Multi-species anatomical imaging using the Quantum GX3 microCT system.

Overview

- Micro-computed tomography (micro-CT) is a powerful tool for zoology.
- The Quantum™ GX3 micro-CT system has exceptional versatility allowing for analysis of skeletal structures and internal morphology for a broad range of animals from small insects to large birds and lizards.

Introduction

Imaging provides many benefits to translational animal research and zoological studies in general. In particular, high-resolution, non-destructive imaging is critical for the study of comparative anatomy, developmental biology, and biomechanics. Micro-computed tomography enables detailed three-dimensional visualization of internal and external morphology across a broad range of species and specimen sizes.

The Quantum GX3 micro-CT system is designed to deliver high spatial resolution, rapid acquisition, and flexible field-of-view (FOV) configurations. With enhanced image-based respiratory and cardiac gating, multiple filter options with automatic sensing, and both continuous and step scanning modes, the system supports imaging small *ex vivo* biological specimens up to 5 kg live animals.

This brief describes how the Quantum GX3 system can be applied to image a diverse array of animal species—including fish, coral worms, honey bees, ladybugs, frogs, lizards, snails, wasps, woodpeckers, and zebrafish—demonstrating its versatility across species, body sizes, and tissue densities.

System capabilities relevant to multi-species imaging

- High resolution for fine anatomical detail
  - Spatial resolution down to 5 µm
  - Minimum voxel size of 2.86 µm (at 8 mm FOV)
  - These specifications enable visualization of fine structures such as: exoskeletal segmentation in insects, trabecular bone in small vertebrates, cranial morphology in reptilian specimens, shell microstructure in gastropods, and delicate internal anatomy in aquatic organisms
- Adjustable FOV for size diversity

FOV options	Example animals that could be imaged
8 mm	Insects, coral worms, small biological specimen
18 mm	Insects, zebrafish, small biological specimen
36 mm	Mice, small frogs, medium fish
72-86 mm	Rats, guinea pigs, rabbits, ferrets, toads, lizards, large fish, birds

- Manifolds, oxygen and exhaust ports, and isoflurane regulator to anesthetize live animals
- Synchronized gated scans to correct for heart and lung motion in live animals
- Low-dose imaging
  - Faster scan times (down to 3.9 sec) mean lower radiation doses
  - The large flat panel detector allows for more photons to be detected in less time, overall reducing radiation dose to animals without sacrificing image quality.

Methods

Scan parameters were selected based on specimen size and composition:

- Voltage range: 30–90 kV depending on density.
- Filter selection: none for very low-density specimen, aluminum for soft tissue or low-density objects, or aluminum/copper combination for dense skeletal or mineralized samples
- Scanning mode:
  - Continuous mode for rapid acquisition and high throughput
  - Step scan mode for enhanced spatial resolution and artifact reduction
  - Stitched scan for high-resolution whole-body rodent imaging
- Active Ring Reduction (ARR) was enabled to minimize ring artifacts in high-resolution datasets

Applications across species

The versatility of the Quantum GX3 system enables imaging across taxonomic groups allowing for visualization of skeletal structures, internal morphology, heart & lung anatomy, dentition, etc. The ability to adjust FOV, X-ray energy, and scanning mode allows protocol optimization for each species while maintaining consistent image quality.

Below are a few examples of images taken on the Quantum GX3 micro-CT imaging system.

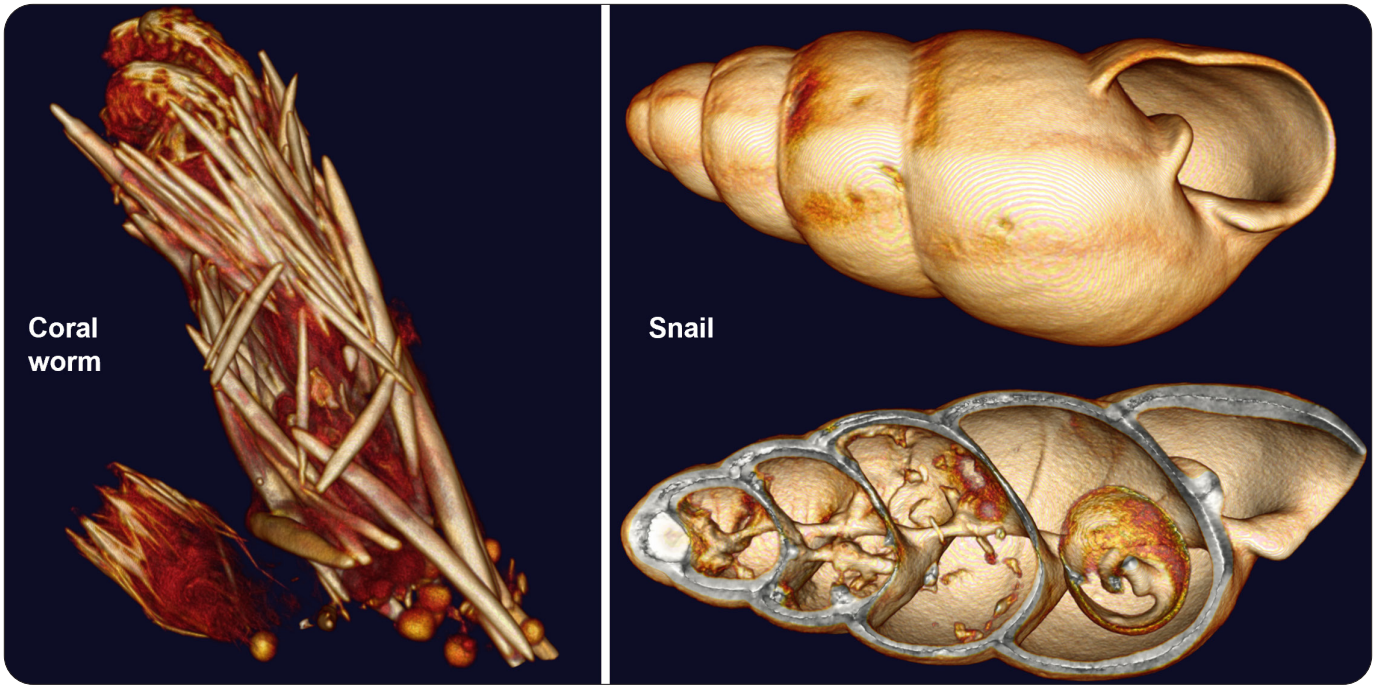

Figure 1: Micro-CT imaging of annelids & gastropods. Acquisition FOV 8-18 mm.

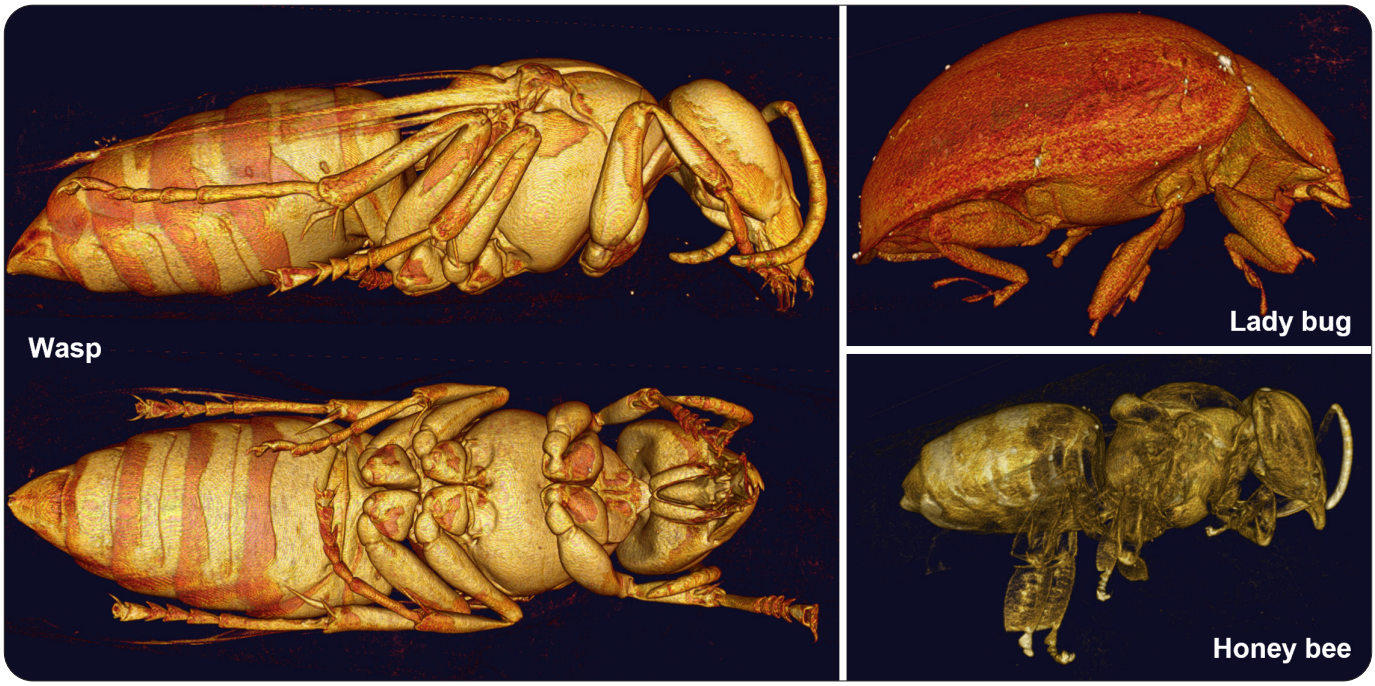

Figure 2: Micro-CT imaging of insects. Acquisition FOV 8-18 mm.

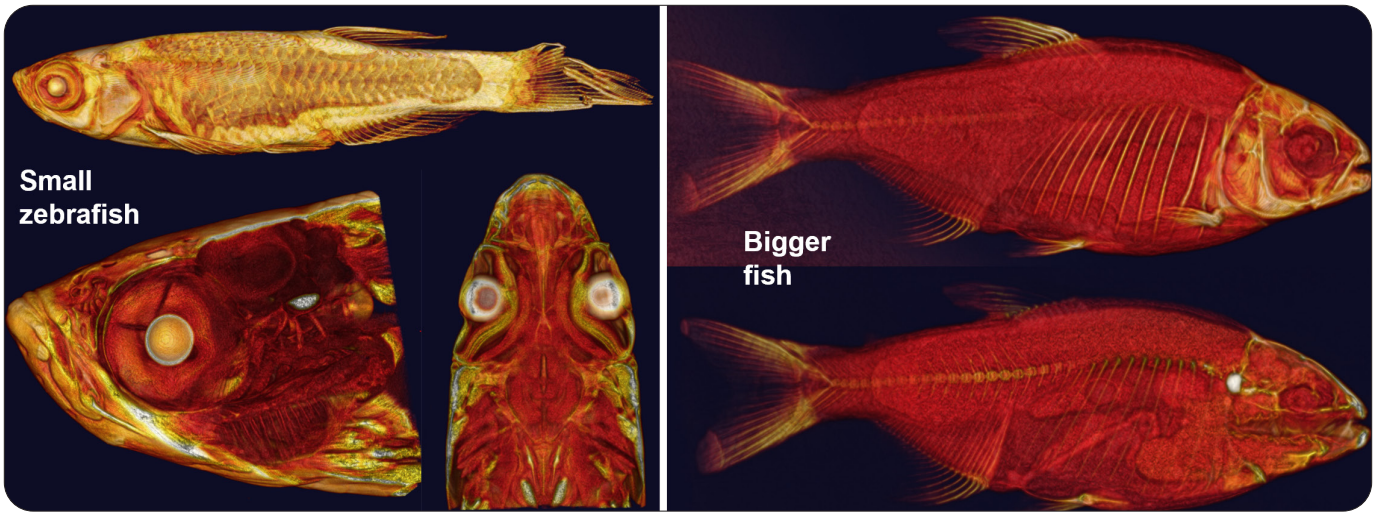

Figure 3: Micro-CT imaging of fish. Acquisition FOV 8-36 mm FOV.

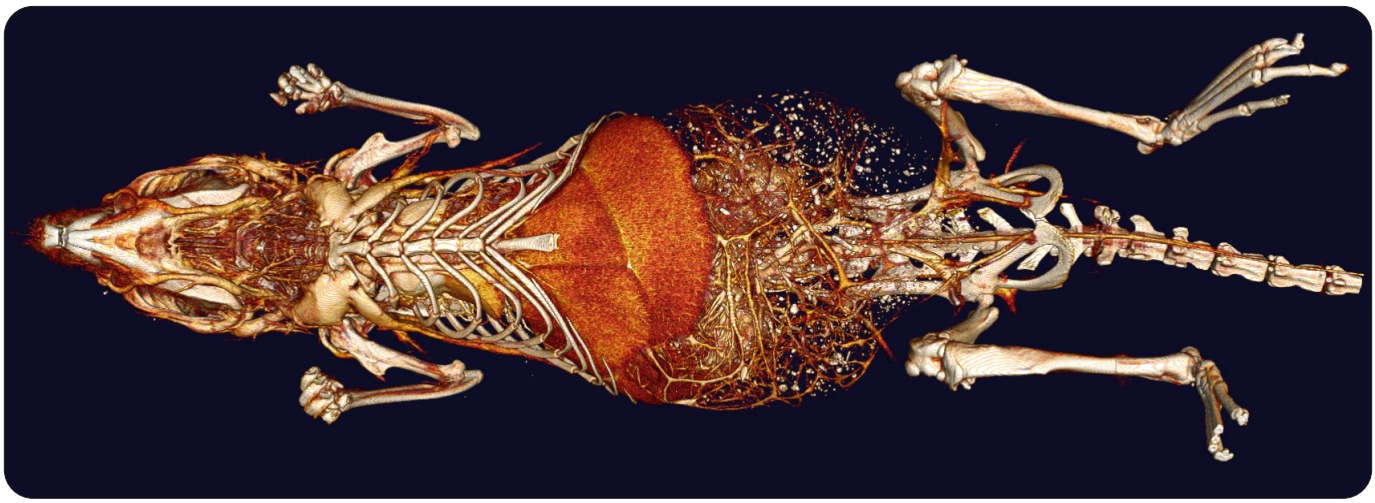

Figure 4: Micro-CT imaging of a whole live mouse. Acquisition FOV 36 mm FOV. Stitched scan of 5 individual contrast-enhanced images.

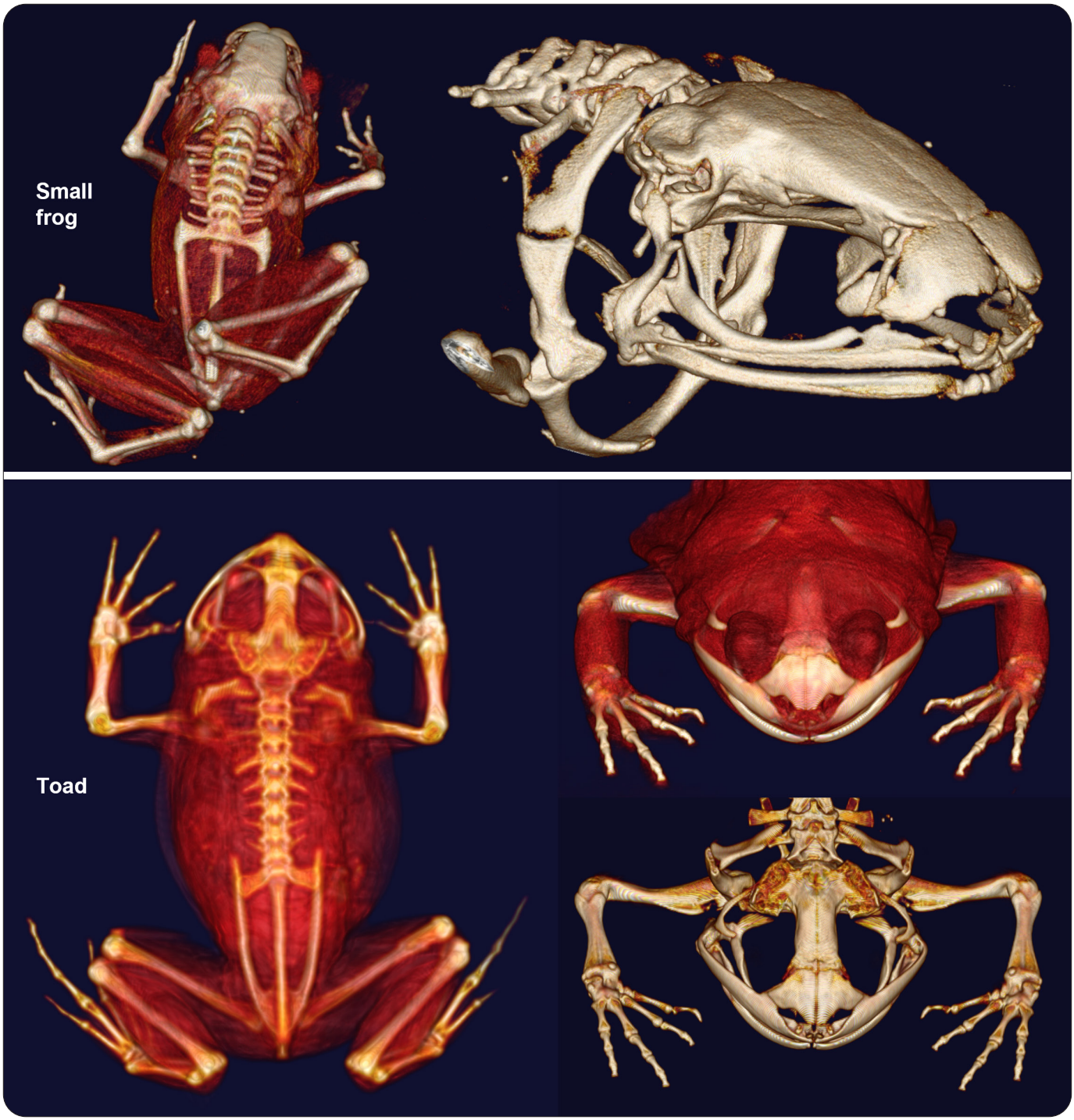

Figure 5: Micro-CT imaging of amphibians. Acquisition FOV 36-72 mm.

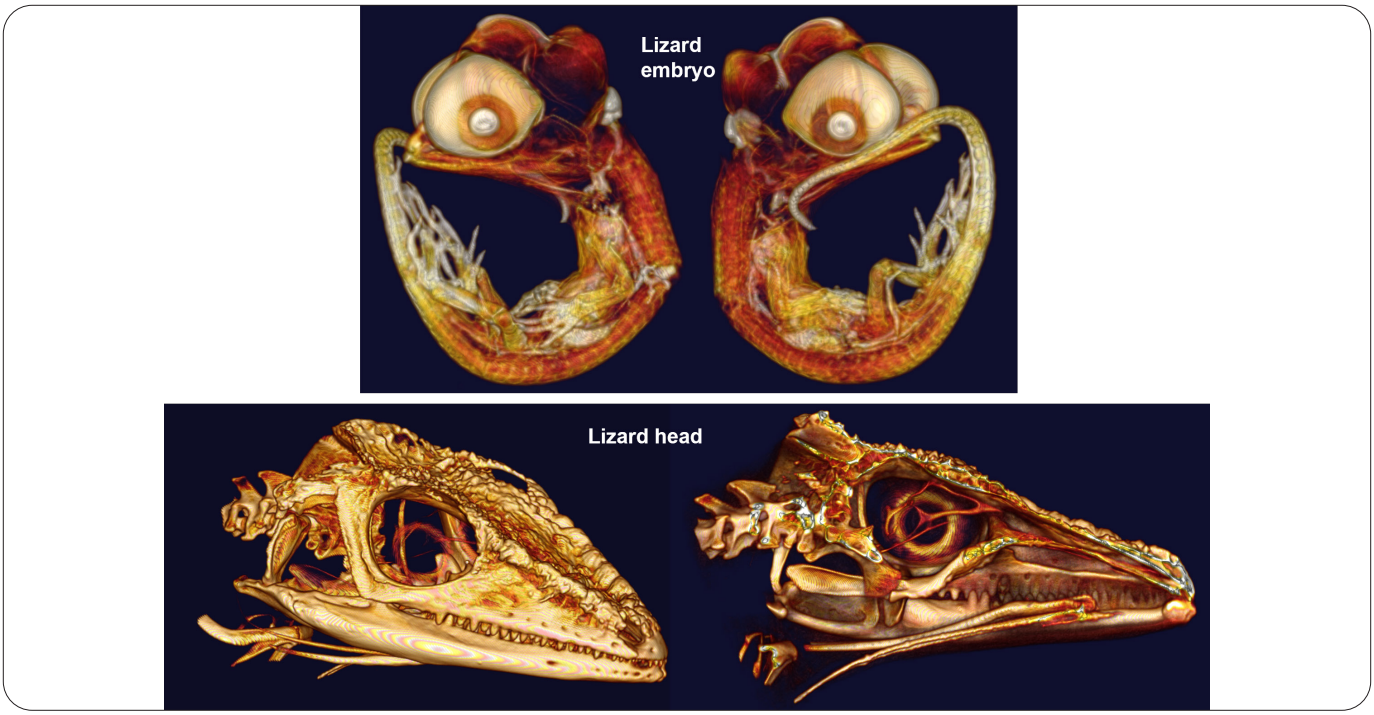

Figure 6: Micro-CT imaging of reptiles. Acquisition FOV 18-72 mm.

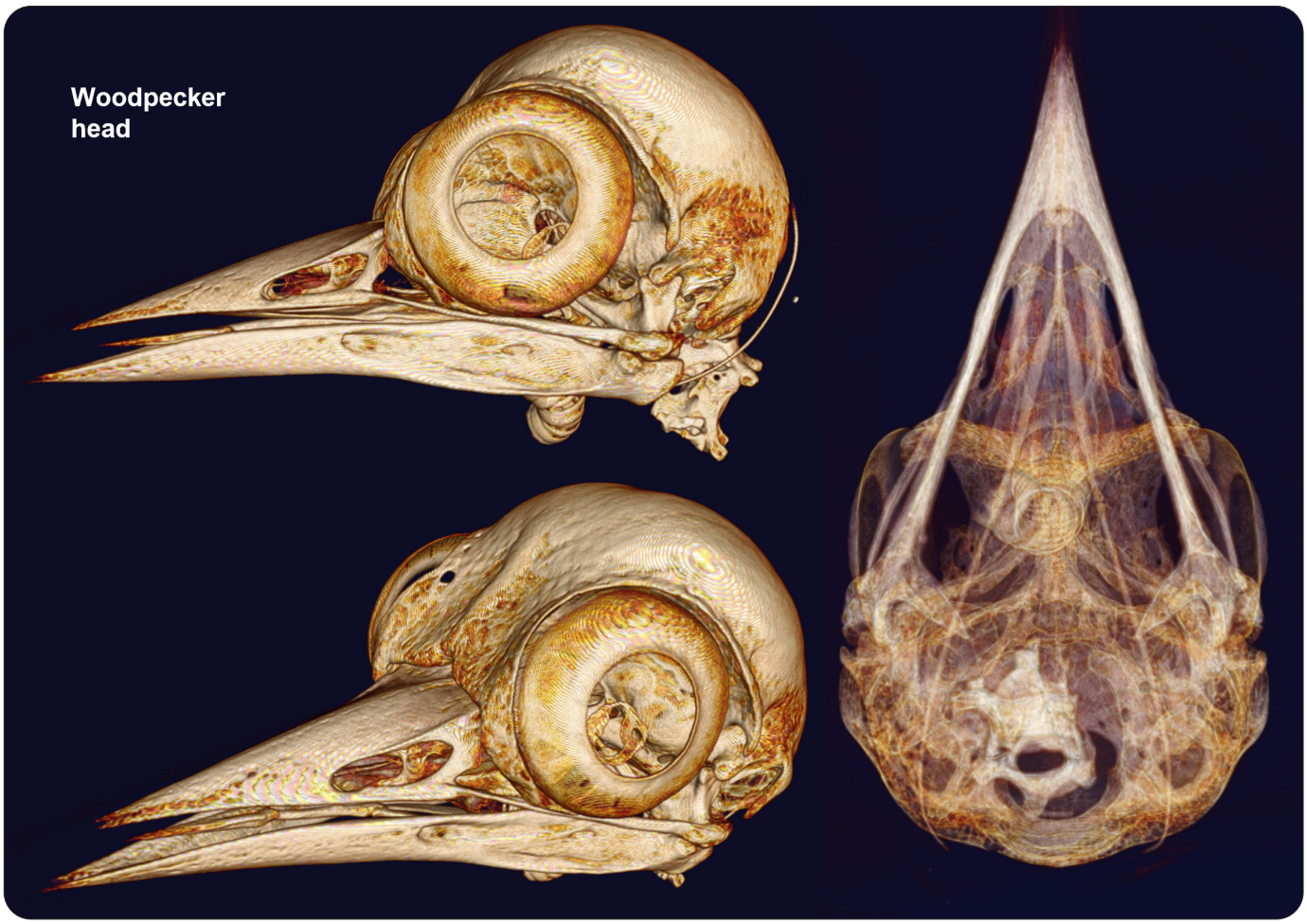

Figure 7: Micro-CT imaging of birds. Acquisition FOV 72 mm.

Conclusion

The Quantum GX3 micro-CT system provides a highly adaptable platform for imaging a wide variety of animal species, ranging from small-scale invertebrates to larger vertebrate specimens.

Its combination of 5 µm spatial resolution, rapid acquisition speeds, multiple field-of-view options, advanced gating capabilities, and artifact reduction technologies enables detailed anatomical visualization across diverse tissue types and body sizes.

For comparative biology, developmental studies, structural analysis, and longitudinal research applications, the Quantum GX3 system offers a scalable and efficient imaging solution.

By supporting both *ex vivo* and *in vivo* workflows, the system bridges microscopic structural detail with whole-organism anatomical context, making it a powerful tool for multi-species biological imaging.

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