Microscopy Imaging Center (MIC)

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The Microscopy Imaging Center (MIC, www.mic.unibe.ch) disseminates expert knowledge and provides technical support in high-end microscopy. It implements new technologies, administers the MIC instrument portfolio, and ensures central access to equipment. It teaches at the Master's and PhD levels and offers training for scientific staff at all levels.

Research Highlights

Medical Faculty

Christine Peinelt, Martin Lochner and Mattias Hediger, and colleagues from the Institute of Biochemistry and the Department of BioMedical Research published "Developing chemical tools to study calcium entry into the cell": Eleven new GSK-7975A-based chemical probes were synthesized to study store-operated calcium entry (SOCE) mechanisms. Microscopy-assisted Ca^{2+} imaging and patch-clamp electrophysiology were employed to characterize their biological activity. Most probes maintained potent SOCE inhibition, including photo-caged, clickable, and deuterated derivatives. The photo-caged GSK-7975A enabled precise spatial and temporal control of inhibition in live-cell imaging experiments. These multifunctional probes provide valuable tools for high-resolution investigation of STIM/Orai-mediated Ca^{2+} signaling.

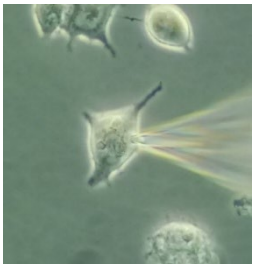

Figure 1 Whole cell patch clamp recordings were used to detect Orai1 ion channel currents.

Tscherrig et al., Cell calcium, 2024. DOI: 10.1016/j.ceca.2023.102834.

Vetsuisse Faculty

Sabine Kaessmeyer and Mathieu de Preux from the Departments of Clinical Research and Veterinary Public Heath as well as Clinical Veterinary Medicine teamed up with Ruslan Hlushchuck from the Institute of Anatomy and colleagues for the project "The anatomy of the equine trigeminal cave": Equine trigeminal-mediated headshaking is a painful neuropathic disorder comparable to human trigeminal neuralgia. In humans, treatment involves destruction of trigeminal ganglion pain fibers within the trigeminal cave, an anatomical structure not yet described in horses. This study provides a detailed analysis of the subarachnoid space surrounding the trigeminal ganglion using MRI, micro-CT and histology, with potential implications for targeted treatment.

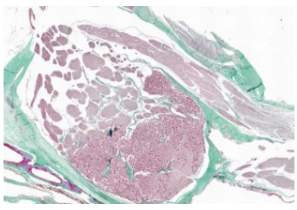

Figure 2 Trigeminal cave cut perpendicular to the porus trigeminus.

Source Figure 2: Adapted from Becker et al. (2024), *Frontiers in Veterinary Science*, 11:1424890, DOI: 10.3389/fvets.2024.1424890, **CC BY 4.0**; arrow and arrowhead removed from the original figure.

Becker et al., Front. Vet. Sci., 2024. DOI: 10.3389/fvets.2024.1424890.

Medical Faculty

DNA-PAINT enables nanometer-resolution imaging of single targets but suffers from non-specific background signals due to off-target binding of DNA-conjugated probes. The study by Christian Soeller and Alexander Clowsley and colleagues from the Institute of Physiology introduces Shielded DNA-PAINT, using partially or fully double-stranded docking strands and high-ionic-strength buffers to reduce non-specific interactions. This approach decreases background signals approximately five-fold in the nucleus, offering a simple, cost-effective improvement compatible with existing DNA-PAINT protocols.

Lučinskaitė et al., Small, 2024. DOI: 10.1002/smll.202405032.

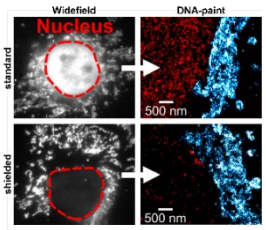

Figure 3 Shielded DNA-PAINT reduces non-specific signal in the nucleus.

Science Faculty

Volker Heussler from the Institute of Cell Biology and colleagues published "Liver-stage P. berghei uses GABARAP for TFEB activation": Using advanced fluorescence and confocal microscopy, we visualized transcription factor EB (TFEB) activation in Plasmodium berghei-infected hepatocytes. Microscopy showed GABA type A receptor-associated proteins (GABARAPs) recruit the folliculin (FLCN)–folliculin-interacting protein (FNIP) complex to the parasitophorous vacuole membrane. Visualization of conjugation of ATG8 to single membrane (CASM) demonstrated strong TFEB activation and dynamic host–parasite interactions.

Schmuckli-Maurer et al., Communications Biology, 2024. DOI: 10.1038/s42003-024-07242-x

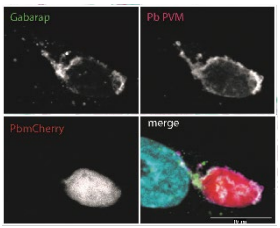

Figure 2 Plasmodium berghei-infected hepatocytes: Host GABARAP proteins are recruited to the parasitophorous vacuole membrane (PVM).

MIC Highlights

Networking - MIC Research Day 2024

On June 26, 2024, more than 180 participants from the Universities of Bern, Fribourg and Zurich, the EPFL in Lausanne and industry representatives attended the traditional MIC Research Day, which took place at the Department of Chemistry, Biochemistry and Pharmaceutical Sciences (DCBP) at the University of Bern. The balanced program of the event was presented by microscopists ranging from PhD students to established researchers. All three faculties of the MIC were represented in the presentations. As usual, this event offered numerous opportunities for networking among imaging professionals at the University of Bern.

Figure 3 MIC Research Day 2024, speaker Li Xin, Theodor Kocher Institute, UniBe.

Event - MIC Symposium 2024

The MIC Symposium 2024 on „Bio-inspired materials and bioengineering" took place on November 15, 2024, at the University of Fribourg. In three sessions, the invited scientific speakers talked about biomedical imaging, advances in imaging single molecules at nanoscale and about how natural phenomena inspire the development of innovative materials and technologies. Prof. Barbara Rothen-Rutishauser, Prof. Jens Stein, Dr. Boris Egger and Dr. Dimitri Vanhecke formed the scientific committee of the MIC Symposium. In the end, it was a spectacular day with stunning microscopic documentations of how fascinating biological processes can be.

Figure 4 Impressions of the MIC Symposium at the University of Fribourg.

Education - CEM Study Trip and Summer School 2024
In February 2024, the students of the PhD program *Cutting Edge Microscopy* (CEM) visited the **Human Technopole Institute (HT)** in Rho Fiera, Milan, Italy. The two-day program included a visit to the cryo-EM facility, the light microscopy facility, the spatial omics unit and a demonstration of electrophysiological experiments in microscopy and optical tweezers. From July 4 to 5, 2024, the annual **summer school** for the CEM students took place in Bönigen, Switzerland. The program was filled with scientific presentations and special guest Vibor Laketa, Head of the Platform for Infectious Disease Imaging at the University of Heidelberg. The beautiful landscape, the pleasant accommodation and the free time to enjoy Lake Brienz contributed to a perfect learning atmosphere.

Figure 5 Impressions of the CEM Study Trip in Rho Fiera, Milan (IT).

MIC Profile

- Instruments, users and usage hours: 96 instruments are registered at the MIC. In 2024, this equipment was used by 511 researchers in a total of 98'879 usage hours.
- Instrument types: 38 wide field microscopes, 3 slide scanners, 15 laser scanning microscopes, 5 two-photon microscopes, 8 spinning disc microscopes, 4 stereo microscopes, 6 transmission electron microscopes (EM), 6 scanning EM, 2 light sheet microscopes, 2 ultrasound systems, 2 atomic force microscopy systems, 1 mass cytometer, 1 imaging mass cytometer and 3 micro computed tomography (micro-CT) instruments.
- Publications: In 2024, MIC users co-authored 105 research articles that included data obtained using MIC instruments.
- Services: Web-based booking system for microscopes; Imaging and image and data analysis; Handling of large data sets; Sample preparation; Training; Newsletter; Publication of news, courses, events and other activities on the MIC webpage (www.mic.unibe.ch).
- Teaching and events. Lecture series on Advanced Microscopy. MIC workshops, MIC trainings, microscopy instrument demonstrations, MIC Research Day, MIC Symposium.
- PhD program *Cutting Edge Microscopy* (CEM). The main aim of the CEM program is to provide an interdisciplinary training program to PhD students to become first-class experts in biological imaging. The unique and interdisciplinary framework established by the MIC provides the necessary infrastructure and expert knowledge. The program is scientifically directed by MIC members Prof. Benoît Zuber and Dr. Steven Proulx and administered by the MIC and CEM coordinator Prof. Ruth Lyck. In 2024, 23 students participated in the CEM program of whom three students received their certificates of graduation.
- Tight collaboration with Data Science Lab (DSL) of the University of Bern for high quality support of MIC users in data handling and image analysis.
- Excellent cooperation with the Graduate School for Cellular and Biomedical Sciences (GCB) and individual master's programs to optimize the MIC teaching portfolio.
- External partners: Swiss Society for Optics and Microscopy (SSOM); Life Sciences Switzerland (LS2), Intersection Microscopy; Scientific Volume Imaging b.v. (SVI); Swiss Microscopy and Imaging Core Facility Network, Euro-BioImaging and Global BioImaging.