



Annual Report 2013

Microscopy Imaging Center (MIC)

University of Bern



The MIC in brief

The **Microscopy Imaging Center** of the University of Bern (MIC) is *the* platform for high-end microscopy. It operates and provides access to state of the art equipment and brings together interested scientists and institutions.

The MIC represents the center of excellence for high-end microscopy in life sciences and beyond.

Founded in 2005, it has continuously increased its activities and is well recognized for its coordinative function in microscopy and imaging. Since 2012, the MIC has an official performance mandate from the University's headship associated with financial support.

MIC Activities

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- Operating, maintaining and providing access to high-end microscopy equipment
 - Microscopy services like sample preparation, data handling, stereology
 - Know-how platform for high-end microscopy
 - Coordinating access and use of shared equipment
 - Performance and utilization reporting of equipment
 - Coordination of microscopy investment and related application support
 - Teaching in cutting-edge microscopy (lectures, practical modules)
 - Quality management in microscopy
 - Publicity of microscopy activities at the University of Bern (e.g. yearly MIC symposium)
-

MIC Organization

The steering committee of the MIC is its **Commission**, where decisions are taken. Involvement of the **MIC-Commission members** is voluntary. The **MIC Coordinator** (Dr. Stefan Tschanz) is the primary contact person and executive of the MIC. The **MIC Board** (chair: Prof. Britta Engelhardt, Medical Faculty, Prof. Volker Heussler, Faculty of Science, Prof. Michael Stoffel, VetSuisse Faculty) represent the MIC within each of the Faculties and to University leadership.

Participating Faculties:	3
Participating institutions:	12
MIC-Commission members:	25

MIC Equipment

Shared microscopes	43 (+5 in 2013)
Light Microscopes (various techniques)	33
Electron Microscopes (various techniques)	7
Further imaging instruments (Atomic Force / Micro-CT)	3



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Introduction

Modern life sciences depend crucially upon microscopy.

The Microscopy Imaging Center at the University of Bern (MIC) is *the* platform for high-end microscopy and provides easy access to an impressive portfolio of state of the art imaging techniques. Almost every task in modern microscopy can be solved with equipment *and* know-how available through the MIC. It is the platform for knowledge exchange as well as a valuable teaching resource for high-end microscopy at the University of Bern.

The spectrum of high-end microscopic techniques provided at the MIC further increased in 2013 and enables scientists at the University of Bern to stay competitive at an international level.

The MIC associated institutes, from the three participating faculties, provide one to two representatives that form the MIC Commission. The majority of equipment accessible through the MIC is located in these member institutes that represent the core of the MIC. However, every scientist of the University of Bern as well as from other research institutions may benefit from all the services offered by the MIC.

The MIC is defined as a support organization according to the principle of **decentralized equipment location** and **central coordination**. During the quarterly meetings of the MIC Commission members, all relevant steering decisions related to high-end microscopy were defined. The rates for shared microscope usage were fixed for all participating institutions. All relevant investments in the field of microscopy were evaluated by the MIC Commission, helping to boost applications and avoid redundant purchases. In 2013, two successful R'Equip grants were evaluated and supported by the MIC allowing the acquisition of top microscopy techniques that position the University of Bern at the highest level in microscopy. As a result of this coordination, MIC grant applications were supported by many research groups across institutions and faculties, a fact that highlights the efficiency and impact of the center.

The MIC Commission meetings are well appreciated discussion events. Here, the experts in many diverse microscopy techniques keep us abreast of the latest knowledge and techniques.

The MIC aims to constantly increase expertise in advanced microscopic techniques among young and advanced scientists at the University of Bern. The yearly MIC symposium was once again a forum for the meeting of stakeholders in high-end microscopy, focusing on the hot topic of light sheet 3D acquisition. The teaching offer provided by the MIC was also well appreciated by an increased number of students and scientists from various domains. This year, 52 students successfully participated in our Cutting Edge Microscopy lecture series.

2013 was the second year, following the MICs foundation in 2005, in which the University's Leadership supported the MIC to the sum of CHF 120'000. This was used for basic operation of the MIC. Among others the MIC tools (see later) were refined and the administrative processes further simplified. Some money was also made available for urgent equipment repairs.

In 2013 many new tools established in 2012 like the MICBOOK equipment manager and the MIC financial reporting system proved their value and became integral parts of the daily work of scientists in the microscopy field.

The MIC is increasingly recognized as a center of excellence with outstanding facilities and expertise within the community of scientists at the University of Bern as well as across Swiss and international microscopy experts.

What people say about the MIC

"From my first day at the University of Bern, I got full support from the MIC. The excellent coordination of the microscopes and support allowed me to advance fast in my research. Effort should be invested to keep this high standard and competitive level."

Prof. Dr. Dimitrios Fotiadis Institute for Biochemistry and Molecular Medicine, MIC member

"We contacted the MIC due to questions regarding proper analysis of brain sections immunohistochemically stained for a novel marker of neuronal cells. Specifically we were interested to know whether stereological assessments are needed for this kind of experiments and in combination with this notion which software should be applied. The support provided was very useful for our studies and helped us to perform the analyses 'state of the art'. From our experiences, it would be advantageous if the support and know-how offered by the MIC would be made more visible for the community of scientist at the University of Bern."

Prof. Hans-Rudolf Widmer, Department of Neurosurgery, MIC user

"The Division of Neurological Sciences at the VetSuisse Faculty joined the MIC in 2013. We appreciate to have a University-based microscopy platform to share our instrument with other researchers and at the same time to have access to cutting-edge microscopes we otherwise could not easily get access to. For the mid-term future, we would welcome an increased visibility of the MIC towards outside in order to negotiate better conditions with the various suppliers."

Prof. Anna Oevermann, DCR-VPH VetSuisse Faculty, MIC user

"Besides granting convenient access to various microscopes and techniques, the MIC provides additional benefits to me such as the contacts with people from other research groups. Working together usually affords opportunities to share ideas and knowledge about other scientific projects in general and about methods and techniques in particular."

Dr. Kathrin Kühni, Dept. of Veterinary Anatomy, MIC user and microscope administrator

"I perceive our MIC students as demanding in the sense of expecting qualified and enthusiastic teachers delivering clearly structured lectures. That is a good thing and I assume every lecturer is striving to fulfill these expectations. In return however, i.e. examination, there is little coming back. I expect the students to communicate if some topics are difficult to understand and might require further explanation that we are happy to provide. Effort from both sides will make the Cutting Edge Microscopy lecture series a satisfying piece of education."

Dr. Gaby Enzmann, Theodor Kocher Institute, MIC user and MIC teacher

"I liked the parcour at the beginning. Thereby we could get an overview of what we were to encounter during the lectures, and also it was nice to once see those microscopes in action. Also, I joined the MIC meeting, which was very informative."

Student from the MIC Cutting Edge Microscopy lecture series, 2013 anonymous.

"Thank you very much for your support when we needed to prove the need for a new confocal microscope in Cell Biology. Our situation became critical all of a sudden when a colleague left with her confocal microscope. University and SNF required that the Bernese MIC platform agrees to prioritize the purchase of this unit and you provided us with the required support letter in a very short period of time. Yet again when a very narrow time window opened for an opportunity to add a high resolution module to the purchase at very low extra cost, you used your connections to rally support and a contribution from another faculty. We appreciate a lot the time and effort you put into this! "

Prof. Beat Suter, Institute of Cell Biology, MIC user and microscope administrator

Organization of the MIC

The Microscopy Imaging Center joins scientists and institutes interested in high-end microscopy. The MIC is based on the collaborative work of the participating institutions. Contributions are effected by voluntary efforts of the MIC members and institutes.

Every institution using and providing high-end microscopy may join the MIC commission, preferably by defining a representative experienced in microscopy.

Institutions from Faculty of Medicine, the Faculty of Natural Sciences, the VetSuisse Faculty at the University of Bern and the Adolphe Merkle Institute of the University of Fribourg are participating the MIC.

The directive panel of the MIC is the **MIC-Commission**, which consists of 25 delegates (MIC-members) from all participating institutions. The steering panel of the MIC is the **MIC-Board** which consists of the chair person (Prof. Britta Engelhardt, also a representative from the Medical Faculty), the MIC coordinator (Dr. Stefan Tschanz) and one representative from each of the participating faculties (Prof. Volker Heussler - Faculty of Science, Prof. Michael Stoffel, VetSuisse Faculty).

Open trades, such as evaluation requests for new equipment are communicated to the MIC coordinator. Together with the MIC-Board, topics are pre-evaluated and prepared for the MIC-Commission meetings where the Commission decides by voting.

The MIC-Commission meets four times a year. Every meeting is concluded with a comprehensive protocol that acts as guideline for the MIC.

For technical microscopy support requests the MIC-coordinator can be called. If direct help is beyond his competencies, he dispatches the problem to the specific contact person (see contact page on <http://www.mic.unibe.ch> or Table 1). Specific contact persons can also be contacted directly.

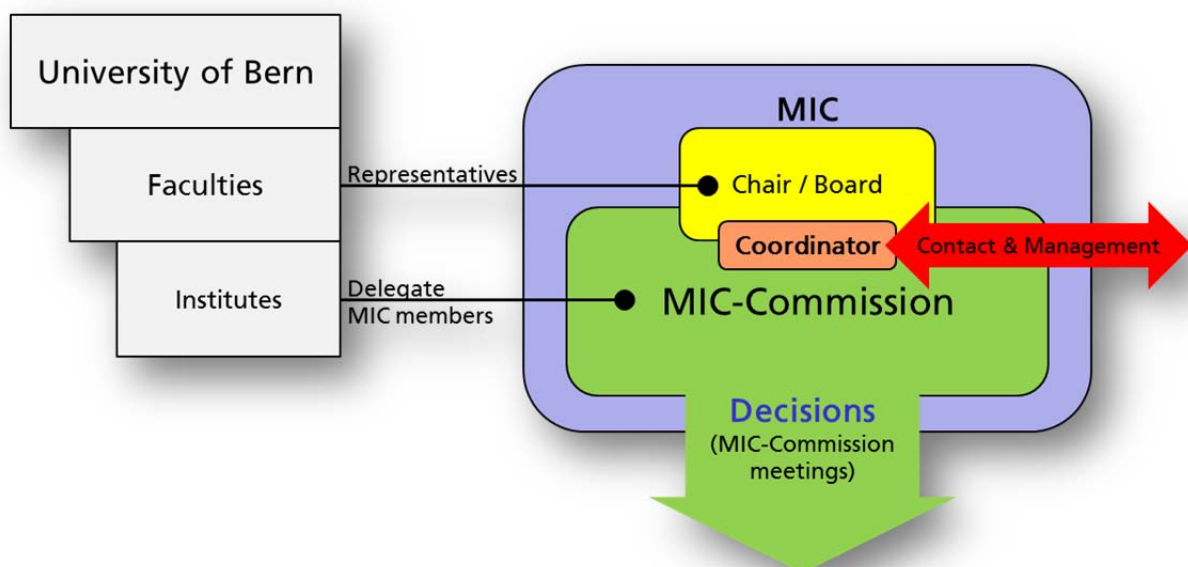


Fig. 1: Structure of the MIC

Table 1: Participating Institutions and Members of the MIC

Faculty	Institute	Delegates (MIC-members) (state Dec. 2013)
Medicine	Anatomy	PD Dr. Edik Babychuk Beat Haenni (core technician) Dr. Daniel Studer Dr. Stefan Tschanz (coordinator) Prof. Dr. Benoît Zuber (contact electron microscopy)
	ARTORG Center	Prof. Dr. Olivier Guenat
	Biochemistry and Molecular Medicine	Prof. Dr. Dimitrios Fotiadis Dr. Gergely Kovacs
	DKF / Pneumology	Dr. Fabian Blank (contact light microscopy)
	DKF	Prof. Dr. Robert Rieben
	Pathology	PD. Dr. Mario Tschan
	Pharmacology	Prof. Dr. Shida Yousefi
	Physiology	Prof. Dr. Thomas Nevian Prof. Dr. Ernst Niggli
Science	Theodor-Kocher Institute	Prof. Dr. Britta Engelhardt (chair, board) PD Dr. Ruth Lyck Prof. Dr. Jens Stein
	Applied Physics	Prof. Dr. Martin Frenz Prof. Dr. Jaroslav Ricka
	Cell Biology	Prof. Dr. Volker Heussler (board) Prof. Dr. Peter Meister
VetSuisse	Plant Science	Dr. Sarah Robinson
	Division of Veterinary Anatomy	Prof. Dr. Michael Stoffel (board)
University of Fribourg	Adolphe Merkle Institute	Prof. Dr. Barbara Rothen-Rutishauser Dr. Dimitri Vanhecke (contact image processing)

MIC Coordinator

The MIC coordinator, Stefan Tschanz (30% part time position dedicated to the MIC), is the key contact person and manager for all MIC matters. He is the addressee for support requests regarding technical, administrative, teaching, funding and other issues. If support can't be provided directly, he mediates the appropriate contacts. The contact person for **light microscopy** is Dr. Fabian Blank (DKF), for **electron microscopy** Prof. Benoît Zuber, Institute of Anatomy, for **image processing** Dr. Dimitri Vanhecke (Adolphe Merkle Institute; University of Fribourg) and for microscopy lab issues Beat Haenni, Institute of Anatomy (see MIC web site).

The coordinator organizes the MIC-Commission meetings four times a year, manages all teaching administration and organizes the international MIC meeting once a year. His administrative tasks comprise all forms of reporting including equipment usage and financial statistics. He is responsible for the internet presence of the MIC (web site and equipment manager) and is also the main contact person for data and image handling issues. He helps scientists to prepare successful grant applications for microscopy investments.

Stefan Tschanz has been the MIC coordinator for the past three years. He succeeded to Prof. Dr. Barbara Rothen-Rutishauser who was coordinator from 2010 to 2011.

Leading house: Institute of Anatomy

In order to have a concrete contact point and address for financial transactions, a "leading house" for the MIC was defined. Due to its extensive experience in microscopy techniques and a large portfolio of equipment, the Institute of Anatomy has taken on this responsibility in 2010. Most of the MIC core staff (coordinator, web master, core lab technician, core microscopy technician) are also members of the Institute of Anatomy.

Performance Mandate ("Leistungsauftrag")

For the second year running, the MIC has received an official mandate from the University Leadership defining its responsibilities as a center of excellence for microscopy. The mandate is associated with an annual financial support of CHF 120'000 to cover basic operating cost incurred by the MIC, i.e. administrative costs (labor and consumables), development of specific IT tools (website, reservation system) and some smaller maintenance work.

The University Leadership, represented by the Rector, Prof. Martin Täuber, defined the following objective target in 2012:

The MIC shall be the central access point for high-end microscopy in life sciences for the entire University of Bern. It provides for the coordination of users. In addition, the MIC evaluates and coordinates investments in life science high-end microscopy for the participating faculties.

The MIC provides the following services:

- *Qualified setup of high-end microscopy*
- *High quality image analysis*
- *Optimal use and coordination of existing resources*
- *Teaching programs in the field of microscopy*
- *Quality management by standardizing processes*
- *Increasing the success of funding applications*
- *Standardizing microscopy fees*
- *Public relations for distinct placing of the MIC as a center of excellence in microscopy*
- *Promotion of knowledge transfer within the University of Bern and to the outside*

(Translated from the original "Leistungsauftrag", 24.01.2012)

Based on a successful evaluation of the performance mandate, the MIC will continue to have this commitment by the University leadership for another two years.

Financial support by the University Leadership

The performance mandate given by University Leadership is associated with an annual financial fund of CHF 120'000 used for basic operation of the MIC.

The MIC-Board and Commission decided to use a substantial part of this money for compensating salary costs of persons located at the Institute of Anatomy, as the leading house. A part was used for small investments and maintenance costs relevant for the entire MIC.

Table 2: Financial support utilization

		Comment
Financial Support University Leadership 2013	CHF 120'000.00	
Salary costs	<i>CHF -104'270.40</i>	MIC Commission decision
MIC Cash Reserve		(CHF 15'729.60)
Maintenance		
Maintenance Server MICBOOK (N. Fankhauser)	<i>CHF -500.00</i>	Coordinator
Extension MICBOOK (N. Fankhauser)	<i>CHF -200.00</i>	Coordinator
Teaching Costs		
Chemicals for MIC teaching module (F. Bank, DKF)	<i>CHF -1'750.00</i>	MIC Commission decision
Small equipment and upgrades		
Imaris Software Upgrade (J. Stein, TKI)	<i>CHF -1'977.00</i>	MIC Commission decision
LD Plan-Neofluar 40x long focal Objective for micro fluid system (O. Guenat, ArtOrg)	<i>CHF -4'790.00</i>	MIC Commission decision
Filter cube for the iMIC and SP2 LSM (P. Meister, ICB)	<i>CHF -2'047.00</i>	MIC Commission decision
Reparation PMT Detector on LSM 510 Meta (E. Babiychuk, ANA)	<i>CHF -3'173.00</i>	MIC Commission decision
Reparation Zeiss AxioObserver, Joystick (R. Lyck, TKI)	<i>CHF -2'746.00</i>	MIC Commission decision
Deficit	CHF -1'453.40	carried by the Institute of Anatomy

Table 3: Salary policy MIC

Name	Function	Part	Costs / Year
Tschanz, Stefan	Coordinator	30%	
Haenni, Beat	Core Lab Technician	15%	
Frank, Sandra	IT / Web master	10%	
Kämpfer, Lilo	Administration	10%	
Schaffer, Herbert	EM Technician	10%	
Total salary cost per year		75%	104'270.40 CHF
MIC cash reserve, guaranteed by the Anatomy			15'729.60 CHF

MIC Revenues and Expenses

In collaboration with the central Finance Department of the University, the MIC established a transparent central financial assessment of all microscopy-related charges within the MIC. This allows a comprehensive overview on the high costs of high-end microscopy with respect to acquisition AND maintenance.

Excessive maintenance and repair costs of high-end microscopes which often are not covered by the initial investment funds are a manifest problem for institutes and may lead to an overload of their regular financial resources.

The straightforward and comprehensive work-flow of the **MIC financial reporting** tool is easily applicable. Most of the MC member institutes submit their financial transactions via this process.

Financial turnover that was assessed by the MIC financial reporting in 2013:

Table 4: Revenues and Expenses

Revenues (pooled):	CHF 66'868.50		Usage fees
Expenses (pooled):	CHF 1'090'198.26		All items
Expenses itemized			
Maintenance	CHF 96'679.66		Repair, updates, service contracts
Sources:	University (via MIC fund)	11'262.75	
	BK & 3. party (*)	85'416.91	
Investment	CHF 993'518.60		New systems, parts and extensions
Sources:	University (direct & via Ress. Commitees)	392'368.00	
	BK	238'519.25	
	3. party	362'631.35	

BK ("Betriebskredit"): Institute funds, 3. Party: SNF and other funds rose by MIC scientists,
 (*) to date, the reporting tool does not allow to separate BK and 3. party sources for maintenance payment. This table does not claim to be complete. Some items may be missing and the correct categorization retrospectively irresolvable.

This table demonstrates that major parts of the microscopy maintenance and investment expenses is contributed through funds from the regular institute budgets and from extramural funds that were raised by MIC members.

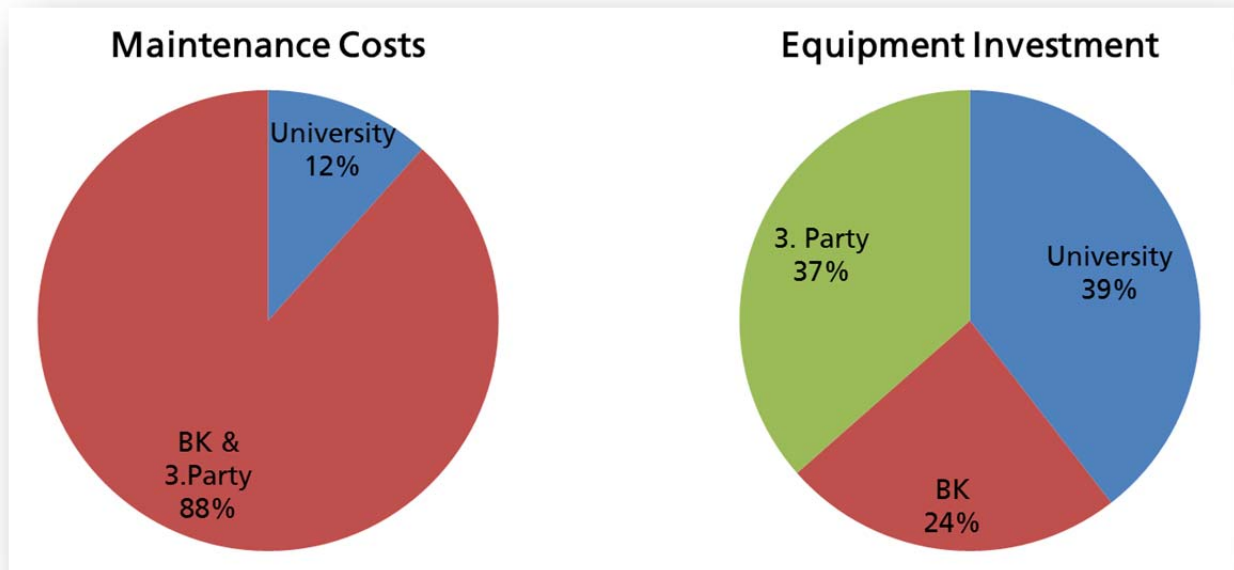


Fig. 2: Splitting of microscopy costs

Human resources

The MIC is essentially based on the contributions of the MIC members that invest a lot of their time for administrating, maintaining and making accessible the attractive equipment collection of the MIC. Without this somehow hidden help, the MIC could never operate.

At the Department of Clinical Research of the Insel Hospital (DCR/DKF), which is also member of the MIC, dedicated positions for the maintenance and administration of the Live Cell Imaging Center (LCI) were implemented. The 50% position as scientific collaborator (Wissenschaftlicher Mitarbeiter II) and 90% as technician clearly contribute to the operability of the MIC. On principle, this contribution is also an effort to be taken into account in the "balance" of the MIC.

Visibility of the MIC

Information on the MIC can be found online at <http://www.mic.unibe.ch>.

Our website provides easy access to all relevant information related to high-end microscopy. Complete insight is given regarding the structure of the MIC, its activities, its teaching program, contacts and available equipment.

The website was re-designed in 2013 by our web master, Sandra Frank with respect to full database related content management.

Special attention was given to a new intranet functionality providing several management tools such as a secured protocol archive, a self-explanatory submission form for microscopes to be listed on the MIC equipment portfolio and an equipment list dedicated to coordinating contact with microscope manufacturers.

In the second successive year, the main search portal Google displays the URL of the MIC in the first position when "microscopy bern" is entered in the international (google.com) or national (google.ch) search.

(<http://www.google.com/search?q=microscopy+bern>)

MIC Symposium

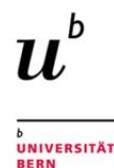
This year's MIC symposium was once again well appreciated at the University of Bern, in Switzerland and adjacent countries. In November 2013, the symposium was dedicated to "Light Sheet Microscopy". The international experts in the field were invited thanks to the good relations with our own excellent experts Prof. Thomas Nevian and Prof. Jens Stein. The talks by the four international speakers, of our local "cracks" and of a representative of ZEISS attracted around 100 scientist. There was a very vibrant discussion about the new and booming Light Sheet technology. The costs of the Symposium were fully covered by support of several equipment manufacturers and the SNSF funded graduate program "ProDoc Cell Migration". The MIC, as *the* center of excellence in microscopy at the University of Bern, was very well promoted.



Fig. 3: Impressions from the MIC Symposium 2013



Symposium of the Microscopy Imaging Center
University of Bern
MIC



Light Sheet Microscopy: 3D Insights Into Solid Organs

Friday November 29th 2013, 10:00
Institute of Anatomy, Old Lecture Hall, Bühlstrasse 26, 3012 Bern

Program

10:00	Stefan Tschanz MIC University Bern	Welcome
10:15	Hans-Ulrich Dodt Medical University Vienna	<i>Ultramicroscopy of cleared specimens</i>
11:00	Günter Giese MPI Heidelberg	<i>Imaging neuronal connections in optically cleared adult mouse brain with a home-built light sheet fluorescence microscope</i>
11:45	Thomas Nevian Physiology, University Bern	<i>Whole-brain evaluation of cortical injection sites for pharmacological treatments of neuropathic pain</i>
12:00		Lunch
13:30	Jan Huiskens MPI Dresden	<i>Visualization of zebrafish development with SPIM and real-time image processing</i>
14:15	Friedemann Kiefer MPI Münster	<i>Visualization of the first lymphatic vessels</i>
15:00	Jens Stein TKI, University Bern	<i>Light sheet microscopy for lymphoid tissue analysis</i>
15:15	Jacques Paysan Carl Zeiss AG	<i>Lightsheet Z.1: Building a microscope around your experiment</i>

www.mic.unibe.ch/symposium

Supported by:



Fig. 4: Flyer of the MIC Symposium 2013

Microscopy Equipment and Services

The main role of the MIC is to provide easy access to high-end microscopes to all the scientists at the University of Bern and beyond. Consequently, the equipment inventory of the MIC is a key performance indicator for the efficacy of the MIC.

A broad variety of microscopic techniques is made available to University members and others, irrespective of being members of the MIC. Many additional services in the field of microscopy are also available. The equipment is located at different institutes at the University and administration and maintenance is performed locally. Nevertheless, access is easy and booking is managed centrally by our MICBOOK equipment manager website. Experts for each particular instrument are available on-site. These experts manage admission and introduce novices to their instruments. The concept of decentralization, local expertise and central coordination makes the MIC an exceptional institution.

It is the dedicated goal of the MIC and its members to offer a state of the art range of high-end imaging techniques that match the needs of the research community. This requires continuous investment in microscopic equipment.

MIC equipment portfolio

MIC equipment allows for the imaging of structures from the centimeter to the nanometer range, including three-dimensional reconstruction and various live-imaging techniques.

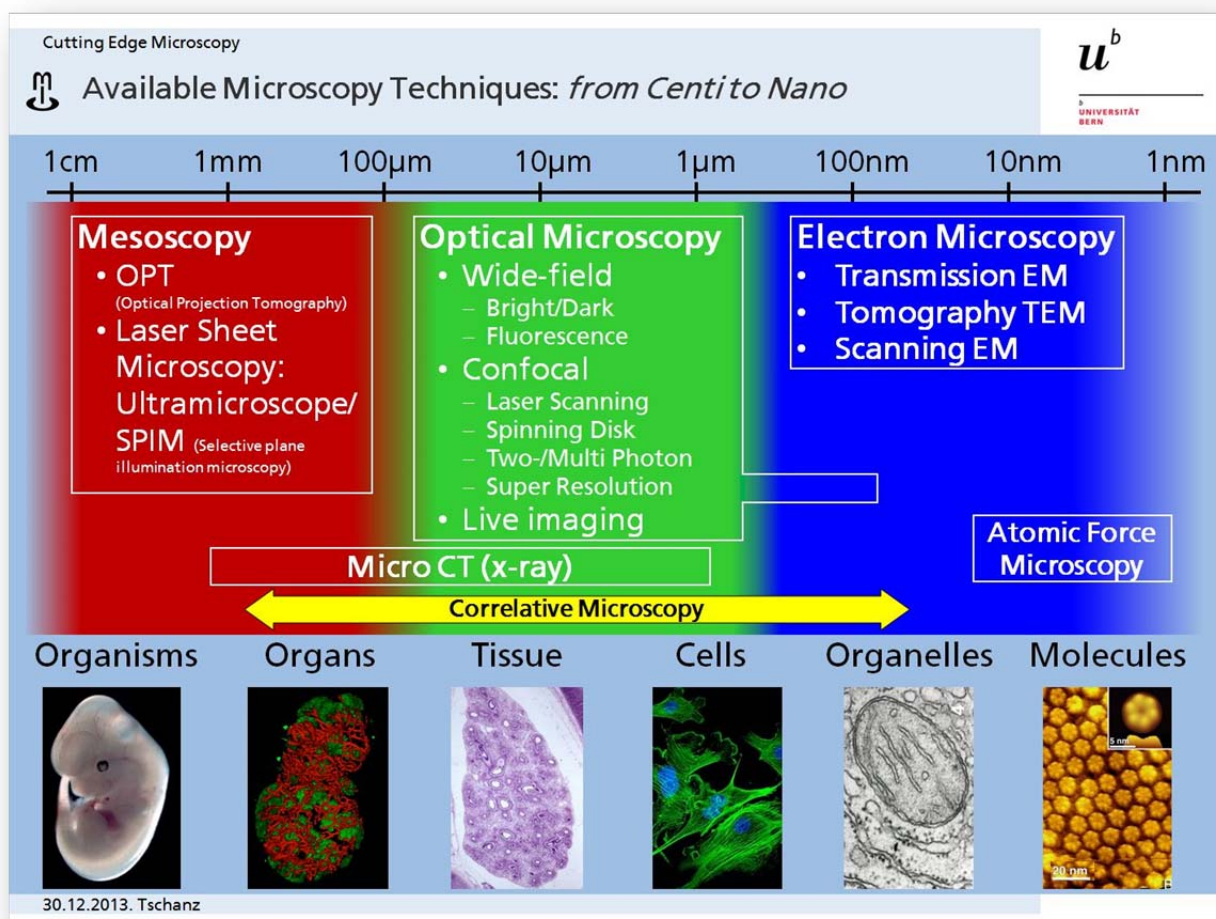


Fig. 5: Magnification range of MIC equipment

Instruments include conventional light and fluorescence microscopes, various laser scanning microscopes including multi-photon extensions and STED, a spinning disk system, microscopes for live cell imaging, laser sheet systems, transmission (with tomography) and scanning electron microscopes, two atomic force systems, a high content analysis system, a micro CT as well as the recently installed super resolution microscope. Every instrument is listed on the MIC website with a technical description and the contact details of the expert responsible for maintenance and introducing new users.

Table 5: Available MIC equipment

Microscopic Technique		Number	
LM	Widefield Fluorescence	10	
	Confocal Laser Scanning Microscopy	16	
	Spinning Disk System	1	
	Super Resolution System	1	
	other LM (High Content Analysis, Reflected Light)	2	
	Mesoscopy (Laser sheet, Optical projection)	3	33
EM	TEM (incl. 2 Tomography TEM)	5	
	SEM	2	7
Other techniques (μ CT, AFM)		3	3
(plus 5 compared to 2012)		Sum	43

Usage modes of MIC equipment

Most of the high-end systems available at the MIC are subject to usage fees.

The MIC-Commission has defined compulsory rates for each category of devices. The rates are published on the MIC website (http://www.mic.unibe.ch/files/Rates_MIC.pdf). Hourly rates and 200 hour packages for heavy usage are offered. The package fee is calculated on the basis of about 15% of a one-hour fee. Packages are effective within one calendar year. Several instruments can be booked with an operator, charged at a higher rate. For long-term and over-night usage instrument administrators can offer special rates.

Usage of some instruments as part of a scientific collaboration with a major contribution of the local experts may be free of charge.

For usage of MIC equipment by non-university clients, especially from the industry higher rates are applied, in most cases twice the university rate.

Some institutions offer microscopy as a full service from sample preparation to microscopic image acquisition. The individual rates including work costs of the lab technician and operator are combined as an all-inclusive rate.

Table 6: Detailed list of MIC equipment

Technique	System name	Institute	Extension
Mesoscopy	LaVision BioTec Ultramicroscope System	Physiology	Laser Sheet
	Selective Plane Illumination Microscope	TKI	Laser Sheet
	Bioptronics Optical Projection Tomography scanner	TKI	Optical Projection
Stereo-Microscope	Leica MZ16 Stereoscope	TKI	
Wide-field	Intravital microscope IVM-500	TKI	Live,
Reflective Light	Keyence VHX-600	Vet. Anatomy	
Fluorescence	General Electric INCell Analyzer 2000	Vet. Anatomy	High Content Analysis
	Leica DMI4000 B fluorescence system	DCR	
	Nikon Biostation CT	DCR	Live, Long-term live
	Nikon Eclipse E600	TKI	
	Nikon Eclipse TE-2000-4	Pathology	Live
	Nikon Optiphot 2	Anatomy	
	Zeiss AxioImager with Apotome	Vet. Anatomy	
	Zeiss AxioObserver with Apotome	TKI	Live
	Zeiss Axiovert 35 with transmission detector	Pharmacology	
CLSM	BioRad Micro-Radiance	Physiology	
	Customized Two-Photon Microscope (Built: T. Nevian)	Physiology	Multi-Photon, Live
	LaVision Biotec TrimScope Two-Photon microscope	TKI	Live, Multi-Photon
	Leica TCS SP2	Cell Biology	
	Leica TCS SP2 MP	Physiology	
	Leica TCS SP5	Plant Sciences	Live
	Nikon Eclipse Ti-E, A1R MP	Applied Physics	
	Nikon TE2000E	IBMM	
	Olympus Fluoview-1000 confocal with Two-Photon excitation	Physiology	Multi-Photon
	Olympus FV 1000	DECR vet	
	VisiTech VtEye confocal with point-scanner	Physiology	
	Zeiss LSM 5 Duo live	Anatomy	Live
	Zeiss LSM 5 exciter	Pharmacology	Live
	Zeiss LSM 510	Pharmacology	
	Zeiss LSM 510 Meta	Anatomy	
	Zeiss LSM710	DCR	Live
Super Resolution	Leica SP8 X STED	Cell Biology	Live(incl. CLSM)
Spinning Disk	iMIC TillPhotonics	Cell Biology	
Scanning EM	Zeiss DSM 982	Vet. Anatomy	STEM
	Philips XL 30 FEG	Anatomy	
Transmission EM	FEI Tecnai F20	Anatomy	Tomography
	FEI Morgagni	Anatomy	
	Philips EM 400	Anatomy	
	Philips CM 12 (ana)	Anatomy	
	Philips CM 12 (vet)	Vet. Anatomy	
Atomic Force	Veeco Bioscope II, AFM add-on for Zeiss Axiovert 200	Applied Physics	brightfield and AF
	Nanoscope II	IBMM	
X-Ray	SkyScan 1172 MICRO Computer Tomography System	Anatomy	μ Tomography

MIC Microscopy Services

Several sample preparation methods for light and electron microscopy are available as charged service in some MIC institutions. This comprises:

- Chemical fixation
- Embedding
- Contrasting
- High-pressure freezing
- Cryo-substitution
- Ultramicrotomy
- Cryo-ultramicrotomy
- Critical point drying
- Sputtering
- Full ultrastructural sample analysis

Rates of these services are determined individually according to operating expenses.

Other consulting services offered by the MIC are:

- Quantification in microscopy: Stereology, including sampling and data assessment
- Image processing: 3D data visualization, image restoration
- IT issues: data handling and storage

Big Data

New microscopy technologies with fast digital image detectors combined with 3D acquisition drastically increase data accumulation. Research data need to be stored for several years in order to trace back scientific work. Both issues can lead to heavy costs that can overcharge the funds of institutes.

Only fully centralized solutions for data storage turn out to be efficient enough. On initiative and with substantial conceptual input from the MIC, the central IT department of the University is now addressing this problem. With the support of the University headship, a new concept for campus-wide storage will reduce the costs for big data storage for the institutes. In summary, a separation of current data (higher price) and archive data (much lower price) will alleviate the resources of institutes. Furthermore the central campus storage offers an efficient, transparent and safe archiving concept that is noticeably superior to all decentralized models.

Utilization statistics of MIC equipment

The degree of utilization of microscopes is a benchmark for the appropriate operation of the MIC and its equipment. It allows us to assess the efficiency of microscopy systems and to determine further requirements. By means of the booking system MICBOOK, which manages all the equipment's bookings centrally (see below), the MIC staff has easy access to detailed reports.

A statistical analysis of utilization of MIC instruments is presented here as "Relative Usage" (see Table 7): The use during the whole year 2013 was analyzed. The duration of utilization was tested versus standard business days (220) with 10h (2200h) period being 100%. Some MIC instruments can be booked over 24h and also at weekends, which results in relative values higher than 100%.

In this period more than 350 users from 20 institutions were using MIC devices.

Table 7: Utilization statistics of MIC devices

Object	Microscope group	Institute	Usage [h]	% of 2200h	Comment
IZB_TILL Photonics iMIC	Spinning Disk	Cell Biology	4424	201%	Overnight, Sa, Su
IZB_Leica TCS SP2	CLSMx	Cell Biology	2774	126%	
DKF LCI Nikon Biostation CT	Fluo LM	DKF	2184	99%	
FEI Tecnai F20	TEM	Anatomy	2002	91%	
LaVision TrimScope	Live Cell imaging	TKI	1692.5	77%	
Zeiss AxioObserver	Live Cell imaging	TKI	1421	65%	
Zeiss LSM 510 Meta (ana)	CLSMx	Anatomy	1204	55%	
Philips CM 12 (ana)	TEM	Anatomy	987	45%	
Nikon Eclipse E600	LM	TKI	931	42%	
DKF LCI Zeiss LSM 710	CLSMx	DKF	754.5	40%	only since 04.2013
Philips EM 400	TEM	Anatomy	837	38%	
DKF LCI Zeiss LSM 710	CLSMx	DKF	754.5	34%	
FEI Morgagni	TEM	Anatomy	635	29%	
DKF LCI Leica DMI4000 B	Fluo LM	DKF	593.5	27%	
Philips CM 12 (vet)	TEM	Vet. Anatomy	489	22%	longer break down
LaVision Ultramicroscope	Mesoscopic imaging	Physiology	477.5	22%	longer break down
Olympus FV 1000	CLSMx	Vet. Anatomy	357	16%	only since 08.2013
Zeiss AxioImager (vet)	Fluo LM	Vet. Anatomy	332.5	15%	
INCell Analyzer 2000	Fluo LM	Vet. Anatomy	308	14%	
Philips XL 30 FEG	TEM	Anatomy	267	12%	
IAP Nikon Ti-E A1R MP	CLSMx	Applied Physics	264	12%	
Leica DMRB (ana)	LM	Anatomy	220	10%	

This table shows the MIC instruments managed by MICBOOK equipment manager for 2013. Some microscopes of the MIC portfolio are not managed by MICBOOK and do not appear on this list. Some low relative usage is due repair-related interruption of usability or due to start of operation during the year.

The MICBOOK Equipment Manager is working now since mid-2012 without any break down or other problem.

Teaching

The teaching activity undertaken by the MIC encompasses a lecture series on high-end microscopy and several practical modules focusing on particular imaging techniques.

Teaching is performed by experts in the fields coming from all participating institutions.

Cutting Edge Lectures Series

This lecture series comprises two hour lessons throughout the entire fall semester covering all relevant high-end microscopic topics (see Table 8).

Table 8: Cutting Edge Program 2013



Microscopy Imaging Center (MIC)

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Lecture series „Cutting Edge Microscopy“ HS2013

KSL ID: 9256

Every Friday, 8:15-10:00, Locations:

- Institute for Anatomy, Bühlstrasse 26, Room A224
- Main building University, Hochschulstrasse 4, Room 205
- EXAM: Main lecture room, Bühlplatzareal, G.Wokerstr. 5,

Date	Subject		Lecturer
20.9.2013	2h Introduction to Cutting Edge Microscopy (including practical part in the Histology room of the Institute of Anatomy)		S. Tschanz (Anatomy)
27.9.2013	Group A: 1h Physical basics of LM imaging, part 1 1h Microscopy Demos	Group B: 2h Microscopy Demos	M. Frenz / J. Ricka (IAP) Various teachers
4.10.2013	Group A: 2h Microscopy Demos	Group B: 1h Physical basics of LM imaging, part 1 1h Microscopy Demos	M. Frenz / J. Ricka (IAP) Various teachers
11.10.2013	1h Physical basics of light optical imaging, part 2 1h Fluorescence Microscopy		M. Frenz / J. Ricka (IAP) F. Blank (DKF)
18.10.2013	<i>Specific applications of fluorescence microscopy:</i> 1h Laser scanning microscopy 1h Laser scanning microscopy and specific applications (FRET, FRAP, Spectral unmixing) and digital image restoration (Huygens and Imaris software)		B. Rothen-Rutishauser (AMI) S. Yousefi (Pharmacology)
25.10.2013	1h Calcium-imaging with confocal microscopy 1h Super resolution imaging		E. Niggli (Physiology) T. Nevian (Physiology)
1.11.2013	1h LED illumination and Grid projection 1h Time Lapse Microscopy		R. Lyck (TKI) R. Lyck (TKI)
8.11.2013	1h Intravital microscopy 1h Multiphoton-intravital microscopy		G. Enzmann (TKI) J. Stein (TKI)
15.11.2013	1h Optical projection tomography 1 h Atomic Force Microscopy		J. Stein (TKI) D. Fotiadis (IBMM)
22.11.2013	2h Transmission Electron Microscopy		D. Vanhecke (A. Merkle Institute)
29.11.2013	MIC Symposium		
06.12.2013	2h Cryo-electron Microscopy		B. Zuber (Anatomy)
13.12.2013	2h Scanning Electron Microscopy		M. Stoffel (Vet. Anatomy)
20.12.2013	2h Stereology		S. Tschanz (Anatomy)
17.01.2014 10:00-12:00	2h Written exam, Location: Main lecture room, G.Wokerstr. 5		S. Tschanz (Anatomy)

Stefan Tschanz, 11.10.2013

The lectures on 17 topics are given by 15 experts in their respective fields. The topics of the lectures are coordinated and discussed between all contributing lecturers. The unique microscopy "demo parcours" deserves particular mention. All the students get a hands-on demonstration of six high end microscopes located at the Bühlpplatz area.

A written exam evaluating the learning success has to be accomplished at the end of the course. The students get 3 ECTS points and are admitted to the advanced practical MIC modules.

Since the start of the Cutting Edge lecture series in 2010 (40 students), its reputation has steadily increased. In 2013, 64 students from several Master and PhD programs were enrolled in the series. The exam was attended by 59 students 52 of which passed.

The formal evaluation of the lecture series by the students, conducted in collaboration with the evaluation office of the University of Bern, indicated a very good perception and highest ranking with respect to quality, scope and relevance.

MIC modules

Eleven different practical microscopy modules were offered by the MIC (see Table 10). Many of them were almost fully booked. All modules dealing with microscopes were undertaken on state of the art devices provided by the MIC.

Table 9: Module attendance 2013

Topic	Teacher	Institute	Participants
Basic module - Histologic/microscopic Lecture and Practical	Christa Rhiner	Cell biology	8
Intravital Microscopy	Gaby Enzmann	TKI	2
Microscopy Applications for Immunological Research	Markus Thelen	IRB Bellinzona	18
Multiphoton Intravital Microscopy	Jens Stein	TKI	2
Optical Projection Tomography	Jens Stein	TKI	1
Practical course in fluorescent staining, fluorescence microscopy, confocal microscopy and image analysis	Fabian Blank	DCR LCI	30
Scanning electron microscopy	Michael Stoffel	Vet. Anatomy	3
Stereology Workshop	Stefan Tschanz	Anatomy	24
Transmission EM practical	Benoît Zuber	Anatomy	3

Table 10: MIC Modules 2012



Microscopy Imaging Center (MIC)

Lectures and practical modules 2013/2014

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Name of the module	Type of module	Semester/Duration	Lecturer	ECTS
Cutting Edge Microscopy (see special time table)	Lecture series	HS - 2h per week		3
Basic module - Histologic/microscopic methods	Practical	HS - 1h lecture + 3 half-day practicals	Christa Rhiner (Cell Biology)	3
Microscopy Applications for Immunological Research	Lecture and Practical	HS - 3 days	Marcus Thelen (IRB, Bellinzona)	1.5
Practical course in fluorescent staining, fluorescence microscopy, confocal microscopy and image analysis	Practical	FS - 2 days	Fabian Blank (LCI DKF)	1
3D image acquisition by grid projection	Practical	FS - 1 day	Ruth Lyck (TKI)	0.5
In vitro Live Cell Imaging	Practical	FS - 2 days	Ruth Lyck (TKI)	1
Transmission electron microscopy	Practical	FS - 2 days	Benoît Zuber (Anatomy)	1
Stereology	Practical	FS - 5 days	Stefan Tschanz (Anatomy)	2.5
Scanning electron microscopy	Practical	FS - 2 days	Michael Stoffel (Vetsuisse)	1
Multiphoton Intravital Microscopy	Practical	FS - 1 days	Jens Stein (TKI)	0.5
Intravital Microscopy	Practical	FS - 2 days	Gaby Enzmann (TKI)	1
Optical Projection Tomography (OPT)	Practical	FS - 1 days	Jens Stein (TKI)	0.5

HS: Fall semester

FS: Spring semester

Administrative Activities

Many administrative tools and process descriptions are provided by the MIC. They were designed and established by the coordinator in order to reduce the administrative workload of the MIC members, equipment users and also the administration by the institutes.

MICBOOK Equipment Manager

<https://micbook.unibe.ch>

The MICBOOK Equipment Manager is the web-based tool for managing utilization of MIC equipment available since November 2012. The system is based on the *Reservation System* at the DKF, originally programmed by Niklaus Fankhauser, a bio-computer scientist. He was employed to completely re-design the system and adapt it to the needs of the MIC. The complete re-design of the software was focused on a straight-forward booking and administration work-flow, mapping the multi-level and multi-institutional structure of the MIC.

In 2013 several user requests were implemented to make MICBOOK even more convenient, e.g. are more straightforward usage statistics, a better refined configuration of equipment properties and a transparent export functionality for reports.

The system is entirely self-managed by the respective microscope administrators. Only little supervision by the MIC coordinator is needed. Every institute can do reports for their unit.

The MICBOOK Equipment Manager is available for the management of non-MIC objects too. The success of MICBOOK is well shown in its use in 2013:

Currently, it manages 121 objects (2012: 66) and is used by more than 380 users (2012: 185). In 2013, more than 5985 equipment bookings were registered.

Grant application support

The MIC has the key task of coordinating and supporting funding requests in the field of microscopy.

The extraordinary costs of high-end microscopes and imaging systems require a coordinated and concerted investment strategy that unites many research groups and avoids redundancies. Such a strategy lowers the costs and exploits the valuable resources with higher efficiency.

It is essential to focus on those technologies which match the needs of the research community best and which allow for highest scientific level *and* an optimal degree of utilization.

The MIC, with all its members and member institutes, has a privileged position enabling it to survey the current situation of the University as a whole and to help to improve the chances of grant applications.

A concise work-flow detailing the interactions between the Resource Committee of the Medical faculty, the applicants and the MIC has been established together with the Resource Committee (see Fig. 6). This process streamlines the communication between all the participants.

Based on this model, the other participating Faculties (Science and VetSuisse) adopt similar guidelines.

Support to successful applications

In 2013, the MIC successfully supported several microscopy investments at the University of Bern:

- Medical Faculty, TKI, Prof. J. Stein:
Photomultiplier repair for multiphoton microscope CHF 12'000.-
 (initiated in 2012, effected in 2013, Ress. Committee of the Med. Faculty)
- VetSuisse Faculty, Dept. of Veterinary Pathology, Prof. Anna Oevermann:
OLYMPUS FV1000 upgrade with 405 nm Laser CHF 43'000.-
 (Resource Committee of the VetSuisse Faculty)
- Medical Faculty, TKI, Ruth Lyck:
Live Cell Upgrade, ZEN Software CHF 100'000.-
 (Resource Committee of the Medical Faculty)
- Medical Faculty, Inst. of Anatomy, Prof. B. Zuber:
FEI Serial Block Face SEM CHF 856'000.-
 (SNF R'Equip, matching funds: Ress. Committee of the Med. Faculty & Anatomy)
- Faculty of Science, Institute of Cell Biology, Prof. B. Suter
Leica SP8 CLSM CHF 720'000.-
 including STED super resolution module
 (SNF R'Equip, matching funds: Ress. Ausschuss of the Science Faculty,
 Cell biology and VetSuisse Faculty)

(some of the successful applications were not yet billed in 2013 and do not appear on the MIC financial report)

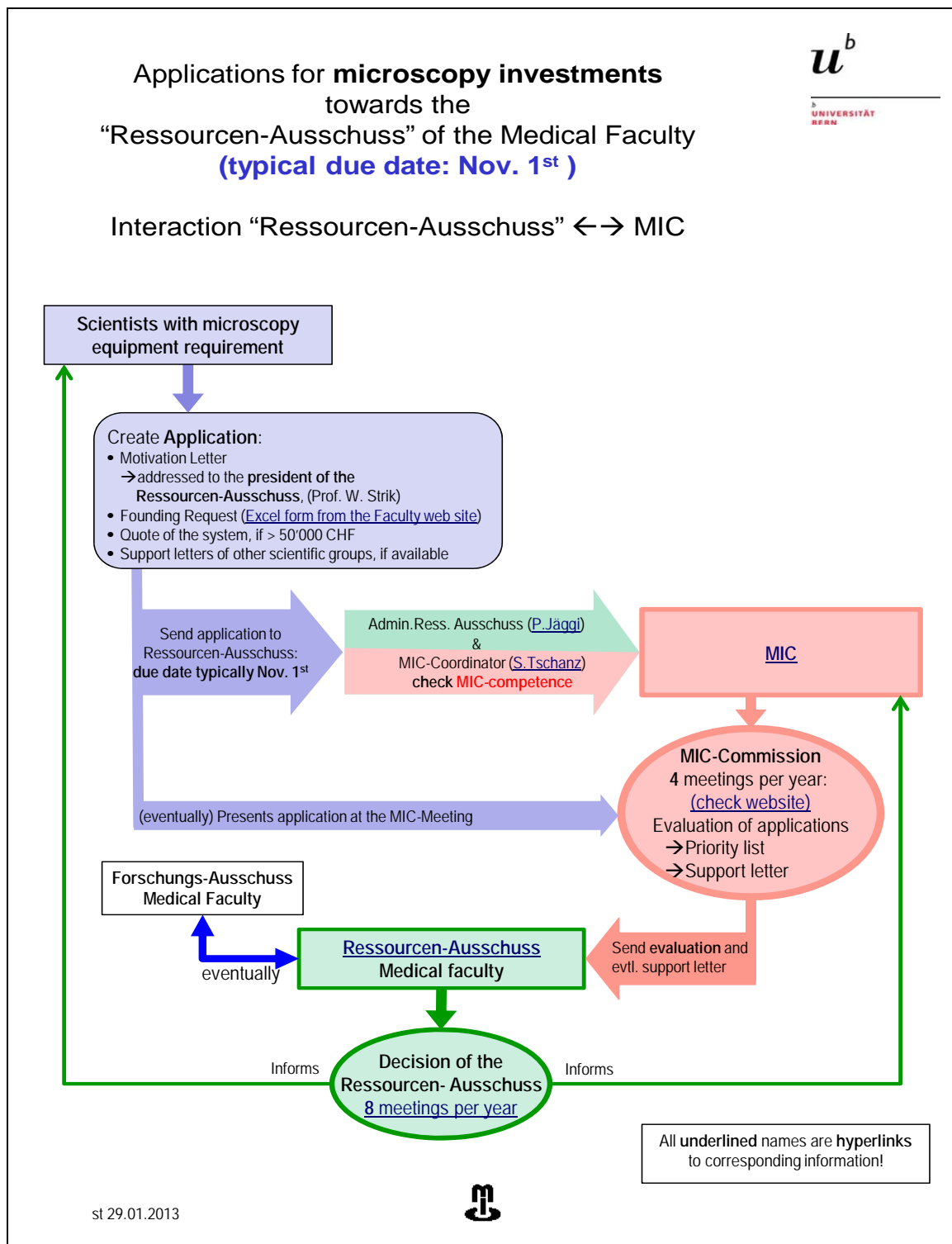


Fig. 6: Funding support work-flow

Publications resulting from work at the MIC in 2013

Users of MIC equipment and services are prompted to mention the MIC as provider of support in the acknowledgements of publications.

(1-52)

1. **Alaeddine F, Hemphill A, Debache K, and Guionaud C.** Molecular cloning and characterization of NcROP2Fam-1, a member of the ROP2 family of rhoGTPases in *Neospora caninum* that is targeted by antibodies neutralizing host cell invasion in vitro. *Parasitology* 140: 1033-1050, 2013.
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4. **Boggavarapu R, Jeckelmann JM, Harder D, Schneider P, Ucurum Z, Hediger M, and Fotiadis D.** Expression, purification and low-resolution structure of human vitamin C transporter SVCT1 (SLC23A1). *PLoS One* 8: e76427, 2013.
5. **Bucher C, Gazdhar A, Benneker LM, Geiser T, and Gantenbein-Ritter B.** Nonviral Gene Delivery of Growth and Differentiation Factor 5 to Human Mesenchymal Stem Cells Injected into a 3D Bovine Intervertebral Disc Organ Culture System. *Stem Cells Int* 2013: 326828, 2013.
6. **Chai Q, Onder L, Scandella E, Gil-Cruz C, Perez-Shibayama C, Cupovic J, Danuser R, Sparwasser T, Luther SA, Thiel V, Rulicke T, Stein JV, Hehlhans T, and Ludewig B.** Maturation of lymph node fibroblastic reticular cells from myofibroblastic precursors is critical for antiviral immunity. *Immunity* 38: 1013-1024, 2013.
7. **Chan SC, Burki A, Bonel HM, Benneker LM, and Gantenbein-Ritter B.** Papain-induced in vitro disc degeneration model for the study of injectable nucleus pulposus therapy. *Spine J* 13: 273-283, 2013.
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