Appendices

2019

KBC Report

Chemical Biological Centre /

Kemiskt Biologiskt Centrum (KBC)

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6/24/2020

UMEÅ UNIVERSITY

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Appendix 2a. Description of the KBC Infrastructures

Biochemical Imaging Centre Umeå (BICU)

Short Summary of the Facility

The Biochemical Imaging Centre Umeå (BICU) provides state-of-the-art imaging technology including advanced light microscopy, affinity measurements and atomic force microscopy. BICU is an open-access imaging centre that offers cutting-edge techniques to researchers all over Sweden according to a fixed organization and user fees as described on the homepage. The combination of methodologies provide means to study strength, as well as spatial and temporal regulation, of interactions between biomolecules in systems ranging from molecules to cells. The centre includes dynamic live cell confocal microscopy and super-resolution microscopy. The state-of-the-art atomic force microscopes allow for ultra-resolution 3D-imaging and force-interaction measurements. Furthermore, the centre provides real-time quantification of binding of biosensors through solid-phase interaction techniques. Apart from providing microscopy services BICU also actively take part in programs aimed at training young researchers in the use of the basic as well as advanced microscopic techniques.
BICU is part of the **National Microscopy Infrastructure (NMI)**: a Swedish infrastructure for the use and support of advanced microscopy in life science. NMI was founded in April 2016 with the financial support from the Swedish Research Council (VR-RFI) and co-financing from the participating Universities. The four participating universities are: Royal Institute of Technology (KTH), Stockholm University (SU), Umeå University (UmU) and University of Gothenburg (GU). The mission of NMI is to provide faster access to innovative technology and competence in microscopy for the life science research community. NMI also coordinates national and international knowledge exchange in microscopy. NMI in Umeå is the node specialized for advanced correlative imaging techniques. Hereby, BICU closely collaborates with Umeå Core Facility for Electron Microscopy (UCEM) to provide correlative light and electron microscopy (CLEM).

Summary of activities during 2019

BICU updated light microscopy instruments during 2019 with financial support from the Medical faculty UmU, Kempe foundations, UCMR, Wallenberg foundations, WCMM. The expected lifetime of the previous instruments had expired and users were asking for updated instruments. These have been installed at UCEM, Chemistry, Molecular Biology and Virology which has expanded the user-basis. These instruments have also complemented the facility with novel technologies such as cryo-CLEM and FLIM as well as state-of-the-art confocal microscopes. We also anticipate that this will increase the numbers of users in 2020. We are also very pleased that we have launched a new organization around the affinity measurement instruments. We believe that this User Club-based management of these instruments will enable financial support for service contracts as well as a base of advanced users that will develop the use of the instruments. We have organized courses for members of the user club. We will also support personnel that maintain the instruments.

Equipment

Equipment "owned" by the infrastructure:

- Zeiss ApoTome microscope
- Nikon A1R Laser Scanning Microscope
- Zeiss Spinning Disk Confocal Microscope
- Zeiss 710 Laser Scanning Microscope
- Bruker Atomic Force Microscope
- Biacore 3000
- Auto-ITC200
- Proteon XPR36
- Ligand Tracer® Green
- Imaris working station (software license and analysis computer)
- Cell Asic Onix system for Microfluidics (Millipore)
- POC mini system (Pecon)

New equipment 2019:

- Leica Sp8 LIA Confocal Microscope
- Leica Sp8 Falcon Confocal Microscope
- Leica Thunder Widefield Microscope
- Cryo-CLEM Widefield Microscope
- Nikon TIRF Microscope

Equipment used but not "owned" by the infrastructure:

- Microinjector (Millipore)
- Cell culture hood and incubator

Service provided by the platform

- Consultation, advice on experimental design and optimization of experimental conditions
- Technical support
- Personal training to provide driver's license for the user on the instrument
- Assistance with data analysis
- Data storage
- **New services 2019**: a User Club organization was established to manage the Affinity Instruments at the Facility (Biacore, ITC and Protein).

Personnel

Richard Lundmark	Associate Professor, BICU Director, MIMS group leader Department of Integrative Medical Biology
Irene Martinez	PhD, BICU Facility Manager, Light Microscopy specialist Department of Medical Biochemistry and Biophysics
Naga Venkata Gayathri Vegesna	PhD, Senior Research Engineer for CLEM (from 2017) Department of Integrative Medical Biology and Department of Medical Biochemistry and Biophysics

Steering board

Thomas Borén	Professor, Medical Biochemistry and Biophysics, UmU
Richard Lundmark	Associate Professor, Integrative Medical Biology, UmU
Magnus Wolf-Watz	Professor, Chemistry, UmU
Linda Sandblad	PhD, Molecular Biology, UmU
Anders Olofsson	PhD, Medical Biochemistry and Biophysics, UmU
Ludmilla Morozova-Roche	Professor, Medical Biochemistry and Biophysics, UmU
Jonathan Gilthorpe	Associate Professor, Pharmacology and Clinical Neuroscience UmU
Stephanie Robert	Assistant Professor, Department of Forest Genetics and Plant Physiology, SLU, Umeå Plant Science Centre
Mattias Alenius	Professor, Molecular Biology
Affiliated to steering board:	
Andrei Chabes	Professor, Head of Department, Medical Biochemistry and Biophysics, UmU
Per-Arne Oldenborg	Professor, Integrative Medical Biology, UmU

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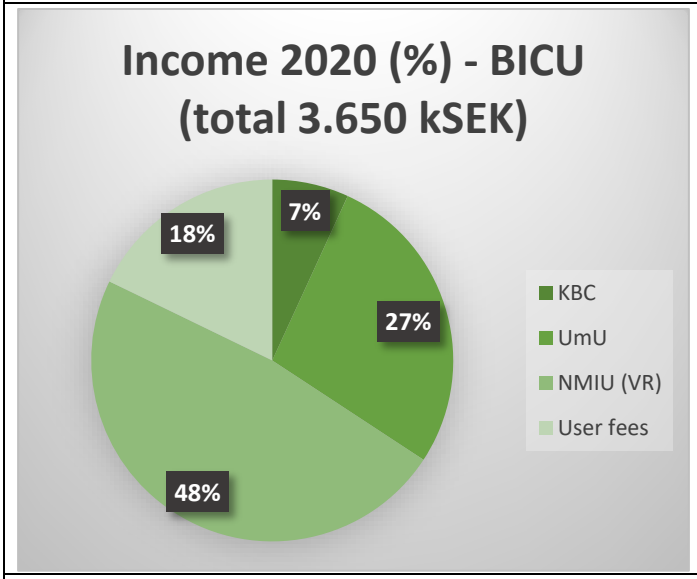
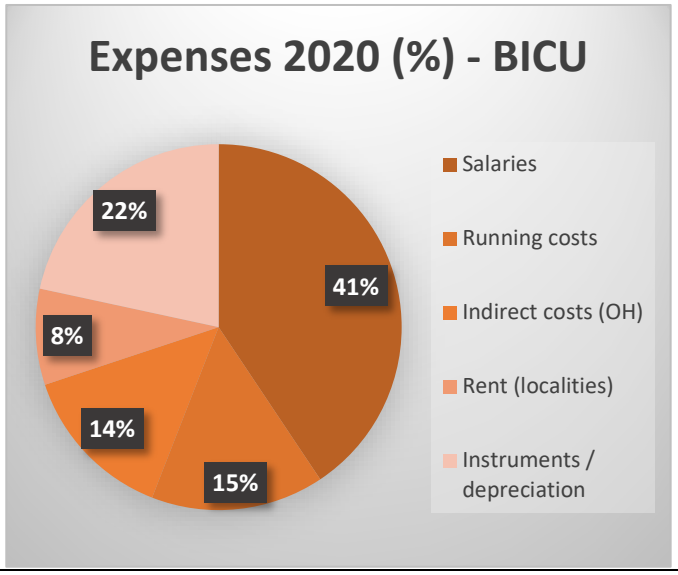
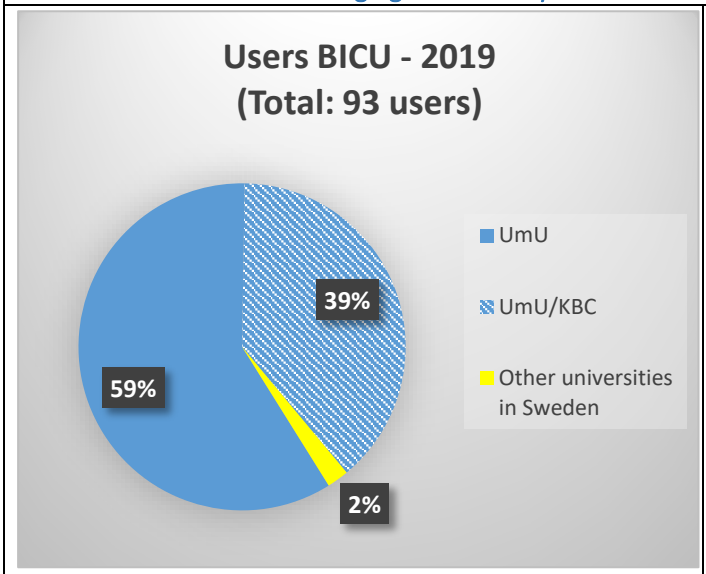
Homepage: https://www.umu.se/en/research/infrastructure/biochemical-imaging-centre-umea-bicu/

Budget - BICU





Users of the Biochemical Imaging Core Facility



	No of users
Light Microscopy	84
Atomic Force Microscopy	5
Affinity Instruments	4
Total	84

Teaching activities

- Personal training, resulting in an individual driver license on a specific instrument, is running throughout the year.
- Facility exchange; Barbara Huebener and Sara Sandin from NTU Singapore (May-June 2019)
- Forskarfredag (27 September 2019)
- KBC Days, Poster presentation, facility show and facility tour (5,6 November 2019)
- Lectures on modern microscopy for Medical students and Biomedical students by Irene Martinez and Richard Lundmark (April and November 2019)
- NMI course: Advanced microscopy for life sciences in Örebro (14 November 2019)
- Imaris workshop (21 November 2019)
- ITC Course (26 November 2019)

Publications

Publication statistics: no publications/year 2019 (co-authored/acknowledged): **0/6**

Umeå Center for Electron Microscopy (UCEM)

Short Summary of the Facility and activities during 2019

Umeå Center for Electron Microscopy (UCEM) has established one of the best equipped and well-supported electron microscopy facilities in Sweden, a research infrastructure with a great international reputation as well as an increasing number of actively collaborating internal users. UCEM is an infrastructure hosting instruments, sample preparation labs and technical staff providing training and service for all directions of electron microscopy (EM) analyses. Instruments, staff, and projects are funded from different external and national sources, through the application by UCEM user groups and individual researchers and from Umeå university central research infrastructure funding as well as from strong research projects, centres and organizations. The aim is to gather excellent and unique EM expertise on the international top-level and make instruments and service accessible to researchers from all scientific fields; biology, medicine, chemistry and physics.

UCEM is a SciLifeLab cryo-EM node with close collaboration with the sister facility at Stockholm University (Solna). In May 2018 UCEM successfully started the national service, offering 50% of the Titan Krios time to national users. National projects apply for instrument time and support through the SciLifeLab cryo-EM portal and are evaluated by a national advisory board. In 2019, the SciLifeLab cryo-EM facility together with user groups from Swedish universities has written a “Behovsanmälan” to VR for a nationally distributed cryo-EM screening network, with the current Cryo-EM nodes as “hubs” and other universities having satellite user facilities with mid-level instrumentation for sample screening and image processing.

UCEM collaborates closely with BICU (Biochemical Imaging Centre Umeå) within NMI (National Microscopy Infrastructure), a VR-RFI project. NMI is a national network of imaging facilities at KTH/SciLifeLab (super-resolution fluorescence), SU (intravital imaging), GU (CCI), UU (image analysis) and UmU (correlative imaging at UCEM and BICU). In 2019, NMI applied and was granted continuation for four years of VR-RFI funding. NMI offers open access to all national academic research projects and joined EuroBioimaging in April 2019 to welcome international facility collaborations. Through the NMI collaboration UCEM and BICU have developed and established correlative light and electron microscopy (CLEM) imaging methods, and support researchers in applying innovative new methods enabling both for specific localization/labelling in a large sample and structural analyses at nm/Å resolution. In September 2019 NMI Umeå installed a new cryo stage fluorescence microscope for direct correlation with cryo-EM (Cryo-CLEM) after successfully applying for UmU MedFak infrastructure funding.

New for 2019 is a collaboration with EM facilities in Sweden through the NanoSPAM network. This new VR-RFI funded project has the aim to enable easier research infrastructure access for both academic and industrial research, and to work with questions concerning sample preparation, transport and access for both MAX IV, international beamlines and cryo-EM. UmU is the host of the VR project and further members are Chalmers, KI, Si.SE, LU and MAX IV.

Today UCEM hosts six electron microscopes (EMs) for different and partly complementary applications, e.g. scanning electron microscopy (SEM) for surface visualization and element analyses, transmission electron microscopy (TEM) for cellular morphology and gold-immunolabeling, cryo-EM for structural biology, tomography and 3D visualization of molecular complexes, microorganisms, cells and tissue using both TEM tomography and focused ion beam (FIB) SEM volume imaging. Additionally, our labs are equipped with a very broad range of sample preparation equipment, e.g. plunge freezing (vitrification for cryo-EM), high-pressure freezing, automated freeze substitution and cryo ultra-microtome sectioning. The most recent addition in terms of sample preparation is focused ion beam milling for cryo-lamella preparation for cryo-EM on complex biological samples. UCEM also hosts graphics computers for image analysis and 3D image processing and assist its users in using HPC2N for large scale image processing.

Equipment

Equipment owned by the infrastructure:

Electron microscopes:

- Jeol 1230 TEM, 80 kV, Tungsten filament, Gatan Orius CCD camera 4 M pix, single and penta grid holders
- Merlin field emission-SEM, In-lens SE, ET-SE, BSD, EsB, STEM, CCD, EDS detectors systems, operating at 20V to 30kV at room temperature and under cryo conditions

- Talos L120 TEM, LaB6 filament, Ceta CMOS 16 M pix, single -, tomography- and Gatan 626 cryo holders
- Scios DualBeam FIB-SEM, Rinity T1/T2, ET-SE, ICE, DBS, CCD detectors, May 2018 upgraded with Aquilos cryo-stage and cryo-transfer.
- Titan Krios 300 kV Field Emission Gun Cryo-TEM, Ceta CMOS 16 M pix detector, FalconIII 16 M pix direct electron detector, Gatan BioQuantum K2 16 M pix direct electron detector including energy filter, phase plate and cryo- autoloader.
- **Added 2019:** Zeiss Evo SEM, LaB6 filament, ET-SE, VPSE-G4, HDBSD, CCD, EDS, WDS, EBSD detector systems, operating at 200V to 30kV, at room temperature and up to 1500°C

EM sample preparation equipment:

- Critical Point Dryer Leica EM CPD300
- Sputter Coater Quorum Q150T-ES
- Cryo Ultra Microtome Leica EM UCF 7
- Cryo Ultra Microtome Leica / Reichart Ultracut FC S
- Ultra Microtome Leica / Reichart Ultracut S (two x)
- High Pressure Freezer Leica EM HPM 100
- Automatic freeze Substitution Leica EM AFS S6E
- Carbon Coater Leica EM ACE 200 Low Vacuum
- Glow discharge system PELCO easiGlow
- Vitrification / Plunge freezing system FEI Vitrobot
- Vitrification / Plunge freezing system Manual from EMBL
- Microwave for cell and tissue preparation PELCO BioWavePro+
- Glass knife maker Leica KMR3
- Fume hoods for EM sample preparation (x four)
- Dehydrated lab area for cryo sample preparation
- Stereo microscopes for dissection (x three), Leica and Zeiss

Equipment bought during 2019

- Leica Cryo CLEM DM6 FS microscope with THUNDER, a new Leica cryo stage fluorescence microscope for direct correlation with cryo-EM
- Upgraded sample preparation with new CLEM and copper tube systems for Leica HPM100 High pressure freezer, for correlative aiding sample holders and vitreous cryo sectioning.
- Ordered new storage and transport possibilities, with storage pucks for safer sample transport and collaboration with MAXIV beamlines for sample preparation.
- Titan KriosLN2 dewars was upgraded with digital readers, connected to the supervisor program Sentinel.
- A new pre-processing computer was integrated for the Cryo-EM data collection workflow
- Supermicro server 7049, with 4 GPUs, 12x16GB memory and 2 Intel Xeon SP Gold processors together with a 80TB staging NAS server

Equipment used (but not owned) by the infrastructure

Preparation equipment:

- Gatan PECS II Broad Ion Beam Miller (BIB)

Computer:

- Graphics workstation – Ronnie Berntsson: 256GB RAM, Xeon 2.1 Ghz x64, 3xNvidia GeForce GTX 1080, 9TB Hard drive. EM Programs installed: Scipion, IMOD, Relion, EMAN, Chimera, MotionCor2, CTFFIND4.

Equipment at common KBC infrastructures:

- KBC autoclave facilities
- KBC liquid nitrogen service
- Media infrastructure at the “Focus environment” for teaching and facility visits
- Physics workshop support
- Freeze during at UPSC

Service provided by the platform

Service and support are offered for all electron microscopy application “doable” on our current instruments and equipment. We have the ambition to be as complete as possible to serve a large community and to meet the demands from all research fields active in Umeå. We are happy to be part of new method development and to establish new EM methods arising from the international EM community.

Facility staff can provide project service, sample preparation and imaging and deliver images and analyses to the users. Alternatively, UCEM provides project support in the form of training; users can work with their projects at the facility, learn methods and instrument operation. Frequently used and highlights of EM methods are:

- Chemical fixation of cells and tissue
- Resin infiltration, different resins and staining alternatives
- Microwave assisted fixation and resin infiltration
- Cryo fixation, high pressure freezing
- Automatic freeze substitution, different resins and staining
- Ultra-microtome sectioning for EM and light microscopy
- Cryo sectioning
- Tokuyasu sectioning
- Gold immunolabeling
- Negative staining EM of microorganisms and protein complexes
- Correlative Light and Electron Microscopy (CLEM)
- Cryo fixation, plunge freezing, vitrification for cryo-EM
- Critical point drying for SEM
- Cryo lamella preparation for cryo tomography
- Cryo EM data collection as national service
- SEM element analyses
- Volume imaging and 3D reconstruction of cellular volumes, tomography, and FIB-SEM
- Intermediate server for image storage and IT support for data transfer
- Image analysis support on facility graphics computer workstations
- FIB assisted analyses of material
- Sample preparation for soft beam line analyses, specifically cryo preparation, for MAXIV – New VR project funding from 2019

Current UCEM staff

The UCEM staff are specialized in different applications and work closely together, during 2019 we have broadened the facility staff competence, so several staff members can support several methods and operate several instruments, the results are shorter waiting times and better support during vacation and teaching or other obligations. During 2019, employments have been moved to the Department of Chemistry, to aid HR administration and work environment questions.

Linda Sandblad	Facility Coordinator, SciLifeLab Cryo-EM Head of Facility, NMI Facility Director, MIMS team leader with 50% research and 50% facility management
Cheng Choo Lee (Nikki)	First research engineer 100% for SEM, FIB, TEM and material analyses
Sara Henriksson	First research engineer 100% for TEM, FIB, SEM, CLEM and sample preparation for life science
Agnieszka Ziolkowska	First research engineer 80% for TEM and sample preparation for life science
Gayathri Vegesna	First research engineer 100% for CLEM, TEM, SEM, BICU support NMI-financed position, employment at IMB (parental leave 2018-2019)
Michael Hall	First research engineers 100% for cryo-EM single particle analyses and tomography
Camilla Holmlund	First research engineer 100% for cryo-EM tomography, CLEM and BICU support. (Employment at Department of radiology)
Hussein Haggag	First research engineer 100% for IT and image analyses. (New employment at Chemistry from Jan 2002)
Thomas Heidler	First research engineer 50%, education coordinator and service support (“vikarie” 2018-2019)

Steering committee	
Lars-Anders Carlson	Assistant Professor (Steering board Chair and contact person), Dept of Medical Biochemistry and Biophysics, Wallenberg Centre for Molecular Medicine (WCMM)
Christoffer Boman	Associate Professor, Dept of Applied Physics and Electronics
Magnus Wolf-Watz	Associate Professor, Dept of Chemistry
Hannele Tuominen	Associate Professor, Umeå Plant Science Centre /Dept of Plant Physiology
Karl-Erik Magnusson	Professor, Dept of Clinical and Experimental Medicine, Linköping university
Kristian Riesbeck	Professor, Dept of Medical Microbiology, Lund university, Lund/Malmö

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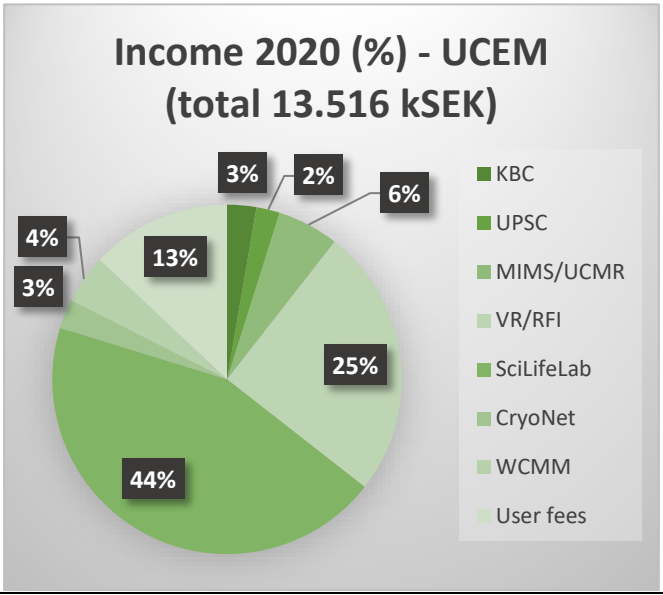
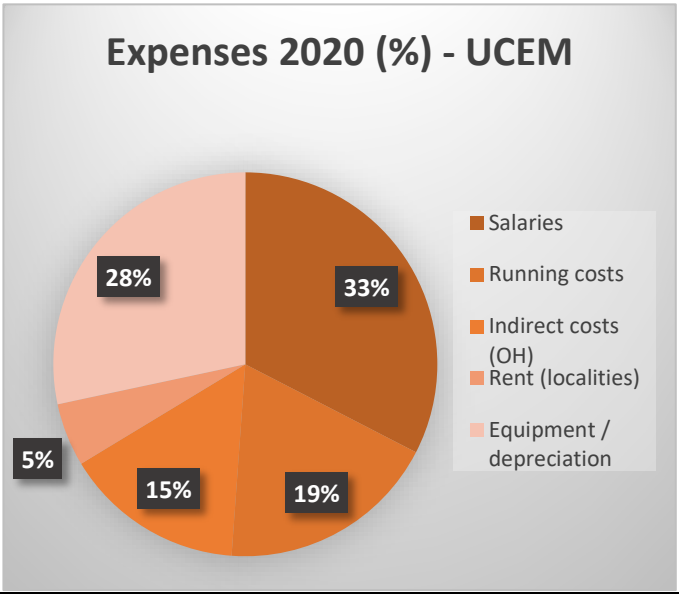
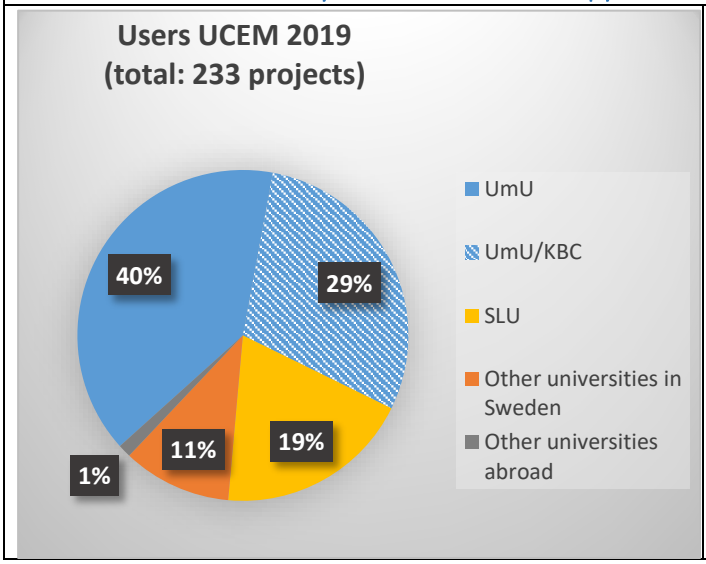
Homepage:
https://www.umu.se/en/research/infrastructure/umea-core-facility-for-electron-microscopy-ucem/

Budget - UCEM





Users of Umeå Core facility for Electron Microscopy



Teaching activities

Teaching activities organized by UCEM and contributed to by UCEM staff are organized on an annual basis.
Courses organized by UCEM:

- 19-21 February 2019: "Basic course in Electron Microscopy". The course is always over-subscribed and a selection of applications with the best motivation is applied. Or aim is to educate PhD student and postdoc users interested in EM, so they understand how electron microscopy is useful in research, have the knowledge to choose appropriate methods for their projects and get the first hands on contact with instruments.
- 26-28 March 2019: "Cryo-electron tomography 3D reconstruction course" Lectures and computation practical with international teachers and SciLifeLab support.
- 6-10 May 2019: "TEM sample preparation", a one-week full time course on sample preparation, lab work including fixation methods, resin embedding, ultramicrotome sectioning and Focused Ion Beam (FIB)-SEM
- 3-5 June 2019: SciLifeLab "Cryo-Electron Microscopy sample preparation and data collection course". Joint SciLifeLab course, lectures and practical sessions with international teachers and participants.
- 17-19 September 2019: "Basic course in Electron Microscopy". Offered second time during 2019, see above.
- 23-28 September 2019. SciLifeLab course "Cryo-EM single particle reconstruction" organized by Stockholm Cryo-EM lab (MH, CH)
- 14 November 2019, Advanced microscopy for life sciences in Örebro (NMI course, LS, SH).

We also offer individual training on all microscopes on request and demand, as well as assistance in sample preparation techniques in our lab.
Contribution to UmU undergraduate teaching:

- 26 Feb – 1 Mars 2019: Four lectures for the course: Molecular Genetics, 15hp; "Protein localization" and "Microscopy techniques" at Molbiol (LS, GV)
- 11 April 2019: Three lectures for the course: Structure biology 7,5hp; "Electron microscopy" and lab demo, at Molbiol (LS, MH)
- 18 November 2019: Two lectures and facility tour for the course "Protein structure and function" with the title "Electron microscopy methods", at Chemistry (LS, MH)
- 22 November 2019: Two lectures and facility tour for the course "Biomaterial och bioenergy" with the title "EM methods for cell wall analyses", at UPSC (LS)
- 9-11th Dec, Toolbox course, Chemistry, SEM lecture and demonstration (NL)

Outreach activities during the past year:

- 22 and 29 Jan 2019: GE health care day, presentation at GE factory in Umeå and GE manager visit at UCEM
- Jan-April 2019: Exam project work with high school student, Midgårdsskolan, half day every week.
- 2 May 2019: Jury member for high school Science project examination at Dragonskolan.
- 27 Sep 2019: ForskarFredag, microscopy activities and EM lab tours and demo.
- 3 Oct 2019: School visit from Germany and Minervaskolan, facility tour
- 10 Oct 2019: School visit Tegskolan, facility tour

Other activities 2019

- 2019 Design and development of new facility homepages at KBC (HH)
- 7th Feb 2019, Facility planning day and lunch for UCEM staff and steering group
- Demo of cryo CLEM systems at Leica in Vienna and Zeiss in Oberkochen (LS, GV, CH)
- 27-28 March 2019: HILFE, Helsinki, poster presentation (LS)
- Facility exchange; Cindi Schwartz from EM facility at NIH Hamilton, Montana worked at UCEM 25th March to 2 April
- 9 April 2019: 1st NanoSPAM meeting at MAXIV in Lund for members organized by UCEM, LS, MH, NL)
- Facility exchange; Barbara Huebener and Sara Sandin form NTU Singapore, Barbra worked at UCEM 6 weeks during May-June 2019, Sara presented current research at an ISB seminar
- 10-14 June 2019 Oral and poster presentations at SCANDEM Gothenburg (SH, NL)

- 26-27 Aug 2019, Poster presentation, "Dynamics of Life" at Djurönäset (LS, MH, TH)
- 30 Sep to 1 Oct 2019 SciLifeLab Days. Oral and poster presentations and group discussions at Djurönäset (LS, NL, AZ)
- 8-10 Oct 2019: CryoNET staff and international network meeting (LS)
- 18 Oct 2019: Oral presentation at EMBL Alumni day in Gothenburg (LS)
- 5-6 Nov 2019: KBC Days, Poster presentation, facility show and facility tour
- 15 Nov 2019: Attending PReSTO Cryo-EM hands-on meeting in Linköping (MH)
- 11 Dec 2019: VR hearing on FRI funding for NanoSPAM (LS)
- 12 Dec 2019: Oral presentation and facility update at Cryo-EM user meeting in Stockholm (MH, TH, LS)

Listed are physical meetings, we have contributed to many more networking meetings over Skype/video link during the last year. Especially engagement in SciLifeLab organization.

Publications

Publication statistics: no publications/year during 2019 (until 2019-11-25) (co-authored/acknowledged): **4/15**

Nuclear Magnetic Resonance (NMR) KBC Core Facility

Short Summary of the Facility

The KBC Core Facility NMR provides access to one of the most powerful liquid and solid-state NMR infrastructures in the Nordic countries and expertise for all researchers in the KBC and Campus environment. This infrastructure is part of the national infrastructure "NMR for Life" (www.nmrforlife.se), funded by KAW and ScilifeLab and operated by the Swedish NMR Centre at the University of Gothenburg and Umeå University. As part of "NMR for Life", the infrastructure grants access to academic and industrial researchers across Sweden.

The facility serves large user groups (often located at KBC) from UMU, SLU and companies, as well as national and international users. Local users span a remarkably wide range of fields, such as materials science, chemical biology and organic synthesis, structural biology, plant and environmental sciences, biogeochemistry and medical metabolomics. Local researchers profit strongly from the facility's status as national infrastructure and collaboration with the Swedish Metabolomics Centre (SMC) and the different structural biology facilities and expertise ("Integrated Structure Biology") at KBC. Fragment-based screening is also offered as national support for CBCS/LCBU, including comprehensive substance libraries.

Summary of activities 2019

In 2019 until November, the usage time of most machines is around 80%. Around 38 PIs have used the facility, with 29 of them representing research groups of the UmU campus (UmU and SLU), with over 30 publications directly generated out of NMR. The external PIs covered most major Swedish Universities, FOI and industry. These PIs were running a broad range of projects from routine analysis for synthesis to complex structural biology and metabolic flux projects.
The service was ranging from basic NMR support (mainly to the synthetic chemists and NMR research groups at the chemistry department) to advanced service (support in both NMR acquisition and analysis) for several KBC departments (e.g. Chemistry, UPSC, EMG and Physics) and other users at the campus (e.g. clinical metabolomics projects together with the hospital). The KBC core facility also has collaborative projects with SLU in the areas of ecology, environmental sciences, and plant physiology. In addition, there are numerous local and national projects as part of the NMRforLife and ScilifeLab.
Further activities: NMR platform employees/leaders participated at national and international conferences (focus on metabolomics with a recent symposium at GU 26th Nov, NMR development and solid-state NMR methods) (Euromar, ICMRBS, Alpine solid-state NMR) participation of UMU NMR employees at Scilifelab facility meetings in Stockholm and KAW NMRforLife work meeting with the NMR centre in Göteborg. Teaching activities at the local level (ca. 3 full-time weeks) for KBC master students (and a Ph.D. student from SLU).

Equipment

The NMR infrastructure equipment consists of five spectrometers with distinct specialities at different magnetic fields, a field cycling relaxometer and certain sample preparation tools including a pipetting robot and ball mills. All spectrometers are equipped with sample changers for automatic handling of standardized routine or screening type experiments.

The 850 MHz instrument, one of the highest available field in Sweden, is used for biomolecular NMR e.g. protein structure and dynamics, in both the liquid and solid-state. This instrument is also the most sensitive in the infrastructure, enabling sample concentrations on the low micromolar scale for 1H detection. Furthermore, it has specialized equipment for deuterium isotope profiling at natural abundance enabling sensitive 2H fluxomics.

The 600 MHz instrument has an advanced samples changer that can handle more than 500 cooled liquid samples. This spectrometer is thus ideal for NMR metabolomics and fragment-based screening but is also used e.g. for plant

cell wall analysis and biomolecular NMR. Furthermore, it is equipped for sensitive heteronucleus detection (^{7}Li, ^{13}C, ^{19}F, ^{31}P, ^{23}Na etc.), enabling more specialized applications including phospholipid analysis or diffusion in ionic liquids, still this feature is also very useful in sensitive routine analysis of small molecules.

The 500 MHz spectrometer is used for solid-state NMR on e.g. lignocellulosic material and bio- / model-membranes, but also more general materials science including minerals. Furthermore, this spectrometer is equipped with a solid-state MAS NMR sample changer and detection equipment enabling metabolomics on intact tissue samples.

The 400 MHz spectrometer is used mainly for automated routine analysis of small organic molecules in the liquid state and typically runs about 9,000 experiments of this type per year. However, the sample changer on this instrument is more than 15 years old and will need to be replaced soon to keep a reliable throughput. Moreover, this spectrometer is very suitable for 19F NMR and can also be used for quantitative 13C NMR.

The 360 MHz spectrometer is of an older type than the other spectrometers and nowadays mainly used in courses. The other spectrometers are of the Bruker Avance III & III HD generation with some interchangeable parts thus simplifying the complex task of maintaining the infrastructure.

Finally, **the field cycling (10 kHz – 40MHz) NMR relaxometer** needs to be mentioned. It can be used to study dynamic properties of the solvent in complex mixtures e.g. to study reorientation dynamics and chemical exchange at hydrated surfaces of e.g. cellulose or modified silica.

New equipment 2019:
A modern sample changer was installed on the 400 MHz instrument for high-throughput capabilities for routine analysis of small molecule synthesis.

List of equipment used (but not owned) by the infrastructure:
Users use various local equipment for sample preparation

Service provided by the platform

The NMR core facility offers for KBC, Campus /UMU/SLU) and nation-wide liquid and solid-state NMR access (up to 850 MHz) in most areas ranging from life sciences and medicine, materials and environment to green chemistry/biology etc. In general, we provide equipment for all routine NMR and expert assistance for complex NMR (as main part or as support) and for users who are less proficient in NMR.
Advanced support of the entire research process can be provided, including bioinformatics data analysis support (through NBIS). Through collaboration with the Swedish Metabolomics Centre, we offer combined NMR- and MS-based metabolomics. The NMR Core facility is a crucial support for structural biology projects associated with the "Integrated structural biology" initiative at UMU. Fragment-based screening is also offered as national support for CBCS/LCBU, including comprehensive substance libraries.
The platform offers support and expertise in the following areas:

- Metabolomics
  - Urine, blood serum and CSF analysis
  - Tissue samples (HR-MAS)
  - Metabolite identification/quantification and multivariate data analysis
- Plant science and Biogeochemistry
  - Cellulose (crystallinity, degree of substitution)
  - Cell-wall characterization (1H-13C HSQC, CP-MAS)
  - Soil chemistry & carbon cycling
  - Bio isotopomer tracking
  - Phosphorus profiling of soil samples and of archaeological sites
- Chemical Biology

- Protein-ligand interactions
  - Fragment-based screening (with commercial or user-supplied libraries)
  - Structure determination of small organic molecules
- Protein structure and dynamics
  - Structure of soluble proteins
  - Structure of membrane proteins/biological membranes
  - Structure insoluble protein aggregates e.g. fibrils
  - Enzyme kinetics, protein dynamics
- Material chemistry
  - Fullerenes
  - Graphite oxide
  - Separation matrices

Personnel

Gerhard Gröbner	Platform Director, Professor, Chemistry
Jürgen Schleucher	Platform Director, Professor, Medical Biochemistry/Biophysics
Mattias Hedenström	PhD, Service, Department of Chemistry
Tobias Sparrman	PhD, Maintenance, solid state NMR Department of Chemistry
Ilona Dudka	PhD, 50/75% SciLifeLab: focus on solid NMR/MS metabolomics: intact biopsies
Joao Figueira	PhD, SciLifeLab: focus on liquid NMR: medicine/environmental science

Steering committee

Bernt Eric Uhlin	Professor, Dept of Molecular Biology
Fredrik Almqvist	Professor, Dept of Chemistry
Pernilla Wikström	Researcher, Dept of Medical Biosciences
Vacant	
Vacant	
Jürgen Schleucher	Professor, Dept of Medical Biochemistry and Biophysics
Gerhard Gröbner	Professor, Dept of Chemistry

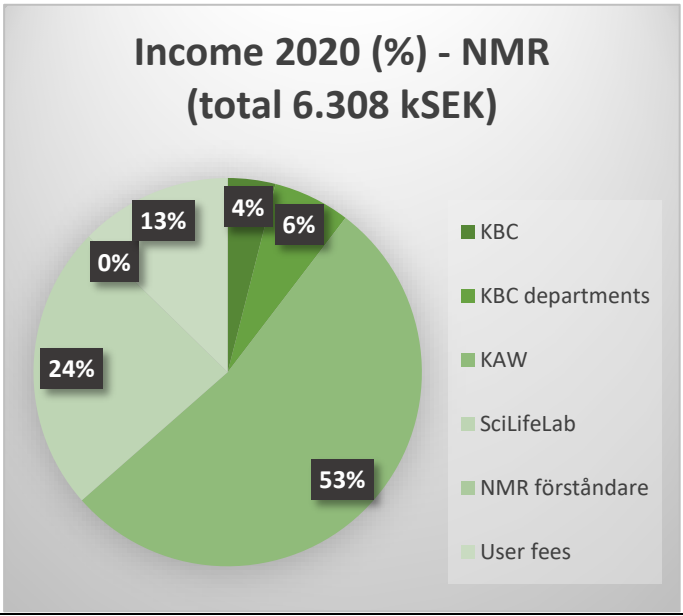
Comment: as part of NMRforLife and SciLifelab: external steering committee via GU (Prof. Göran Karlsson at NMR centre is the main responsible for these two NMR infrastructures.)

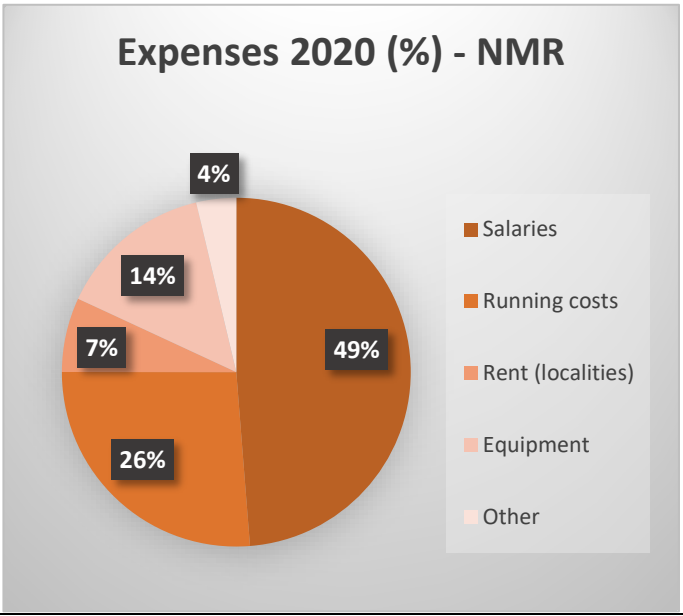
Contact information

Nuclear Magnetic Resonance (NMR), KBC building - 1st floor, Linnaeusväg 10
90736 Umeå

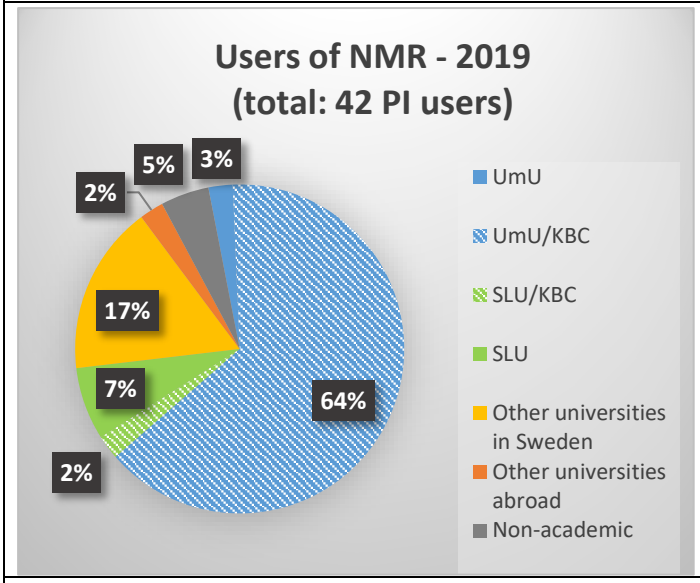
Homepage:
https://www.umu.se/en/research/infrastructure/nmr/
www.nmrforlife.se

Budget - NMR





Users of the KBC NMR Core Facility



Teaching activities

Based on the 3 NMR modules (developed for the KBC graduate schools) basic NMR, advanced NMR and applications were taught for Master students (and individual) PhD. students.
3 weeks of full-time NMR modules in total during 2019:

- Autumn (two occasions)

Personnel from the Swedish Defence agency (FOI) get also hands-on support.
The platform is regularly involved in site visits of school classes and has been represented in local events such as KBC days, MIMS days and KBC based conferences.
In addition, there is also hands-on training for individual researchers (PIs, postdocs, PhD. and master students) at the NMR spectrometers by platform personnel whenever necessary.

Future development

New equipment 2020:

- Ultra-fast solid-state MAS NMR Probe: in 2020 Q1, a unique (for Sweden), 0.7 mm ultrafast (>100kHz) solid-state MAS NMR probe will be installed in Umeå. This high spinning speed dramatically improves

resolution and sensitivity. It provides new analytical capabilities and structural and dynamic insights into more complex biological solids and materials. In addition, isolated natural macromolecules have now become accessible without the need for isotope labelling, and requiring only tiny sample volumes, even small intact biopsies/material systems can now be investigated. The technique equally benefits materials science, for studies of magnetic materials, energy-storage devices, heterogeneous systems such as cement, glass, photovoltaics, and solid-state lighting.

- Dynamic Nuclear Polarization (DNP) NMR: in 2020 Q2 (at our SNC partner site at GU together with AstraZeneca), the first DNP machine in the Nordic countries will be installed. DNP made a most dramatic impact on solid-state NMR development with dramatically improved sensitivity (factor 20-200), albeit at low temperatures (20-100 K). Samples not accessible to conventional NMR can now be studied at atomic resolution, ranging from 3D structure determination of surface/interface molecules or complex biomolecules to materials science and chemistry. DNP has revolutionized the study of insensitive nuclei in low concentrations in a wide range of systems, notably, molecules at surfaces and interfaces in inorganic nanosystems, dilute surface species employed as heterogeneous catalysts, and in characterizing the nano-to-micro sized domains of heterogeneous systems.

Proposed activities for 2020:

- Advanced NMR course for PhDs/Postdocs under the KBC umbrella
- A 1-day symposium for NMR/MS metabolomics (coordination with Kjell Grankvist (coordinator for Cancer biobanks at UMU; and SMC)
- A 1-day symposium for NMR supported fragment-based screening in drug design
- Inauguration of a solid-state 0.7 mm Ultra-fast (>100kHz) solid-state MAS NMR probe at 850 MHz, the first in Sweden (delivery Q1 2020).

Outreach planned for 2020:

Swedish NMR Centre (GU and UMU) organizes the Nordic NMR meeting (20-22 Oct. 2020).
Two symposia in Umeå (NMR/MS metabolomics and fragment-based drug screening).
Inauguration of 0.7 mm Ultra-highspeed MAS probe (first in Sweden) in Q1.
Establishing a KBC based NMR course for PhD students/Postdocs.
Participation in international NMR courses at the Swedish NMR Centre at GU.
All Umeå-based NMR groups present the facility and research at national and international conferences.

Publications

Publication statistics: no publications/year during 2019 (co-authored/acknowledged): **14/14**. Additionally, there are over 20 publications with pure instrument use (often routine NMR in chemical synthesis).

Chemical Biology Consortium Sweden (CBCS)

Short Summary of the Facility

The Chemical Biology Consortium Sweden (CBCS) Umeå (former LCBU) gives Swedish researchers the possibility to identify small molecules with biological effects that can be used to generate insights into complex biological processes or as starting points for drug development. This can be achieved by providing screening services of small drug-like molecules to a biological target, all the way from consultation and guidance to assay development, small-molecule high throughput screening, and follow-up studies, as well as in further development of their identified compounds through chemistry projects involving e.g. synthesis of new derivatives. Top-quality can be assured in all lines of the process by updated and experienced personnel with a scientific background in combination with continuously updated compound collections (in total over 200 000 compounds). The CBCS Umeå facilities today include a high-throughput screening lab, a clean cell lab, a bacterial lab, an organic chemistry lab, and offices. Screening projects in CBCS Umeå are labour-intensive and, although one employee can run more than one project at the same time, we cannot accept more than two full screening/chemistry projects/full-time employee and year. Furthermore, several small projects are constantly being performed (mainly with local users at UmU) to prepare for a full screen or as additional follow-up after a screen. Another important activity of CBCS is to maintain and service our instrument park (open for users at UmU as described below) and train new users. Finally, CBCS Umeå also gives two courses.

The successful projects performed by CBCS have direct applications to solve complex research problems, which has resulted in many high-quality research publications over the last years, also during 2019. Furthermore, the CBCS projects are, and have been, of tremendous importance for young researchers to start up their own research program and in the initiation of start-up companies.

The research infrastructure for chemical biology in Umeå has been operative since 2006, from 2009 it was called the Laboratories for Chemical Biology Umeå (LCBU). Since 2010 it is part of CBCS, Chemical Biology Consortium Sweden, together with a second node at KI. In 2012, CBCS became a national infrastructure integrated with a SciLifeLab platform.

Equipment

Description of equipment owned by CBCS Umeå

- Plate readers, Biotek Synergy H4 with Biostacker and Tecan 200
- High Content Screening Microscope – Thermo Scientific Array Scan VTI
- 2 Liquid handling robotics, Beckman Coulter NxP with 96- and 384-well head.
- 2 Microplate (96/384w) liquid dispensers, Matrix Wellmate and ThermoScientific Multidrop
- 2 Gilson 333/334, 322 Prep-Scale systems
- Nexera UHPLC-system connected to diode array detector (SPP M20A) and evaporated light scattering detector (Sedex 85)
- H-Cube (ThalesNano, Budapest, Hungary) continuous-flow hydrogenation system

New 2019: Funding for a new high-content screening microscope secured during 2019.

List of equipment used (but not owned) by CBCS Umeå

- Waters Acquity UPLC system connected to FLR detector, Waters 2996 DAD and Waters 486 Tunable Absorbance detector
- Agilent 1290 binary LC System connected to an Agilent 6230 Accurate-Mass TOF LC/MS
- Agilent 1260 binary LC System connected to an Single Quad LC/MS
- Rudolph Autopol IV automatic polarimeter
- Mettler Toledo UMT5 Comparator
- Biotage Isolera One Flash chromatograph
- 2 NMR Spectrometers, Bruker DRX-400 and Bruker DRX-600

Service provided by the platform

CBCS aims to help researchers to identify and develop bioactive small molecules through chemical library screening and follow-up chemistry developments. This can be of interest in basic research in many fields such as life science and plant science. To achieve this, CBCS Umeå offers many different types of services, from scientific collaborations

to instrument use and courses. The scientific collaborations are the core of CBCS. These can be in the form of a compound screening of our chemical libraries, assay development to prepare for a screen, or chemistry projects to improve or further develop identified bioactive compounds (e.g. for target identification, improved bioactivity, or to advance their use as research tools for example by introducing fluorescence).
To initiate these types of collaborations, an application has to be sent in, which is evaluated by an external independent project review committee (PRC), see figure above. The PRC assists in prioritizing the applications and the projects are given a rank. The most highly ranked projects are subsequently carried out by CBCS in collaboration with the PI. The PRC meets and ranks project applications twice a year.
Smaller projects (not more than 2 weeks work for a full-time employee) can be initiated without sending in an application. A typical small project can be e.g. technical assistance/advanced training for the use of our instrument park, a small screen of a chemical library where the use of our liquid handlers and plate readers are needed, or minor custom synthesis projects.
Since 2018, research groups have the possibility to apply for Assay Development projects, in addition to Screening and Chemistry projects. Assay Development projects were added because of an apparent need from the users to get assistance to develop assays suitable for screening of chemical libraries. In addition, we have also seen an increased interest in chemistry support post-screening, which likely is because the power of this support has spread and many users lack expertise or collaboration partners with organic chemistry knowledge.

Personnel

Stina Berglund Fick	PhD, Head of Facility, Department of Chemistry
Erik Chorell	Assistant Professor, Facility Director (from 2018), Department of Chemistry
Marcus Carlsson	PhD, Department of Chemistry
Anna Eriksson	PhD, Department of Chemistry
Weixing Qian	PhD, Department of Chemistry
Per-Anders Enqvist	(till 2017)
Mikael Elofsson	(Facility director till 2017)
Jonas Eriksson	(till 2016)
David Andersson (20%)	PhD, Department of Chemistry

Contact information
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Contact person:
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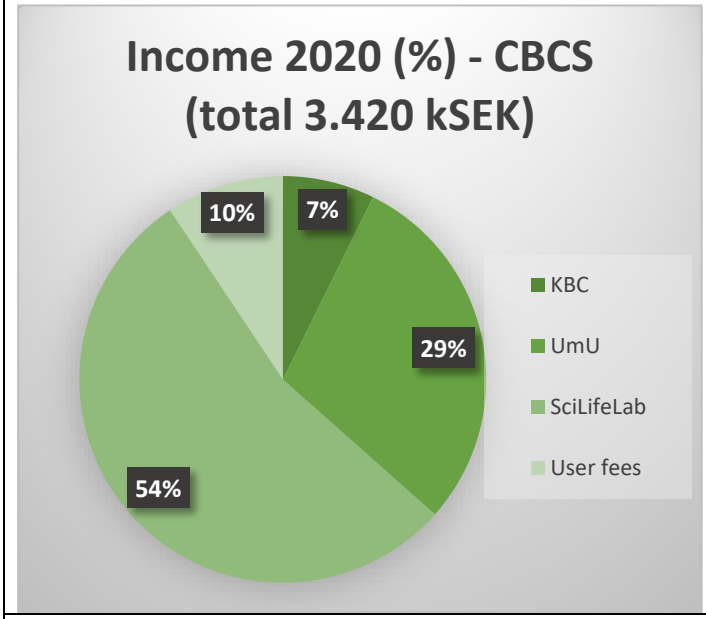
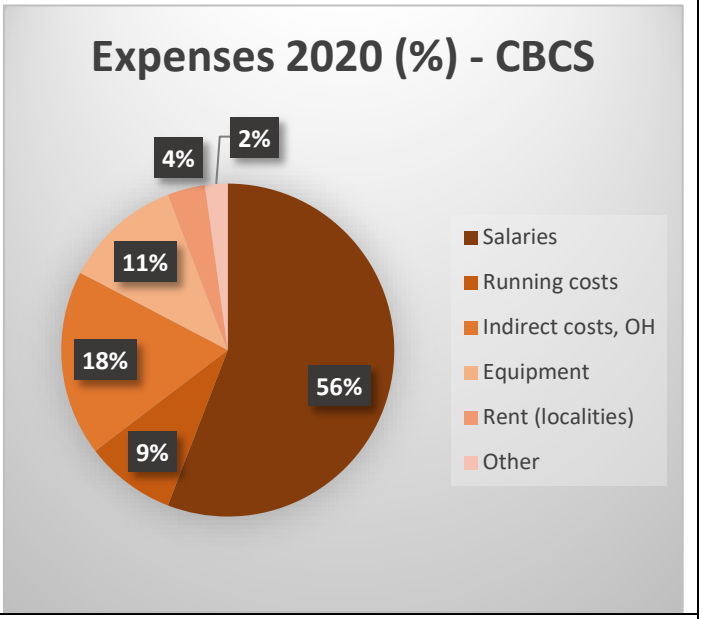
Homepage:
https://www.umu.se/en/research/infrastructure/cbcs/

Budget - CBCS

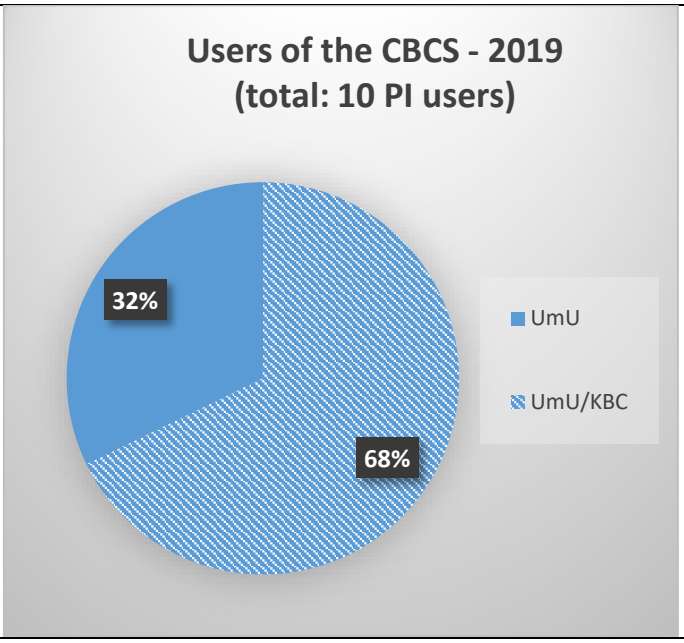




Users of the Chemical Biology Consortium Sweden (CBCS) Umeå

The projects performed by CBCS can be very labour-intensive (2 screening projects/full-time employee and year).

In addition, 10 projects from UmU were using CBCS Umeå Instrument park in 2019.



Teaching activities

CBCS aims to give two courses:

- A web-based introductory course (2 ECTS) to the field; “Introduction to High Throughput Screening”, that runs continuously over the year. The course has been running since 2013 participated by in total of 200 registered students (approx. 40 students/year).
- The practical course “Assay development in HTS” (2 ECTS) at the advanced level is given once every other year as a hands-on course for users aiming at starting up a project in collaboration with CBCS. The typical number of participants for this course is 8-12 students/occasion. This course was planned for 2019 but had to be postponed to 2020 because of a too high working load on our personnel and not enough interest. The next occasion is planned for 2020.

Publications

Publication statistics: no publications during 2019 (co-authored/acknowledged): **6/1**

Vibrational Spectroscopy Core Facility (ViSp)

Short Summary of the Facility

This uniquely equipped open access facility that provides Fourier transform infrared (FTIR) and Raman spectroscopy and microspectroscopy to detect and localise chemical changes in a broad range of samples. Spectral recording speed can be as high as milliseconds and spatial resolution is on the sub-micrometre level, allowing to follow rapid reactions and determine the chemical composition of subcellular components without external agents (dyes, labels, markers). Detectable concentrations are generally in the micromolar range, but augmented techniques are available to push detection limits well beyond these (at extreme cases allowing single molecules to be detected). The techniques are inexpensive, versatile and non-destructive, providing a holistic overview of the entire chemical composition of the sample simultaneously, for solids, liquids and gases alike. In addition to chemical compositional changes, structural/conformational (e.g. alpha-helix/beta-sheet structures of proteins) and organisational (e.g. crystallinity levels, the orientation of polymers, etc.) changes can be detected/monitored and localised.
ViSp is a Core Facility at the Chemical Biological Centre (KBC) and is an UmU Research infrastructure. ViSp is spearheading the International Society for Plant Spectroscopy and is part of the Euro-Bioimaging Network via their Swedish node.

Summary of activities 2019

Conferences:

1. 2nd International Plant Spectroscopy Conference (IPSC), Berlin, Germany, March 25-29. (invited keynote lecture, session chair, co-organiser)
2. European Conference on the Spectroscopy of Biologial Materials (ECSBM), Dublin, Ireland, August 19-22. (oral presentation)
3. Oorgandagarna, Umeå, Sweden, June 12-14 (poster presentation)

Panels, seminars, reach-out:

1. Environmental and Biogeochemistry seminar series, Umeå University (oral presentation)
2. KBC Days, Umeå University (poster presentation, panel discussion, infrastructure tour)
3. Wallenberg Wood Science Centre Summer School (infrastructure tour)

New larger scale research projects:

1. On site, non-destructive chemical compositional analysis of natural growing trees. Together with Johan Westing (Skogforsk) and Rosario Garcia Gil (SLU)
2. Raman spectroscopic assessment of pancreatic cancer. Together with Prof. Olof Lindahl (UmU, Department of Radiation Sciences)

PhD and Master Student supervision:

1. Max Hahn (main supervisor: Prof. Ulf Ahlgren, UCMM)
2. Michael Baumgärtner (main supervisor: Natuschka Lee, Umeå University)

Other activities in 2019:

1. Guest Editor for a Special Issue on Technical Advances in Frontiers in Plant Sciences
2. Steering Board member of the Vibrational Spectroscopy Section of the Swedish Chemical Society
3. Head of the International Society for Plant Spectroscopy

Equipment

- Bruker IFS 66 v/S vacuum bench FT-IR spectrometer, with accessories (including oil and dry pumps, different detectors and sampling units)
- Bruker Vertex 80v vacuum bench FT-IR spectrometer, with accessories (including a dry pump, different detectors and sampling units)
- Bruker Equinox 55 FT-IR spectrometer with Hyperion 3000 microscopy unit, with accessories (including ATR and grazing angle microscopy accessories, single element and FPA detectors and various sampling units)
- Bruker Tensor 27 FT-IR spectrometer with Hyperion 3000 microscopy unit, with accessories (including ATR and grazing angle microscopy accessories, single element and FPA detectors and various sampling units)
- Bruker BRAVO portable Raman spectrometer, including docking station and various sampling heads

- Renishaw inVia confocal Raman microscope, including 5 different laser lines (458, 488, 514, 633, 785 nm), polarizers, different magnification lenses (normal, long working distance, water and oil immersive, 5x – 100x) and fiber optic probe
- Additional auxiliary components: Computers controlling each instrument, a standalone desktop computer for users to process their data and backup storage; a Large screen TV for demonstration purposes, a peristaltic pump, an autotitrator, a sterile bench, a refrigerator and a freezer for storing samples and consumables

New 2019: Funding has been secured to purchase a new, state-of-the-art Raman microscope in 2019

Equipment used (but not owned) by the infrastructure

The equipment of the Cell Wall Analytical Facility was used in a project to complement the work done by ViSp, and paid for using the regular user fees. The interactive focus environment of KBC has been used on several occasions, including teaching and conferences.

Service provided by the platform

ViSp holds key competence and world-leading expertise in developing instrumentation, optimising measurement and cutting-edge data analysis methods in a wide range of scientific disciplines. Due to the exceptional versatility of the techniques, example projects cover a wide range of scientific disciplines and applications, from materials sciences (nanotechnology, semiconductors) to plant sciences (high-throughput chemotyping/screening, investigating the effects of gene manipulations or environmental factors), from chemistry (absorption on mineral surfaces, real-time, in situ monitoring of reactions, protein conformational changes) to medicine (assessing tissue compositional changes under various pathological conditions, diagnosing and monitoring disease onset and progression, drug targeting and molecular mechanistic studies).

The services available at ViSp range from experimental design to perform measurements and analysing spectral data. Consultation and publication work (e.g. writing manuscripts, correspondence with editors/reviewers, etc.) are free of charge. Method development work is prioritised and is charged by instrument fees only, provided that the developed method benefits a broad range of users. Method development confined to individual projects is still prioritised but charged at normal rates.

Personnel

András Gorzsás	PhD, Platform Manager, Department of Chemistry, Umeå University,

Steering committee

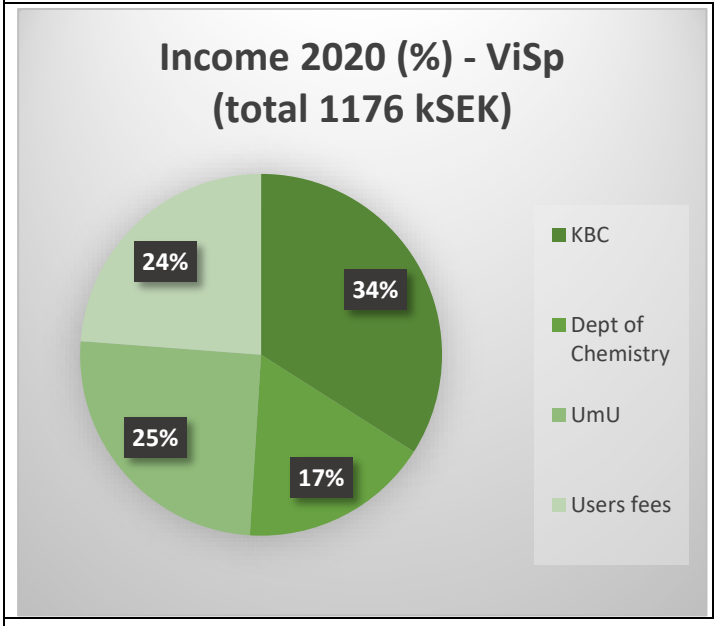
Madeleine Ramstedt	Associate Professor, Dept. of Chemistry, UmU
Thomas Moritz	Professor, Dept. of Forest Genetics and Plant Physiology, SLU, UPSC
Thomas Wågberg	Professor, Dept. of Physics, UmU
Ulf Ahlgren	Professor, Umeå Centre for Molecular Medicine
National Advisory Board	
Björn Sundberg	Stora Enso
Per Persson	Center for Environmental and Climate Research, Lund University

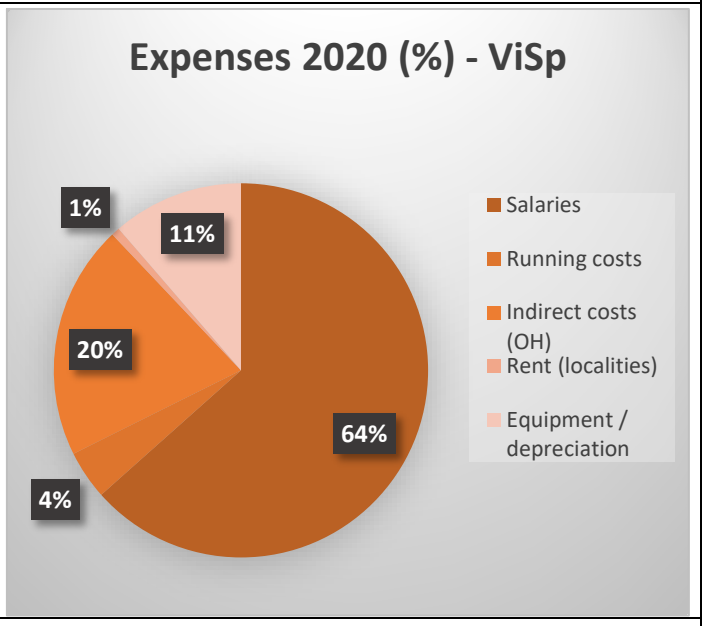
Contact information

Chemistry Department, B building, floor 1 (microspectroscopy) and floor 6 (spectroscopy)
Linnaeus väg 10,
SE-907 36 Umeå

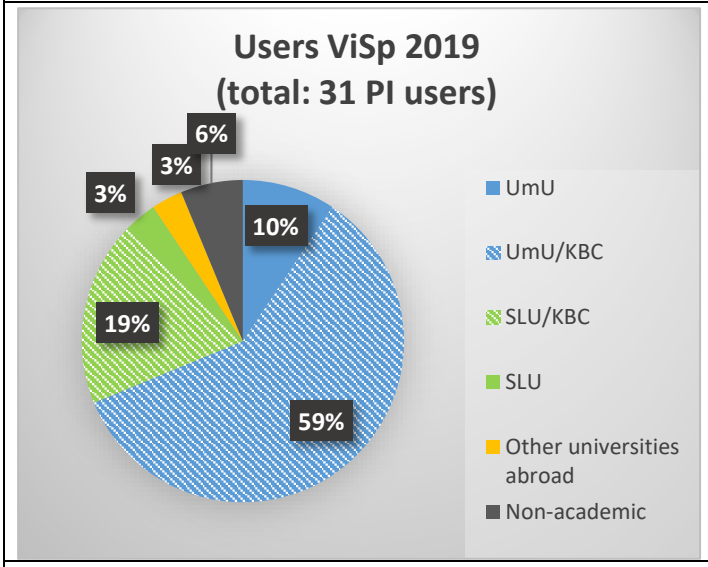
Homepage:
https://www.umu.se/en/research/infrastructure/visp/

Budget - ViSp





Users of Vibrational Spectroscopy Core Facility



Teaching activities

ViSp is regularly involved in several courses at Umeå University and SLU (and even abroad, albeit less frequently). In addition, ViSp provides its own one-week-long user license course, twice a year. It frequently attracts users from beyond Umeå, often international participants as well. In fact, some instrument manufacturers recommend their customers to take this course instead of providing their training. Other, educational activities include participation in e.g. Lärarnas Fortbildning and Forskarfredag, but these are not listed here.

Teaching activities 2019:

Courses at Umeå University and SLU (lectures, labs, tutorials):

1. Natural Products Chemistry (responsible: Leif Jönsson, Department of Chemistry, UmU)
2. Advanced Experimental Tools in Chemistry (responsible: Erik Björn, Department of Chemistry, UmU)
3. Molecular Spectroscopy (responsible: Thomas Wågberg, Department of Physics, UmU)
4. Genetics and biotechnology in forest production systems (responsible: Rosario Garcia Gil, Department of Forest Genetics and Plant Physiology, SLU)
5. Energy technology (responsible: Magnus Andersson, Department of Chemistry, UmU)
6. Vibrational Spectroscopy User License Course (responsible: András Gorzsás, Department of Chemistry, UmU), twice a year

Courses outside Umeå (invited lectures):

7. PhD course on Plant Cell Walls, University of Helsinki and Luke, Finland (responsible: Anna Kärkönen, Luke, Finland)

Course development:

8. New spectroscopy focused course at the Department of Chemistry, scheduled for fall 2020 (responsible: André Ohlin, Department of Chemistry, UmU)

Publications

Publication statistics: no publications during 2019 (co-authored/acknowledged): **5/18**

Protein Expertise Platform (PEP)

Short Summary of the Facility

The Protein Expertise Platform, PEP, provides researchers/customers with much appreciated expert advice and advanced services in questions of bioinformatics, cloning, bacterial growth optimization and protein production. The PEP keeps a variety of stock solutions and sells many different ready to use vectors, bacterial strains, competent cells, media, antibiotics and more.

Equipment

Equipment owned by PEP:

- Tabletop shaker incubator N-BIOTEK NB-205 (for 15 mL, 50 mL tubes)
- Centrifuge Beckman Avanti J-26 XP
- Centrifuge Eppendorf 5415R (tabletop)
- QSONICA Sonicator
- GE HealthCare Äkta pure 25M (large scale protein purification, delivered Sept. 2018)
- GE HealthCare Äkta start (small scale protein purification)
- Eppendorf Thermomixer Comfort (shaker incubator for 1.5 mL Eppendorf tubes)
- PCR machine "BIOER"
- Ice machine

Equipment used (but not owned) by PEP:

- Termaks 37°C incubator
- Müve cooled incubator ES110
- Shaker incubator Kühner Climo Shaker ISF-1-V (two shakers, for Erlenmeyer flasks up to 2L)
- Shaker incubator Kühner Lab-Therm LT-X (incubator for smaller flasks)
- Shaker incubator HT Infors Unitron (or Erlenmeyer flasks up to 2L)
- Centrifuge Sorvall RC 12 BP (2L bottles)
- Centrifuge Beckman Coulter Optima L-100K Ultracentrifuge
- Centrifuge Beckman Coulter Allegra X-15R (two centrifuges for 15 mL, 50 mL tubes and plates)
- GE HealthCare Äkta FPLC
- GE HealthCare Äkta purifier
- Beckman Coulter UV/Vis spectrophotometer DU 730
- DeNOVIX DS-11 spectrophotometer (Nano-drop)
- Alpha Innotech Imager HP (gel imager)
- Aculab Antilon scale (high accuracy scale)
- Millipore Synergy UV (deionized H2O)
- Miele Professional (dish washing machine)
- Thermo Scientific -80°C freezer
- Arpege 70 (Liquid N2 large sample storage dewar)
- Mass-spectrometer Agilent
- MALVERN Zetasizer Nano (dynamic light scattering, DLS)

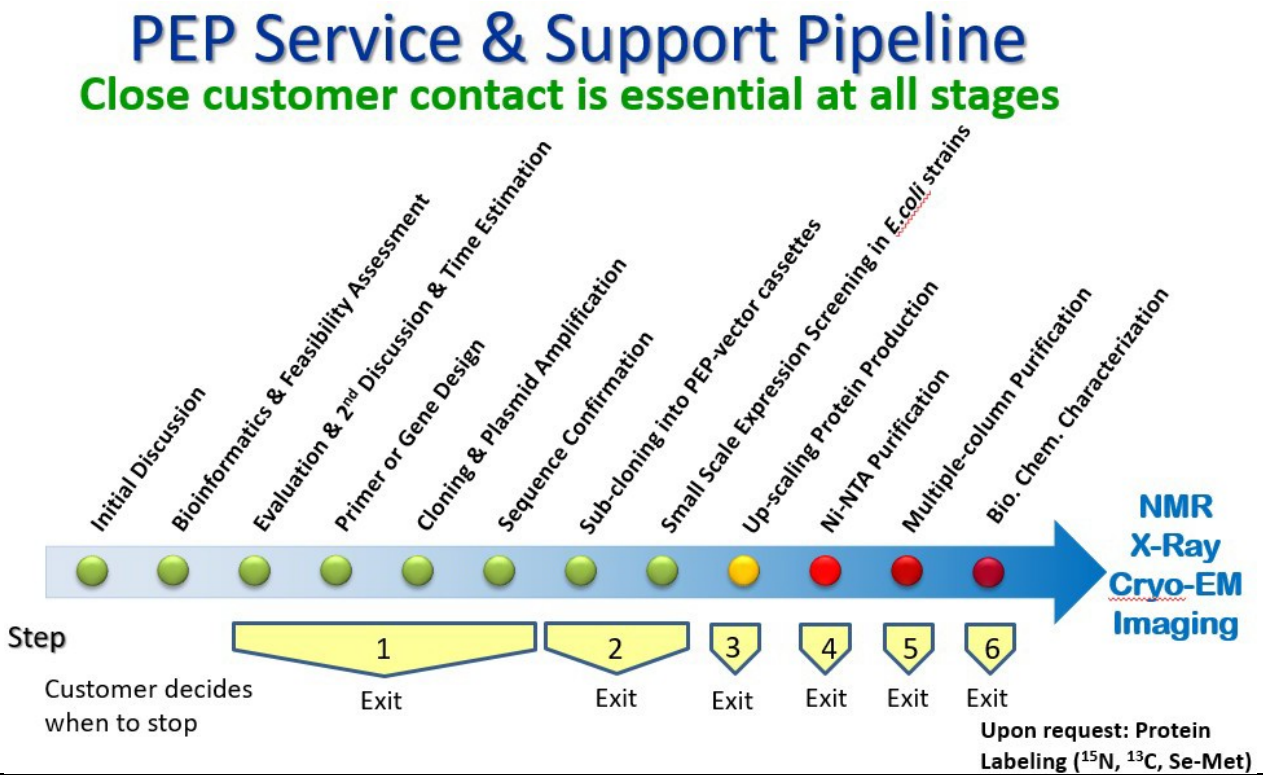
New: in 2018, the Faculty of Science and Technology granted support for the purchase of an Äkta pure 25M protein purification system (GE HealthCare).

Service provided by the platform

- **Materials**: The PEP provides necessary materials for cloning and protein expression. (See PEP home page) Project feasibility check and planning: a project usually starts with an in-depth consultation of the researcher/customer.
- **Bioinformatics analysis**: sequence analysis & alignments, codon optimization, secondary structure predictions, construct design, database searches, comparative 3D structural modelling, etc.
- **Molecular cloning**: standard and advanced cloning and mutagenesis, ligations, sub-cloning, transformations and plasmid preparations.

- **Protein expression screening (small scale)**: protein expression and solubility screening to quickly test several different bacterial host cells, various growth conditions (temp., media, OD at harvest, etc.) and protein fusion partners that lead to enhanced expression levels and/or solubility.
- **Protein expression (scale-up)**: Successful conditions are transferred to larger culture volumes for scaled-up protein production.
- **Protein purification**: 6xHis-tagged proteins purified with single or double step Ni-NTA matrix (incl. cleavage of the 6xHis-tag with a protease such as TEV, SUMO, 3C, Caspase 7) followed by Size Exclusion Chromatography (SEC).
- **Protein characterization**: UV based protein concentration determinations, CD measurements, dynamic light scattering, full-length protein mass-spectrometry and also possible NMR spectroscopy.

New 2019: protein expression in Yeast cells was added to the list of PEP services.



Method development

Many of PEPs projects required the development of new protein expression protocols, which means solving challenging and time-consuming optimization and large-scale purification problems. The PEP continuously develops new methods and protocols for the production difficult to express proteins, such as very large proteins, large protein complexes for EM studies, anaerobic production of easily oxidized proteins (e.g. iron-sulphur cluster containing proteins) and proteins that are very toxic to the *E. coli* host cells. During the last three years, PEP has developed complex cloning strategies and methods for the expression of highly toxic bacterial toxins and anti-toxins.

In 2019, PEP has included Yeast protein expression to the list of services. Several research groups at the Dept. of Chemistry and the KBC develop methods that have the potential to be transferred to the PEP and could be provided by PEP as a service. For example protein expression in plant cell suspensions, methods for incorporating non-native, or chemically modified amino acids into proteins, chemically modifying purified proteins e.g. with fluorescent probes or other markers, labelling proteins for spectroscopic (NMR: ^{13}C, ^{15}N) or diffraction experiments (X-ray: SeMet, or Neutron diffraction: deuteration).

Personnel

Uwe H. Sauer	Associate professor, Platform Coordinator
Mikael Lindberg	PhD, Platform Manager
Christin Grundström	Protein specialist (20%) (until November 27, 2019)

Steering committee	
Uwe H. Sauer	Associate professor, Platform Coordinator,
Stefan Björklund	Professor, Dept of Medical Biochemistry and Biophysics
Åsa Strand	Professor, Dept of Plant Physiology
Linda Sandblad	Dept of Chemistry
Richard Lundmark	Associate professor, IMB & MIMS
Niklas Arnberg	Professor, Dept. Clin. Microbiology & MIMS
Magnus Wolf-Watz	Associated professor, Dept of Chemistry

Contact information

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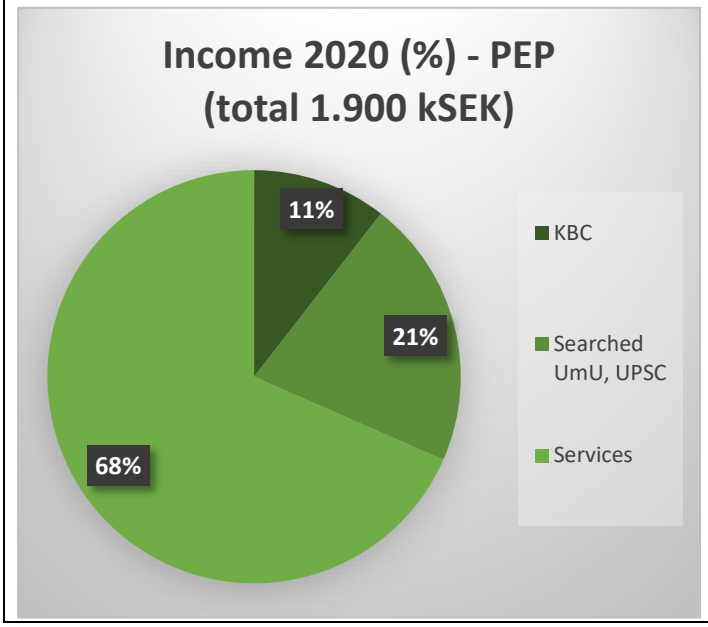
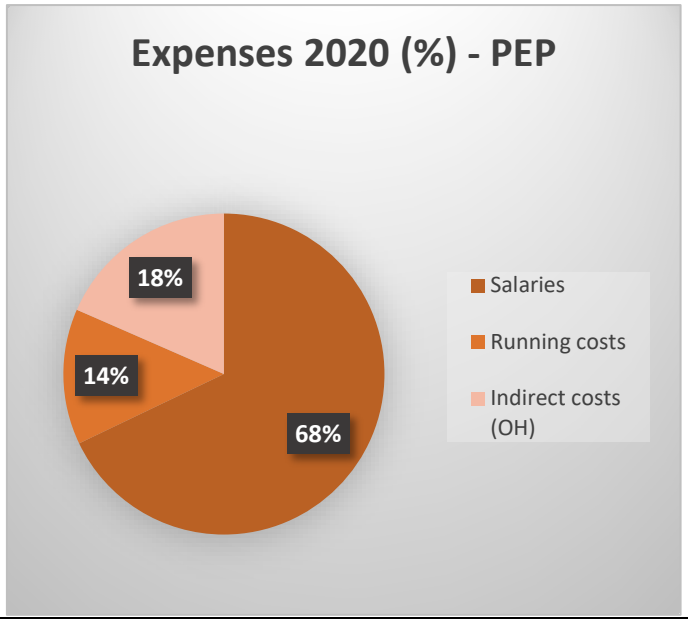
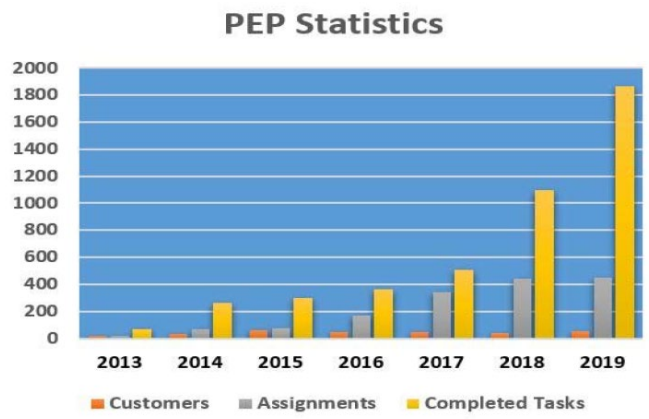
Homepage: https://www.umu.se/en/research/infrastructure/pep/

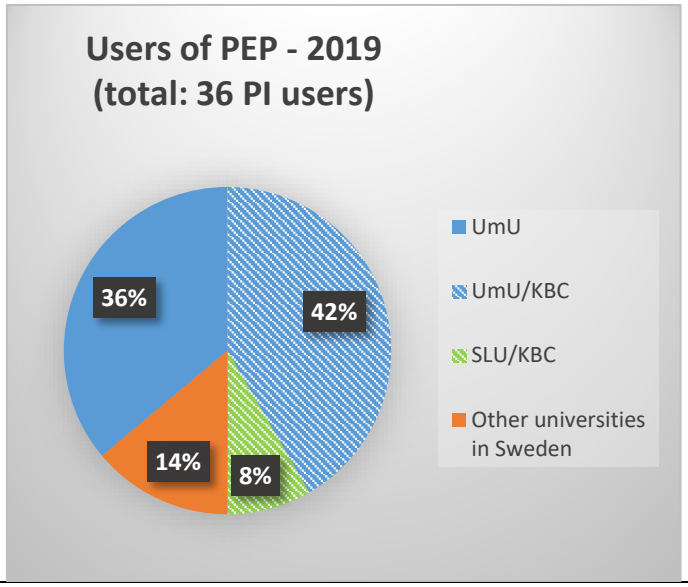
Budget - PEP





Users of Protein Expertise Platform





The PEP has strategically strengthened the life science research at Umeå University. The "PEP Statistics" figure reflects the increasing demand for PEP's services. During 2019 PEP served 51 customers and finished 1864 tasks. (Tasks include cloning/subcloning, mutagenesis, sequencing of results and sequence analysis, expression screens, upscaling, establishing purification protocols, and protein quality assessment.) The majority of tasks were requested from PI's belonging to Umeå University's two faculties and were distributed over 13 different departments/institutions/research centres. About 50% of the PI's came from the KBC environment. Outside UmU, the PEP had customers from 5 Swedish universities: SLU Umeå, Lunds Univ., Uppsala Univ., Göteborg/Sahlgrenska and Chalmers Univ. of Tech. The high demand for PEP services is proof of satisfied customers and the need for cloning and protein production services. The strength of PEP lays in the very experienced staff, a flexible approach and the ability to solve hard problems at all stages of a project. In addition, it is very important and appreciated to keep a close personal dialogue with the customers.

Teaching activities

PEP continues to co-organize the practical course on advanced methods in "Cloning, Protein Expression and Purification" (CPEP). The CPEP courses were initially financed through the UCMR & UPSC graduate schools. In 2014 the CPEP course was entirely financed by the PEP and since 2017 by funds provided by the Dept. of Chemistry and the KBC (each contributing 50 kSEK). In 2018 a CPEP course was organized (Feb. 28th to March 9th, 2018). More than 170 PhD-students and post-docs have successfully participated in the past CPEP courses. The interest in the CPEP courses is overwhelming with 2-3 times as many applicants as can be accepted. Therefore, the next CPEP course is planned to be given early in 2020 (Jan. 29th – Feb. 7th).
In addition to the CPEP courses, personnel from PEP has participated the "Protein Crystallization" and the "Basic Bioinformatics" graduate courses.

Future development

In case financial support for a new PEP employee can be secured: Protein expression in Eukaryotic expression system, such as Insect cells (Baculovirus infected cells), Plant cell suspensions and mammalian cell lines, in addition to existing *E. coli* and Yeast cells. Customers have requested these services, however, although PEP or associated researchers have the expertise, PEP does not have the personnel to establish them. Each of these expression systems will likely require a half time or better full-time expert. During 2020 PEP will focus on securing further funding, especially from different departments of Umeå University (both from the Tek. Nat. and Med. fak.) and SLU in order to expand its services.

Publications

Publication statistics: publications during 2019 (co-authored/acknowledged): **2/7**
In addition, during 2019, PEP's services and materials were used to 1 PhD thesis.

NanoLab

Short Summary of the Facility

NanoLab comprises a wide variety of advanced fabrication and characterization tools. Some tools are located in a cleanroom and some are positioned in normal experimental labs for easier access. The cleanroom is classified as class 100 in rest and as class 1000 during operation, which corresponds to 10 000 times less airborne particles compared to a normal laboratory environment. In such an environment, it is possible to manufacture and study materials and devices with extremely high precision. Since its inception, the NanoLab infrastructure has been in continuous development. The current plans are to add two more pieces of equipment during 2020, which are projected to be of interest for several faculties at the university.

The facility has demonstrated to be invaluable for the University´s rapidly expanding research in the fields of biotechnology, sustainable energy, microelectronics, optics and photonics, and nanotechnology. Some specific focus areas include microfluidic devices for detection of Alzheimer and Parkinson disease using electrochemistry, nanocatalysts for fuel cells, solar-driven water splitting, and organic light-emitting devices and solar cells. It is also of obvious interest for scientists that are interested in, e.g., the fabrication, characterization and usage of thin films, materials that feature structures on the micrometre or sub-micrometre level, or the appropriate characterization of different surfaces. As such, its potential users encompass experimental researchers in a notably broad variety of fields in natural science and medicine. NanoLab is also represented during the KBC days and many other university activities.

Equipment

Equipment owned by the infrastructure:

- Mask aligner (Karl Süss Mask Aligner MJB3)
- Plasma processing system (Diener ATTO)
- Nanoimprinter (Obducat NIL 2.5)
- Thin-film deposition system (PVD75 thermal evaporator)
- Optical tensiometer (Attension Theta)
- X-ray diffractometer (PANalytical Xpert3 Powder)
- Optical microscopes (Olympus BX41, BX51, GX71)
- Spin coaters (SPIN150-NNP)
- Vacuum drying oven (BIOBASE)
- Ultrasonic cleaners
- Hotplates
- UV-curing box
- Analytical scale

Equipment used (but not owned) by the infrastructure:

- Fluorescence spectrometer LS45
- UV/VIS spectrometer Lambda 35
- UV/VIS/NIR spectrometer Lambda 1050+
- Dektak XT profilometer
- ORIEL Sol 3A
- Photonic Multichannel analyzer PMA-12
- NanoScope IV scanning probe microscope

Service provided by the platform

The NanoLab facility is open for everyone, provided that the user has been trained and approved for the equipment of interest. Technical assistance for new or non-trained users is available upon request. The high-quality cleanroom environment is further available for specific experiments designed by the users during a limited time. **During 2019**, new stamps for the nano-imprinter have been purchased (for a cost of >150 000 SEK) for improved utilization of the nano-imprinter, repairs and maintenances of key pieces of equipment have been performed (for 130 000 SEK), and the facility website has been modified and included to the KBC website.

Personnel

Roushdey Salh	PhD, The manager of NanoLab, Department of Physics (facility maintaining and equipment trainings)

Steering committee

Ludvig Edman	Chair, Professor, Department of Physics
Thomas Wågberg	Professor, Department of Physics
Magnus Andersson	Associate professor, Department of Physics
Linda Sandblad	PhD, Department of Chemistry

Christoffer Boman	Associate professor, Department of Applied Physics and Electronics (from 2017)

Contact information

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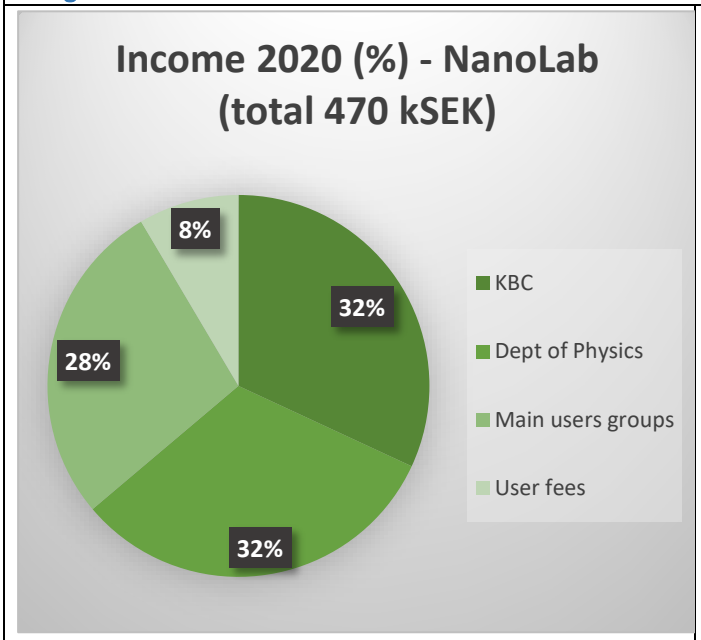
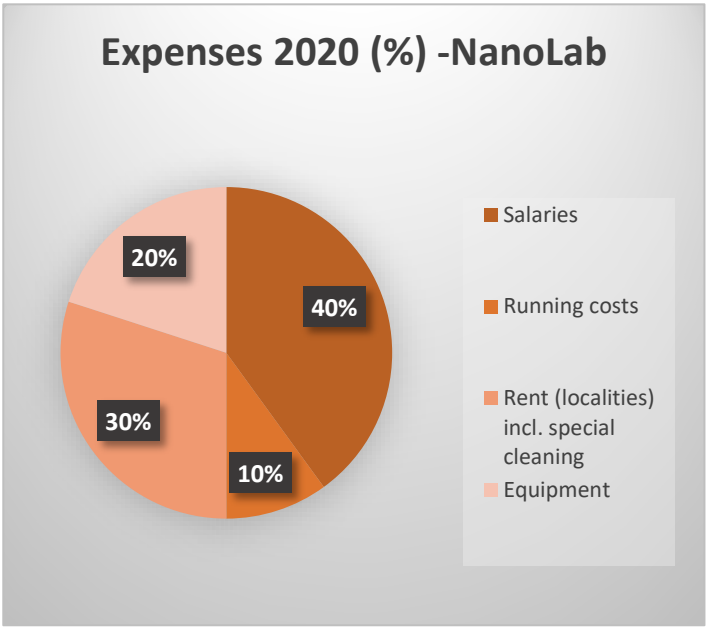
Budget -NanoLab





Users of NanoLab

The NanoLab's users (**34** active users in 2019) are currently mainly from the Department of Physics and Department of Chemistry, KBC, Umeå University. In addition, the infrastructure was used by ca 40 GU students/UmU.

Teaching activities

NanoLab is used for both undergraduate and graduate teaching. Two advanced courses on the undergraduate level (NanoScience 7.5hp and Advanced Materials 7.5hp) are currently using NanoLab as their laboratory facility in which the experiments are carried out. Two courses on the graduate level (Cleanroom technology 1.5 ECTS and Physical thin film deposition 1.5 ECTS) are also offered annually and are announced on the KBC website. These courses have primarily attracted participants from the Departments of Physics, Chemistry and Applied Physics, but participants from the international business program and the Department of Clinical Microbiology have also attended. Specific teaching and training sessions have also been offered on a regular basis to interested users. The courses are given in English, and the numbers of students range between 17 and 25 in each undergraduate course, and between 5 and 10 in each graduate course. For the coming years, courses are planned in Nano-imprinting and Material surface modification.

Future development

NanoLab has established a strong capacity for the fabrication and characterization of various nano- and micro-sized structures, using the methods outlined in the previous sections. Within the next few years, the goal is to expand NanoLab's capacity to make it even more attractive for researchers at (and outside of) the University.
For this end, a newly purchased X-ray diffractometer has been added to NanoLab. The development plan also includes the application of funding for a sputter deposition system, which can be used for precise coating of a wide

range of materials on essentially any substrate. A select number of applications that will be realized by such an acquisition include gold or carbon coatings for electron microscopy samples, silver and dielectric layer coatings for laser spectroscopy lenses, indium-tin-oxide coatings for transparent conducting substrates, and bio-compatible ceramic coating for medical implants.
It is also our intention to replace our 15-year-old scanning probe microscope with a modern instrument with largely improved resolution and capacity for measurement on liquid samples. We anticipate that this instrument will of large interest for scientists from the Departments of Chemistry, Applied Physics and Electronics, and Microbiology. The projected cost for the acquisition of this instrument is slightly above 1 Mkr.
We further plan to strongly advertise the existence and capacity of NanoLab both internally at the university and externally to academic and industrial parties, and also to investigate how we can achieve synergistic collaborations with other infrastructures at the University, e.g., the Umeå Core Facility for Electron Microscopy (UCEM) and the Vibrational Spectroscopy Platforms at Umeå University (VISP).

Publications

Publication statistics: no publications during 2019 where instrumentation in the platform was used: **15**

Biogeochemical Analytical Facility (BAF)

Short Summary of the Facility

The Biogeochemical Analytical Facility (BAF) started in 2017 and is located at the Department of Ecology and Environmental Science (EMG), Umeå University (UmU). BAF infrastructure hold instruments for analysis of key chemical parameters in terrestrial and aquatic biogeochemical and ecological research and as such is of major interest for a large range of research groups. BAF act as a core analytical facility for several major research projects run by the researchers at EMG together with their collaborators and now opens up for other users at Umeå and other universities.

Summary of activities 2019

Our main activities in 2019 have been:
- performing analyses for an increasing number of customers
- performing major services on key instruments

In 2019 we established contact with other labs, especially the analytical lab at SLU (Umeå). Together with the SLU laboratory facility and colleagues at Dept. of Chemistry at UmU, we have developed a new unique method for analyzing hydrogen isotope ratios (^{2}H) in solid samples. This involves a system with a specially constructed vacuum chamber for pre-treatment of samples BAF prior to analyses performed with a new instrument at SLU (funded by the Kempe foundation). This makes BAF internationally unique by providing a pre-treatment method that solves the current major uncertainties in analyses of ^{2}H in solid samples, and we currently have discussions with other labs that are interested in adopting the method. Our intention is that the method should be available for all users during 2020.

The BAF facility has also been presented at the KBC days 2019, on the information screens, and via a poster by Anders Jonsson.

Equipment

- Gas chromatograph
- TOC analyser
- Nutrient analyser
- Fluorometer
- Liquid Scintillation counter
- Respicond
- Flow cytometer
- Microbalance
- Spectrophotometer

BAF can use a flow injection analyzer (FIA) owned by the teaching lab. We primarily use this to measure nutrients in samples with high concentrations of salt, as e.g., in KCl-extractions of soil samples. BAF also has access to the instrument platform placed at CIRC in Abisko if needed.

Service provided by the platform

BAF provides an important service and enables analysis of key chemical parameters in terrestrial and aquatic biogeochemical research with low detection limits and high precision conducted at reduced costs when comparing to commercial laboratories.

Personnel

Anders Jonsson	PhD, Department of Ecology and Environmental Science. Technician at BAF. In charge of the lab facilities and a majority of the instruments at BAF
Reiner Giesler	Professor, Department of Ecology and Environmental Science. In charge of the Respikond at BAF
Sonia Brugel	PhD, Department of Ecology and Environmental Science. In charge of the Flow cytometer at BAF

Steering committee

Ann-Kristin Bergström	Professor, Department of Ecology and Environmental Science

Reiner Giesler	Professor, Department of Ecology and Environmental Science
Anders Jonsson	PhD, Department of Ecology and Environmental Science
Jan Karlsson	Professor, Department of Ecology and Environmental Science
Jurgen Schleucher	Professor, Department of Medical Biochemistry and Biophysics

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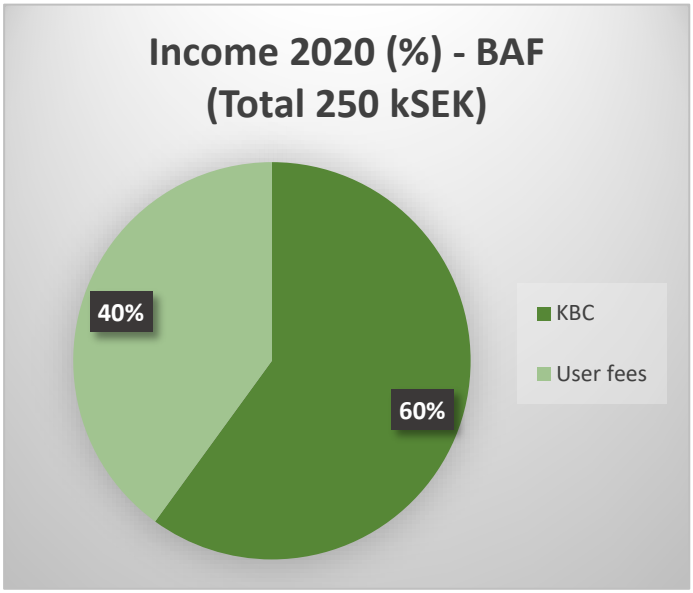
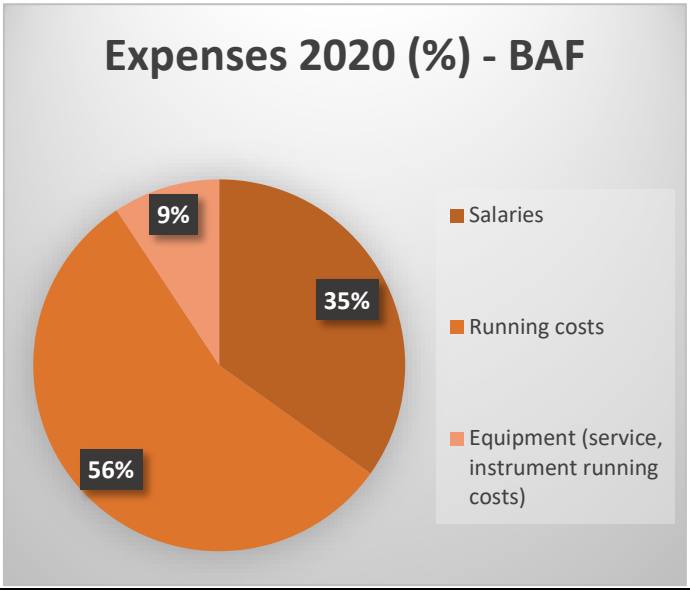
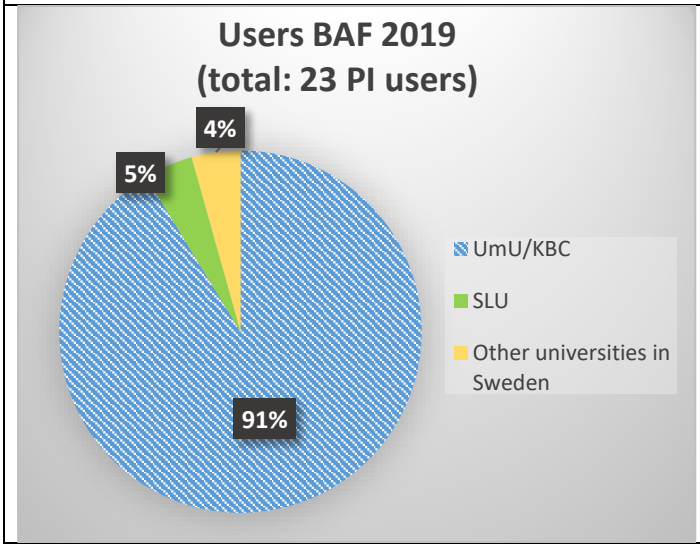
https://www.umu.se/en/research/infrastructure/baf/

Budget - BAF





Users of the Biogeochemical Analytical Facility



There has been an increase in the use of the facility during the year. The actual number of persons using the labs are higher since each PI usually have several persons (as PhDs, post-docs, master students). In 2019, the facility was also used by LOREX-PH:d students from 12 Universities in the U.S. (https://www.aslo.org/lorex/lorex-projects/)

Teaching activities

Analyses have been carried out for ungraduated and graduated courses, as well as for master thesis. In 2019, these analyses yielded 16180 SEK (November 2019).

Future development

Planned activities for 2020 for BAF involve investments for upgrading software and computers on our inverted phase-contrast microscopes so these can be connected to the web for easy and safe handling and storage of analytical results. We are also planning to include an appliance for automatic counting of zooplankton using a stereomicroscope and to incorporate the new method for analyzing hydrogen isotope ratios (^{2}H) in solid samples. We also aim to invest in a new spectrophotometer (cost approximately 140 000 SEK) and a new MQ-water device (cost approximately 170 000 SEK). We intend to apply to the Faculty of Science and Technology (UmU) for grants for these investments and depending on the outcome part of these costs may be taken from accumulated funds within BAF.

Publications

Publication statistics: no publications during 2019 (co-authored): **2.** No statistics on publications where the platform is mentioned in Acknowledgements is available.

Biopolymer Analytical Platform (BAP)

Short Summary of the Facility

The Biopolymer Analytical Platform, BAP, (former UPSC Plant Cell Wall and Carbohydrate Analytical Facility) has become an official KBC facility in 2018. BAP is dedicated to supporting research among KBC groups on cell walls of terrestrial and aquatic plants, and biopolymer materials. It offers necessary knowledge and analytical methods/tools to examine cell wall materials such as lignin, cellulose and hemicellulose, as well as in fine detection of other carbohydrate compounds by applying a large range of conventional wet chemistry methods and analytical instruments such as gas chromatography/mass spectrometry (GC/MS). We have extended our competence not only on plant cell walls but also on non-land plant materials such as algae, peat and sediment with several KBC and SLU research groups during the last three years. For example, identification of organic compounds in soil, sediment and peat were performed using Pyrolysis(Py)-GC/MS with KBC and SLU research groups.

Summary of activities 2019

During 2019, we have focused on setting up Matrix-Assisted Laser Desorption/Ionization - Time-Of- Flight Mass Spectrometer (MALDI-TOF MS) and Size Exclusion Chromatography (SEC) with a help of Totte Niittylä's (platform director) PhD student and postdoc, together with a researcher, Ola Sundman (a steering committee member), besides our usual services. We are also starting developing a new method of using tetramethylammonium hydroxide (TMAH)-Py-GC/MS for the detection of p-coumarate and ferulate contents in grass cell walls.

Equipment

- Pyrolysis-GC/MS (Pyrolyzer: PY-2020iD and AS-1020E, FrontierLabs, Japan and GC/MS: Agilent 7890A/5975C, Agilent Technologies, Inc. USA)
- 2x GC/MS (Agilent 7890A/5975C, Agilent Technologies, Inc. USA)
- Size exclusion chromatography (SEC) (OMNISEC RESOLVE & REVEAL, Malvern, UK)
- Matrix- Assisted Laser Desorption/Ionization - Time-Of-Flight Mass Spectrometer (MALDI-TOF MS) (Waters Corporation)
- Microplate Spectrophotometer (Epoch, BioTek Instruments, Inc., USA)
- 2x balances (Mettler Toledo, Switzerland)
- centrifuge (Hettich, Germany)
- sample concentrator together with heating blocks (Techne, Barworld Scientific Ltd. UK)
- vacuum desiccator
- soxhlet
- **2019:** electronic repeating pipette

Equipment owned by UPSC:

- Freeze-dryer (Coolsafe, ScanVac, Labogene, DK)
- centrifugal mill (ZM 200, Retsch, Germany)
- ball-mill (MM 400, Retsch, Germany)
- sonication bath (Sonorex, Bandelin, Germany)
- **2019:** Matrix-Assisted Laser Desorption/Ionization - Time-Of-Flight Mass Spectrometer (MALDI-TOF MS) (Waters Corporation), previously placed in the KBC Proteomics Facility, was repaired and added to the infrastructure.

Equipment owned by Umeå University:

- sieve shaker (AS200, Retsch, Germany)

Service provided by the platform

Our services include carbohydrate/lignin composition and lignin structure analysis in various lignocellulose materials such as wood, pellets, plant litters, soil and tar. Selected examples of applications are:

- Pyrolysis-GC/MS for carbohydrate and lignin (G, S and H types) content estimation and identification of organic compounds in soil/sediment
- TMS/Alditol acetate sugar-GC/MS for monosaccharide composition analysis
- Updegraff cellulose/anthrone assay for crystalline cellulose determination
- Klason, thioglycolic acid and acetylbromide lignin assay for lignin determination

- Enzymatic assays for soluble sugar (sucrose, glucose and fructose) and starch detection
- SEC for determination of MW, DP and viscosity of lignocellulose polymers. The table below shows available analyses and the charge.

In 2017, we have included acetylbromide lignin analysis as one of the standard methods in lignin determination. This is a very practical method to analyze samples on a small scale (less than 1 mg). In addition, Multi Angle Laser Light Scattering (MALLS) detector was purchased and implemented into our SEC system at the end of 2017. Unfortunately, another part of the SEC system (autosampler, pump, degasser and column oven) broke down in early 2018 and will be replaced with the new system, OMNISEC RESOLVE, in Nov 2018. After initial training and optimization, we plan to offer analysis with SEC MALLS as part of the platform service in 2019.

Personnel

Totte Niittylä	Associate Professor, director of the platform, Dept. of Forest Genetics and Plant Physiology, SLU
Junko Takahashi-Schmidt	PhD, the laboratory manager, Dept. of Forest Genetics and Plant Physiology, SLU

Steering committee

Totte Niittylä	Associate Professor, Dept. of Forest Genetics and Plant Physiology, SLU
Ewa Mellerowicz	Professor, Dept. of Forest Genetics and Plant Physiology, SLU
Hannele Tuominen	Associate Professor, Dept. of Plant Physiology, UmU
Leif Jönsson	Professor, Dept. of Chemistry, UmU
Junko Takahashi Schmidt	PhD, Dept. of Forest Genetics and Plant Physiology, SLU
Ola Sundman	PhD, Dept. of Chemistry, UmU

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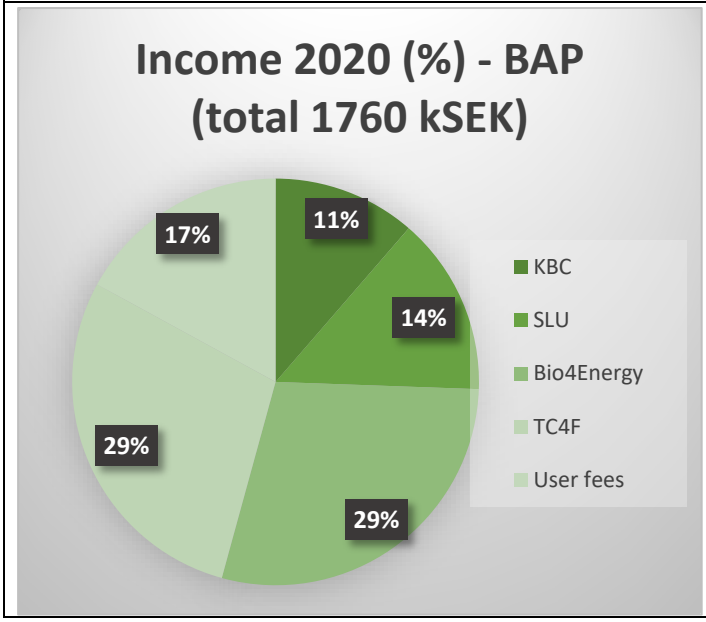
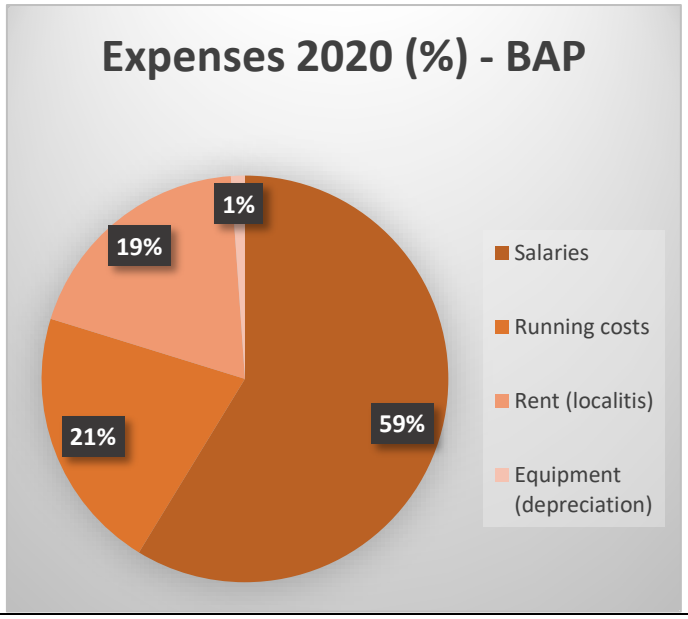
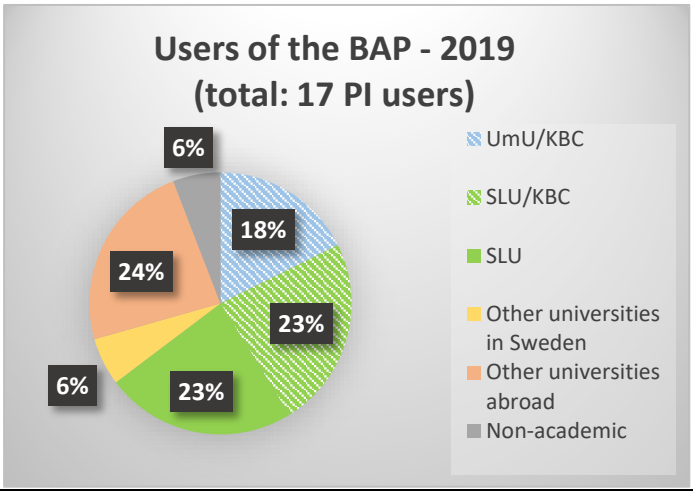
Budget - BAP





Users of the Biopolymer Analytical Platform



Teaching activities

We taught conventional wet chemistry-based cell wall analysis and modern instrumental techniques using GC/MS on cell wall materials and soluble carbohydrates as a part of the following courses:

- Basic chemistry of forest ecosystems (Skogsekosystemets kemiska grunder), SLU (VT2019, SG0210) – soluble sugar (Glc, Fuc and Suc) analysis.
- Biomaterials and Bioenergy (HT2019, 5BI201) – determination of non-volatile extractives, acid-soluble/insoluble lignin, acetyl bromide lignin and crystalline cellulose determination.
- WWSC summer school visit to Umeå (HT2019) - A short demonstration of analytical methods performed in BAP to WWSC PhD students.

Publications

Publication statistics: no publications during 2019 (co-authored/acknowledged): **1/3**

Swedish Metabolomics Centre (SMC)

Short Summary of the Facility

Swedish Metabolomics Centre (SMC) is a collaboration between SLU and UmU and is located at KBC (Umeå Plant Science Centre's localities). The main aim of the facility is to support the researchers at Swedish Universities with mass spectrometry-based analysis of metabolites and lipids in biological tissues and to become a leading knowledge centre in metabolomics and related areas. The purpose is to continuously develop the facility up to date with the latest techniques and methodology, as well as being transparent and cost-effective to reduce the costs for the users. By having open access function with open calls for method development the facility is accessible for a wide range of users in the field of biology and medicine, not only in need for standard metabolomics analysis.
From 2016, SMC is part of the SciLifeLab organization, under the proteomics and metabolomics platform.

Swedish Metabolomics Centre did not apply for the continued KBC support in 2020 and was therefore not evaluated for their activities during 2019.

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https://www.umu.se/en/research/infrastructure/metabolomics/

Appendix 2b. Description of the new Infrastructures that received KBC support in 2020

X-ray photoelectron spectroscopy platform (XPS)

Short Summary of the Facility

The X-ray photoelectron spectroscopy (XPS) platform is an open infrastructure at Umeå University enabling users both within UmU and outside to obtain analyses of the chemical composition of their sample surface. Knowledge of the elemental composition, oxidation state and spatial distribution of atoms at surfaces, near-surfaces, and interfaces is crucial to our understanding of key reactions in nature and technology. Surfaces are, after all, the immediate interface through which materials - as small as metal nanoparticles and bacteria, to as big as nuclear fuel reactors and spaceships - interact with their environments. XPS, also known as Electron Spectroscopy for Chemical Analysis (ESCA), is now one of the most widely used tools in countless fields of science and engineering where an advanced understanding of surfaces and interfaces is needed.

Strategic relevance

XPS Platform represents the only facility in Sweden and was the first in the world, who could routinely provide cryogenic XPS analyses. Furthermore, the XPS platform is the only facility for XPS analyses in Northern Sweden (north of Uppsala). The platform supports a unique field of research, developed at the Department of Chemistry involving investigations of fast-frozen samples including mineral-aqueous solution interfaces, interfaces of biomaterials with biologically relevant media, and surface chemistry of microorganisms. The platform also supports a large range of research areas by providing state-of-the-art surface analysis in areas including ecology, chemistry, physics, archaeology, molecular biology, dentistry and engineering. Through the years it has provided data forming the base of numerous research projects including more than 40 PhD theses and several hundred peer-reviewed scientific articles. Furthermore, the XPS platform is part of a recently formed national network of expertise under the name Swedish National Platform for X-Ray Photoelectron Spectroscopy – SNAXPS bringing together XPS facilities at seven national locations (Umeå University, Uppsala University, RISE (KTH), Linköping University, Chalmers University, Lund University and MAX lab) to form a national infrastructure for surface analysis using XPS.

Equipment

AXIS Ultra DLD electron spectrometer manufactured by KRATOS Analytical Ltd. (UK)

Services provided

The XPS platform provides a full range of conventional XPS experiments including spectroscopy under monochromatic Al Kα excitation, angle-resolved XPS, small area analysis, XPS imaging, and has unique experience in cryogenic measurements of hydrated (wet) samples. All experiments are performed with AXIS Ultra DLD electron spectrometer manufactured by KRATOS Analytical Ltd. (UK). The main fields of application at our XPS Platform facility are currently:

- Environmental samples, in particular, the composition of mineral-aqueous solution interface
- Biological specimens such as intact bacterial cells and algae
- Control of surface modification of materials for catalysis, bio-separation processes and antibacterial applications
- Carbon-based materials
- Cellulose fibres and films
- Commercial analysis for the external customers (industry, consulting agencies, etc.)

The platform is developing and promoting a unique field in XPS application, cryogenic XPS, which provides investigations of fast-frozen samples including mineral-aqueous solution interfaces, interfaces of biomaterials with biologically relevant media, surface chemistry of microorganisms and algae. This method development has resulted in a number of publications and invitations to international meetings.

Personnel	
Andrey Shchukarev	PhD, Platform manager. Department of Chemistry
Steering committee	
Andrey Shchukarev	Research fellow, Department of Chemistry
Madeleine Ramstedt	Associate professor, Department of Chemistry
Knut Irgum	Professor, Department of Chemistry
Jean-François Boily	Professor, Department of Chemistry

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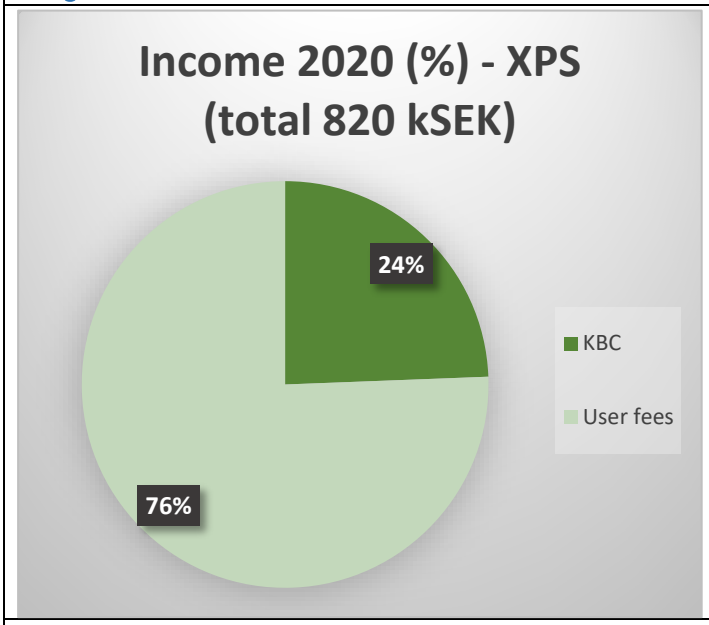
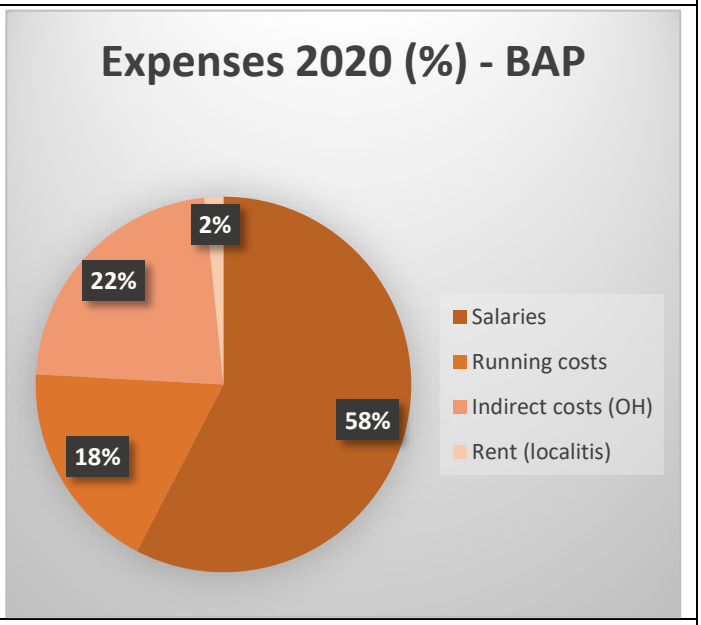
Homepage: https://www.umu.se/en/research/infrastructure/xps/

Budget XPS





KBC Support for XPS in 2020: 200 kSEK.

Users of XPS

Core Users: Department of Chemistry: Andrey Shchukarev – method focus (New applications), Jean-François Boily – method focus (Geochemistry), Madeleine Ramstedt – method focus (Biology).

Other users UmU: 20 PIs

External Users (Sweden): 11 PIs

Industry: LKAB, Boliden, IKEA

Non-profit Scientific cooperation all over the world: Slovakia (Erasmus project), Mexico, Iran, Germany, France, USA, Israel, Spain, Finland, and Russia

Teaching activities

XPS Platform actively participates in several courses at the Department of Chemistry (Biophysical-Chemical Concepts, Advanced experimental tools in chemistry, Environmental Analytical Chemistry, Bioresource Techniques) and Luleå University of Technology (Polymer technology). On demands, a special Surface Analysis and XPS courses can be given for advanced level and/or PhD students (1-6 participants).

Future development

To ensure Umeå University's XPS Platform strategic goal to meet tomorrow's challenges in innovative science and technology and to cover today' increasing needs for surface analysis in Northern Sweden, we want to buy a new X-Ray Photoelectron spectrometer. The cost of this instrument is about 10 Mkr. This strategic investment would keep UmU and the consortium of 3 Northern Universities at the forefront of surface and interface-related research. In December 2018, the Chemistry Department's Board for Research Strategy supported this initiative, and we are now in the process of acquiring financial support at the Faculty level, from Umeå University, and funding agencies. Financial support from two Northern Sweden Universities, Mid University and Luleå Technical University, has been preliminary agreed upon (1 Mkr and 1-1.5 Mkr, respectively). In addition to new instrument purchase, we are planning to acquire a new XPS Platform staff member to be trained and substitute Andrey Shchukarev after his retirement (2022/2024).

Publications

Publication statistics: no publications during 2019 (authored or co-authored by the core users): **9**

Ancient and Environmental DNA Lab (aeDNA Lab)

Background and description

Analysis of ancient environmental DNA (aeDNA) is a rapidly expanding scientific field, opening exciting new possibilities to address paleoenvironmental, ecological and evolutionary research questions. In the past three years, we have seen a rapid increase in publications that utilize aeDNA technique to unravel the diverse ecological histories in all corners of the globe.

The aeDNA studies require DNA-free working environment to eliminate false signals from modern DNA contamination. To facilitate and promote innovative research development in paleoecology, evolutionary biology and aquatic ecology, where Umeå University has strong research groups, Department of Ecology and Environmental Sciences (EMG) established an **Ancient and Environmental DNA (aeDNA) Lab** in 2018. The possibility for processing soils, peat bogs, lake sediments and water samples in-house at Umeå University for subsequent DNA analyses significantly reduces the contamination risk, at the same time cuts down the waiting and processing time for all studies. The aeDNA Lab will also be an important asset to facilitate and strengthen collaboration with the archaeologists at Umeå University. We feel this platform will benefit a much larger group of researchers if it becomes a part of KBC infrastructure.

Lab information and equipment

- The aeDNA Lab is located in the basement of the Naturvetarhuset (NC). This site is selected after careful evaluation together with Akademiska Hus, most importantly for its physical isolation from other modern DNA labs in the KBC building. It consists of a shower room, 1st preparation room, 2nd preparation room (size 1.5m x 1.5m where one changes to clean suit, mask, etc.), and the working lab (size 3.86 m x 5.62 m).
- The working lab has positive air pressure, accompanied by a HEPA air filter system at 40 l/s.
- Both the preparation room and the working lab have a UV sterilization system and alarms installed.
- The aeDNA lab provides the space for DNA extraction and pre-PCR preparations. The lab contains a -20°C freezer, a 4°C fridge, a droplet generator (for droplet digital PCR only), a centrifuge for Eppendorf tubes without temperature control, a UV crosslinker, an oven with rotators, a biological (PCR) hood, a notebook computer, shelves, and work benches.

Services provided by the platform

Tasks can be performed in this lab include:

- DNA extraction from paleo- and environmental samples
- aeDNA storage
- Pre-DNA amplification (PCR) preparations
- Droplets generation for droplet digital PCR (ddPCR) for DNA quantification
- Total DNA/RNA quantification using Fluorometer (Qubit)
- Library preparation for metagenomics

Service, maintenance and booking will be administered by the steering group. Our primary responsibility is to provide a contamination-free lab to researchers and supervise their activities rather than to provide analytical service. Because of the uniqueness of each specimen, samples are best processed by the individual project team. The platform will be open to researchers at UmU and SLU in need of a contamination-free lab. The running cost of the lab will be partly covered by user fees. Internal and frequent users will be charged on an annual fee basis. External users should have a local collaborator and will be charged on usage or task basis. The detailed price tag will be further discussed once this facility is accepted into the KBC system.

Until now, this facility has been in a “test-run” phase and is managed locally by EMG. Once it becomes a KBC platform, we will provide contact details to the lab manager on the UmU and KBC platform webpages.

Personnel	
David Hall	Lab coordinator/manager, Senior research engineer at Department of Ecology and Environmental Sciences
Doreen Yu-Tuan Huang	Lab coordinator/manager, Postdoctoral fellow at Department of Ecology and Environmental Sciences

Steering group	
Xiao-Ru Wang	Professor, Department of Ecology and Environmental Sciences
Jonatan Klaminder	Associate professor, Department of Ecology and Environmental Sciences
Christian Bigler	Associate professor, Department of Ecology and Environmental Sciences

Contact information	
Visiting address: Natural Sciences building, A1, Umeå University	Contact person: Xiao-Ru Wang Department of Ecology and Environmental Sciences, Umeå University, 901 87 Umeå E-mail: xiao-ru.wang@umu.se

Users of aeDNA Lab

In this short time since its establishment in 2018, the lab has served a large number of projects funded by KaW, EcoChange, VR, and Formas. By now, more than 10 MSc and PhD projects have utilized this facility. More groups from EMG, Chemistry, UPSC and SLU are now asking for access to this facility.

Teaching activities

To limit the risk of contamination, this facility is not used for undergraduate teaching. A large group of undergraduates practising in the lab may lead to contamination disaster. However, we support supervised MSc and PhD projects. By now, more than 10 MSc and PhD projects have utilized this facility.
We teach the general rules of working in aeDNA lab in the basic and advanced courses in ecology and environmental science.

Economy

Remodel of the basement space, construction and installation of all necessary equipment of the clean lab took 2 years to complete. EMG and individual PI/projects jointly put up over 1Mkr to establish this platform, which is by now fully functional.
Maintaining a functional aeDNA lab is tedious and costly. Strict rules need to be followed as a part of the routine cleaning and contamination monitoring. To make this platform available to broader users, a dedicated support is very necessary. Tasks include:

- teach the new users how to work in aeDNA lab
- manage the booking system
- evaluate and register the biological samples brought into the lab
- register activities performed in the lab
- perform routine cleaning
- monitor contamination level in the lab, including surface contamination and airborne contamination
- plan and perform periodical total cleaning and sterilization
- instruments service

KBC Support for AeDNA Lab in 2020: 100 kSEK.

Single cell microscopy and FISH (Fluorescence In Situ Hybridization)

Background and description

The goal of the **Single cell microscopy and FISH (Fluorescence In Situ Hybridization)** infrastructure is to provide access to:

- reagents and laboratory space to carry out this method in own projects;
- computers with bioinformatics programs for evaluation and design of gene probes if needed.

The evaluation will be performed in one of UmU's / KBC's infrastructures, such as BICU, UCEM, ViSP and others, depending on the project's objectives. That is, this infrastructure will hopefully contribute to more cooperation between the various infrastructures and other research institutions.

The advantage of the FISH method is that all types of cells can be identified, visualized and quantified without cultivation or gene sequencing. The method is fast and relatively simple compared to other molecular biological methods which rely on the extraction of cellular components such as DNA. Although cell-destructive molecular biological methods produce more accurate information of larger amounts of data, they are impractical for rapid analysis and also lack the ability to provide information on cell morphology, growth pattern, distribution, and association with other organisms in their natural environment. FISH can thus function both as a pilot study and partly as a valuable, complementary method for more advanced molecular biological methods. All types of cells (prokaryotes, eukaryotes and at least certain viruses) can be analysed in all types of samples (environmental, clinical, food, and industrial/biotechnology samples). The FISH method is based on hybridization of fluorescence-labelled gene probes with specific target genes directly inside the cell. The most common gene target for cell identification is the ribosomal gene, but also housekeeping genes, functional genes, pathological genes, or even whole genomes can be targeted. The hybridization reactions can be visualized in the microscope (fluorescence or electron microscopy, RAMAN spectroscopy, nanoSIMS), or quantified via flow cytometry or microarray technology. At present, there are at least 30 different versions of the FISH method and the method is constantly developing. There are also plans to collaborate with other KBC infrastructures to integrate the FISH methodology more with other detection methods (i.e., except with BICU and UPSC fluorescence microscopy units, also with UCEM, ViSp and flow cytometry at the Faculty of Medicine.

Equipment

All the necessary equipment, computers, reagents and knowledge to perform and optimize most of the various FISH technologies are available at KBC - at the EMG's laboratories and at a laboratory near BICU's fluorescence microscope. The research facility is equipped also with a library of at least 50 different gene probes for different cell types (especially for prokaryotes and a selection of eukaryotes), which can if necessary, enable a quick analysis without the need for large orders or project planning. In cases where new gene probes need to be ordered (due to new species or target genes which has not been investigated before), a contract has been established with the internationally known biomarker company BIOMERS in Germany, where it is possible to receive a discount for the purchase of new biomarkers (https://www.biomers.net/).

Personnel

Natuschka Lee	PhD, Department of Ecology and Environmental Sciences

Contact information

Natuschka Lee
Lab Microbial Geoecology and Astrobiology, Department of Ecology and Environmental Science, Chemical Biological Centre (KBC), Umeå University
E-mail: natuschka.lee@umu.se

Users of FISH

Today, FISH is included in different research projects, e.g. in plant, fungal and animal biology, microbial geo-ecology, pathogen detection, and different industrial applications, e.g. wastewater treatment, cellulose-paper industry, and food production.

Teaching activities

FISH has been taught in several ways:

1) For about 10 years in Germany (http://microbial-systems-ecology.net/fish_course_new.html) - where it was also carried out in collaboration with microscopy companies (Zeiss, Cameca nanoSIMS) and other researchers from the Max Planck Institute and Helmholtz Institute.
2) At Umeå University:
    a. Basic courses at EMG (Art Knowledge and Systematics, from 2016 onwards - where it is launched as a rapid method for identifying microbes).
    b. EU course on microbial interactions with plants, fungi and insects (COST FA 1405) in autumn 2018 - conducted in collaboration with UPSC.
    c. In various students' projects (e.g., master thesis) at EMG and in collaboration with UPSC, Chemistry and SLU Umeå (since 2016 onwards).
    d. A special bioinformatics program has been installed on the computers at EMG and at UPSC's general bioinformatics platform, which enables phylogenetic studies of cells and the evaluation and design of biomarkers for different PCR applications for FISH.

Economy

According to a decision of the KBC's board in 2017, 100 kSEK was allocated to initiate the construction of a FISH laboratory / infrastructure at KBC for the coming years. These support was used to:
a) adapt a laboratory at the Dept. of Medical Biochemistry and Biophysics (installation of a fume cabinet, replacement of lab furniture, adaptation of electrical system) for a cost of over 100 kSEK (the cost was split 50% between EMG and FISH);
b) organize an EU COST course on microbial interactions with plants, fungi and insects (COST FA 1405) with twelve participants (doctoral students, postdocs, researchers - partly from UmU and partly from different EU countries);
c) introduction to the BICU fluorescence microscope.
Reagents for FISH, purchase of computers for phylogeny and bioinformatics-based design of gene probes, student guidance have been paid for by Natuschka Lee's project funds, or have received some basic support for collaborations with other researchers (e.g. via joint research applications - with others university or with industry such as SCA / Bo Rydin). This strategy will also be applied in the coming years.
To date, all FISH analyses have been conducted as direct collaborations, usually free of charge or through joint research applications. There is currently no policy on how external projects should be financed. It depends on the number of samples, the type of FISH protocol and the selection of gene probes and the evaluation method, the user fee policy will be further developed.

KBC Support for the Single cell microscopy and FISH infrastructure in 2020: 50 kSEK.

Future development

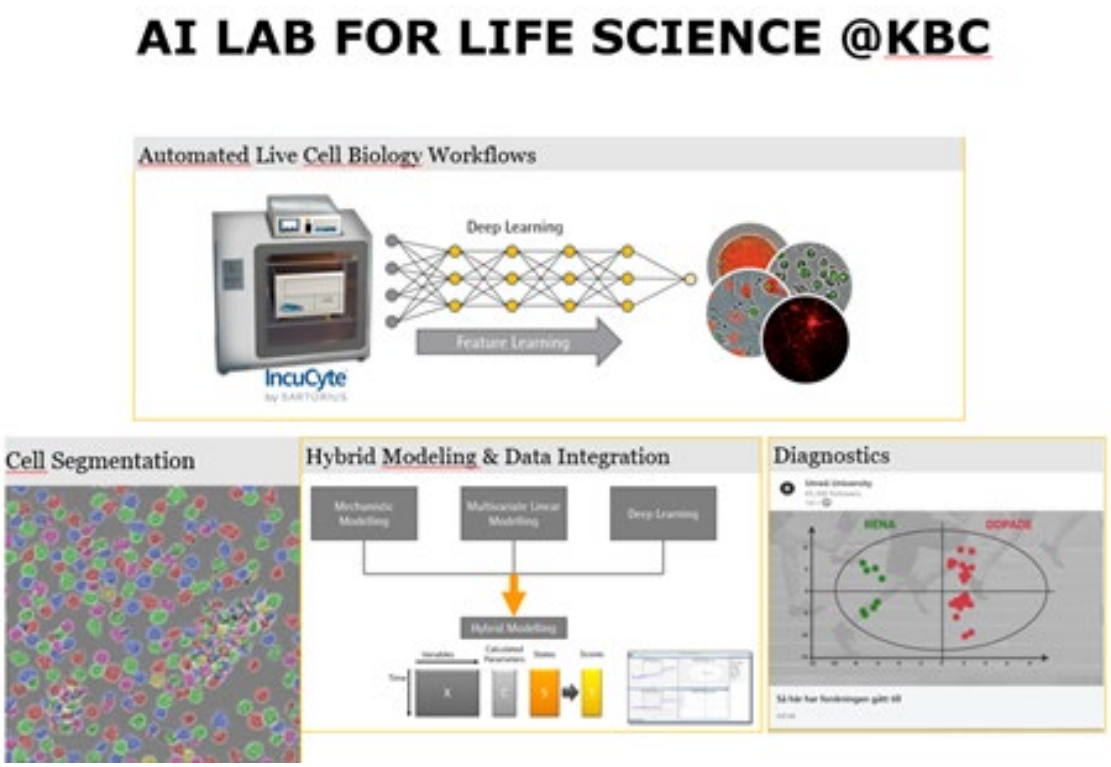
In the near future, an annual national course "Single Cell Microscopy and FISH" is planned at UmU, for example, as a part of the SciLifeLab's offering as no such course is offered in Sweden. There are already several requests for this course, including applicants from outside UmU. Furthermore, discussions are ongoing with representatives of the SciLifeLab in Uppsala (Stefan Bertilsson et al.) about organizing a joint course on this in Uppsala. Two invitations from the universities in South Africa and Turkey have been received to arrange a local version of this course there.

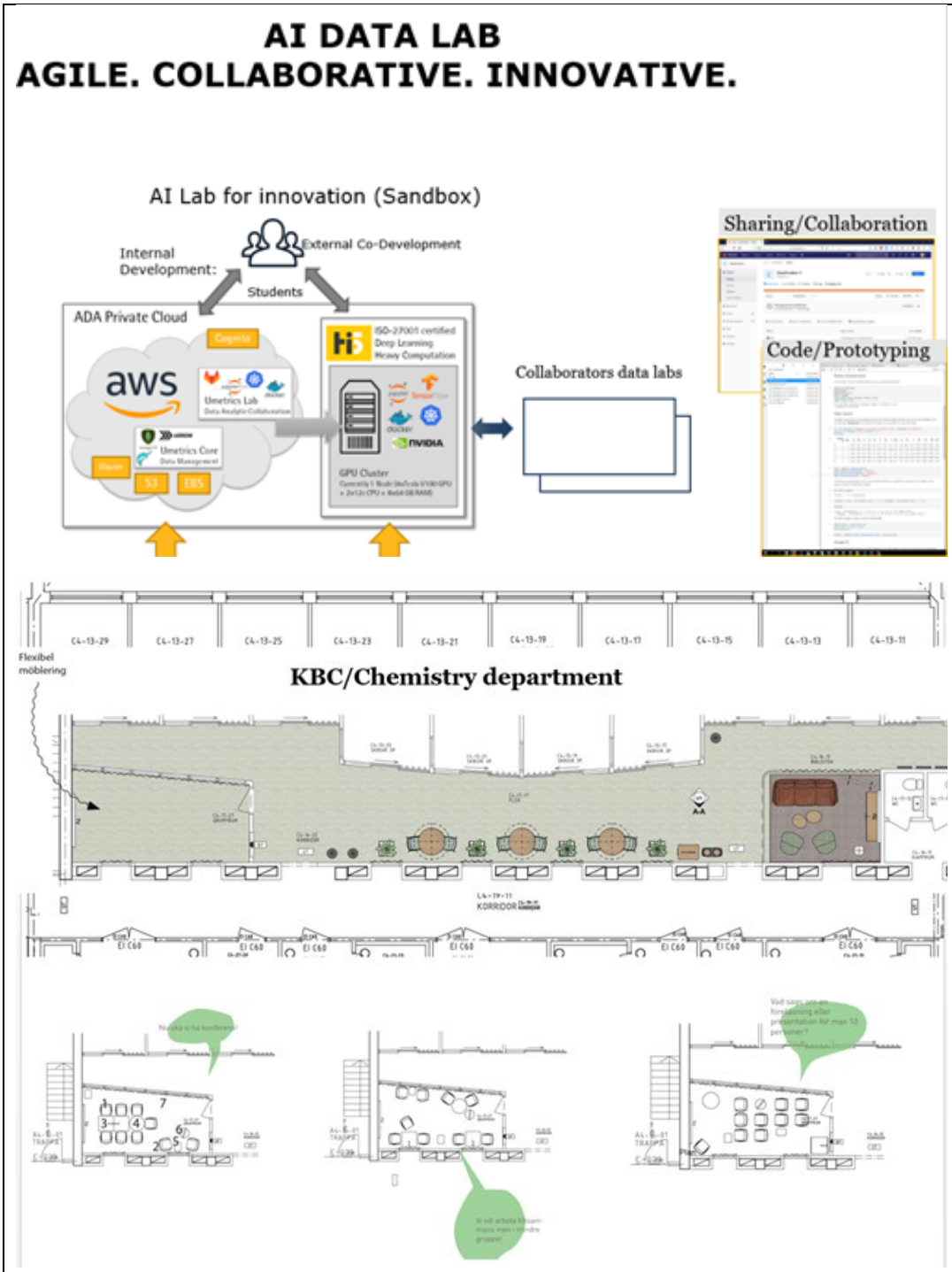
AI lab for Life Science @KBC

Background and description

The data is today's oil of life science. Technological development has accelerated the generation of data from different instruments and platforms in life science. At present, large amounts of raw data are generated for virtually all analyzes, instruments and platforms and, if one assumes Moore's law, standard omics research projects will quickly achieve petabyte size for raw data. Traditional statistics and data analysis are not designed to handle the new types of large-scale, heterogeneous, and complex data in life science.
Several AI initiatives have been funded to handle this kind of data, both by private (first of all, KAW / WASP) and public funds (such as VINNOVA) for a total of almost 4 billion SEK. At UmU alone, more than 100 AI researchers have been employed since 2011 in connection with a billion investments in AI and autonomous systems, mathematics, humanities and social sciences. A similar investment in life science is still lacking. Here, UmU and KBC can proactively work to establish an AI Lab for Life Science. This would directly support research infrastructures that already exist and are co-financed by KBC including BICU, ViSp, NMR, Metabolomics.

The purpose of this declaration of interest is to establish an "AI lab for life science" to provide
- a virtual Data Lab platform (incl. Deep Learning / GPU capacity);
- a physical meeting place at KBC that has already been sketched out according to the proposal below;
- the possibility of personal research support;





Contact information
Contact person:
Johan Trygg
Department of Chemistry, Umeå University
90187 Umeå
E-mail: johan.trygg@umu.se

Services and booking Will be available from the 24/7-2020.
Teaching activities AI lab for Life Science @KBC aims at creating conditions for strengthening existing courses and new education. Workshops, seminars, and personal support will be provided.
Economy 360 kSEK /year - 40% FTE 400 kSEK (one-time cost) - AI lab for life science meeting place, including technical equipment 100 kSEK /year – running costs of AI lab. **KBC Support for the AI lab for Life Science @KBC in 2020: 100 kSEK.**

Appendix 2c. Conferences, workshops, symposia, and other events organised by/within the KBC environment during 2019

Name of the event	Dates	Organising department/unit
The 4th International Tea Bag Index Symposium	20-21 February 2019	EMG
SciLifeLab Outreach Event: National Bioinformatics (NBIS) and Genome Sequencing (NGI) mingle in Umeå	28-29 March 2019	NBIS, NGI
Oorgandagarna - Inorganic Days Conference	12-14 June 2019	Chemistry, Swedish Chemical Society
LONA days at KBC: Pollinate Northern Sweden	30-31 August 2019	EMG
Symposium “Current topics in evolutionary biology”	5 September	EMG
KBC DAYS	5-6 November 2019	KBC
Workshop: The implications of varroa mites on bee health in Västerbotten	20 November	EMG, Arthropodum network
Webinar series ‘Sustainable Cities and Circular Bioeconomy’	9 Apr, 29 Apr, 28 May	Bio4Energy & Green Technology and Environmental Economics
IceLab Lunch Pitches	8 Jan, 22 Jan, 19 Feb, 19 Mar, 2 Apr, Nov 12, 26 Nov, 10 Dec	IceLab
Seminars at KBC	No.: 116	KBC departments
PhD Thesis defences	No.: 22	KBC departments
Social activities:		
KBC Stafetten 2019	26 February 2019	KBC
KBC Grillfest 2019	4 June 2019	KBC
Outreach events:		
Fascination of Plants Day 2019	18 May 2019	UPSC
ForskarFredag 2019	27 September 2019	UmU

Appendix 2d. Research courses organised at KBC in 2019

Courses	Year	ECTS	Dates	Organising departments / units
Basic Course in SEM and TEM	2019 spring	1 ECTS	19-21 Feb	UCEM
Basic Course in SEM and TEM	2019 fall	1 ECTS	17-19 Sep	UCEM
Bioanalytical methodologies with emphasis on use of chromatography and mass spectrometry in metabolomics analysis	2019 spring	6 ECTS	18-22 Feb; 11-15 Mar	SMC
Cleanroom technology – User License Course	2019 fall	1.5 ECTS	28-29 Nov	NanoLab, Dept of Physics
Cryo-EM sample preparation and data collection	2019 spring		3-5 Jun	SciLifeLab, UCEM
Cryo-EM Course on Tomography	2019 spring	1 ECT	26-28 Mar	SciLifeLab, UCEM
IceLab Camp 2019	2019 fall	2 ECTS	9-12 Sept	IceLab, KBC
Python programming with applications to bioinformatics	2019 fall		7-10 Oct	NBIS
Practical course at UCEM: TEM sample preparation course part II	2019 spring		6-10 May	UCEM
Thin Film Deposition technology (Physical Vapor Deposition)	2019 fall	1.5 ECTS	5-6 Dec	NanoLab, Dept of Physics
Vibrational Spectroscopy User License Course	2019 spring	2 ECTS	6-9 & 13 May	ViSp
Vibrational Spectroscopy User License Course	2019 fall	2 ECTS	11-15 Nov	ViSp

Appendix 3. Partners of the Coalition Umeå for Life Science (CU4LS)

Umeå Centre for Microbial Research (UCMR) Contact: Professor Yaowen Wu, Director Homepage: **https://www.ucmr.umu.se/**	UCMR Umeå Centre for Microbial Research
Statement: Centre of Excellence promoting research on molecular infection medicine and antibiotic resistance	

Molecular Infection Medicine Sweden (MIMS) Contact: Professor Oliver Billker, Director Homepage: **http://www.mims.umu.se/**	MiMS Molecular Infection Medicine Sweden Nordic EMBL Partnership for Molecular Medicine
Statement: Molecular Infection Medicine Sweden fosters the next generation of scientists to conduct outstanding research into molecular microbiology and infection medicine. The institute is the Swedish node in a Nordic Partnership for Molecular Medicine with the European Molecular Biology Laboratory. MIMS leverages its European network for the advancement of research in Sweden	

Umeå Plant Science Centre (UPSC) Contact: Professor Ove Nilsson, Director Homepage: **https://www.upsc.se/**	Umeå Plant Science Centre
Statement: A Centre of Excellence in Experimental Plant Biology	

Chemical Biological Centre (KBC) Contact: Professor Stefan Björklund, Scientific Coordinator Homepage: **https://www.umu.se/en/kbc**	KBC Chemical Biological Centre www.umu.se/en/kbc
Statement: An interdisciplinary centre for basic science-oriented research in life/natural sciences, technology, medicine and forest sciences at Umeå University (UmU) and the Swedish University of Agricultural Sciences (SLU)	

Umeå Centre for Molecular Medicine (UCMM) Contact: Professor Lena Gunhaga, Head of department Homepage: **https://www.umu.se/en/umea-centre-for-molecular-medicine/**	UCMM Umeå Centre for Molecular Medicine
Statement: A Research Centre focused on Development and Disease	

Appendix 3. Partners of the Coalition Umeå for Life Science (CU4LS)

The Biobank Research Unit at Umeå University Contact: Associate professor Ingvar Bergdahl, Director Homepage: https://www.umu.se/en/biobank-research-unit/	
Statement: We provide data management for research in approximately 50 human sample collections from northern Sweden	

Umeå Center for Functional Brain Imaging (UFBI) Contact: Professor Lars Nyberg, Director Homepage: https://www.umu.se/en/umea-center-for-functional-brain-imaging/	UFBI Umeå center for Functional Brain Imaging
Statement: Inter-disciplinary research center using imaging techniques to examine brain structure and function in relation to both basic and clinical questions	

Wallenberg Centre for Molecular Medicine at Umeå University (WCMM) Contacts: Professor Lars Nyberg, Director Homepage: https://www.umu.se/en/wallenberg-centre-for-molecular-medicine/	Wallenberg Center for Molecular Medicine
Statement: WCMM conducts research in cancer, infection biology, neuroscience and metabolic disorders including diabetes. WCMM is part of a nationwide effort to strengthen molecular life science in an initiative launched by the Knut and Alice Wallenberg Foundation	

Umeå Centre for Comparative Biology (UCCB) Contacts: Professor Leif Carlsson Homepage: https://www.umu.se/en/research/infrastructure/umea-centre-for-comparative-biology-uccb/	
Statement: Experimental animal core facility with tools and infrastructure for state-of-the-art analyses	

Translational Research Center at Umeå University (TRC) Contacts: Associate professor Magnus Hultdin, Homepage: https://www.umu.se/en/department-of-medical-biosciences/trc/	TRC TRANSLATIONAL RESEARCH CENTRE
Statement: Bringing clinicians and scientists together	

Appendix 3. Partners of the Coalition Umeå for Life Science (CU4LS)

Vibrational Spectroscopy Core Facility (ViSp) Contacts: Andras Gorzsas, PhD, Platform Manager Homepage: https://www.umu.se/en/research/infrastructure/visp/	ViSp VIBRATIONAL SPECTROSCOPY CORE FACILITY
Statement: An open access infrastructure for fast and detailed chemical compositional analysis	

Chemical Biology Consortium Sweden (CBCS) Contacts: Assistant Professor Erik Chorell, Facility Director Homepage: https://www.umu.se/en/research/infrastructure/cbcs/	CBCS CHEMICAL BIOLOGY CONSORTIUM SWEDEN
Statement: The Umeå node of the Chemical Biology Consortium Sweden enable screening and development of bioactive small molecules within all areas of life science	

Umeå Center for Electron Microscopy (UCEM) Contacts: Linda Sandblad, PhD, Facility Director and Coordinator, SciLifeLab Cryo-EM Head of Facility, NMI Facility Director Homepage: https://www.umu.se/en/research/infrastructure/umea-core-facility-for-electron-microscopy-ucem/	UCEM Umeå Core Facility Electron Microscopy
Statement: Electron Microscopy Core Facility and National Cryo-EM Node for Life Science Research	

Biochemical Imaging Centre Umeå (BICU) Contacts: Professor Richard Lundmark, Director, Head and Coordinator Homepage: https://www.umu.se/en/research/infrastructure/biochemical-imaging-centre-umea-bicu/	BICU
Statement: Advanced light microscopy core facility and national node within correlative imaging	

Swedish Metabolomics Centre (SMC) Contacts: Annika Johansson, PhD, Head of Facility Homepage: https://www.umu.se/en/research/infrastructure/metabolomics/; https://www.swedishmetabolomicscentre.se/	Swedish Metabolomics Centre
Statement: We make knowledge accessible by combining the right expertise and the right instruments based on each researcher's questions	

Appendix 3. Partners of the Coalition Umeå for Life Science (CU4LS)

Integrated Science Lab (IceLab) Contacts: Professor Martin Rosvall Homepage: https://icelab.se/; https://www.umu.se/en/research/infrastructure/integrated-science-lab-icelab/	
Statement: For the love of launching and landing new ideas, we connect researchers from different disciplines and integrate computational modeling, data-driven research, and experiments	

Umeå Marine Sciences Centre (UMF) Contacts: Professor Johan Wikner, Director Homepage: https://www.umu.se/en/umea-marine-sciences-centre/	
Statement: UMF supports marine research and education, and produces status reports of the sea, with special focus on the Gulf of Bothnia	

AI lab for Life Science @KBC (AI Life Science @KBC) Contacts: Professor, Johan Trygg	
Vision statement: Better health for more people Mission statement: Enabling the development of new and better therapies and more affordable medicine	

Nuclear Magnetic Resonance (NMR) KBC Core Facility (NMR Core facility) Contacts: Professor Jurgen Schleucher, Platform Director Homepage: https://www.umu.se/en/research/infrastructure/nmr/	
Statement: The UmU node of the Swedish NMR centre provides access to world-class NMR methods to address fundamental questions in life sciences	

Betula project Contacts: Professor Lars Nyberg , Head of the project; Mikael Stiernstedt, PhD Homepage: https://www.umu.se/en/research/projects/betula---aging-memory-and-dementia/	
Statement: Longitudinal study with the main objectives to study how memory functions change during adult life and old age, to identify risk factors for dementia and to identify early preclinical signs of dementia	

Appendix 3. Partners of the Coalition Umeå for Life Science (CU4LS)

SLU Stable Isotope Laboratory (SSIL) Contacts: Mats Öquist, PhD, Director Homepage: **https://www.slu.se/en/departments/forest-ecology-management/ssil/**	

Molecular ecology laboratory, SLU Contacts: Göran Spong, PhD Homepage: **https://www.slu.se/en/research/research-excellence/research-infrastructure/laboratorier/molecular-ecology-laboratory/**	