

Phase-Contrast and Dark-Field X-ray Imaging: Making Waves in Medicine



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What is Phase-Contrast & Dark-Field imaging?

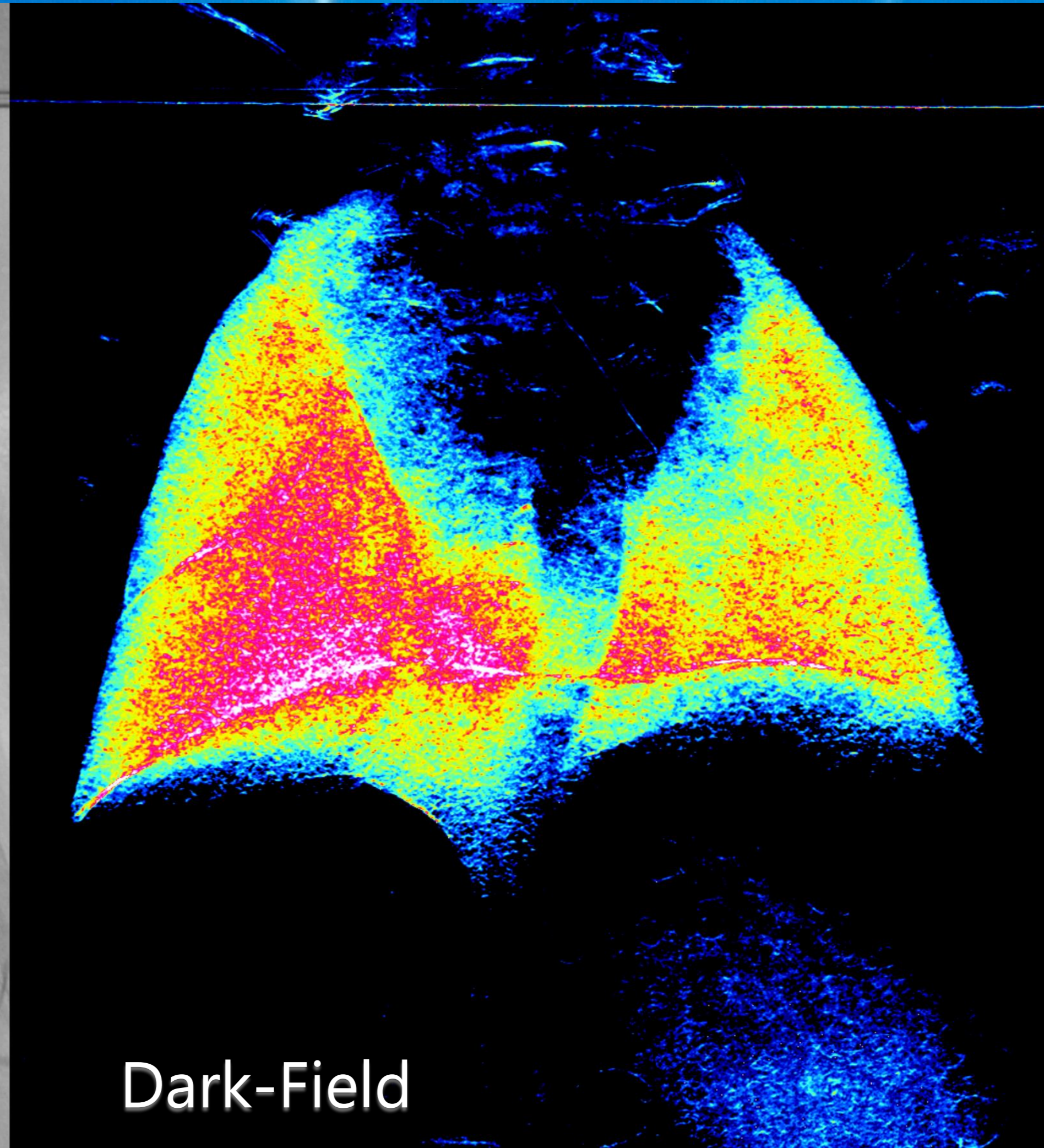
- Conventional X-ray contrast comes from photoelectric absorption
- Phase contrast enhances object boundaries through refraction effects
- Dark-field contrast arises from X-ray multiple scattering by microstructures

Saving Lives with New Imaging Technologies

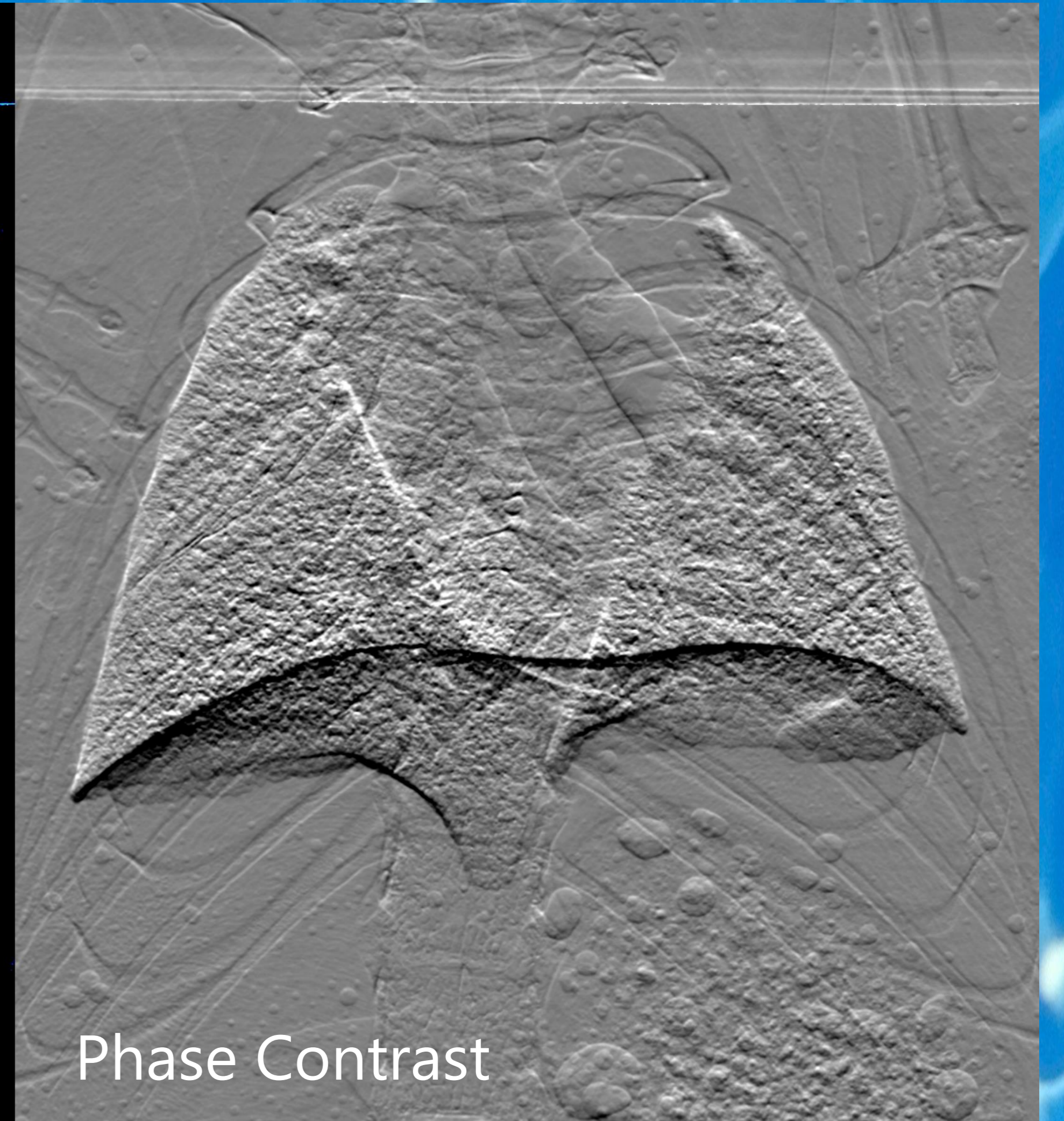
- Our phase-contrast images reveal better ways to resuscitate infants at birth
- Phase-contrast and Dark-field imaging provide better diagnostic information for lung, heart and brain diseases
- Radiation exposure can be reduced by factors in the thousands for soft-tissue 3D imaging



Absorption Contrast



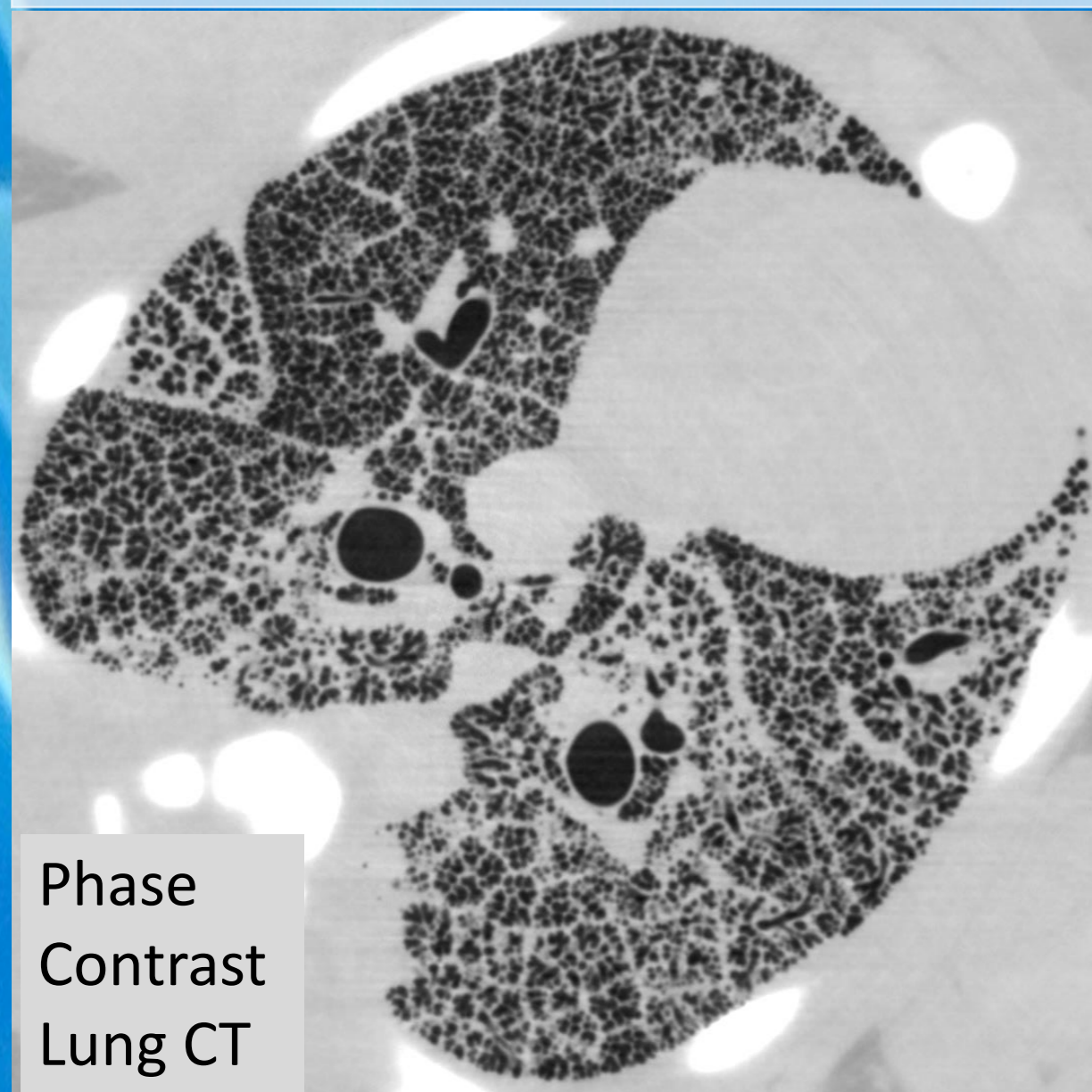
Dark-Field



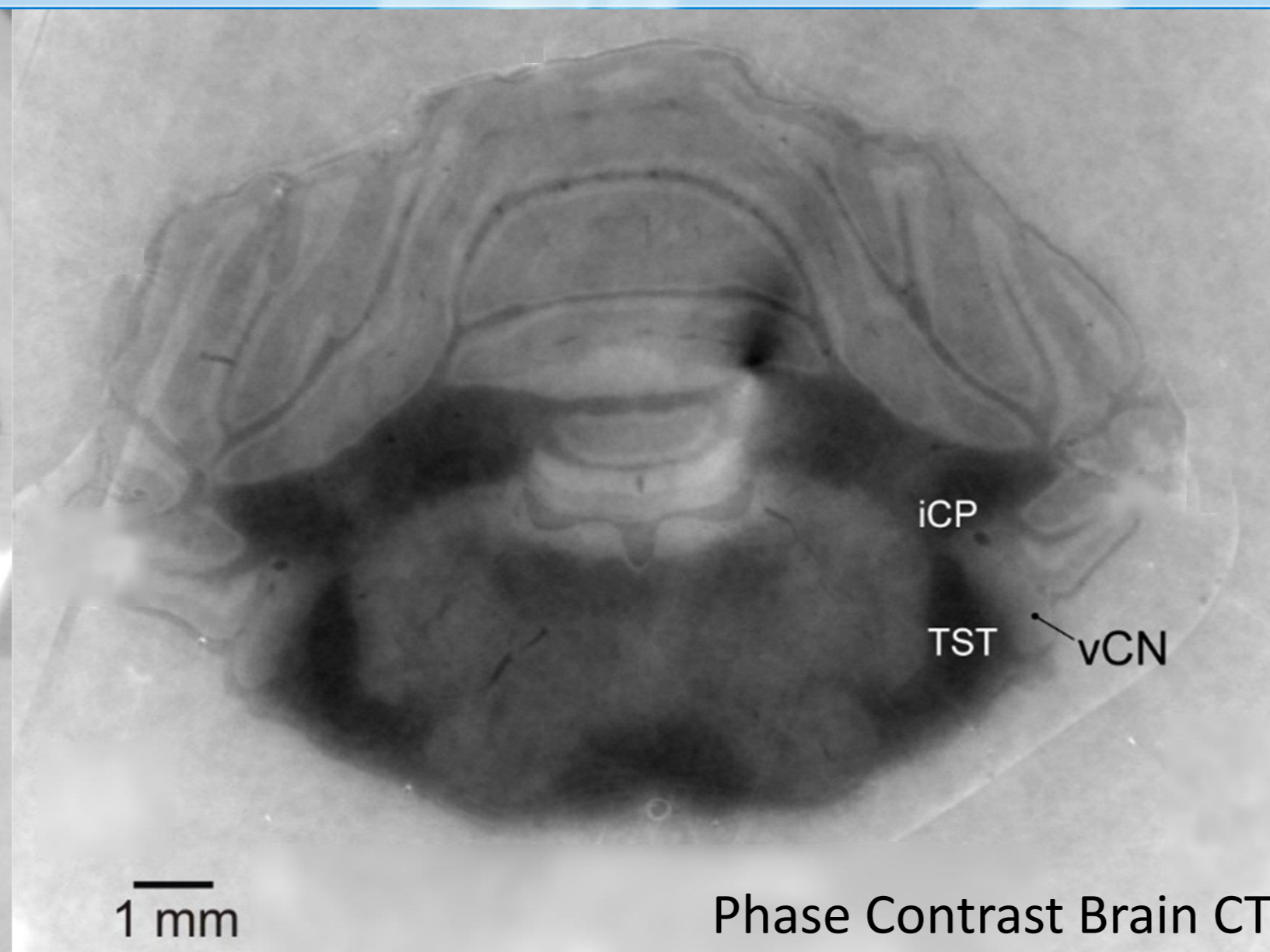
Phase Contrast

High-resolution 3D Imaging with minimal Radiation

- Phase contrast can boost image contrast-to-noise ratios >200-fold!
- Phase retrieval can reduce radiation exposure >40,000 fold!
- We are working to make this technology clinically available



Phase Contrast Lung CT



Phase Contrast Brain CT

Research Projects

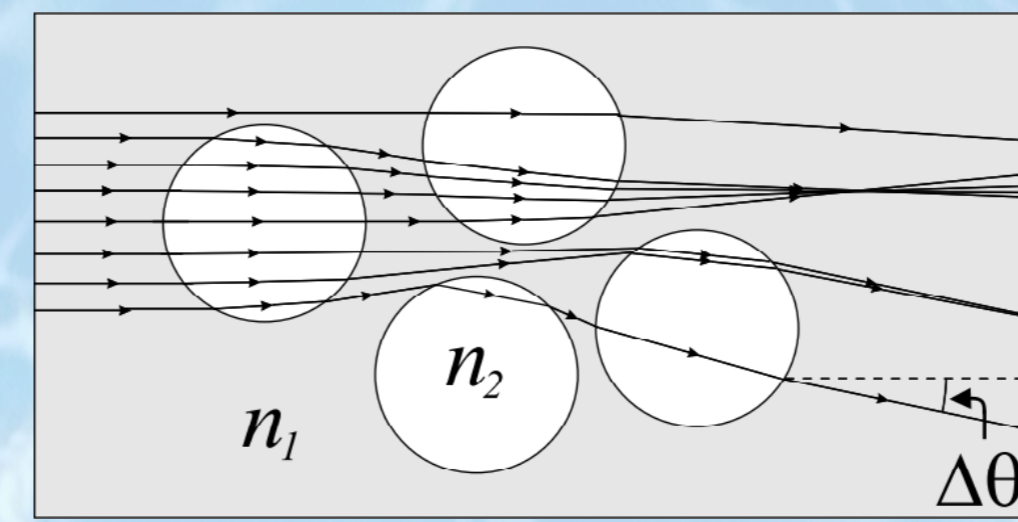
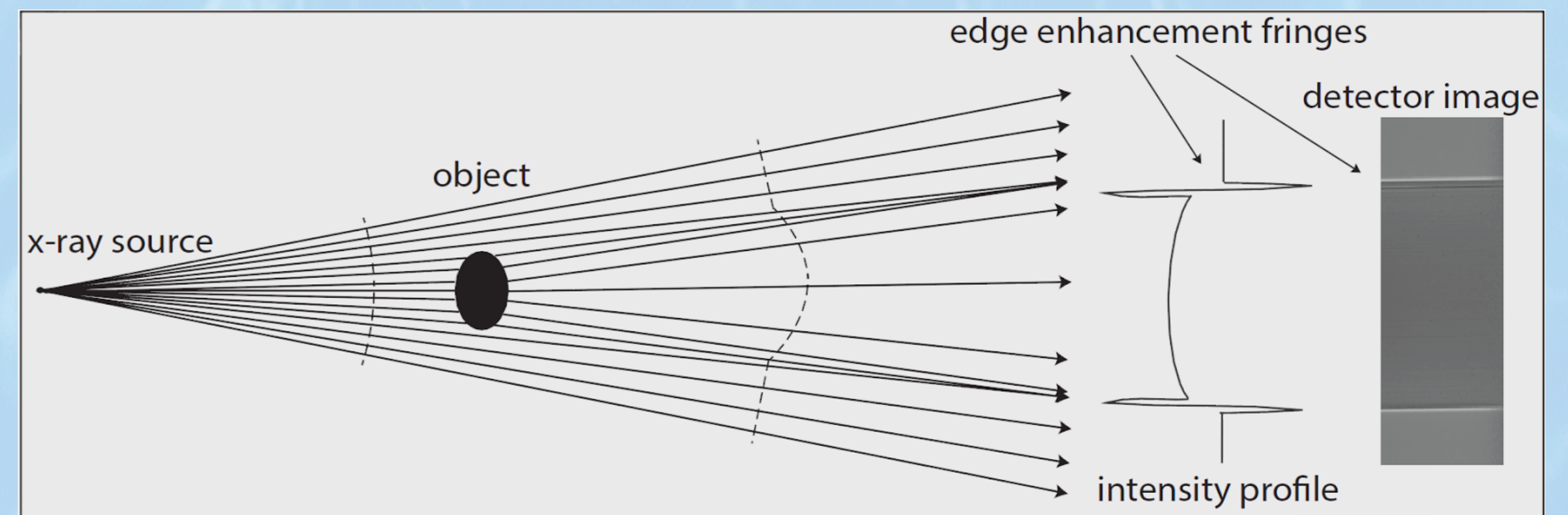
- Ultra low dose X-ray phase-contrast Computed Tomography (CT)
- Dark-field imaging for microstructure characterisation
- Spectral X-ray Imaging
- Phase retrieval algorithms
- Small-angle X-ray scatter-based imaging
- Compton scatter-based imaging
- Super-resolution X-ray imaging
- Quantitative structural and functional imaging for biomedical and diagnostic applications
- Translational research – from the synchrotron to the clinic

X-ray sources

Real-time phase contrast imaging requires a bright and partially coherent X-ray source. We conduct our experiments at these facilities:

- Australian Synchrotron in Melbourne
- SPring-8 synchrotron in Japan
- δ X-ray Laboratory at Monash University

Making the transition from the synchrotron to the laboratory is a key step forward for translating new technologies into clinical practice.

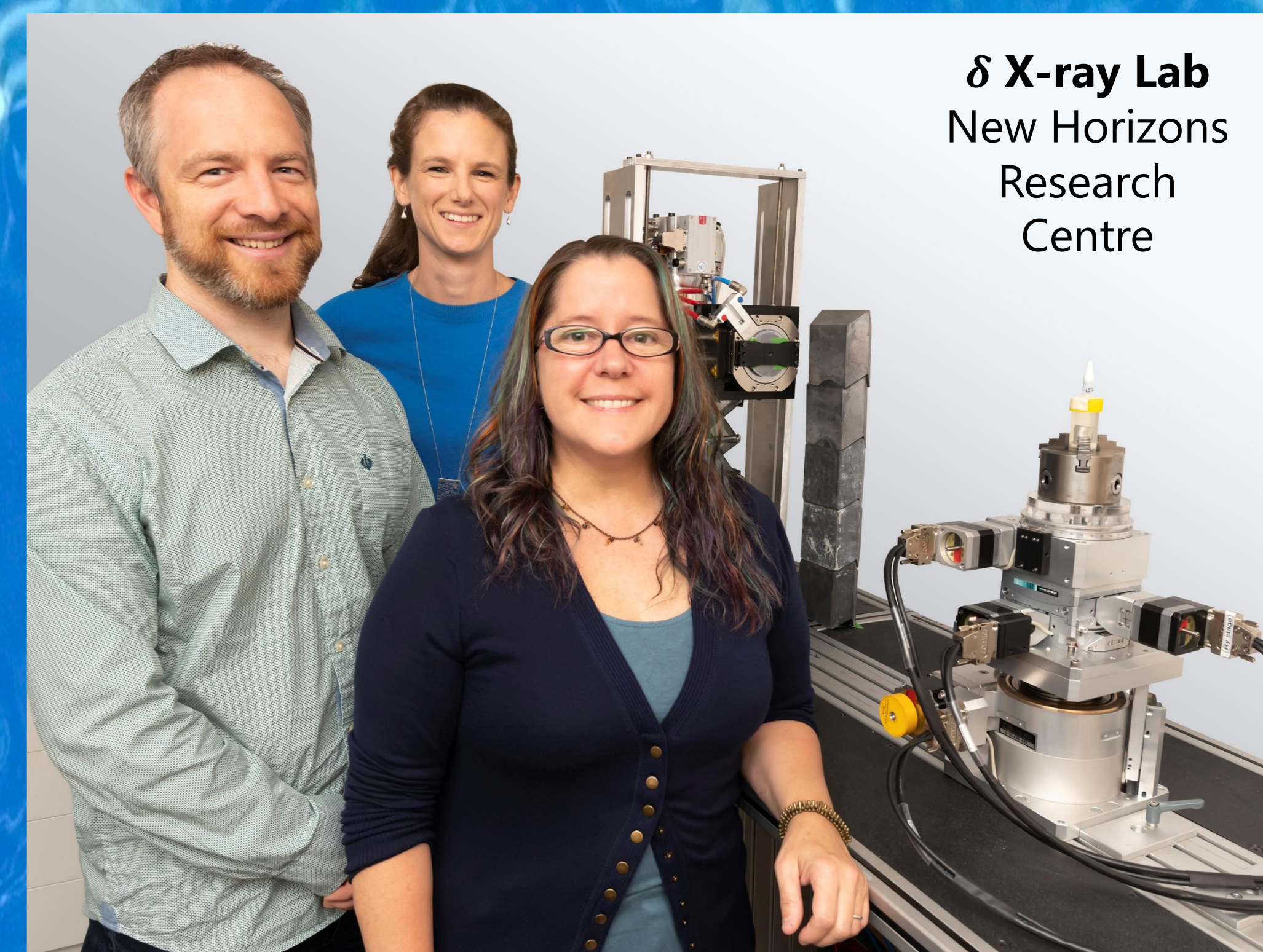
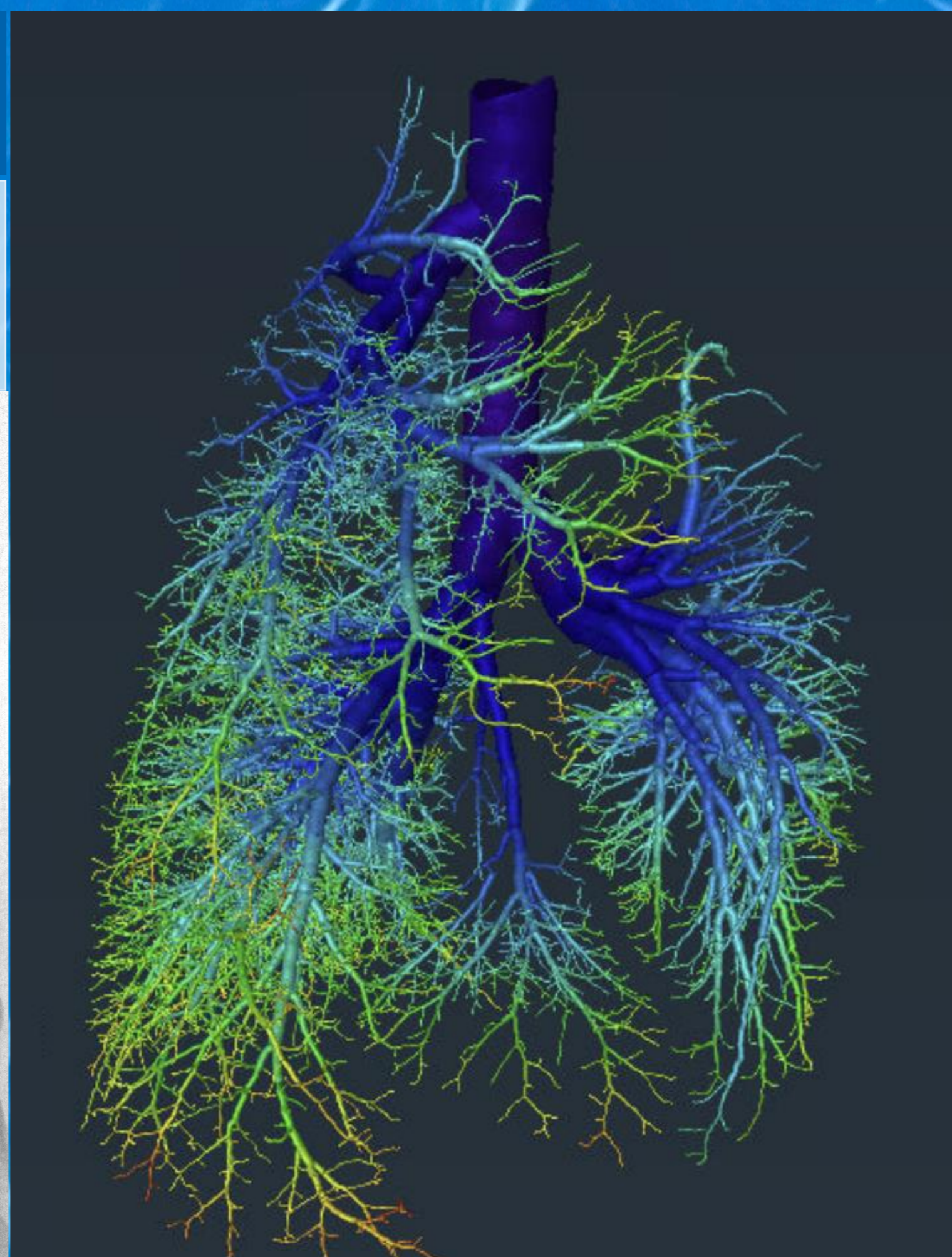
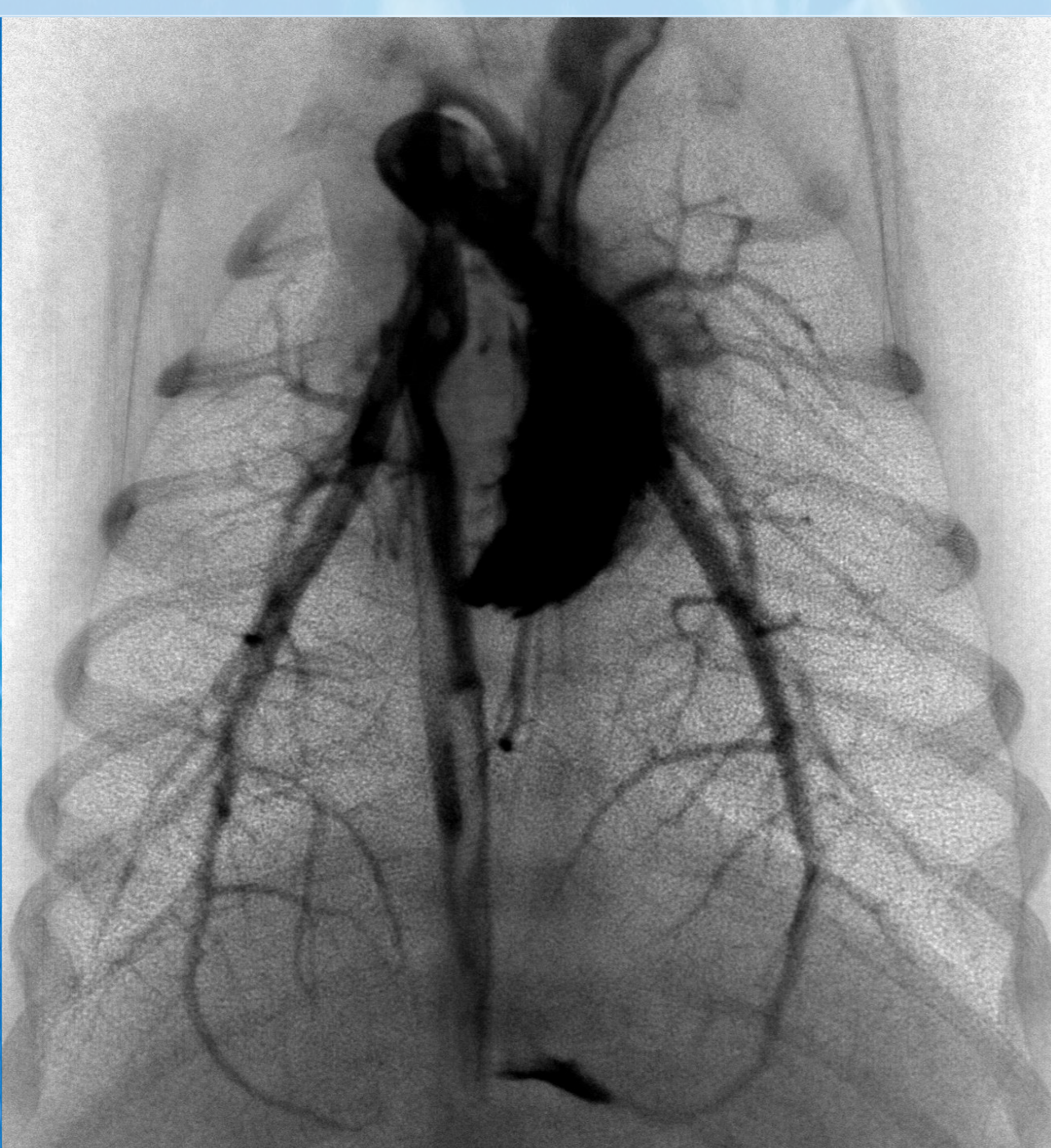
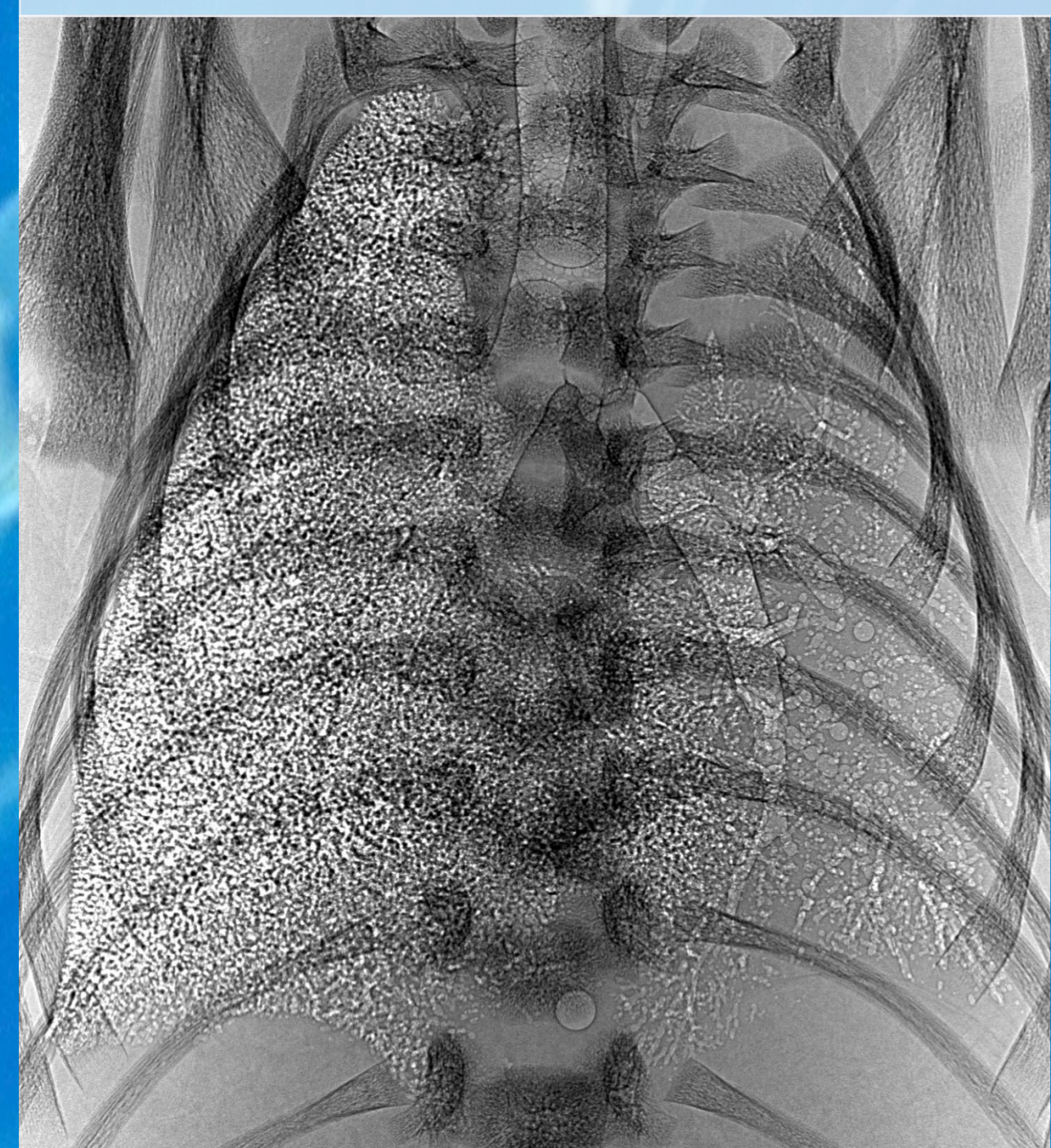


Above: How phase variations become visible as bright intensity fringes.
Left: Refraction through multiple scattering objects creates speckle patterns and dark-field signals.



Cardio-pulmonary imaging

- Contrast agents, like iodine, allow measurement of blood flow (middle)
- Air in the lungs serves as a contrast agent, with contrast enhanced 10-100 fold with phase-contrast (left) and dark-field imaging



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