



# Cell and Molecular Imaging

### 2 Units:

Cryo-EM (UmU and SU at Solna)

• Cryo-EM national screening network

### Integrated Microscopy Technologies – IMT

- IMT Advanced Light Microscopy (KTH)
- IMT CAT (tomography, GU)
- IMT Focused Ion Beam (tomography, UmU)

#### https://www.scilifelab.se/units/cryo-em/

## National Microcopy Infrastructure

**NMI** was founded in 2016 Financial support from VR-RFI The Swedish Euro-BioImaging Node

### 5 Nodes:

- Super-resolution and Cell profiling (KTH)
- Correlative multimodal imaging (GU)
- Intravital microscopy (SU)
- Correlative light and electron microscopy (UmU)
- Image Analysis (UU)

# LINDA SANDBLAD

- MIMS (Molecular Infection Medicine in Sweden, the Nordic EMBL partners) Team leader
- Director of Umeå Centre for Electron Micorscopy (UCEM)
- SciLifeLab Scientific director for Cell end Molecular Imaging plattform and Umeå Site Director
- NMI, National Microscopy Infrastructure Co-Director of the Umeå Node
- SciLifeLab Site Director at Umeå



### SciLifeLab – Unique instruments and methods for imaging

Resrach Infrastructure



Cutting-edge equipment

+



Highly skilled staff, consisting of ~500 tech experts



Biology needs more staff scientists: independent professionals advance science in ways faculty-run labs cannot go.nature.com/2pRPywi

# SciLifeLab infrastructure from 2021 - platforms and units

#### **Platforms**

#### Organization

PIONEOPMATICS	GENOMICS	Bioinformatics	Clinical Proteomics and Immunology	Cellular and Molecular Imaging
BIOINFORMATICS	GENOMICS	Support, Infrastructure and Training <sup>Chalmers, GU, LU, LU, KI, KTH, NRM, SLU, SU, UmU, UU</sup> Compute and Storage <sup>UU</sup>	Autoimmunity and Serology Profiling <sup>KTH</sup> Affinity Proteomics <sup>KTH, UU</sup> Cellular Immunomonitoring <sup>KI, LIU</sup>	Cryo-EM <sup>SU, UmU</sup> Integrated Microscopy Technologies <sup>KTH, GU, UmU</sup>
CLINICAL GENOMICS	CLINICAL PROTEOMICS & IMMUNOLOGY	BioImage Informatics <sup>UU, KTH</sup> AIDA Data Hub <sup>LiU</sup>	Global Proteomics and Proteogenomics <sup>KI</sup> Glycoproteomics <sup>GU</sup>	Integrated Structural Biology
		Genomics	Metabolomics	Swedish NMR Centre <sup>GU, UmU</sup> Structural Proteomics <sup>LU</sup>
METABOLOMICS	SPATIAL & SINGLE CELL BIOLOGY	Ancient DNA <sup>UU, SU</sup> Microbial Single Cell Genomics <sup>UU</sup> National Genomics Infrastructure <sup>KI, KTH, SU, UU,</sup> <sup>UmU</sup>	Swedish Metabolomics Centre <sup>UmU, SLU, Chalmers</sup> Exposomics <sup>SU</sup>	Chemical Biology and Genome Engineering
				Chemical Biology Consortium Sweden KI, UmU
CELLULAR & MOLECULAR IMAGING	INTEGRATED STRUCTURAL BIOLOGY	Clinical Genomics	Spatial and Single Cell Biology	Chemical Proteomics KI
			Eukaryotic Single Cell Genomics <sup>KI</sup> Spatial Proteomics <sup>KTH</sup> In Situ Sequencing <sup>SU</sup> Advanced FISH Technologies <sup>KI</sup>	Genome Engineering Zebrafish <sup>UU</sup>
		Clinical Genomics Gothenburg <sup>GU</sup>		
		Clinical Genomics Linköping <sup>LiU</sup> Clinical Genomics Lund <sup>LU</sup>		Drug Discovery and Development
CHEMICAL BIOLOGY & ENOME ENGINEERING	DRUG DISCOVERY & DEVELOPMENT	Clinical Genomics Stockholm <sup>KI, KTH</sup>	Spatial Mass Spectrometry <sup>UU</sup>	Integrated units KI, KTH, SU, UU, LU
		Clinical Genomics Uppsala <sup>UU</sup> Clinical Genomics Örebro <sup>ÖRU</sup>		



**Charlotte Stadler** 

# -> Spatial Proteomics

1. Bespoke high-throughput Immunofluorescence

- Sample type: cell lines/primary cells
- **Key applications:** Subcellular protein localization upon various cell conditions
- Hundreds of targets one by one in cells in plate format



### 2. Highly multiplexed imaging



F HUMAN PROTFIN AT

- **Sample type:** tissue sections or cells from human/mouse
- **Key applications:** immune oncology, cardiovascular, inflammation, cell type composition and distribution
- Up to 40 proteins analyzed simultaneously



# Advanced Light Microscopy Node (Stockholm)



#### Nanoscale biological visualisation





#### Single molecule dynamics







Stefan

FCS/FCCS FRET-FCS iFCS STED-FCS



Lightsheet Lattice lightsheet Image analysis

EUROBBIOIMAGING

https://www.scilifelab.se/facilities/alm

# NMI Node in Gothenburg – Centre for Cellular Imaging

### Key research and expertise areas:



### Key Technologies: Correlated Multimodal Imaging

- Super-resolution microscopy: SIM and SMLM
- Electron Microscopy (TEM, SEM, Tomography)
- Functional Imaging (FRET, FRAP, FCS/FCCS)
- CLEM and CAT
- Non-linear microscopy: multiphoton, SHG, THG
- MALDI-IMS
- Microfabrication techniques and 3D-print technology
- Laser Microdissection and Pressure Catapulting
- Image processing and analysis

and more ...

Julia Fernandez-Rodriguez, GU Rafael Camacho, GU

# NMI Node in Stockholm – IntraVital Microscopy

State-of-the-art SP8 multispectral imaging systems



Leica Reference site for

BIOIMAGING

EURO



S/THG imaging

FLIM

S/THG imaging

Microspectroscopy

Deep tissue live-imaging

animals



**Christiane Peuckert** PhD in Neurosicence





Stina Tucker PhD in Neuropathology



plants

Edouard Pesquet PhD in Plant Biology



Authorized to image large variety of samples in various conditions (transgenic, infectious studies, BSL-2,...)

insects

biomaterials cell cultures



**The national Cryo-EM facility,** 2 nodes (Umeå - Stockholm), A network for regional support

- Single particle for structure biology (SPA)
- Electron tomography for cell biology (ET)
- Electron diffractoin of small crystals (MicroED)
- Image processing support (in DDLS)







Ademovirus; Rafie et al., Science Advances (2021)

**Cryo-EM Facility** 

**2 Nodes:** Stockholm University and Umeå University - A new national screening network – UU, GU, LU

#### Instruments:

- 3 x <u>Titan Krios</u> 300 kV, with energy filtered direct electron detectors
- 2 x Cryo-EM screening instruments, <u>Talos Arctica at SU</u>, <u>Glacios</u> at UmU, 200 kV (+ one Glacios at UU)
- Talos L120 kV, for room temperature screening (+ one Talos at GU
- <u>Scios DualBeam</u> FIB-SEM, for Cryo lamella preparation
- Sample vitrification, plunge freezing, Vitrobot all at sites
- High pressure freezing and cryo ultra microtomes







### Cryo-EM project support





Advice on sample preparation in your lab: Cell culture, dissection, fixation, protein purification, storage Biosafety: BSL2 adjustable lab for infection medicine

Cryo-Sample preparation: Plunge freezing, Vitrobot, manual alternatives, HPF, in dehumidified lab environment Storage and transport, Cryo-EM grid screening and data collection support Data transfer: Local storage servers, national transfer via ftp, SciLifeLab Data Center

Image processing: Pre-processing on the fly, local workstations, connection to national clusters - Presto

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# **Cryo-EM – Single particle**





### Scios DualBeam - Focused Ion Beam Scanning Electron Microscopy

A focused ion beam inside an SEM mill away the surface of the sample allowing a new area to be visible for the scanning beam. Sequential milling/scanning creates a 3D-volume of the sample.

#### Contact: Sara.Henriksson@umu.se

SciLifeLab





Slice and view by FIB-SEM





