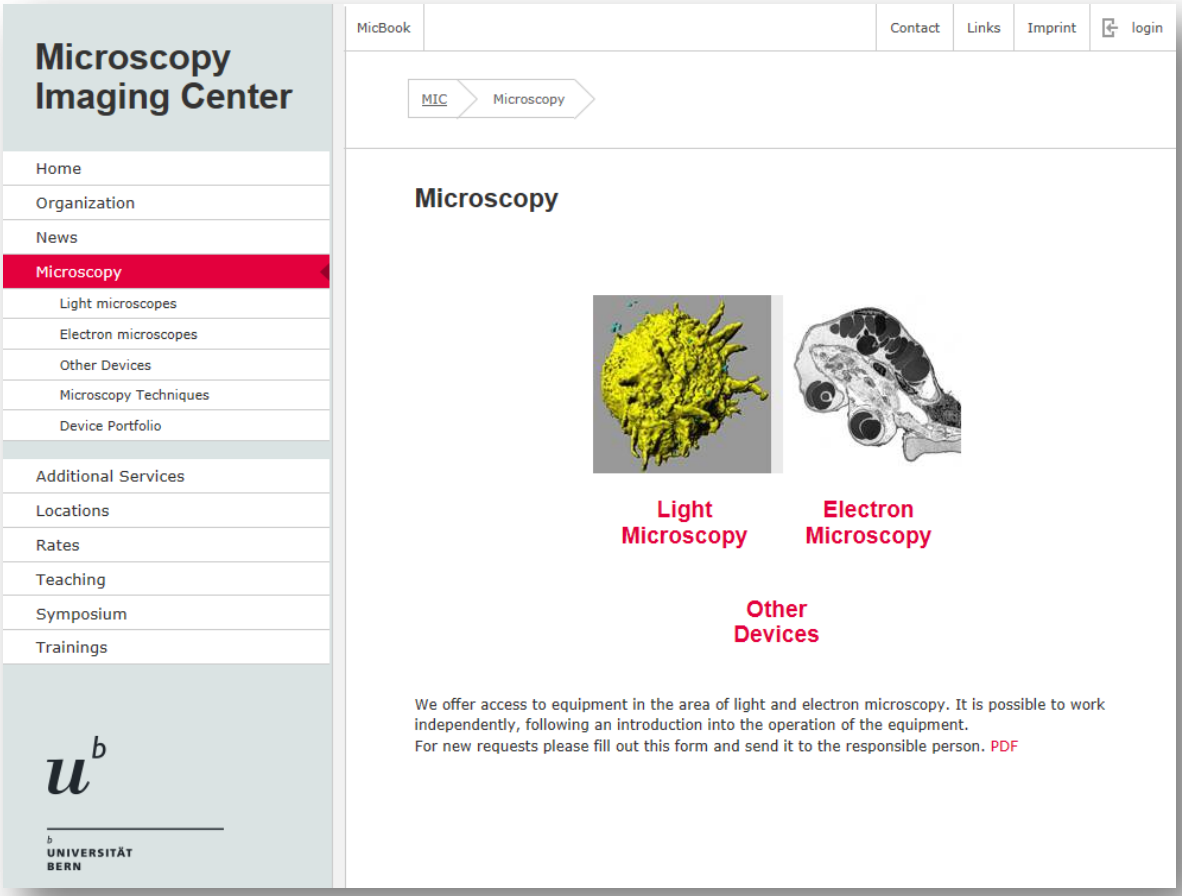
UNIVERSITÄT BERN

Faculty of Medicine
VetSuisse Faculty
Faculty of Science

Microscopy Imaging Center

Annual Report 2014

Microscopy Imaging Center (MIC)
University of Bern



April 2014

The MIC at a glance

The **M**icroscopy **I**maging **C**enter of the University of Bern (MIC) provides centralized access to high end microscopy and imaging equipment. It organizes the shared use of a wide range of state-of-the art systems and unites scientists and institutions with an interest in microscopy.

The MIC confirms its function as the center of excellence for high-end microscopy in life sciences and beyond at the University of Bern.

Founded in 2005, the MIC permanently increased its activities and is well recognized for its coordinative function in microscopy and imaging. In 2015, the MIC keeps its official performance mandate from the University's leadership established in 2012.

Updated information about the MIC is available under www.mic.unibe.ch

MIC Activities

- 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

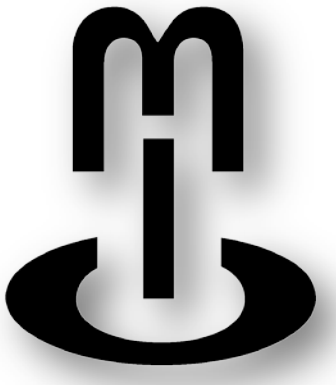
MIC Organization

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:	24

MIC Equipment

Shared microscopes	**46** (+3 in 2014)
Light Microscopes (various techniques)	35
Electron Microscopes (various techniques)	8
Further imaging instruments (Atomic Force / Micro-CT)	3



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Introduction

Microscopy is essential in modern life sciences. It provides the imperative tools linking molecular and genetic information with structure and function of the investigated organisms.

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 provided by MIC affiliates. It is widely acknowledged as facility for knowledge exchange as well as a valuable teaching resource for high-end microscopy at the University of Bern.

The range of high-end microscopic techniques provided at the MIC further increased in 2014 by three systems, particularly the unique 3D capable electron microscope (Serial Block Face Scanning EM). The portfolio of high-end microscopes accessible through the MIC allows scientists at the University of Bern to stay competitive at an international level.

All MIC associated institutes (from the three participating faculties and the Adolf Merkle Institute in Fribourg) forming the core of the MIC, provide at least one representative. Together these representatives constitute the MIC Commission. The majority of equipment accessible through the MIC is located in these member institutes. 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, all relevant steering decisions related to high-end microscopy are 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 2014 again, the two R'Equip proposals evaluated and supported by the MIC were successful allowing the acquisition of top microscopy techniques. Thus the University of Bern maintains its position at the highest level in microscopy. Many other grant proposals from various research groups across institutions and faculties managed and supported by the MIC were successful, a fact that highlights the efficiency and impact of the center.

The MIC Commission meetings are well appreciated discussion events. Here, the experts in microscopy techniques keep us up-to-date of the latest knowledge and techniques.

The MIC's goal is to continuously increase expertise in cutting-edge microscopic techniques among young and advanced scientists at the University of Bern. This year's MIC symposium focused on the hot topic of Super Resolution Microscopy with lectures from the relevant international experts in the field. The symposium was once again a meeting of stakeholders in high-end microscopy from all over Switzerland. The MIC contributed also to important public demonstrations where the outstanding scientific work at the University of Bern was presented to the interested lay audience ("Nacht der Forschung", "DKF Tag der offenen Türen").

The "Cutting Edge Microscopy" lecture series, part of the teaching program provided by the MIC, was successfully passed by 40 Students. The "MIC modules" providing training for dedicated microscopy techniques were followed by dozens of students and a workshop on image processing was fully booked by 50 scientists.

Again in 2014 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 administrative tools (see below) were refined and the administrative processes further simplified. Part of the budget was also made available for urgent equipment repairs.

The necessity and the success of the MIC is underscored by the fact that the voluntary time effort required by every MIC member to provide shared usage of microscopes (especially the system administrators) increases constantly. The downside of this success, however, is that the time effort to run the MIC has started to impair the scientific work of those attending to the microscopes. To avoid that the MIC is the victim of its own success it has decided to evaluate a solution where a newly founded position called "MIC Light Microscopy Manager" will take over many technical support tasks and the user management.

The MIC is established as the 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.

Organization of the MIC

The Microscopy Imaging Center unites scientists and institutions involved in high-end microscopy. The MIC is based on shared use of microscopy equipment and collaborative work of the participating institutions. The high quality of the MIC services critically relies on 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 the 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 involved in the MIC organization.

The directive panel of the MIC is the **MIC-Commission,** which consists of 24 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 participants from the University of Fribourg do not vote for items specifically related to the University of Bern

The MIC-Commission meets four times a year. Every meeting is concluded with a comprehensive protocol that acts as directive for the MIC (accessible for members on the web).

Technical microscopy support is organized on several levels: System related support is provided by the corresponding microscope administrators. General requests are collected by the MIC-coordinator and are dispatched to dedicated contact person (see contact page on http://www.mic.unibe.ch or Table 1). Specific contact persons can also be contacted directly.

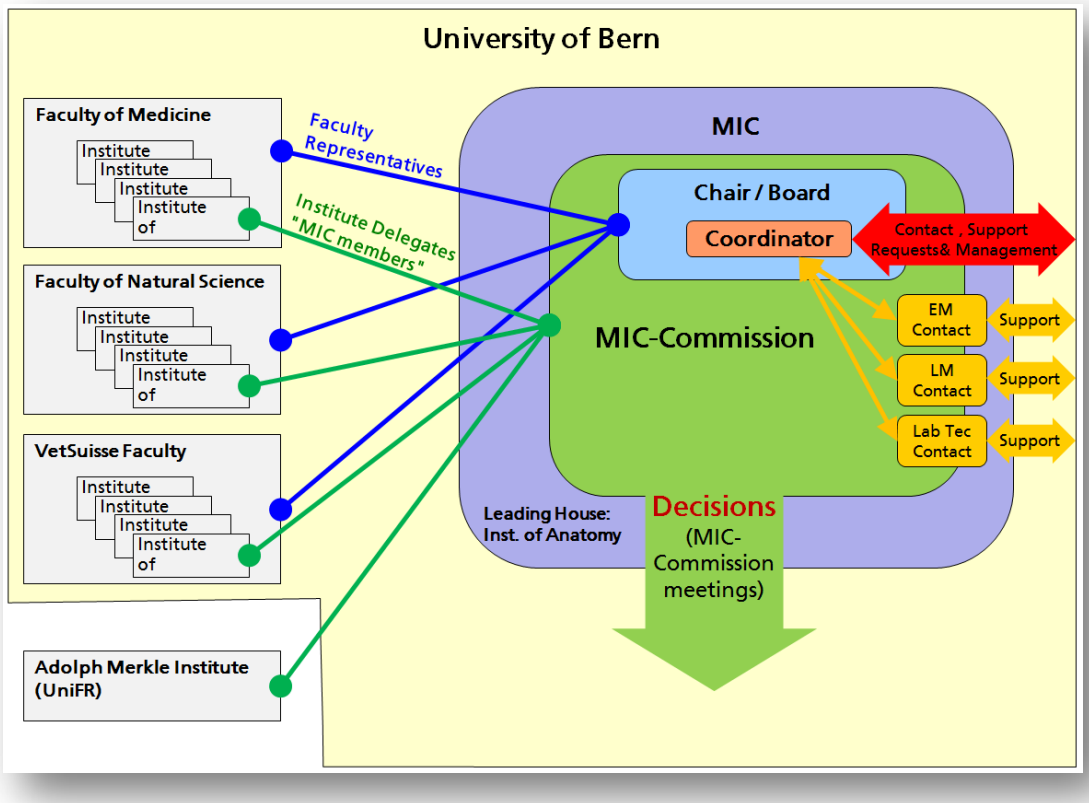

Fig. 1: Organigram of the MIC

Table 1: Participating Institutions and Members of the MIC

Faculty	Institute	Delegates (MIC-members) (state Dec. 2014)
Medicine	Anatomy	PD Dr. Edik Babiychuk Beat Haenni (**core technician**) PD Dr. Stefan Tschanz (**coordinator, contact stereology**) Prof. Dr. Benoît Zuber (**contact electron microscopy**)
	ARTORG Center	Prof. Dr. Olivier Guenat
	Biochemistry and Molecular Medicine	Prof. Dr. Dimitrios Fotiadis Prof. Dr. Roch-Philippe Charles
	DKF / Pneumology	Dr. Fabian Blank (**contact light microscopy**)
	DKF	Prof. Dr. Robert Rieben
	Pathology	Dr. Ilaria Marinoni
	Pharmacology	Prof. Dr. Shida Yousefi
	Physiology	Prof. Dr. Thomas Nevian Prof. Dr. Ernst Niggli
	Theodor-Kocher Institute	Prof. Dr. Britta Engelhardt (**chair**, **board**) PD Dr. Ruth Lyck Prof. Dr. Jens Stein
Science	Applied Physics	Prof. Dr. Martin Frenz Prof. Dr. Jaroslav Ricka
	Cell Biology	Prof. Dr. Volker Heussler (**board**) Prof. Dr. Peter Meister
	Plant Science	Dr. Sarah Robinson
VetSuisse	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 primary 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 four years.

Leading house: Institute of Anatomy

The Institute of Anatomy functions as "leading house" for the MIC, in order to have a specific contact point and address for financial transactions. Most of the MIC core staff (coordinator, web master, core lab technician, core microscopy technician) are members of the Institute of Anatomy but are partly paid out of the budget of the MIC (see "Financial support by the University

Leadership"). Due to its extensive experience in microscopy techniques and a large portfolio of equipment, the Institute of Anatomy is well suited for this task.

Performance Mandate ("Leistungsauftrag")

The MIC has 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 objectives 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 year.

The MIC was defined as pilot organization demonstration the feasibility of shared competence centers at the University of Bern (Prof. Christian Leumann, current Vice Rector Research and future Rector of the University of Bern). The success of the MIC confirmed the concept of such interfaculty centers.

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 together with the University Board 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 support and maintenance costs relevant for the entire MIC.

Table 2: Financial support utilization

Financial Support University Leadership 2014	CHF 120'000.00	Comment
Salary costs	*CHF 104'270.40*	MIC Commission decision
MIC Cash Reserve	**CHF 15'729.60**	
Cash expenses		
Maintenance		
Maintenance Server MICBOOK (N. Fankhauser)	*CHF 500.00*	Coordinator
Various		
Workshop ImageJ L. Gelman (FMI Basel)	*CHF 234.80*	Travel costs
Visit Yury Belyaev, evaluation MIC LM supporter	*CHF 593.82*	Travel costs
Small equipment and upgrades		
Maintenance Axiovert lamp, light fiber (S. Yousefi, Pharmacology)	*CHF 1'955.90*	MIC Commission decision
Repair: GATAN Cryo Holder TECNAI (B. Zuber, Anatomy)	*CHF 5'756.80*	MIC Commission decision
Huygens Software (V. Heussler)	*CHF 2'000.00*	MIC Commission decision
Repair: Nikon Biostation (F. Blank)	*CHF 3'207.60*	MIC Commission decision
Maintenance LaVision SPIM (J. Stein)	*CHF 1'520.00*	MIC Commission decision
Sum cash expenses:	***CHF 15'768.92***	
Deficit	**CHF -39.32**	**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, H./ Studer D.	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

The MIC central financial assessment that is organized in collaboration with the central Finance Department of the University allows to list all microscopy-related charges and incomes of MIC associated Institutes. The assignment of transactions is easy but voluntary. Some costs may not be listed in the following overview.

While initial investment for expensive high-end microscopy systems is mainly covered by research grants, maintenance and repair costs have to be funded by the institutes where the microscopes are located. Some incomes are generated by fee-based usage of the systems. However, maintaining the microscopes does stress regular financial resources of the institutes.

The rough estimate of microscopy maintenance costs that had to be compensated by institute funds is about CHF 60'000.- (see Table 4)

The straightforward and comprehensive work-flow of the **MIC financial reporting** tool is easily applicable. Most of the MIC member institutes submit their financial transactions via this process. The assignment is done by just labeling transactions with the so-called "Projekt-Abrechnungs-Objekt" (PAO) (see Fig. 2 below)

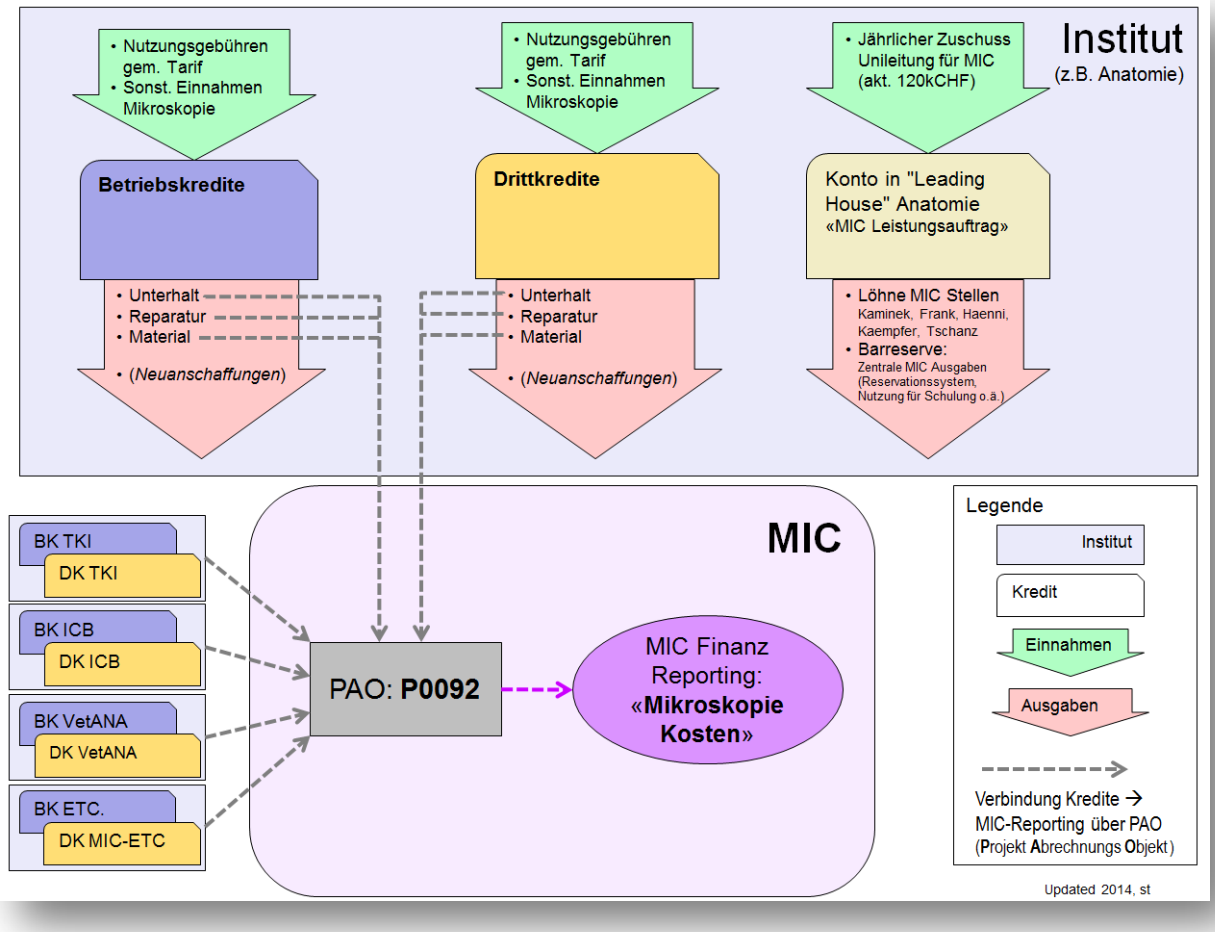

Fig. 2: Workflow of the MIC Finance Reporting

(the communication with the Finance Department is German, the workflow is therefore in German, too)

Financial turnover that was assessed by the MIC financial reporting in 2014:

Table 4: Revenues and Expenses

Revenues (pooled):	Usage fees (+ 31% compared to 2013)	CHF 87'696.50	
	Compensations (Faculty funds)	CHF 68'316.90	
	Total revenues	**CHF 156'013.40**	
Expenses: (pooled):	Repair, updates, extensions, service contracts.		**CHF 214'540.88**
Remaining gap			**CHF 58'527.48**

This table does not claim to be complete. Some items may be missing and the correct categorization in retrospect is irresolvable.

Human resources

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

During the last years, the MIC's shared usage principle was increasingly successful. Many MIC high-end microscope providers and administrators reach a level of MIC-dedicated engagement that interferes critically with their own research. Therefore, the MIC evaluated the implementation of a central support position dedicated to high-end light microscopy. This MIC-based light-microscopy manager is intended to work on a shared way for all participating MIC institutes by migrating between the microscopes. Qualification should be a bio-physical formation and some years experience as a facility manager in microscopy. Main task will be the optimal setup and maintenance of the systems, the introduction of new users, the contact to microscope manufacturers and the immediate support in case of technical problems. The position will be financed pro-rata by the participating institutes and with a substantial help of the University leadership. The feasibility and reasonability of such a shared position with that broad contract specification was evaluated in collaboration with microscopy facility leaders from Switzerland and Germany and positively approved. At present state most of the administrative prerequisites are performed and we intend to employ a suited person by the end of 2015.

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 adapted to the new corporate design of the University of Bern by our web master, Sandra Frank. Launched in December 2014, it is one of the first sites that follows the regulation of the University Board. It corresponds to the layout of the so-called Web-Apps and was designed in collaboration with the Web-Office of the University keeping its own database driven content management principle.

Special attention was given to an extended 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.

The announcement of trainings, teaching and symposia is fully automated and database drive. It consists of an easy to use registration function for participants.

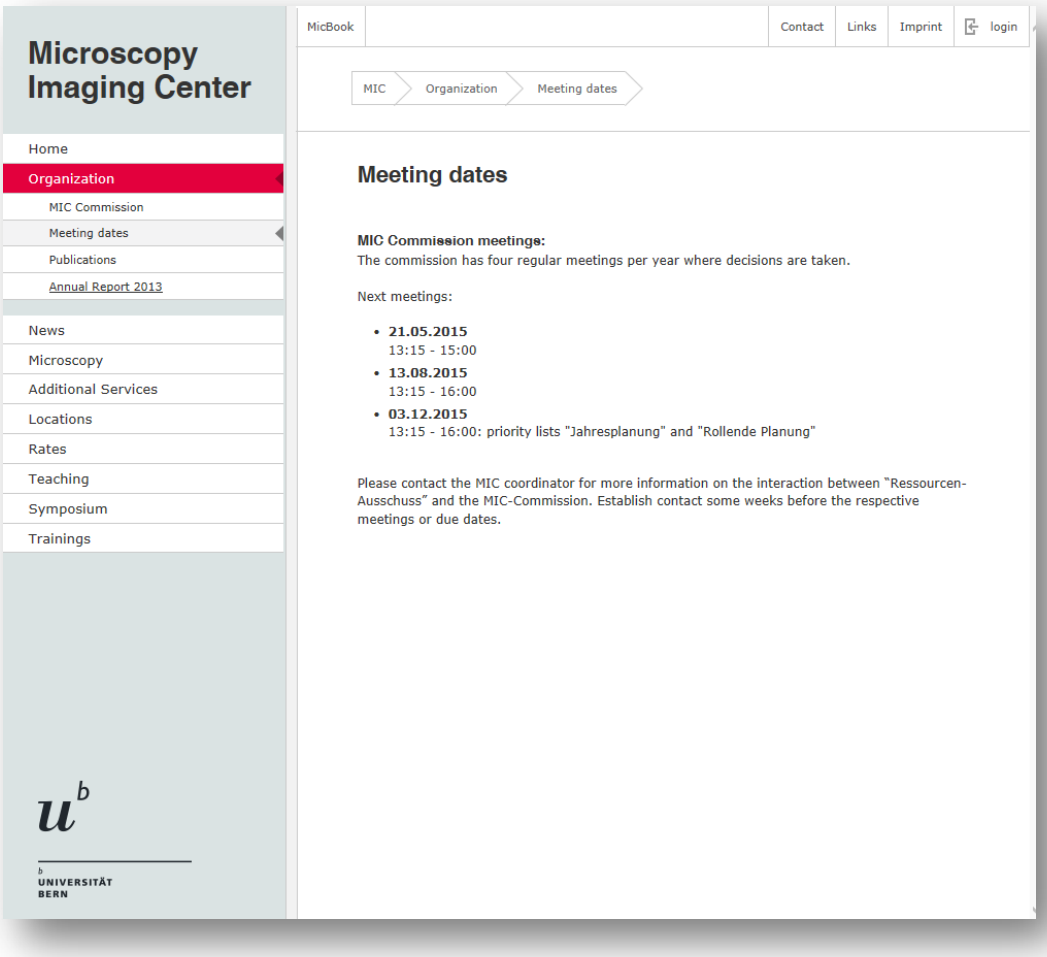

Fig. 3: Print Screen of the MIC Website in the new Corporate Design of the University of Bern

In the third successive year, the most relevant 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)

The MIC was also present at two important public events where the outstanding research at the University of Bern was presented to the public: The "Nacht der Forschung" in the evening of September 6th and the "Tag der offenen Türe" in the frame of the 20 years anniversary of the Department of Clinical Research (DCR/DKF) of the Medical Faculty and the Insel hospital.

Fig. 4: Flyer and Presentation "Nacht der Forschung"

MIC Symposium

This year's MIC symposium was on a scientifically very "hot" topic: the "Super Resolution" principle which was granted the Nobel Prize in Chemistry 2014. This fascinating imaging technique based on light however goes far beyond the limits of light limited resolution up to the nanometer rage and is therefore called "Nanoscopy".

The Symposium was again very well attended by around 80 scientists from the University of Bern and of many other Swiss and international institutions. An international board of outstanding experts in the field was invited thanks to the good relations with our own excellent experts Prof. Pierre Meister and Prof. Thomas Nevian. The costs of the Symposium including a welcoming standing lunch were mainly covered by support of major microscopy manufactures: Zeiss, Leica Nikon and Gloor Instruments.

The MIC, as *the* center of excellence in microscopy at the University of Bern, was very well promoted.

Fig. 5: Flyer of the MIC Symposium 2014

Fig. 6: Impressions from the MIC Symposium 2014

Microscopy Equipment and Services

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

A broad selection of microscopic techniques is made available to University members and other scientists, irrespective of being members of the MIC. Many additional services in the domain of microscopy are also available. The equipment is located at different institutes of the University and administration and maintenance is performed locally. Nevertheless, access is straightforward 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 extraordinary institution.

It is the ambition 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.

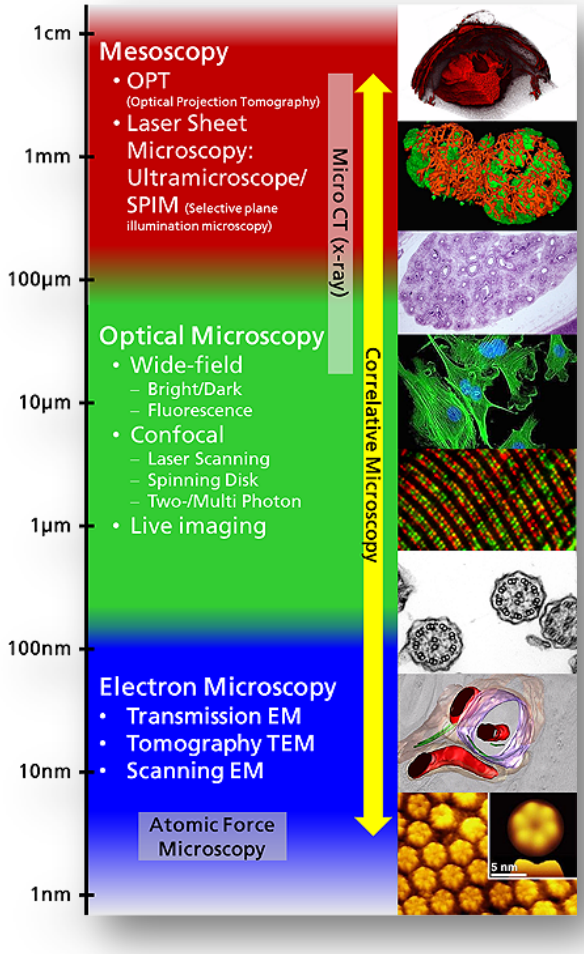

Fig. 7: Magnification range of MIC equipment

Instruments include conventional light and fluorescence microscopes, a fluorescence slide scanner, 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, a new 3D serial block face scanning electron microscope, 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		#	
Mesoscopy	Light / Laser sheet	2	
	Optical Projection	1	3
Light Microscopy	Fluorescence (Widefield)	10	
	Confocal Laser Scanning Microscopy	16	
	Spinning Disk System	1	
	Super Resolution System	1	
	High Content Analysis	1	
	Slide Scanner	1	
	other LM (Reflected Light, Stereo microscope)	2	**32**
Electron Microscopy	TEM (incl. 2 Tomography TEM)	5	
	Serial Block Face SEM	1	
	SEM	2	**8**
Other	Atomic Force Microscope	2	
	Micro CT (X ray)	1	**3**
	(plus 3 compared to 2013)	**Sum**	**46**

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	New 2014
Mesoscopy	LaVision BioTec Ultramicroscope System	Physiology	Laser Sheet	
	Selective Plane Illumination Microscope	TKI	Laser Sheet	
	Bioptonics Optical Projection Tomography scanner	TKI	Optical Projection	
Stereo-Microscope	Leica MZ16 Stereoscope	TKI		
Wide-field	Intravital microscope IVM-500	TKI	Live,	
	Zeiss M2	Anatomy	Automatic stage	X
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		
	3DHISTECH Slide Scanner, Zeiss based	IBMM	Automatic scanning	X
	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 Till Photonics	Cell Biology		
Scanning EM	Zeiss DSM 982	Vet. Anatomy	STEM	
	Philips XL 30 FEG	Anatomy		
SBF SEM	FEI Quanta 250 FEG, with Gatan 3View	Anatomy	3D	X
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

A big issue of recent microscopy and imaging techniques is the data flush. 4D fast and/or long image capture with high resolution / high bit depth detectors combined with 3D acquisition dramatically increase data acquisition rate. Research data need to be stored safely 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 on a University wide level turn out to be efficient enough.

On initiative and with substantial conceptual input from the MIC, the central IT department of the University (ID) implemented a multi-level storage concept that allows secure and affordable data storing. In summary, a separation of current data (higher price) and archive data (much lower price) alleviates 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 sharing of the MIC 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 microscopes in 2014 is presented here. During this period 247 scientists (+13.5% in 2014) worked on MIC microscopes during roughly 28'000h.

Some microscopes of the MIC portfolio are not managed by MICBOOK still being part of the 46 systems available through the MIC. Thus they do not appear on this list.

Full usage as expressed in usage hours per microscope might differ considerably depending on the research work associated with the system, e.g. surgery of animals, collecting cells etc. In addition, system start up and shut down, which might take considerable time are not included in

the listing of active usage hours below. Break downs and repair periods additionally reduce the availability of the microscopes. Some systems started to be used only during the year.

Table 7: Utilization statistics of MIC devices 2014

Microscope	Technique	Location	Usage [h]	
IZB_Leica SP8 STED	CLSMx	Cell Biology	5069.75	**
IZB_TILL Photonics iMIC	Spinning Disk	Cell Biology	4501	
DKF LCI Nikon Biostation	Fluo LM	DKF	2928	
FEI Tecnai F20	TEM	Anatomy	2003	
IZB_Leica TCS SP2	CLSMx	Cell Biology	1743	
LaVision TrimScope	Live Cell Img.	TKI	1426.5	*
DKF LCI Leica DMI4000 B	Fluo LM	DKF	1315.5	
DKF LCI Zeiss LSM 710	CLSMx	DKF	1192.5	
Philips EM 400	TEM	Anatomy	1079	
Zeiss AxioObserver	Live Cell Img.	TKI	1013	
FEI Morgagni	TEM	Anatomy	987	
Zeiss LSM 510 Meta (ana)	CLSMx	Anatomy	850	
INCell Analyzer 2000	Fluo LM	Vet. Anatomy	628	
Nikon Eclipse E600	LM	TKI	597	
Philips CM 12 (ana)	TEM	Anatomy	591	
Olympus FV 1000	CLSMx	VetSuisse Faculty	585.5	
LaVision Ultramicroscope	Mesoscopy	Physiology	507	
Philips XL 30 FEG	SEM	Anatomy	380	*
Philips CM 12 (vet)	TEM	Vet. Anatomy	295	
Keyence VHX-600	LM	Vet. Anatomy	220	
Zeiss AxioImager (vet)	Fluo LM	Vet. Anatomy	137.5	
Leica DMRB (ana)	LM	Anatomy	111	*
IAP Nikon Ti-E A1R MP	CLSMx	Applied Physics	48	*
IAP Bioscope II AFM	AFM	Applied Physics	47	**
Zeiss DSM 982	SEM	Vet. Anatomy	44	*

Table 7 shows the MIC microscopes managed by MICBOOK equipment manager for 2014. *: repair periods, **: new in MICBOOK or new acquisition.

In 2014, the overall usage of microscopes was increased by **18.4%.**

The mean degree of utilization for scientific operation was **over 50%.**

Teaching

The teaching activity provided by the MIC includes 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.

Image Processing

In 2014 a new series with IT focused training in image processing was started.

The first module covered the famous **ImageJ** software that allows a flexible and straightforward processing of practically all kind of digital images. After an introduction to digital images by the MIC coordinator Dr. Stefan Tschanz, Dr. Laurent Gelman from the Friedrich Miescher Institute in Basel – a well-known expert in bio imaging - coached the workshop that was fully booked with over 50 participants.

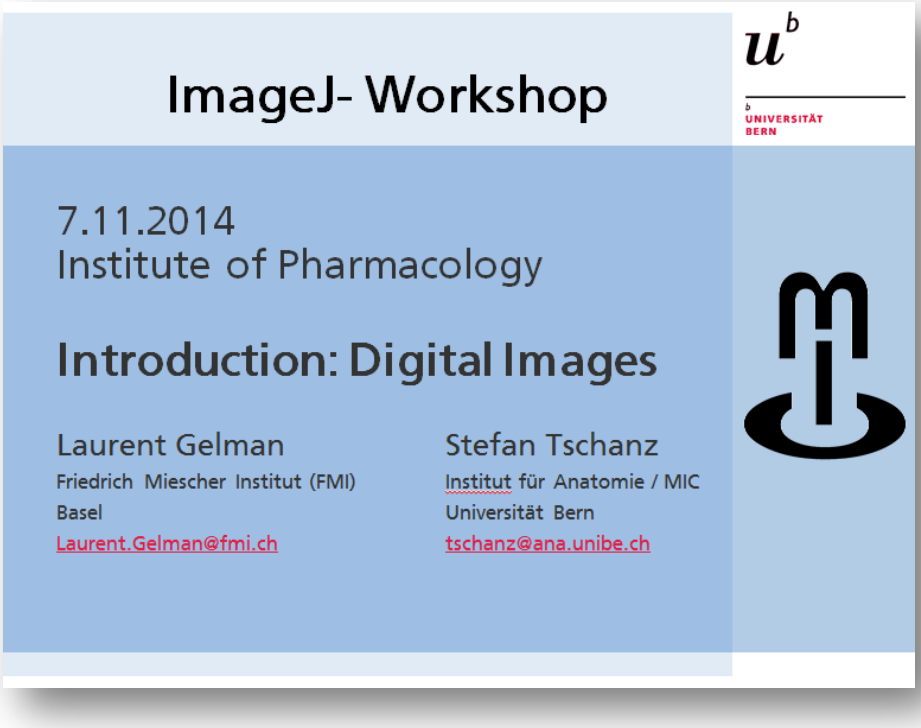

Fig. 8: ImageJ Workshop

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).

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 Bühlplatz 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 2014, 63 students from several Master and PhD programs registered for the series. The exam was attended by 52 students 40 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.

Table 8: Cutting Edge Program 2013

Microscopy Imaging Center (MIC)

Lecture series "Cutting Edge Microscopy" HS2014

UNIVERSITÄT BERN

KSL ID: 9256

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

Institute of Anatomy, Bühlstrasse 26, Room A224

Room U113, Dept. of Chemistry, Freiestrasse 3

Date	Subject	Lecturer
19.09.2014	2h Introduction to Cutting Edge Microscopy (including practical part in the Histology room of the Institute of Anatomy)	Tschanz S. (Anatomy)
26.09.2014	Group A: - 1h Physical basics of LM imaging, part 1 - 1h Microscopy Demos Group B: - 2h Microscopy Demos	 Ricka J. (IAP) Various teachers Various teachers
03.10.2014	Group A: - 2h Microscopy Demos Group B: - 1h Physical basics of LM imaging, part 1 - 1h Microscopy Demos	 Various teachers Ricka J. (IAP) Various teachers
10.10.2014	1h Physical basics of light optical imaging, part 2 1h Fluorescence Microscopy	Ricka J. (IAP) Blank F. (DKF, MU50)
17.10.2014	Specific applications: 1h Laser scanning microscopy 1h Optical projection tomography	 Rothen-Rutishauser B. (DKF, MU50) Stein J. (TKI)
24.10.2014	1h Calcium-imaging with confocal microscopy 1h Super resolution imaging	Niggli E. (Physio) Nevian T. (Physio)
31.10.2014	1h Light sources for fluorescence microscopy 1h Time Lapse Microscopy	Lyck R. (TKI) Lyck R. (TKI)
07.11.2014	1h Intravital microscopy 1h Multiphoton-intravital microscopy	Enzmann G. (TKI) Moalli F. (TKI)
14.11.2014	1h CLSM specific applications (FRET, FRAP, Spectral unmixing) & digital image restoration (huygen and Imaris software) 1h Atomic Force Microscopy in Biology	Yousefi S. (PKI) Fotiadis D. (IBMM)
21.11.2014	2h Transmission Electron Microscopy	Vanhecke D. (AMI)
28.11.2014	2h Cryoelectron Microscopy	Zuber B. (Anatomy)
05.12.2014	MIC-Symposium	
12.12.2014	2h Scanning Electron Microscopy	Stoffel M. (Vet. Anatomy)
19.12.2014	2h Stereology	Tschanz S. (Anatomy)
03.02.2015	8:00 - 10:30 2h Written exam (Location: Dept. of Chemistry, U113)	Tschanz S. (Anatomy)

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 2014

Topic	Teacher	Institute	Participants
Basic module - Histologic/microscopic Lecture and Practical	Christa Rhiner	Cell biology	14
Intravital Microscopy	Gaby Enzmann	TKI	2
Microscopy Applications for Immunological Research	Markus Thelen	IRB Bellinzona	10
Multiphoton Intravital Microscopy	Jens Stein	TKI	6
Immunohistochemistry, immunofluorescence and microscopy in paraffin embedded sections	Fabian Blank	DCR LCI	6
Practical course in fluorescent staining, fluorescence microscopy, confocal microscopy and image analysis	Fabian Blank	DCR LCI	16
Scanning electron microscopy	Michael Stoffel	Vet. Anatomy	2
Stereology Workshop	Stefan Tschanz	Anatomy	14
Transmission EM practical	Benoît Zuber	Anatomy	3

Table 10: MIC Modules 2014

Microscopy Imaging Center (MIC)

Lectures and practical modules 2014/2015

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 - 1 days	Benoît Zuber (Anatomy)	0.5
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
Immunohistochemistry, immunofluorescence and microscopy in paraffin embedded sections	Practical	HS, 5 days	Fabian Blank (LCI DKF)	2.5

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 2014 again several adaptations requested by the users were implemented to make MICBOOK even more convenient. It allows a refined usage statistics, a per-system based configuration of equipment properties and an export functionality for reports directly to MS Excel ®.

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 2014:

Currently, it manages 131 objects (2013: 121) and is used by more than 500 users (2013: 380). In 2014, 8988 equipment bookings (2013: 5985) corresponding to a usage of 42513 hours were managed by MICBOOK.

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

Grant application support

A key task of the MIC is coordination, evaluation and possible support of funding requests in the field of microscopy.

Funding from Faculty resource committees and University sources in the field of Microscopy is only accessible if the respective projects are evaluated by the MIC commission. It seems that the Swiss National Science Fund also appreciates the advises of the MIC: in the last years all microscopy R'Equip proposals supported by the MIC were successful

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. 9). 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 2014, the MIC successfully supported several microscopy investments at the University of Bern.

Notice: Both R'Equip proposals covering microscopy equipment that were evaluated and finally supported by the MIC commission in 2014 were successful and will be effected in 2015.

- Prof. J. Stein, Theodor Kocher Institute , Medical Faculty:
  Replacement of a Short Pulse Laser Modules for a 2 Photon microscope CHF 42'598.-
  (Resource Committee of the Med. Faculty)
- Proff. H-U. Simon / S. Yousefi, Institute of Pharmacology, Medical Faculty:
  ZEISS AxioObserver.Z1 fluorescence microscope CHF 99'082.-
  (Resource Committee of the VetSuisse Faculty)
- Prof. D. Fotiadis, Institute of Biochemistry, Medical Faculty:
  DED Camera for Tecnai TEM CHF 840'000.-
  (SNF R'Equip, matching funds: Resource Committee of the Med. Faculty & University)
- Proff. O. Guenat, R. Rieben, ARTORG Lung Regeneration Technologies/ DCR Medical Faculty
  Microscopy equipment for "Organ-on-Chip" microfluidic systems CHF 364'260.-
  including STED super resolution module
  (SNF R'Equip, matching funds: "Etat Lehre und Forschung", Insel hospital)

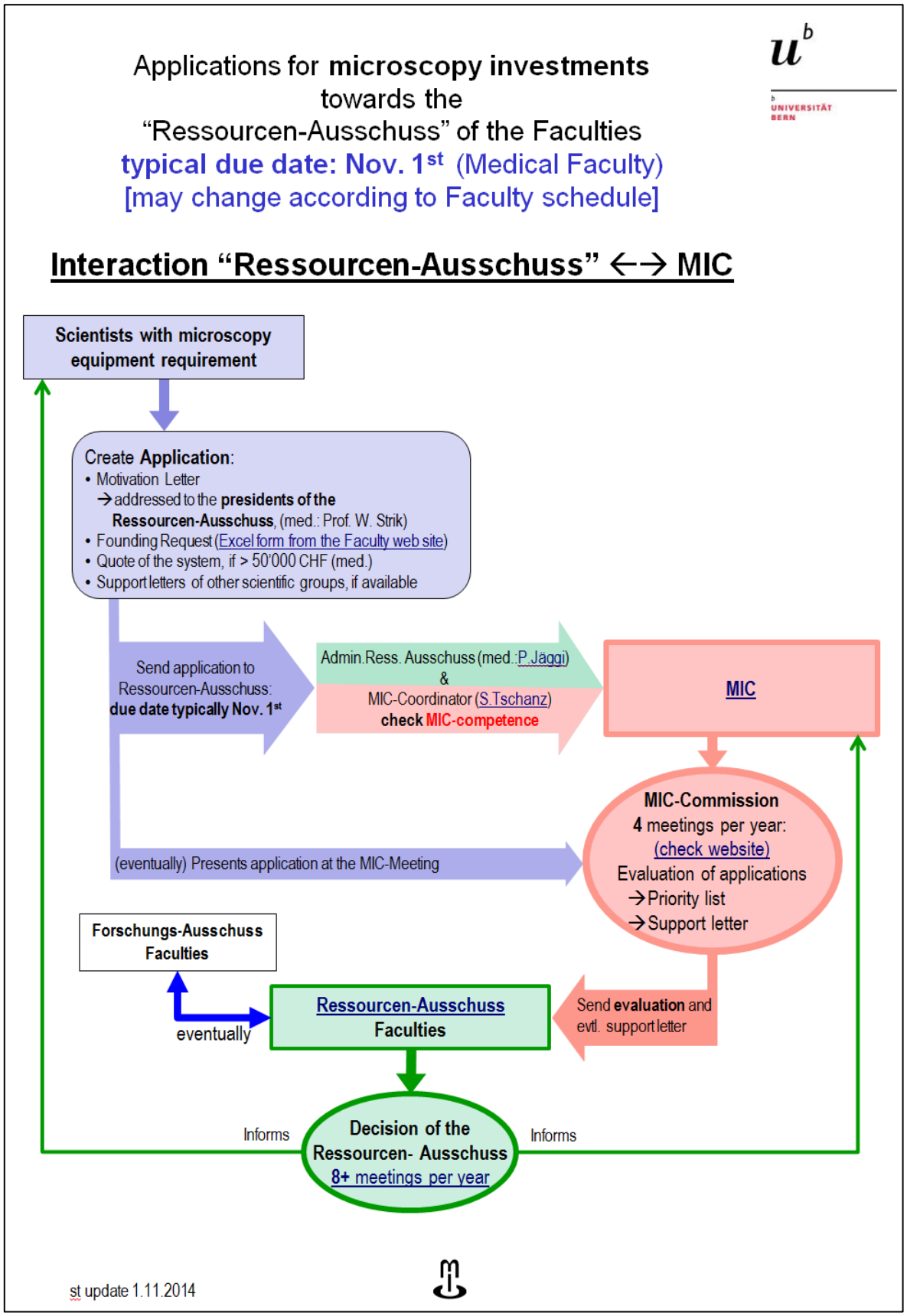

Fig. 9: Funding support work-flow

Publications resulting from work at the MIC in 2014

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

(1-67) [+15 in 2014]

1. **Abe J, Shichino S, Ueha S, Hashimoto S, Tomura M, Inagaki Y, Stein JV, and Matsushima K**. Lymph node stromal cells negatively regulate antigen-specific CD4+ T cell responses. *J Immunol* 193: 1636-1644, 2014.
2. **Askjaer P, Galy V, and Meister P**. Modern tools to study nuclear pore complexes and nucleocytoplasmic transport in Caenorhabditis elegans. *Methods Cell Biol* 122: 277-310, 2014.
3. **Atanassoff AP, Wolfmeier H, Schoenauer R, Hostettler A, Ring A, Draeger A, and Babiychuk EB**. Microvesicle shedding and lysosomal repair fulfill divergent cellular needs during the repair of streptolysin O-induced plasmalemmal damage. *PLoS One* 9: e89743, 2014.
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5. **Barre SF, Haberthur D, Stampanoni M, and Schittny JC**. Efficient estimation of the total number of acini in adult rat lung. *Physiol Rep* 2: 2014.
6. **Blom SM, Pfister JP, Santello M, Senn W, and Nevian T**. Nerve injury-induced neuropathic pain causes disinhibition of the anterior cingulate cortex. *J Neurosci* 34: 5754-5764, 2014.
7. **Bongoni AK, Kiermeir D, Jenni H, Bahr A, Ayares D, Klymiuk N, Wolf E, Voegelin E, Constantinescu MA, Seebach JD, and Rieben R**. Complement dependent early immunological responses during ex vivo xenoperfusion of hCD46/HLA-E double transgenic pig forelimbs with human blood. *Xenotransplantation* 21: 230-243, 2014.
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12. **Clift MJ, Endes C, Vanhecke D, Wick P, Gehr P, Schins RP, Petri-Fink A, and Rothen-Rutishauser B**. A comparative study of different in vitro lung cell culture systems to assess the most beneficial tool for screening the potential adverse effects of carbon nanotubes. *Toxicol Sci* 137: 55-64, 2014.
13. **Cortes H, Leitao A, Gottstein B, and Hemphill A**. A review on bovine besnoitiosis: a disease with economic impact in herd health management, caused by Besnoitia besnoiti (Franco and Borges,). *Parasitology* 141: 1406-1417, 2014.
14. **Draeger A, Schoenauer R, Atanassoff AP, Wolfmeier H, and Babiychuk EB**. Dealing with damage: plasma membrane repair mechanisms. *Biochimie* 107 Pt A: 66-72, 2014.
15. **Duehrkop C, Denoyelle J, Shaw S, and Rieben R**. Use of dextran sulfate in tourniquet-induced skeletal muscle reperfusion injury. *J Surg Res* 187: 150-161, 2014.
16. **Duehrkop C, and Rieben R**. Refinement of tourniquet-induced peripheral ischemia/reperfusion injury in rats: comparison of 2 h vs 24 h reperfusion. *Lab Anim* 48: 143-154, 2014.
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