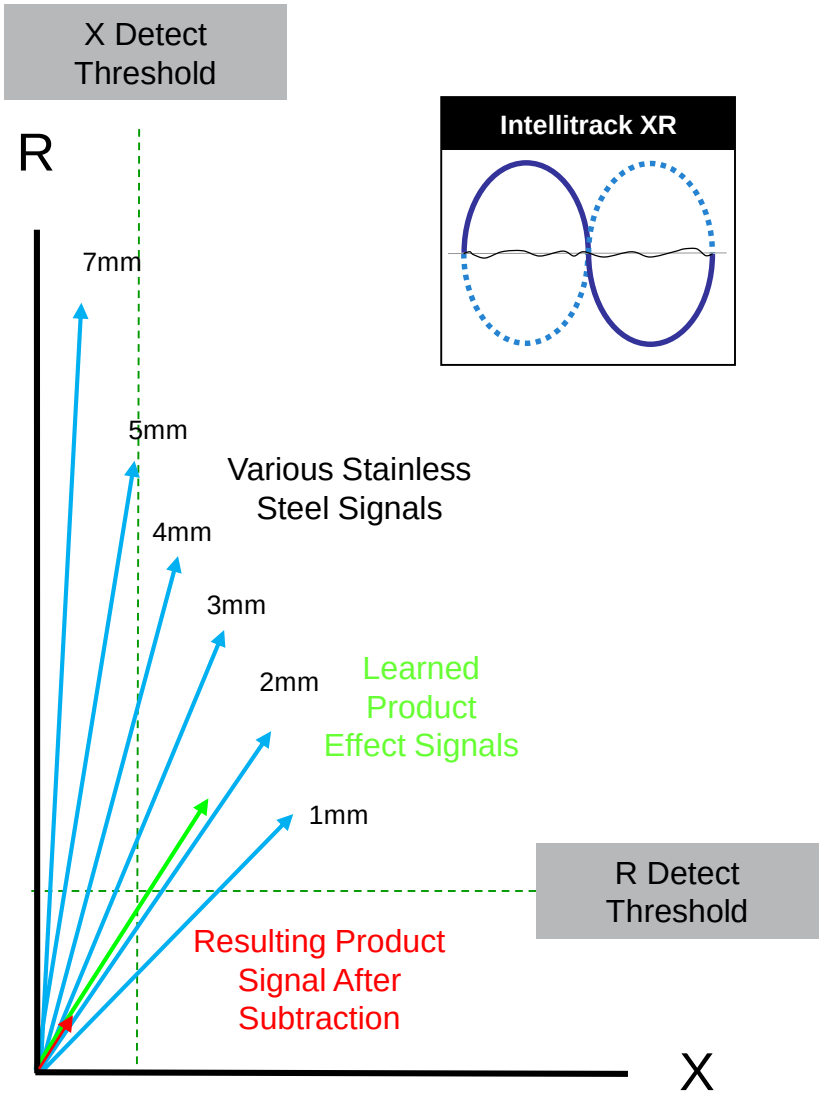
How Intellitrack XR (IXR) is Different

- The product X and R signals are stored during auto learn. Information from both channels is used and NOT combined (shown in light green)
- During production the learned signals are subtracted from the actual signals
- The learned signals are also tracked and updated continuously in production
- The resulting X and R product signals are very small (shown in red)
- Two thresholds are set – one for X and one for R. Detection can be on either or both channels. (shown in dark green)
- Metal can never be phased out!

IXR learns and cancels both product signals enhancing detection



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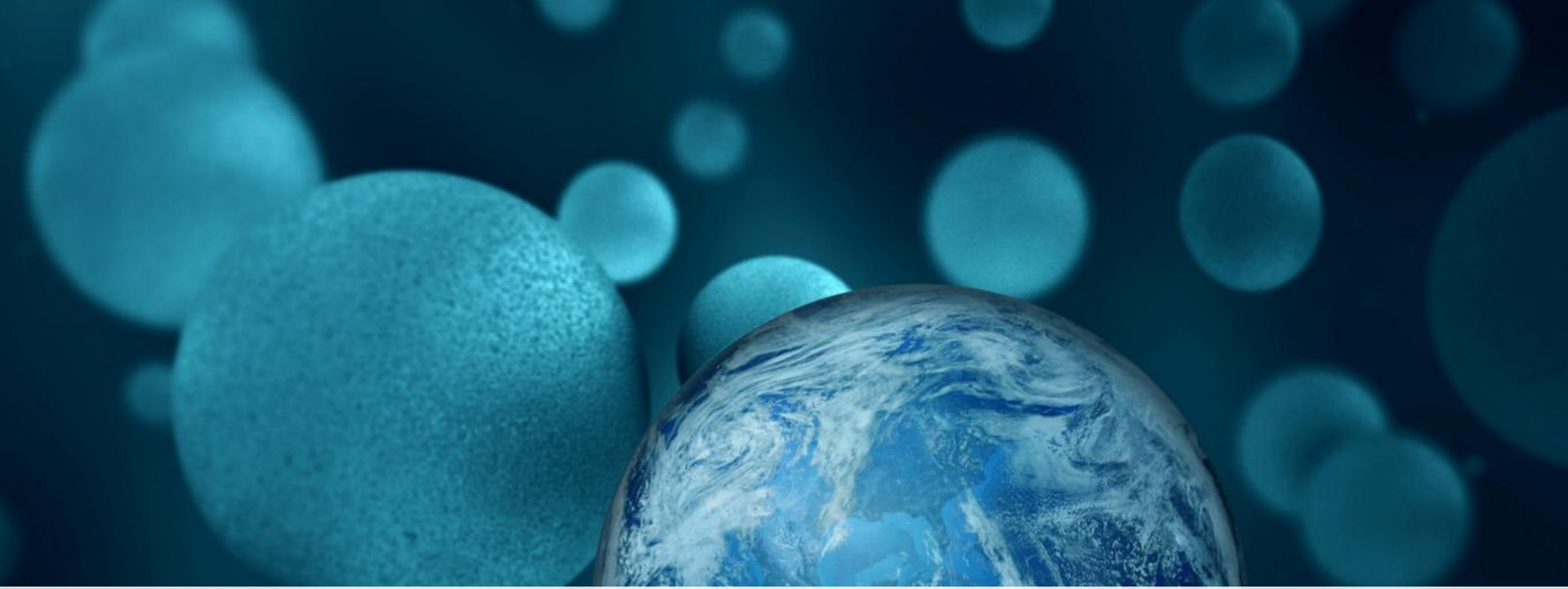

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Sentinel Multiscan Metal Detection

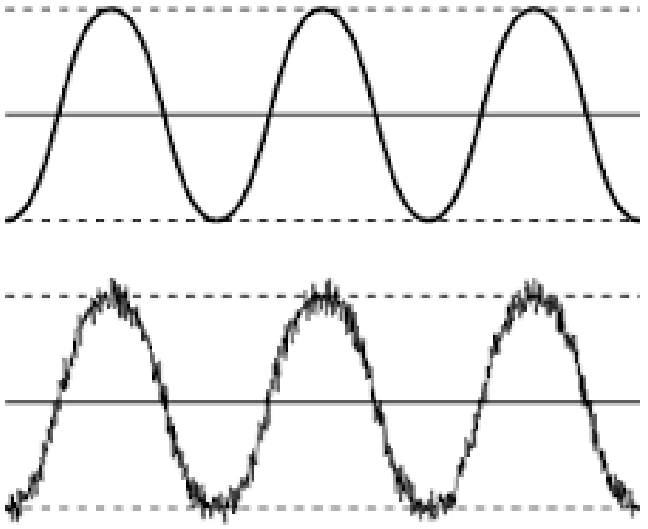
Multiple Frequencies

All metals whether iron, stainless steel, brass or aluminum react differently to an electromagnetic field. Their reaction changes based on shape, size, orientation and position. The small signal from the metal contaminant can hide inside of a much larger signal from a wet, salty or high mineral content product. Add to this unwanted electrical interference and vibration effects and you have the potential for metal foreign objects to go undetected.

The Sentinel detector offers an entirely new approach to this challenging problem. You no longer must pick the “best” frequency for an application or try running some combination of fixed dual frequencies. Instead, you select 1, 2, 3, 4, or 5 frequencies, use a step-by step wizard to set up your product and test any/all the types of contaminants

Problems for metal detection

- Vibration – **SOLVED – solid core**
- Looping
- Radios - **SOLVED**
- VFDs - **SOLVED**
- Static (product and external)
- Grounding
- Power
- Sensitivity over-reach
  - Aperture Size
  - Product Effect / Orientation Effect
  - **SOLVED**



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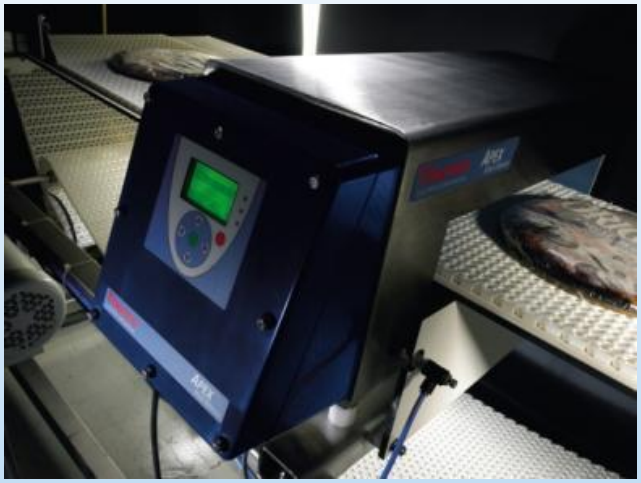

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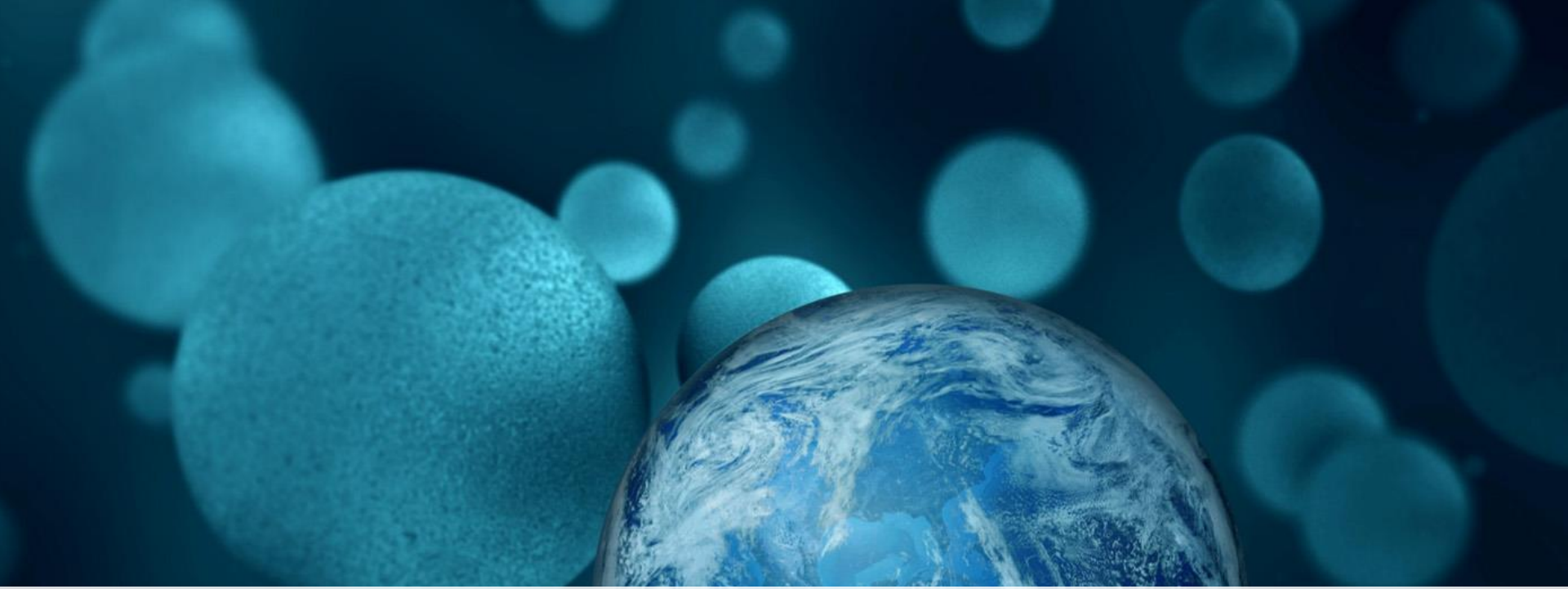
1 in 1,000,000 one metal detector

$1/1{,}000{,}000^5 = 1\text{ -}30^{th}$ decimals = very long time



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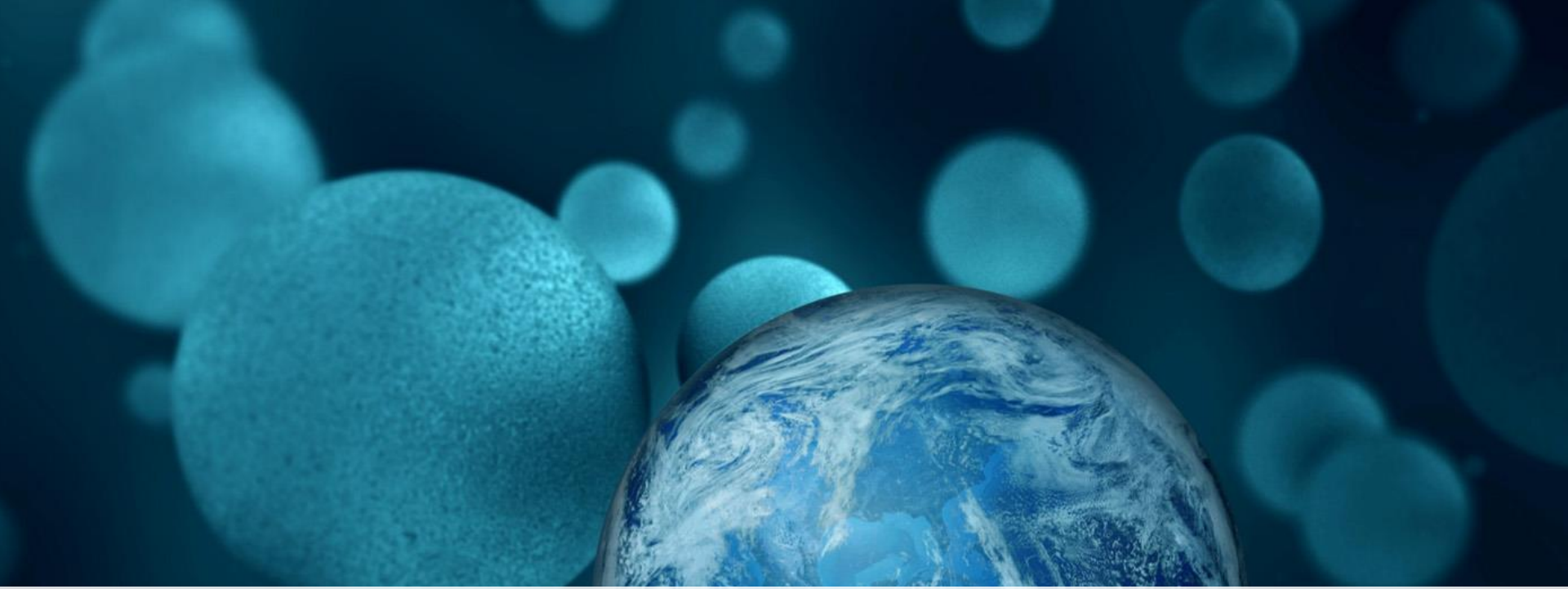
Benefits

- better detection
- less false rejects
- incredibly easier troubleshooting



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