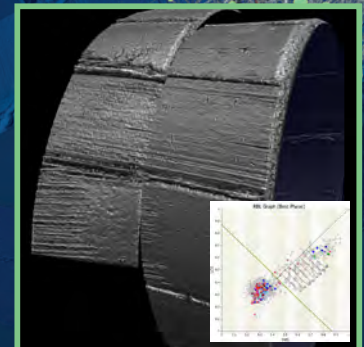




QUANTUM  
3D MICROSCOPE

# TAKE FIREARM AND TOOL MARK IDENTIFICATION TO THE NEXT LEVEL

BRING OBJECTIVITY TO COMMON  
SOURCE CONCLUSIONS



+ S1 AND F1 MODEL

 **LEADS ONLINE**  
[formerly Forensic Technology]

## FOR FIREARM AND TOOL MARK IDENTIFICATION

THE QUANTUM 3D MICROSCOPE (Q3M) HAS CAPABILITIES BEYOND THOSE OF CONVENTIONAL COMPARISON MICROSCOPES. TECHNOLOGICAL ADVANCEMENTS IN 3D TOPOGRAPHY MEASUREMENTS ARE UNLOCKING MUCH-NEEDED INNOVATIONS.

Q3M PROVIDES FIREARM AND TOOL MARK EXAMINERS WITH THE BEST 3D VISUAL AND QUANTITATIVE TOOLS FOR COMMON SOURCE DETERMINATION.



### Support Expert Conclusions Using Objective Methods

Firearm and tool mark identification is evolving and now requires 3D measurements to support expert conclusions using objective methods that provide confidence levels and error rates.



### Bullets, Cartridge Cases, and Other Small Objects

Q3M includes two models, each specialized for a range of imaging specifications and object surface characteristics.

The Q3M S1 model captures the rifling marks on fired bullets, and tool marks on other small objects with shapes with cylindrical rotation and complex surface deformations.

The Q3M F1 model captures the breech face, firing pin, and ejector marks, as well as the full headstamp on fired cartridge cases.



**IBIS**

### Powered by IBIS® Technology

Q3M capabilities are derived from 3D technology innovations in IBIS Search Networks that were developed over more than a decade.

While IBIS focuses on finding the needle-in-the-haystack (previously unrelated firearm crimes), Q3M focuses on specific casework and studies, evaluating and quantifying the strength of agreement in common source determinations.

# BULLETS

# CARTRIDGE CASES



BULLET

CARTRIDGE CASE



TEST-FIRED BULLETS

TEST-FIRED CARTRIDGE CASES

## 3D ACQUISITION



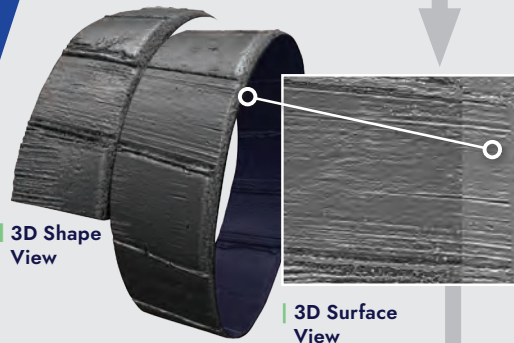
Q3M S1 MODEL



Q3M F1 MODEL

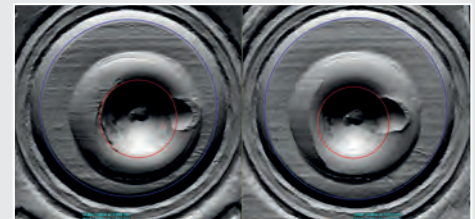
+  
Q3M CAN SAVE HOURS OR DAYS COMPARED TO DOING THE SAME CASEWORK ON A COMPARISON MICROSCOPE.  
REACH CONCLUSIONS WITH HIGHER CONFIDENCE IN A FRACTION OF THE TIME.

## 3D COMPARISON VIEWING



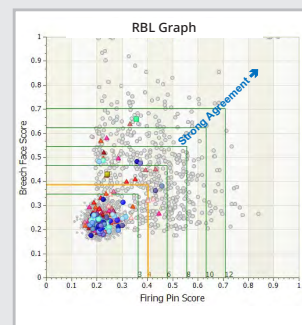
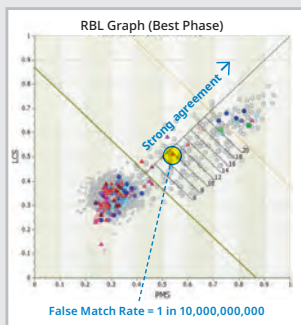
3D Shape View

3D Surface View



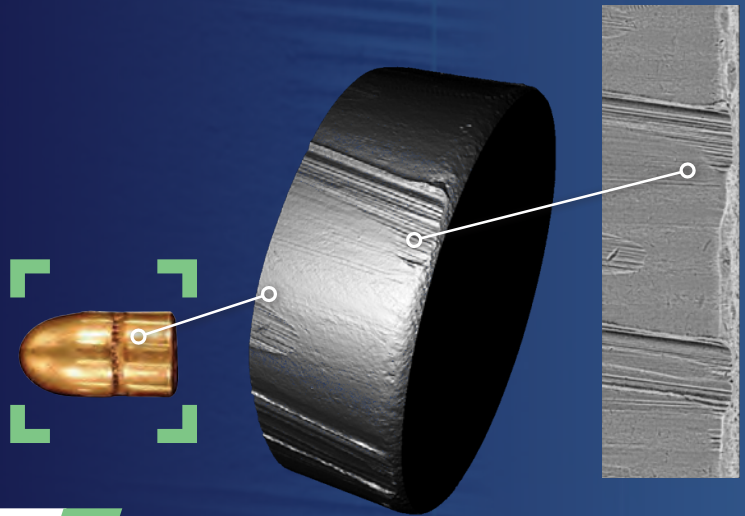
3D Comparison

## QUANTITATIVE ANALYSIS



# 3D COMPARISON VIEWING

A WHOLE NEW LEVEL OF VIEWING IS MADE POSSIBLE WITH 3D MICROSCOPY. MORE DETAILS CAN BE SEEN WITH LESS EFFORT.



## Common Features

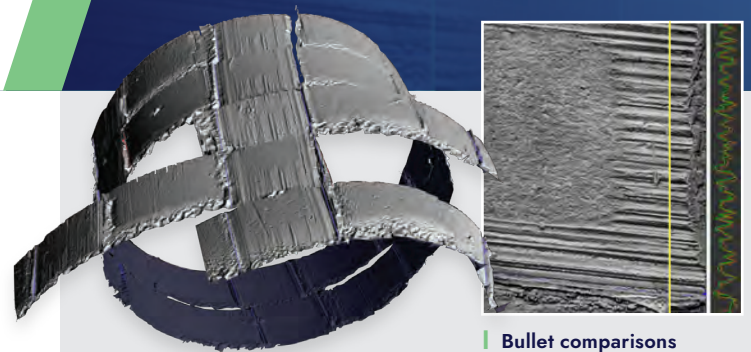
- Intuitive side-by-side comparisons
- Surface and shape views, always in focus
- Movement and rotation in locked or free modes
- Hairline moveable across overlapped surfaces
- Visual enhancements emphasize the marks
- Simulated lighting and surface reflectivity options
- Best match alignment based on similarities
- Sectional line profiles of the topography
- Graphical and textual annotations
- Saved bookmarks of comparison views to resume work later

## S1 Model Features

- Up to 6 objects compared simultaneously side-by-side
- Horizontal and vertical side-by-side views

## F1 Model Features

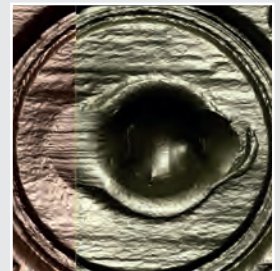
- Independent view for each region-of-interest



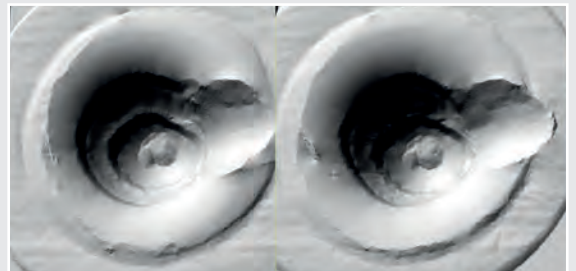
| Bullet comparisons



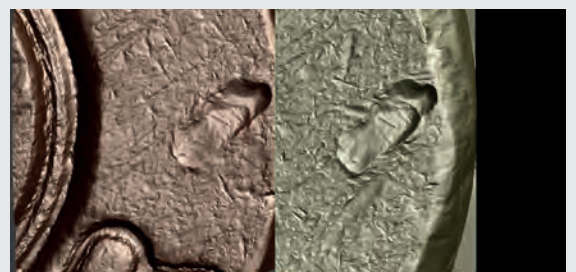
| 3D full headstamp



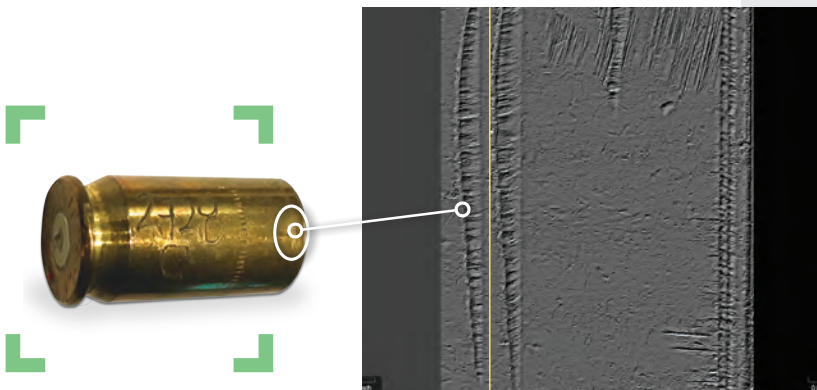
| Primer comparison



| Centerfire firing pins comparison



| Ejector comparison



| Ejection port mark comparison

# QUANTITATIVE ANALYSIS

TOPOGRAPHY MEASUREMENTS FEED ALGORITHMS THAT OFFER OBJECTIVE RESULTS IN SUPPORT OF SCIENTIFIC STUDIES AND EXPERT CONCLUSIONS WITH CONFIDENCE LEVELS AND ERROR RATES.

COMPARE BULLETS FROM UNKNOWN AND KNOWN SOURCES, AND GRAPHICALLY REPRESENT THE STRENGTH OF COMMON SOURCE SIMILARITY USING Q3M'S INNOVATIVE RBL GRAPH<sup>1</sup>.



## RBL Graph

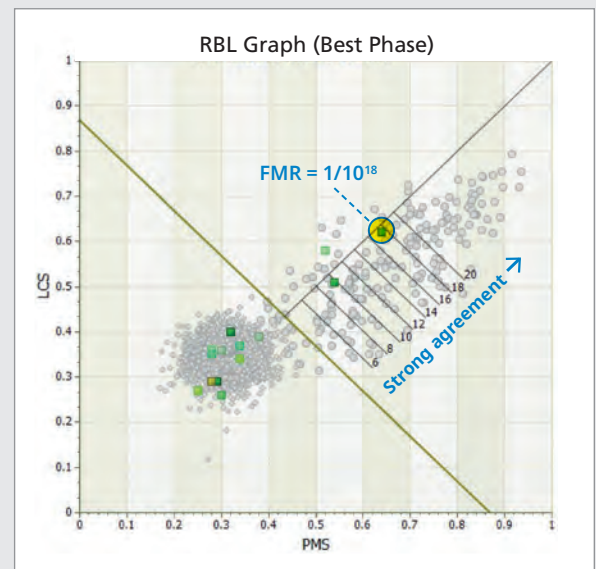
- The RBL method visually demonstrates quantifiable differences between matching and non-matching conditions.
- False Match Rate (FMR) provides a reliable error rate to support expert conclusions.
- Clustering automatically groups same source items based on FMR as well as phase consistency (patent pending).

### RBL Graph – Bullets

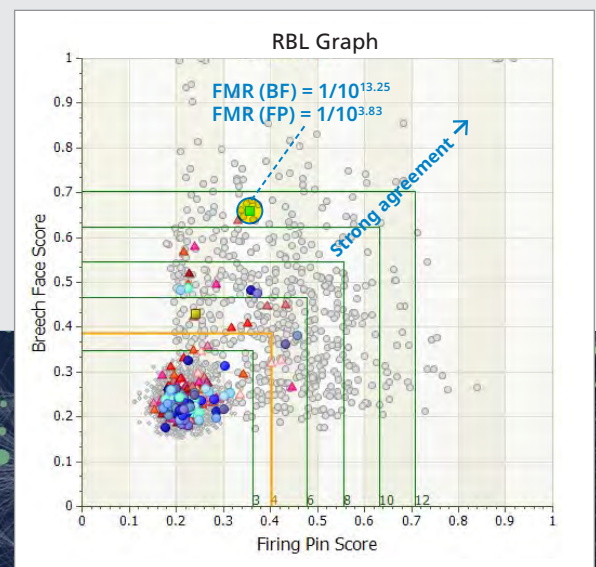
- Correlation provides line counting and pattern matching scores (LCS and PMS).
- Best Phase mode is well-suited for intact bullets. Best LEA mode is well-suited for partial or damaged bullets.
- Currently for conventional rifling. Methods for other types are in development.
- Subclass Warning Coefficient indicates the possible influence of subclass characteristics.

### RBL Graph – Cartridge Cases

- Correlation provides two independent scores for breech face and firing pin marks.
- Currently for centerfire cartridge cases. Methods for rimfire and specific subtypes are in development.



Quantitative Analysis Results - Bullets



Quantitative Analysis Results - Cartridge Cases



THE FALSE MATCH RATE (FMR) FOR A GIVEN SIMILARITY SCORE REPRESENTS THE PROBABILITY THAT TWO BULLETS THAT WERE NOT FIRED FROM THE SAME FIREARM WOULD GENERATE A GREATER SCORE.

<sup>1</sup> Roberge, D., Beauchamp, A., & Lévesque, S. (2019). Objective Identification of Bullets Based on 3D Pattern Matching and Line Counting Scores. *International Journal of Pattern Recognition and Artificial Intelligence*, 33(11)

# 3D MICROSCOPE TECHNICAL CHARACTERISTICS

## Common Characteristics

- Non-Linear Photometric Stereo 3D sensor capable of measuring purely specular surfaces and diffusive surfaces (patented)
- Calibration to traceable measurement standards

## S1 Model Characteristics

- Pilot cameras with smart positioning function
- Intelligent surface tracking for full object wraparound or across fragments
- Field of view: 2.88 x 1.8 mm at 4.0x nominal magnification
- Surface width: 2.8 mm
- Lateral resolution: 2.98  $\mu\text{m}/\text{pixel}$
- Depth precision: Less than 0.2  $\mu\text{m}$
- Object dimensions: Up to 50 mm long and 28 mm diameter

## F1 Model Characteristics

- Field of view: 6.7 X 6.7 mm at 1.6x nominal magnification
- Lateral resolution: 3.25  $\mu\text{m}/\text{pixel}$
- Depth precision: Less than 0.4  $\mu\text{m}$ .
- Object dimensions: Up to 27 mm diameter

## CUSTOMIZED MOUNTING STUBS

A set of 10 customized stubs is provided for the easy mounting of objects of various shapes and sizes. All calibers of bullets, in various shapes, can be mounted, including test fires, and damaged and fragmented evidence.



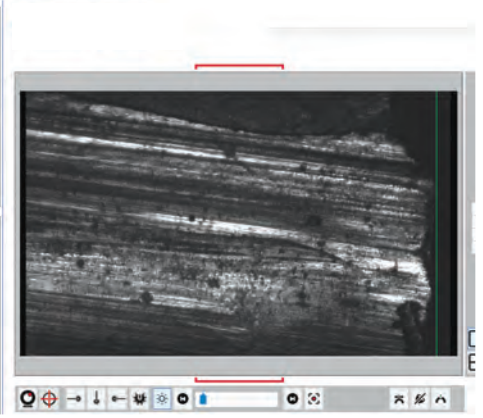
Stub is magnetically secured to shaft and automatically retracts

Set of 10 customized stubs

Left pilot camera



Right pilot camera



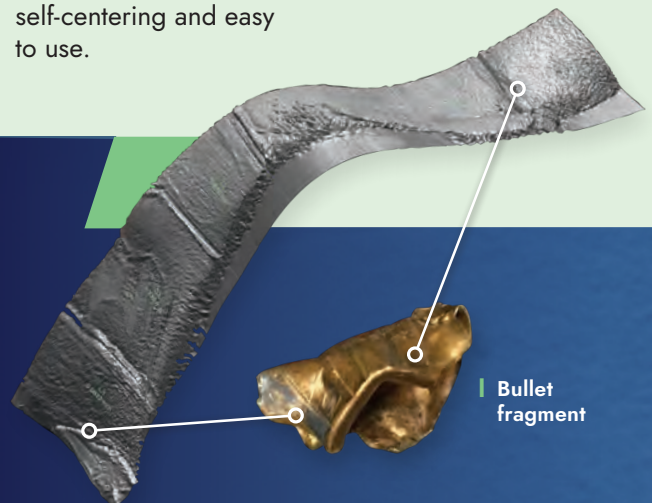
Live camera view

## UNIVERSAL CARTRIDGE CASE HOLDER



HOLDER IS  
MAGNETICALLY  
SECURED ONTO THE  
RETRACTABLE TRAY

The Q3M-F1 includes two universal cartridge case holders that are self-centering and easy to use.



Bullet fragment

## ADD-ON TO IBIS

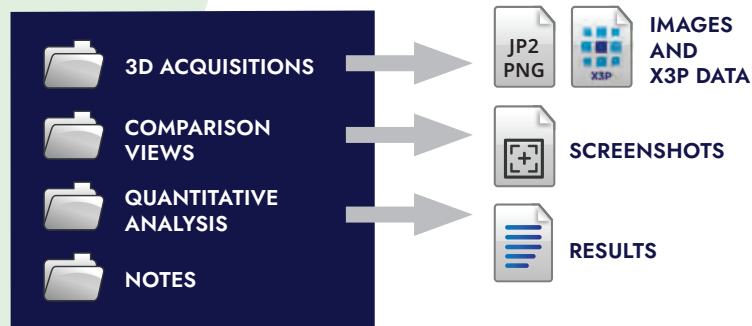
The Q3M Acquisition Unit can be shared as part of an IBIS Acquisition Station for entries onto an IBIS Search Network.

This can be advantageous if the use of the equipment can accommodate the volume of IBIS entries and 3D microscope casework.

## FLEXIBLE DATA MANAGEMENT

- Organize captured data and results in workspaces
- Easily document the work product in notes
- Output images, screenshots, notes, and results for expert reports and external information management systems
- Import and export 3D acquisition data in native and X3P/OpenFMC formats

### WORKSPACE



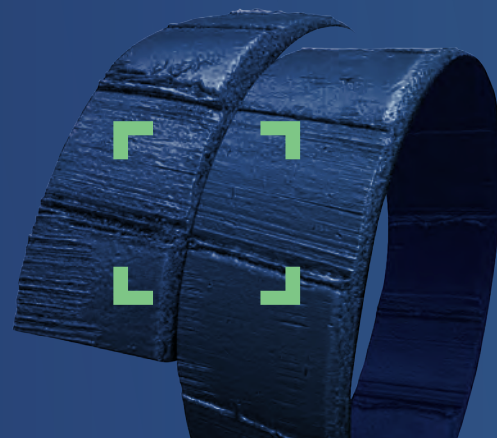
## Q3M EXTENSIONS FOR DISTRIBUTED AND REMOTE WORK

- Q3M Extension software has all the capabilities of a Q3M Station except 3D acquisition.
- Workload can be distributed by focusing 3D acquisitions of physical evidence on a Q3M Station and having examiners work in parallel on comparison viewing and analysis to prepare their conclusions and reports, at their desk or at home.
- Q3M workspaces are easily shared like other files or documents, inside and outside the organization.
- Examiners can share workspaces for peer reviews.



## TRAINING, PROFICIENCY TESTING, AND RESEARCH STUDIES

- Acquire objects once, and freely view and share
- Build training sets and reference sets
- Use measurements from reliable 3D topography data
- Perform studies to advance the firearm and tool mark identification discipline
- Collaborate in community research projects based on shared 3D data





# QUANTUM

3D MICROSCOPE



**ADVANCE MORE CASES FASTER**



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