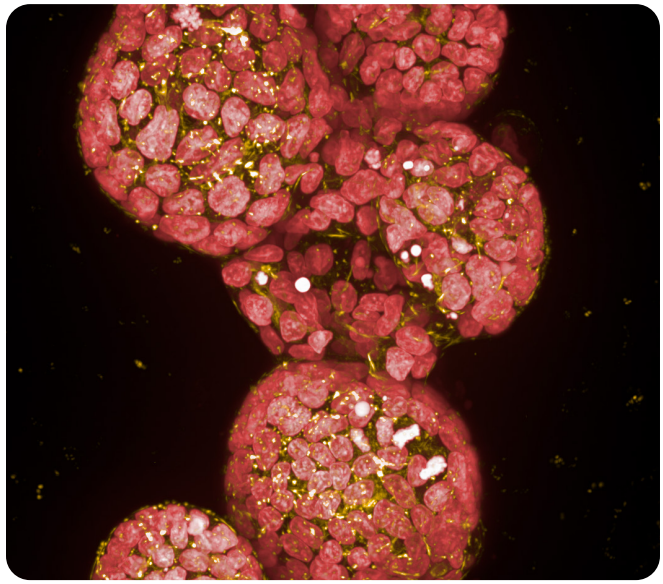
FEATURED PUBLICATIONS

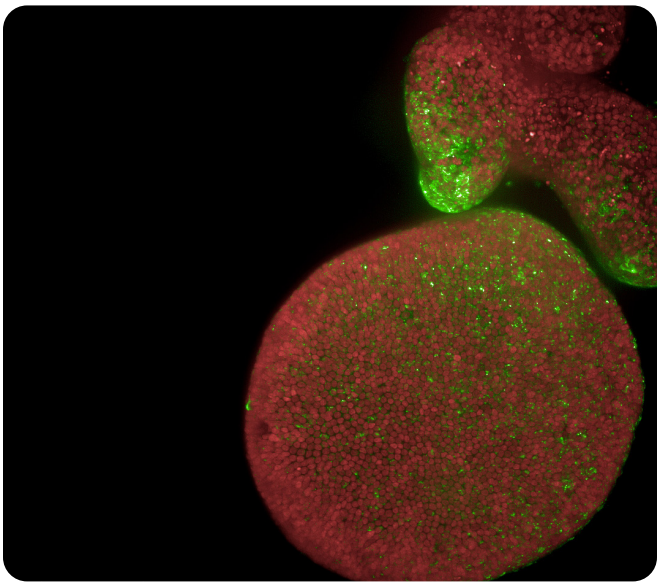
Analysis of 3D cell models with Revvity high-content imaging systems

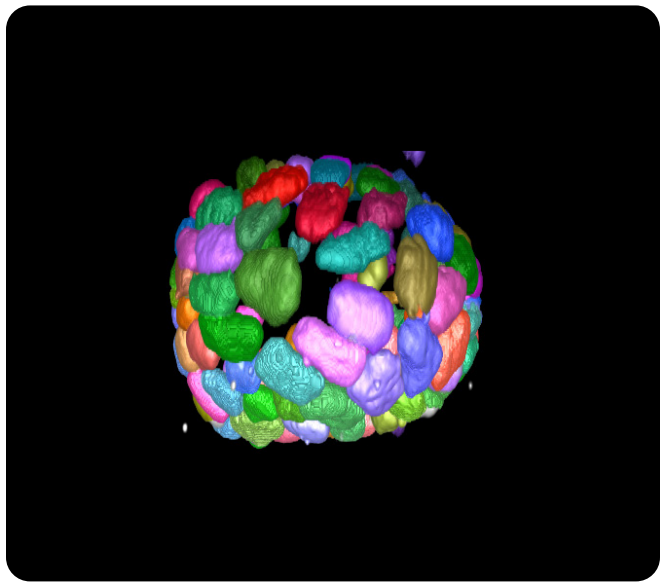
3D cell culture models, such as spheroids, organoids, and microtissues, have gained popularity over recent years as tools for research, drug discovery and toxicity studies. They provide more physiological relevance than biochemical assays and 2D cell cultures, as they more closely represent the microenvironments, cell-to-cell interactions, and biological processes that occur *in vivo*.

Revvity's high-content imaging systems provide highly sensitive solutions for 3D cell imaging, while our intuitive software platforms give you the tools to analyze the most complex 3D cell models and generate more physiologically relevant data that can power better-informed decisions.

Discover what's possible. Browse publications showcasing the Opera Phenix™ and Operetta™ CLS high-content systems and Harmony™ software in real-world research.







Featured publications

The following independent, peer-reviewed studies illustrate how researchers have used Revvity high-content imaging systems in 3D cell model research.

Dissecting endometrial cancer complexity in response to standard and targeted therapies

Vaccarella S, Bruno V, Orlandi G, et al. Cell Death Dis 16, 873 (2025). doi.org/10.1038/s41419-025-08051-8

In this study, researchers establish a patient derived endometrial cancer organoid (PDO) platform that faithfully recapitulates tumor phenotype, genomic alterations, and expression profiles of the original patient tissue. Notably, PDO responses to both standard therapies and targeted treatments closely mirror the responses observed in patients, underscoring their translational relevance.

Importantly, the platform also incorporates the tumor microenvironment by analyzing matched cancer associated fibroblasts (CAFs), revealing distinct and often therapy resistant behavior alongside pro inflammatory senescence. Enabled by the synergy of high content imaging (Opera Phenix) with complementary Revvity assay and detection platforms, the researhers obtained a more holistic and multiparametric assessment of therapeutic response across tumor and stromal compartments, supporting an advanced approach to study treatment efficacy and resistance mechanisms in endometrial cancer.

Organoids as a Biomarker for Personalized Treatment in Metastatic Colorectal Cancer: Drug Screen Optimization and Correlation with Patient Response

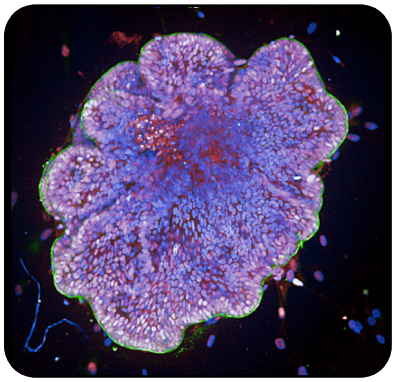
Smabers LP, Wensink E, Verissimo CS, et al. Journal of Experimental & Clinical Cancer Research. 2024;43(1). doi:10.1186/s13046-024- 02980-6

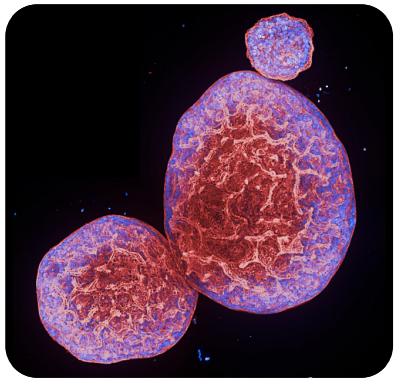
To address the heterogeneity in treatment response observed in colorectal cancer, Smabers and colleagues optimized patient-derived organoid (PDO) drug screening methods using the Operetta CLS high-content analysis system. By implementing a five-step optimization strategy, they achieved significant correlations between organoid sensitivity and clinical outcomes, demonstrating that optimized PDO screens corresponded with patient-specific responses to standard chemotherapies.

Improved Drug-Response Prediction Model of APC Mutant Colon Cancer Patient-Derived Organoids for Precision Medicine

Shin YJ, Jo EH, Oh Y, et al. Cancers. 2023;15(23):5531. doi:10.3390/cancers15235531

Jae Shin et al. developed an improved drug-response prediction model for colorectal cancer patient derived organoids using the ATPlite™ luminescence assay, EnVision™ plate reader, and Operetta CLS high-content analysis system. By identifying that conventional organoid culture conditions increase resistance to oxaliplatin through apoptosis inhibition, they created modified medium conditions that significantly correlated organoid response with outcomes for oxaliplatin treatments.





Images courtesy of Romain Dautreppe and Nicolas Gatimel, Hopitaux de Toulouse.

Viability Analysis and High-Content Live-Cell Imaging for Drug Testing in Prostate Cancer Xenograft-Derived Organoids

Van Hemelryk A, Erkens-Schulze S, Lim L, et al. Cells. 2023;12(10):1377. doi:10.3390/cells12101377

Van Hemelryk and colleagues developed an optimized live-cell imaging workflow for drug testing in prostate cancer xenograft-derived organoids using the Opera Phenix high-content screening system. This high-resolution approach enabled detailed visualization of individual organoids and quantification of various cell death modalities, allowing researchers to distinguish between cytostatic and cytotoxic treatment effects at the single-organoid level.

Cell-Type-Specific High Throughput Toxicity Testing in Human Midbrain Organoids

Renner H, Becker KJ, Kagermeier TE, et al. Frontiers in Molecular Neuroscience. 2021;14. doi:10.3389/fnmol.2021.715054

Renner and colleagues used the Operetta high-content analysis system and Harmony software in an automated workflow to examine the neurotoxic effects of 84 compounds on standardized human midbrain organoids. The study identified known neurotoxicants and revealed a compound with previously unrecognized toxicity. 3D organoid cultures also showed higher sensitivity to certain compounds than traditional 2D cultures.

Publication list

Toxicity

- **3D Human Renal Proximal Tubule (RPTEC-TERT1) Organoids 'Tubuloids' for Translatable Evaluation of Nephrotoxins in High-Throughput.** Yucha, S. E. V.; Quackenbush, D.; Chu, T.; Lo, F.; Sutherland, J. J.; Kuzu, G.; Roberts, C.; Luna, F.; Barnes, S. W.; Walker, J.; Kuss, P., PLOS ONE 2022, 17 (11), e0277937. DOI: 10.1371/journal.pone.0277937.
- **Bisphenol A Impairs Renal Function by Reducing Na+/K+-ATPase and F-Actin Expression, Kidney Tubule Formation *in Vitro* and *in Vivo*.** Yoo, M. H.; Lee, S.-J.; Kim, W.; Kim, Y.; Kim, Y.-B.; Moon, K.; Lee, B.-S., *Ecotoxicology and Environmental Safety 2022,* 246. DOI: 10.1016/j.ecoenv.2022.114141.
- **3D Microtissues Mimic the Architecture, Estradiol Synthesis, and Gap Junction Intercellular Communication of the Avascular Granulosa.** Ip, B. C.; Leary, E.; Knorlein, B.; Reich, D.; Van, V.; Manning, J.; Morgan, J. R., *Toxicol Sci* 2021, 186 (1), 29–42. DOI: 10.1093/toxsci/kfab153.

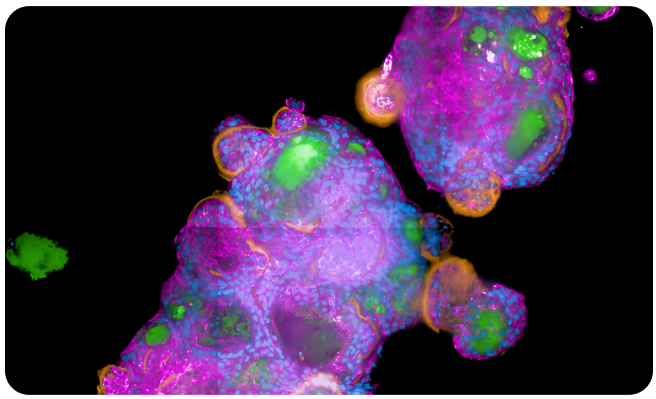


Image provided by: D.Wilfingseder, A.Noureen. Institute of Hygiene and Medical Microbiology, Medical University of Innsbruck

- **Development of a Human Liver Microphysiological Coculture System for Higher Throughput Chemical Safety Assessment.** Ip, B. C.; Madnick, S. J.; Zheng, S.; Van Tongeren, T. C. A.; Hall, S. J.; Li, H.; Martin, S.; Spriggs, S.; Carmichael, P.; Chen, W.; Ames, D.; Breitweiser, L. A.; Pence, H. E.; Bowling, A. J.; Johnson, K. J.; Cubberley, R.; Morgan, J. R.; Boekelheide, K., *Toxicological Sciences* 2024, 199 (2), 227–245. DOI: 10.1093/toxsci/kfae018.

- **Performance Assessment and Economic Analysis of a Human Liver-Chip for Predictive Toxicology.** Ewart, L.; Apostolou, A.; Briggs, S. A.; Carman, C. V.; Chaff, J. T.; Heng, A. R.; Jadalannagari, S.; Janardhanan, J.; Jang, K.-J.; Joshipura, S. R.; Kadam, M. M.; Kanellias, M.; Kujala, V. J.; Kulkarni, G.; Le, C. Y.; Lucchesi, C.; Manatakis, D. V.; Maniar, K. K.; Quinn, M. E.; Ravan, J. S.; Rizos, A. C.; Sauld, J. F. K.; Sliz, J. D.; Tien-Street, W.; Trinidad, D. R.; Velez, J.; Wendell, M.; Irrechukwu, O.; Mahalingaiah, P. K.; Ingber, D. E.; Scannell, J. W.; Levner, D., *Commun Med* 2022, 2 (1), 1–16. DOI: 10.1038/s43856-022-00209-1.

Oncology

- **An in Silico Model of T Cell Infiltration Dynamics Based on an Advanced in Vitro System to Enhance Preclinical Decision Making in Cancer Immunotherapy.** Lewin, T. D.; Avignon, B.; Tovaglieri, A.; Cabon, L.; Gjorevski, N.; Hutchinson, L. G., *Frontiers in Pharmacology* 2022, 13, 837261. DOI: 10.3389/fphar.2022.837261.
- **A Scalable 3D High-Content Imaging Protocol for Measuring a Drug Induced DNA Damage Response Using Immunofluorescent Subnuclear γH2AX Spots in Patient Derived Ovarian Cancer Organoids.** Keles, H.; Schofield, C. A.; Rannikmae, H.; Edwards, E. E.; Mohamet, L., ACS *Pharmacol.* Transl. Sci. 2023, 6 (1), 12–21. DOI: 10.1021/acsptsci.2c00200.
- **Development of a Cancer Metastasis-on-Chip Assay for High Throughput Drug Screening.** Ozer, L. Y.; Fayed, H. S.; Ericsson, J.; Al Haj Zen, A., *Front. Oncol.* 2024, 13. DOI: 10.3389/fonc.2023.1269376.
- **Surface Modification of Mesoporous Silica Nanoparticles as a Means to Introduce Inherent Cancer-Targeting Ability in a 3D Tumor Microenvironment.** Prabhakar, N.; Långbacka, E.; Özliseli, E.; Mattsson, J.; Mahran, A.; Suleymanova, I.; Sahlgren, C.; Rosenholm, J. M.; Åkerfelt, M.; Nees, M., *Small Science* 4, (9) 2024. DOI: 10.1002/smsc.202400084.
- **Engineering a multilayered 3D stromal barrier model for quantitative analysis of T cell infiltration and cytotoxicity.** Morimura, R.; Nada, I.; Mizue, Y.; Shinozaki, E.; Fujita, N.; Katayama, R.; Matsusaki, M.; Hirohashi, Y.; Kitano, S.; Torigoe, T., *Acta Biomaterialia* 2025, 206, 173-185, 1742-7061, DOI: 10.1016/j.actbio.2025.09.012.
- **Dissecting endometrial cancer complexity in response to standard and targeted therapies.** Vaccarella, S.; Bruno, V.; Orlandi, G. *et al. Cell Death Dis* 16, 873 (2025). DOI: 10.1038/s41419-025-08051-8.
- **A high-throughput bone marrow 3D co-culture system to study resistance to BCR signalling targeted agents in B-NHL.** Zadro, A.; Arribas, A.; Colombo, M. V.; Cannas, E.; Spriano, F.; Cascione, L.; Mensah, A. A.; Simonetta, F.; Petta, D.; Candrian, C.; Arrigoni, C.; Bertoni, F.; Moretti, M., Br J Haematol 2026, 208: 716-721. DOI: 10.111/jh.70273.
- **MicroRNA-mediated PTEN downregulation as a novel non-genetic mechanism of acquired resistance to PI3Kα inhibitors of head & neck squamous cell carcinoma.** Pulito, C.; Vaccarella, S.; Palcau, A. C.; Ganci, F.; Brandi, R.; Frascolla, C.; Sacconi, A.; Canu, V.; Benedetti, A.; De Pascale, V.; Donzelli, S.; Fisch, A. S.; Manciocco, V.; Covello, R.; Pimpinelli, F.; Morrone, A.; Fazi, F.; Pellini, R.; Muti, P.; Meens, J.; Karamboulas, C.; Nichols, A. C.; Strano, S.; Klinghammer, K.; Tinhofer, I.; Ailles, L.; Fontemaggi, G.; Blandino, G., Drug Resistance Updates 2025, 81, (101251) 1368-7646, DOI: 10.1016/j.drup.2025.101251.

3D Method & Materials Development

- **Dynamic Matrices with DNA-Encoded Viscoelasticity for Cell and Organoid Culture.** Peng, Y.-H.; Hsiao, S. K.; Gupta, K.; Ruland, A.; Auernhammer, G. K.; Maitz, M. F.; Boye, S.; Lattner, J.; Gerri, C.; Honigmann, A.; Werner, C.; Krieg, E., *Nature Nanotechnology* 2023. DOI: 10.1038/s41565-023-01483-3.
- **High Throughput 3D Gel-Based Neural Organotypic Model for Cellular Assays Using Fluorescence Biosensors.** Kundu, S.; Boutin, M. E.; Strong, C. E.; Voss, T.; Ferrer, M., *Communications Biology* 2022, 5 (1236). DOI: 10.1038/s42003-022-04177-z.
- **Development of an automated 3D high-content cell screening platform for organoid phenotyping.** Bozal, S. B.; Sjogren, G.; Costa, A. P.; Brown, J. S.; Roberts, S.; Baker, D.; Gabriel, P.; Ristau, B. T.; Samuels, M.; Flynn, W. F.; Robson, P.; Courtois, E. T., *SLAS Directory* 2024, 29 (7), 2472-5552. DOI: 10.1016/j.slasd.2024.100182.

Vascular Biology

- **Precision Culture Scaling to Establish High-Throughput Vasculogenesis Models.** Dennison, N. R.; Fusenig, M.; Grönnert, L.; Maitz, M. F.; Ramirez Martinez, M. A.; Wobus, M.; Freudenberg, U.; Bornhäuser, M.; Friedrichs, J.; Westenskow, P. D.; Werner, C., *Advanced Healthcare Materials* 2024, 13 (18), 2400388. DOI: 10.1002/adhm.202400388.

Neurodegeneration / Neurology

- **Mitochondrial Dysfunction and Mitophagy Defects in LRRK2-R1441C Parkinson's Disease Models.** Williamson, M. G.; Madureira, M.; McGuinness, W.; Heon-Roberts, R.; Mock, E. D.; Naidoo, K.; Cramb, K. M. L.; Caiazza, M.-C.; Malpartida, A. B.; Lavelle, M.; Savory, K.; Humble, S. W.; Patterson, R.; Davis, J. B.; Connor-Robson, N.; Ryan, B. J.; Wade-Martins, R., *Human Molecular Genetics* 2023, 32 (18), 2808–2821. DOI: 10.1093/hmg/ddad102.

Regeneration

- **High-throughput 3D phenotypic screening identifies repurposed MEK inhibitors as drivers of chondrogenesis for cartilage regeneration.** Hadi Hajiali, H.; Cholewa-Waclaw, J.; Ballard, J.; Okur, K. E.; Elliott, R.; Carragher, N. O.; El Haj, A. J., *Front. Bioeng. Biotechnol.* 14:1748443.14 DOI: 10.3389/fbioe.2026.1748443.

Revvity high-content imaging systems: designed with 3D cell culture models in mind

Due to their size, 3D cell models and tissues pose characteristic challenges to any imaging system but benefit greatly from confocal imaging. Our spinning disk confocal high-content imaging systems with automated water-immersion objectives help you quickly and easily generate content-rich, physiologically relevant data from 3D samples.

The **Operetta CLS** system's unique combination of technologies provides flexibility, sensitivity, and resolution for 3D cell culture imaging, whilst the **Opera Phenix OptIQ** system is our advanced confocal solution for 3D high-content screening. It features a microlens-enhanced dual-disk design with pinhole distances optimized for thick samples such as 3D cell models.

With 3D cells models in mind, both systems utilize automated water-immersion objectives and confocal spinning-disk technology, together with the optional PreciScan™ intelligent acquisition software plug-in.

Automated water-immersion objectives

Captures up to four times more light than air objectives and provides higher resolution in X,Y, and Z, so you can get more detail faster, and image deeper into 3D structures.

Confocal spinning-disk technology

Ideal for imaging 3D spheroids, this technology allows you to acquire image stacks with improved signal-to-noise ratios, high X, Y, and Z resolution, high frame rates and minimal sample illumination.

Save time with pre-scan intelligent acquisition

Pre-scan at low magnification to locate spheroids, then automatically rescan at higher magnification with the spheroid centered in the image.

Opera Phenix OptIQ high-content screening system

Intuitive software to analyze the most complex 3D cellular models

Revvity software solutions give you the tools to optimize imaging of 3D cell models and their automated workflow-centric interfaces, with integrated artificial intelligence, make advanced 3D image analysis straightforward. You can turn data into understanding with our intuitive Harmony imaging and analysis software

- Speed up 3D image acquisition by targeted imaging of microtissues
- Better understand your cell models by exploring them in the 3D viewer and XYZ viewer
- Create Z stack overviews (or gallery)
- Produce 3D renderings and movies
- Analyze morphologies and volumes in 3D
- Calculate Maximum Intensity Projections containing height profiles

As datasets for 3D cell models are often huge, data from Harmony software and all major high-content screening and cell imaging systems can seamlessly integrate with Image Artist™, our next generation image analysis and management platform.

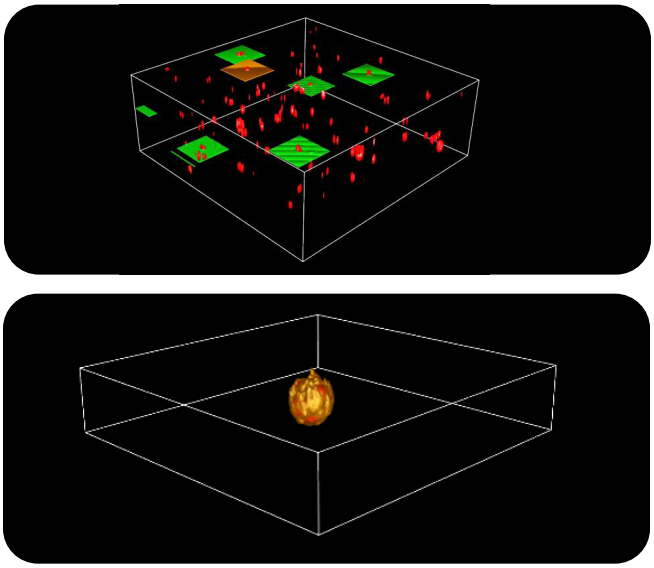
Harmony high-content imaging and analysis software

Drives the Operetta and Opera Phenix systems and includes a wide range of features to analyze the most complex cellular models in 3D, reliably discriminate phenotypes, and turn your biological data into knowledge.

Image Artist high-content image analysis and management platform

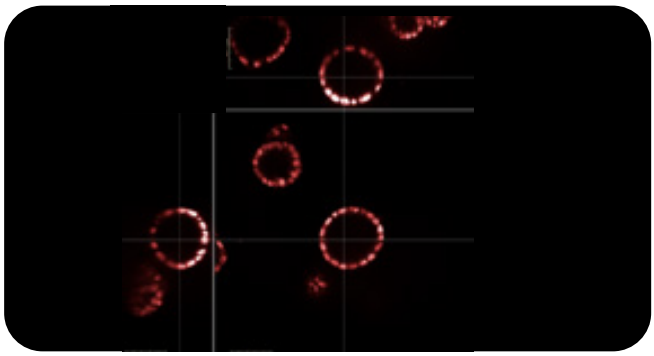
Quickly process, analyze, share and store the vast volumes of data generated by high-content screening and cellular imaging of 3D objects, and get answers sooner.

PreciScan 3D image acquisition:

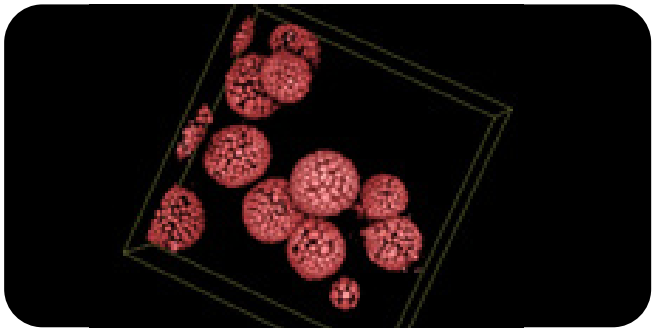


10x pre-scan in x, y, and z dimensions (left), 63x magnification re-scan (right).

3D image visualization:



XYZ view



3D view

For research use only. Not for use in diagnostic procedures.