

DEPARTMENT OF BIOTECHNOLOGY

WHAT IS BIOTECHNOLOGY ?

- Biotechnology is essentially the product of interaction between the science of biology and technology.
- Biotechnology is as old as human civilization.
- The term biotechnology was introduced in 1917 by Karl Ereky, a Hungarian Engineer.

Ereky defined biotechnology as *“all lines of work by which products are produced from raw materials with the aid of living things”*.

GHENT UNIVERSITY = CRADLE OF BIOTECHNOLOGY

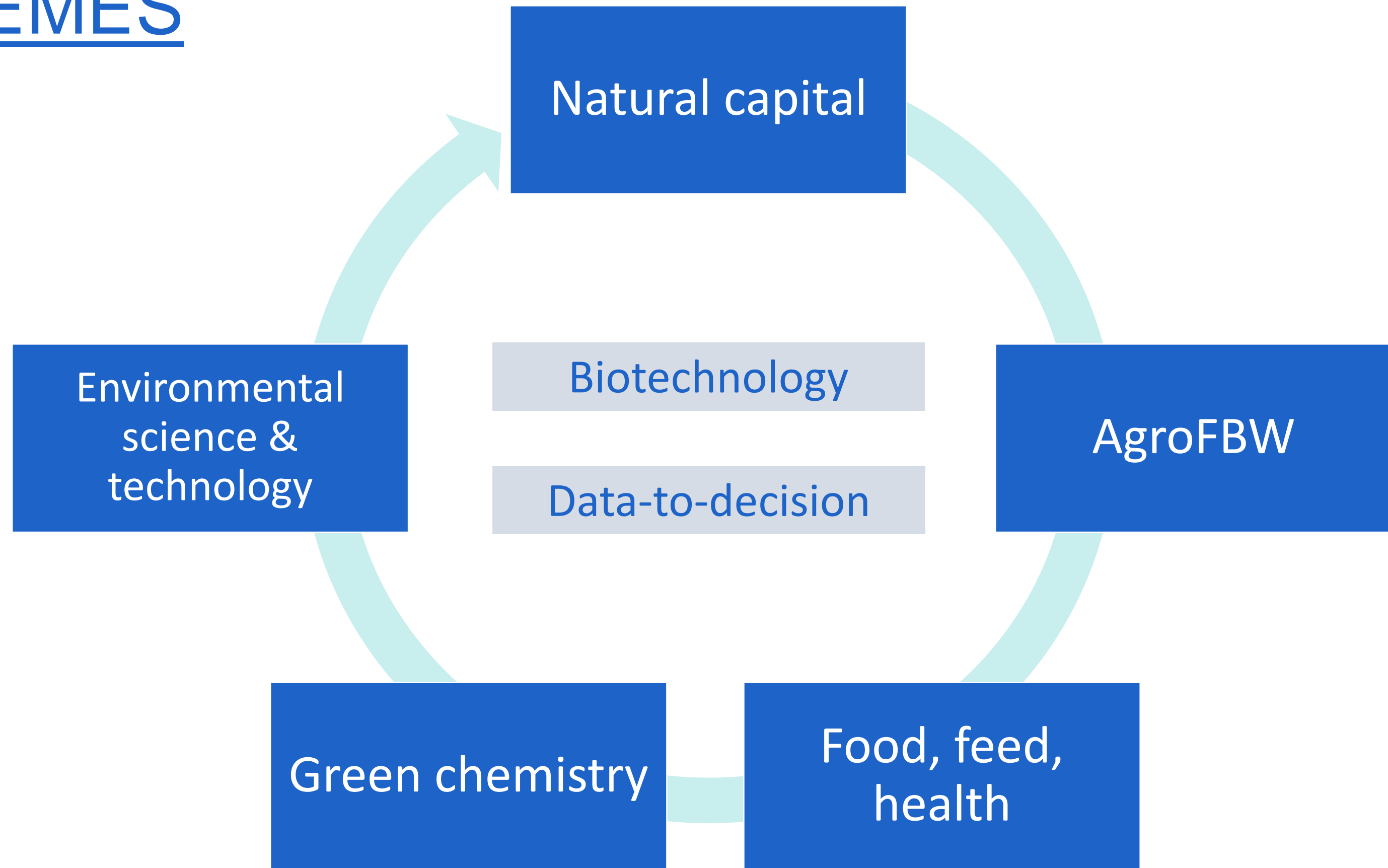
- Plant biotechnology :
Prof. Jeff Schell[†] and
em. Marc Van Montagu
- Medical biotechnology :
Prof. em. Walter Fiers





FACULTY OF BIOSCIENCE ENGINEERING

THEMES



DEPARTMENT OF MOLECULAR BIOTECHNOLOGY

- 2000: new department of Molecular Biotechnology LA14.
- Founders: Prof. Erick Vandamme, Prof. P. Van Oostveldt,
Prof. G. Gheysen.
- Members: +1 ATP & 1 AAP.
- Later: changing ZAP-crew, ca. 4 on average.

DEPARTMENT OF BIOTECHNOLOGY

- 2017: reorganisation of the departments at FBW
- Discussion at the faculty: do we really need a biotechnology department ?!
- Finally: BW25

DEPARTMENT OF BIOTECHNOLOGY

- New entity starting January 1st 2018
- G. Gheysen, currently head of department
- 240 people in total
- 24 professors
- 28 permanent administrative and technical staff
- 175 scientific staff (120 PhD, post-doc)
- Merge of research groups in different biotechnology fields.

TRADITIONAL BOUNDARIES: THE COLORS OF BIOTECHNOLOGY



White Biotechnology = industrial biotechnology
e.g. low resource consuming processes, sustainable energy sources



Green Biotechnology = agricultural biotechnology
e.g. development of plants resistant to insects, diseases



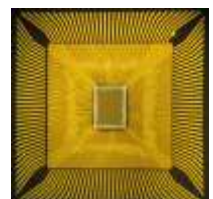
Grey Biotechnology = environmental biotechnology
e.g. biodiversity maintenance, contaminants removal



Red Biotechnology = medical biotechnology
e.g. production of protein drugs



Blue Biotechnology = marine biotechnology
e.g. increasing seafood supply and safety



Gold Biotechnology = Bio-informatics



RESEARCH UNITS

CMET



CMET STAFF

Professors



Support Staff



~ 80 staff
~20 postdocs
~40 PhD
~10 support
~30 master students

CMET: HISTORY

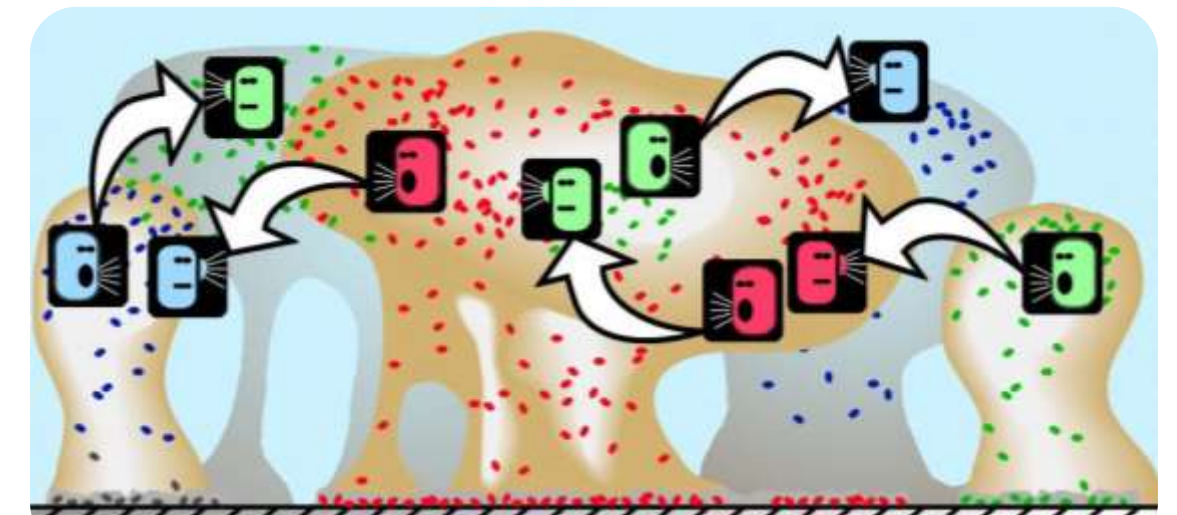
- Former Department: BW06 “*Biochemical and Microbial Technology*”
- CMET was founded in 1977 as LME “*Laboratory of Microbial Ecology*”
- Became LabMET “*Laboratory of Microbial Ecology and Technology*” around 2000
- Under the initial lead of em. prof. dr. ir. Willy Verstraete until 2011
(*present chairman of FWO*)
- In 2016 the name changed into CMET
“*Center for Microbial Ecology and Technology*”
- Published ~100 A1 publications in 2017

CMET RESEARCH

CMET researchers study microbial communities & interactions to better understand and steer ecological processes with an ultimate aim of improving and enabling biotechnological applications

Research domains

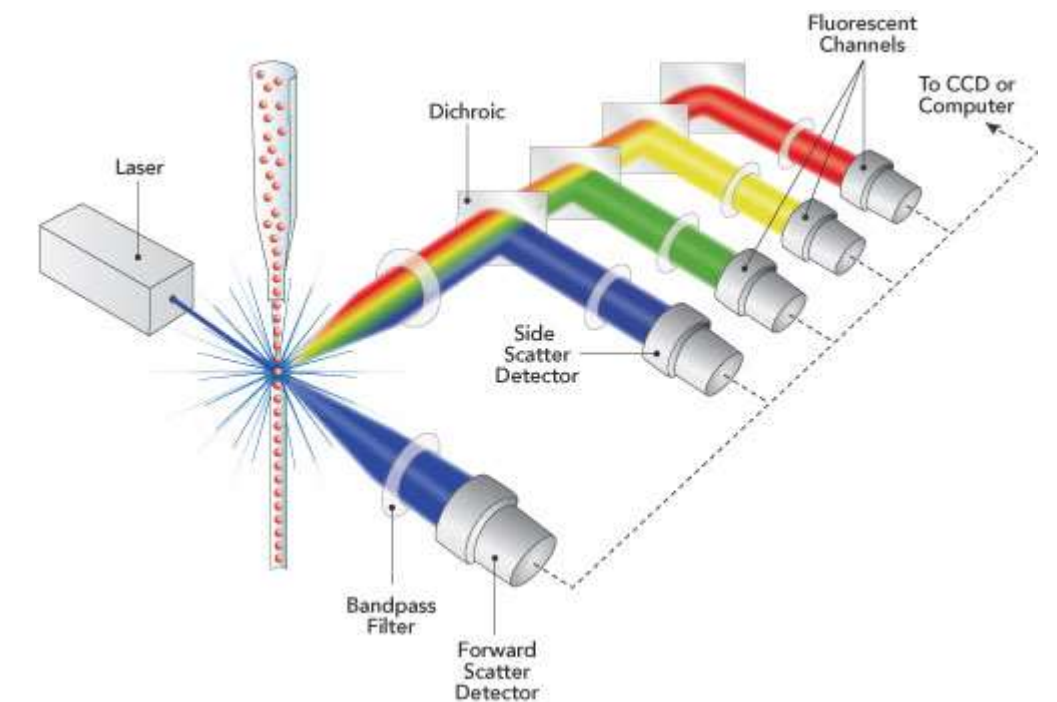
- Applied Microbial Ecology
- Host-Microbe Interaction
- Life Support Systems for Space
- Resource Recovery and Valorization
- Water Treatment and Production
- Microbial Electrocatalysis & Electrochemical Engineering
- Microbial Resource Management (composition & activity of microbial communities)



Microbes as multicellular organisms

CMET: FACILITIES

- Technology hall (fermentation, electrochemistry, wastewater treatment), reactor labs
- SHIME Lab, cell culture lab
- Microbiology and molecular biology labs, with focus on analysis and steering of microbial community composition and activity, both aerobic and anaerobic
- Flow cytometry lab
- Analytics:
 - IC: *cations, anions, S components, organic acids*
 - GC: *SCFA, Biogas, alcohols,*
 - HPLC
 - AAS, VSS, TSS, BOD, COD, Kjeldahl nitrogen, ...





CMET SERVICES

- Applied microbial ecology services
- Microbial electrocatalysis services
- Host microbe interactions services
- Anaerobic digestion and fermentation services
- Biological nitrogen management services
- Biomaterials & nanotechnology services



CMET TOMORROW

- Growth due to increase in academic staff
- Will move to Proeftuinstraat with department in 20xx
- One of founding labs of CAPTURE



Visual of the new CAPTURE building



*Visual of Eiland Zwijnaarde, part of Tech Lane
Ghent Science Park*



**CENTRE FOR ADVANCED PROCESS TECHNOLOGY FOR
URBAN RESOURCE RECOVERY**

<http://capture-resources.be>

Research domains in CAPTURE

- **CO₂ TO PRODUCT**
- **WATER 'FIT-FOR-USE'**
- **PLASTICS TO RESOURCE**

CSB

CSB STAFF

Professors



Marjan De Mey
(*metabolic engineering*)



Tom Desmet
(*enzyme engineering*)



Inge Van Bogaert
(*membrane engineering*)

Technical and administrative staff



Gilles Velghe
(*lab manager*)



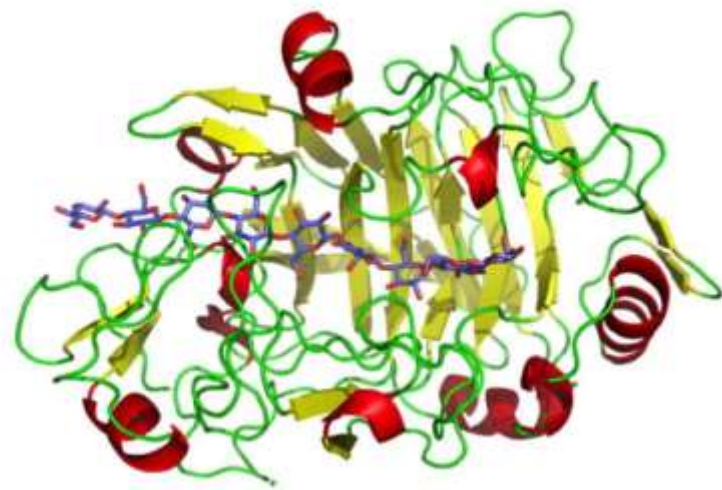
Dominique Delmeire
(*administration*)



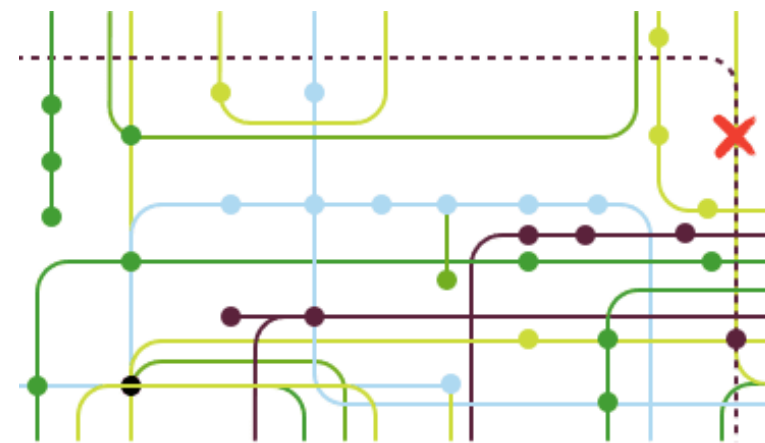
31 persons in total
(*excl. students and interns*)

CSB'S MISSION

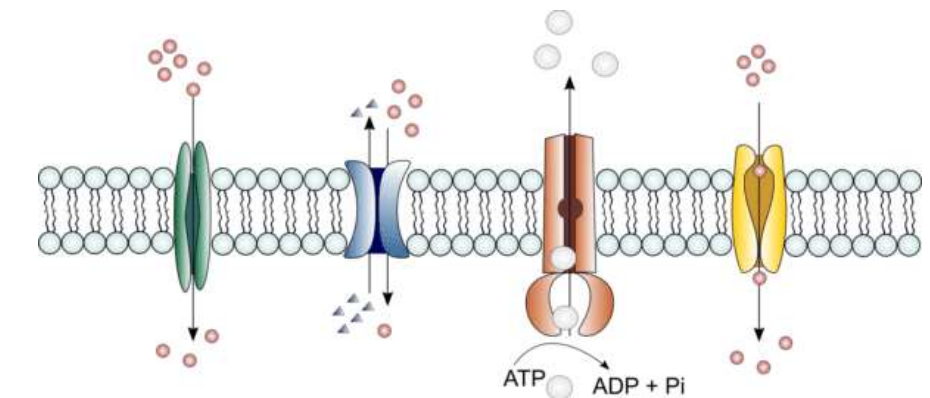
Synthetic biology =
artificial (re)design of biological systems for practical applications



Enzyme engineering
new or improved specificities



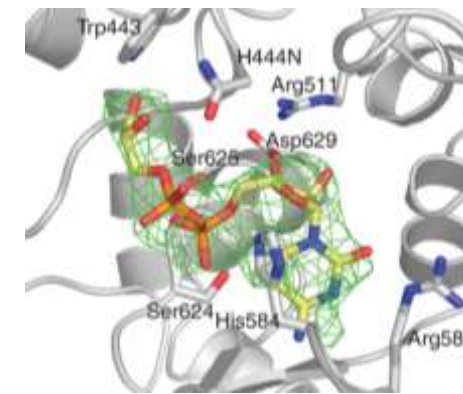
Metabolic engineering
new or improved pathways



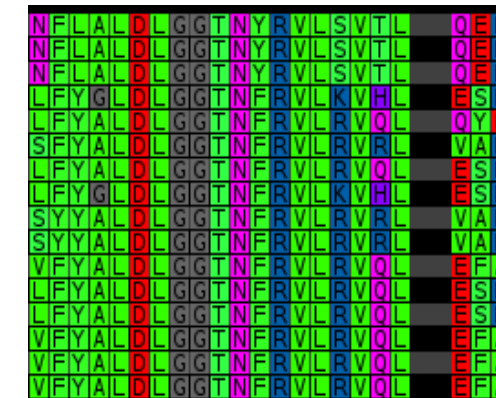
Membrane transport engineering
removing the barrier for substrate/product

(1) Hotspot analysis of enzymes

= targets for mutagenesis



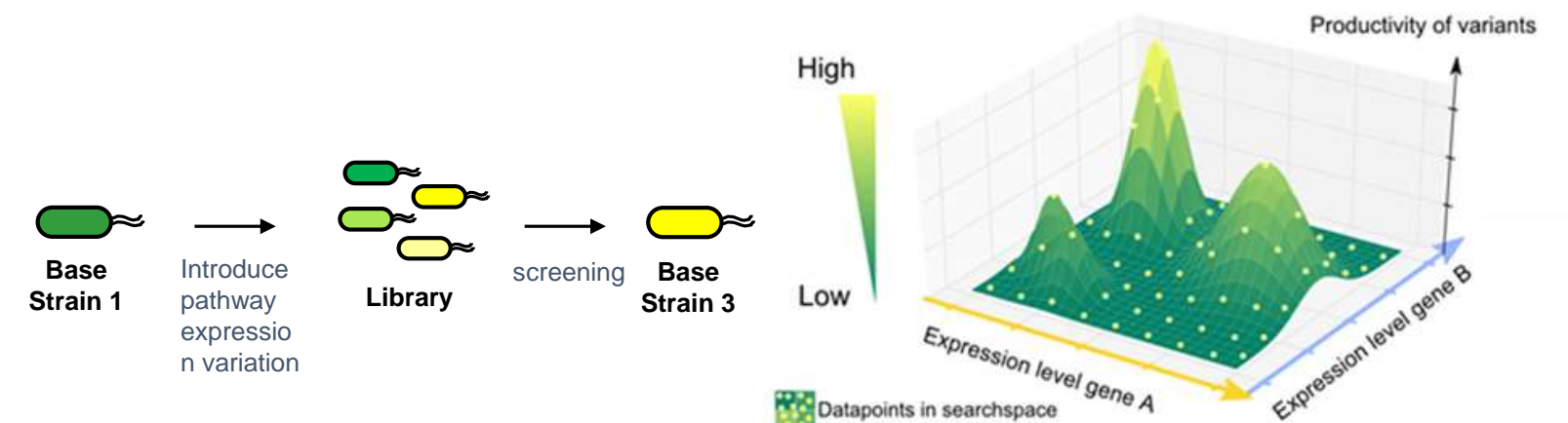
modeling/docking



correlated positions

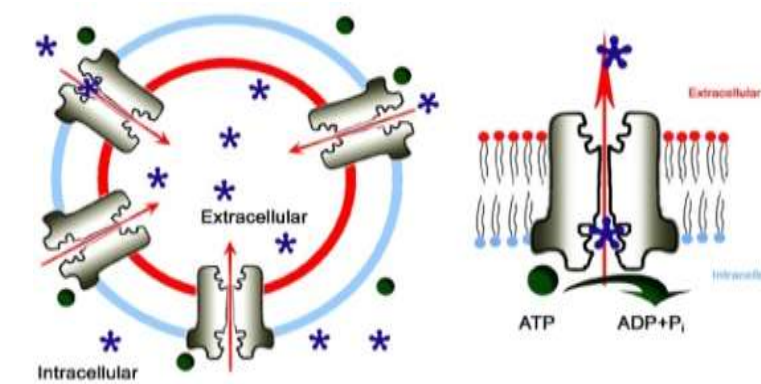
(2) Microbial cell factory design

= combinatorial and rational engineering



(3) Transporter incorporation

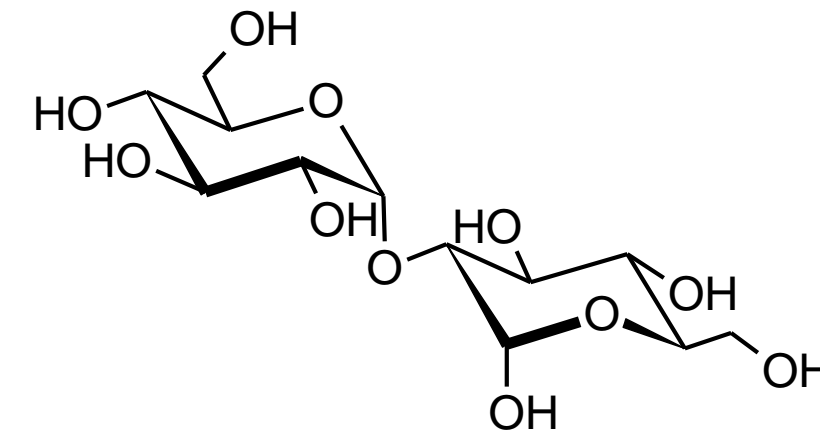
= evaluation and localization



Inside-out vesicles

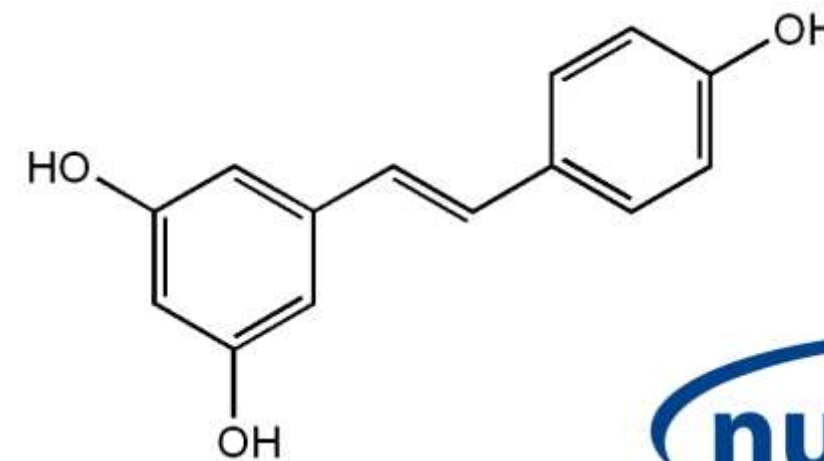
(1) Specialty carbohydrates

= healthier sugars, prebiotics, pharmaceuticals...



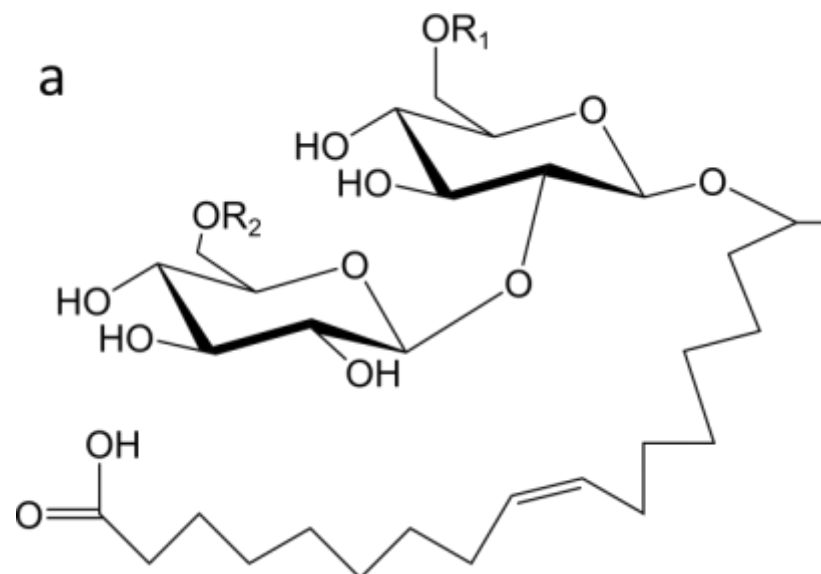
(2) Secondary metabolites

= polyphenolics, flavonoids,...



(3) Amphiphilic glycolipids

= biological detergents

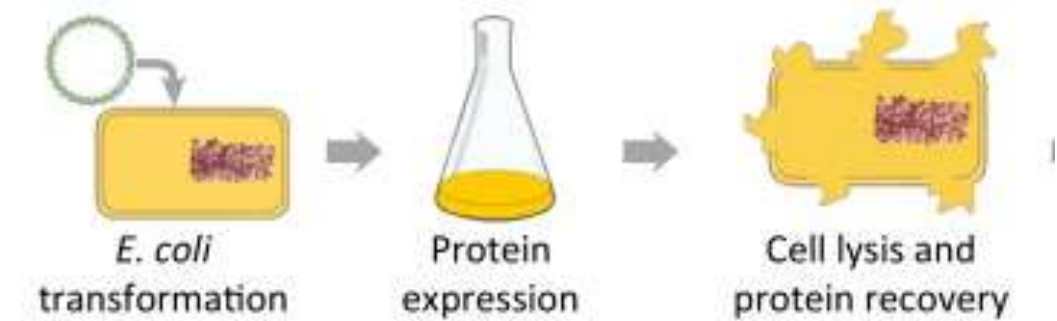
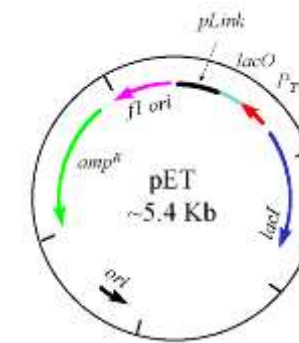


Recombinant protein **expression**

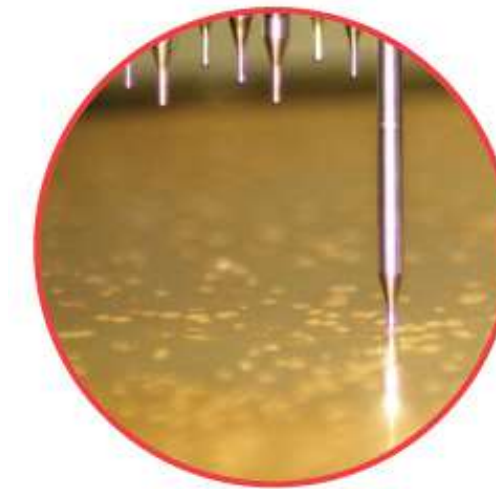
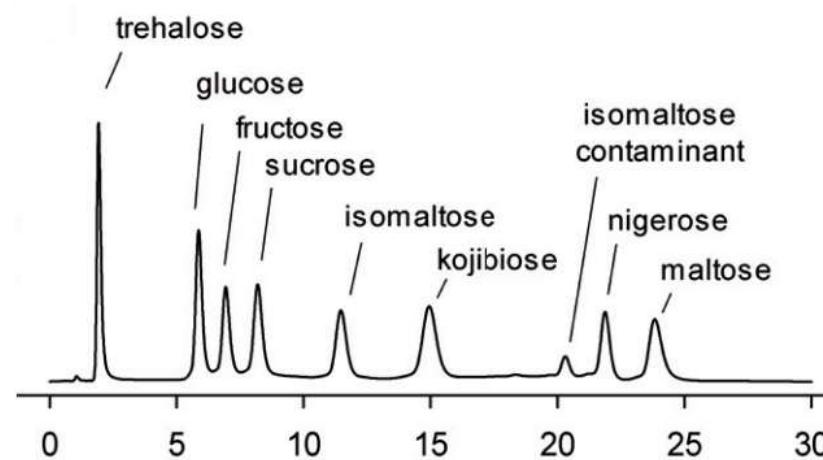
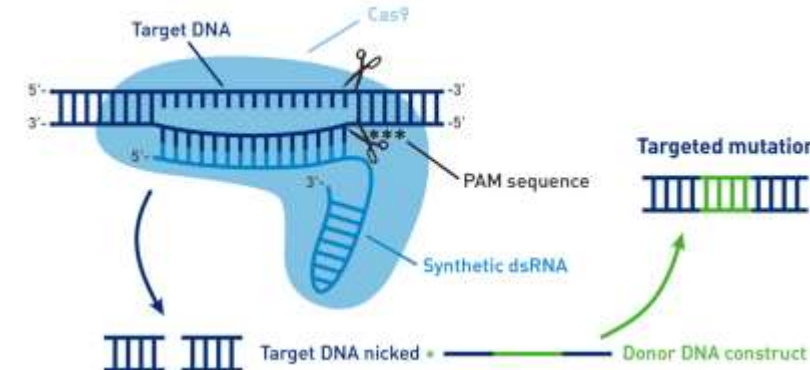
Microbial strain **modification**

High-throughput **screening**

Carbohydrate analysis



Basic DNA editing using CRISPR/Cas systems



InBio.be

InBio.be STAFF

Professor



3 PostDocs
13 PhD Students/Scientific Researchers
1 Assistant

Lab management and research coordination

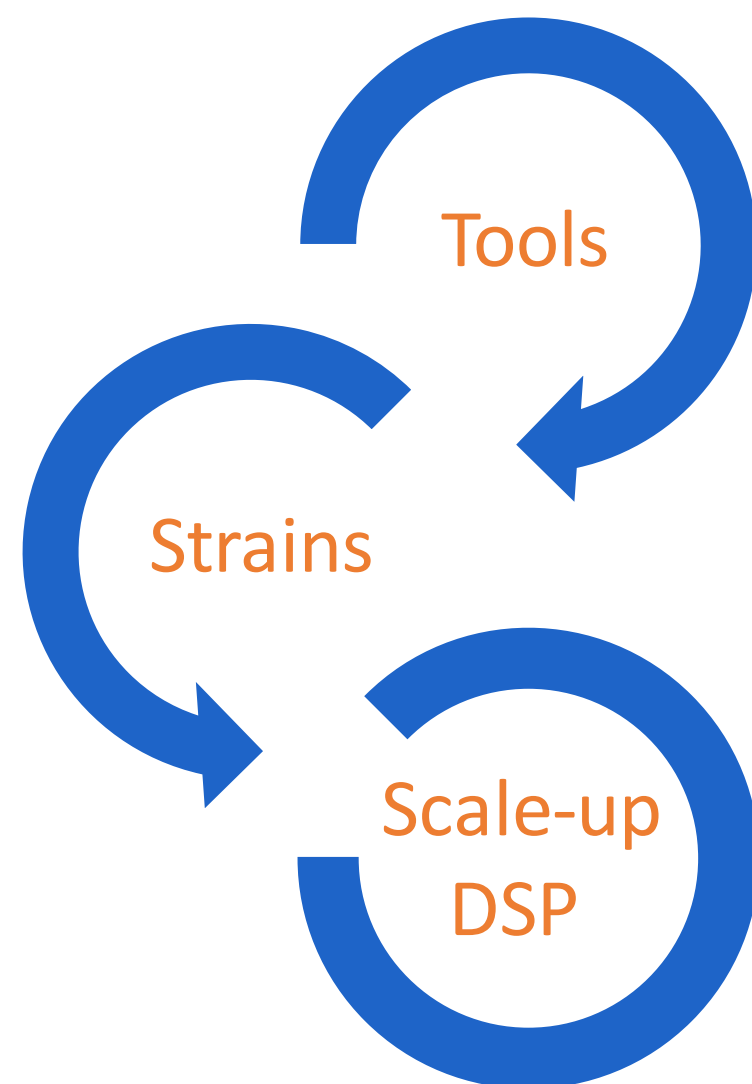


InBio.be HISTORY



- Formerly LIMAB: Laboratory of Industrial Microbiology And Biocatalysis
- Together with CMET: Department of Biochemical and Microbial Technology
- Headed by Prof. Erick Vandamme
- Prof. Wim Soetaert appointed since 2004
- Close collaboration with industry
- Almost 20 years of experience in specialty carbohydrate bio-engineering
- Strong track record in metabolic engineering and biocatalysis

InBio.be RESEARCH strategy



Industrial biotechnology: Integrated process development

At InBio.be white biotechnology approaches are applied to develop bio-based production processes for high-value, complex chemical compounds, using microbial cell factories.

State of the art interdisciplinary techniques are applied in an integrated approach, combining synthetic biology based tool-, strain- and process development.

InBio.be: current RESEARCH focus



Biosurfactants and active glycolipids

- Applied in almost every aspect of modern daily life
- Pioneering role in domesticating the workhorse *Starmerella bombicola*



Human milk oligosaccharides

- Contribute to the baby's health and brain development
- Now commercialized at our spin-off company Inbiose



Aminoglycosides

- Treatment of orphan diseases, broad-spectrum antibiotics, anti-virals
- Started to develop a platform technology for their versatile production

InBio.be SERVICES & EQUIPMENT

When interested in collaborations

When interested in using our equipment

=> InBio@UGent.be



MOBI

MOBI STAFF

Professors



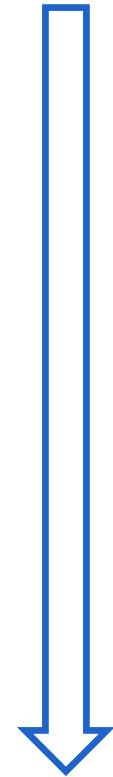
Technical and administrative staff



In total 54 persons

MOBI'S HISTORY

- Former *Department of Molecular Biotechnology*, founded in 2000



- [Applied Molecular Genetics](#), Prof. Dr. Godelieve Gheysen
- [Biochemistry and Glycobiology](#), Prof. Dr. Els Van Damme
- [Cell Systems and Imaging](#), Prof. Dr. Winnok De Vos
- [NanoBioTechnology](#), Prof. Dr. Andre Skirtach
- [Epigenetics and Defence](#), Prof. Dr. Tina Kyndt

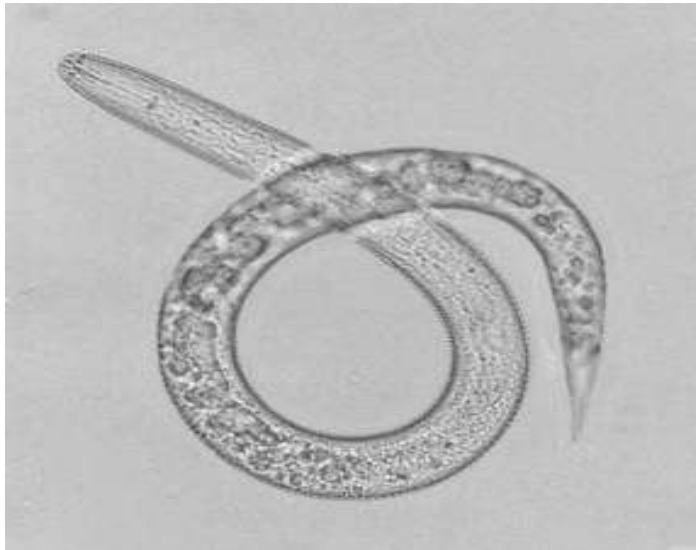


MOBI RESEARCH

The research unit **Molecular Biotechnology** brings together different teams active in the area of **biotechnology on eukaryotic cells**. The research makes use of molecular techniques and specialized microscopy, and aims for agricultural and biomedical applications

Research domains

- [Applied Molecular Genetics](#), Prof. Dr. Godelieve Gheysen
- [Biochemistry and Glycobiology](#), Prof. Dr. Els Van Damme
- [NanoBioPhotonics](#), Prof. Dr. Andre Skirtach
- [Epigenetics and Defence](#), Prof. Dr. Tina Kyndt
- [Cell Systems and Imaging](#), Prof. Dr. Winnok De Vos, Prof. Dr. Sarah Baatout (guest professors)



Expression analysis of plant genes in nematode feeding cells and the role of these plant genes in supporting nematode infection

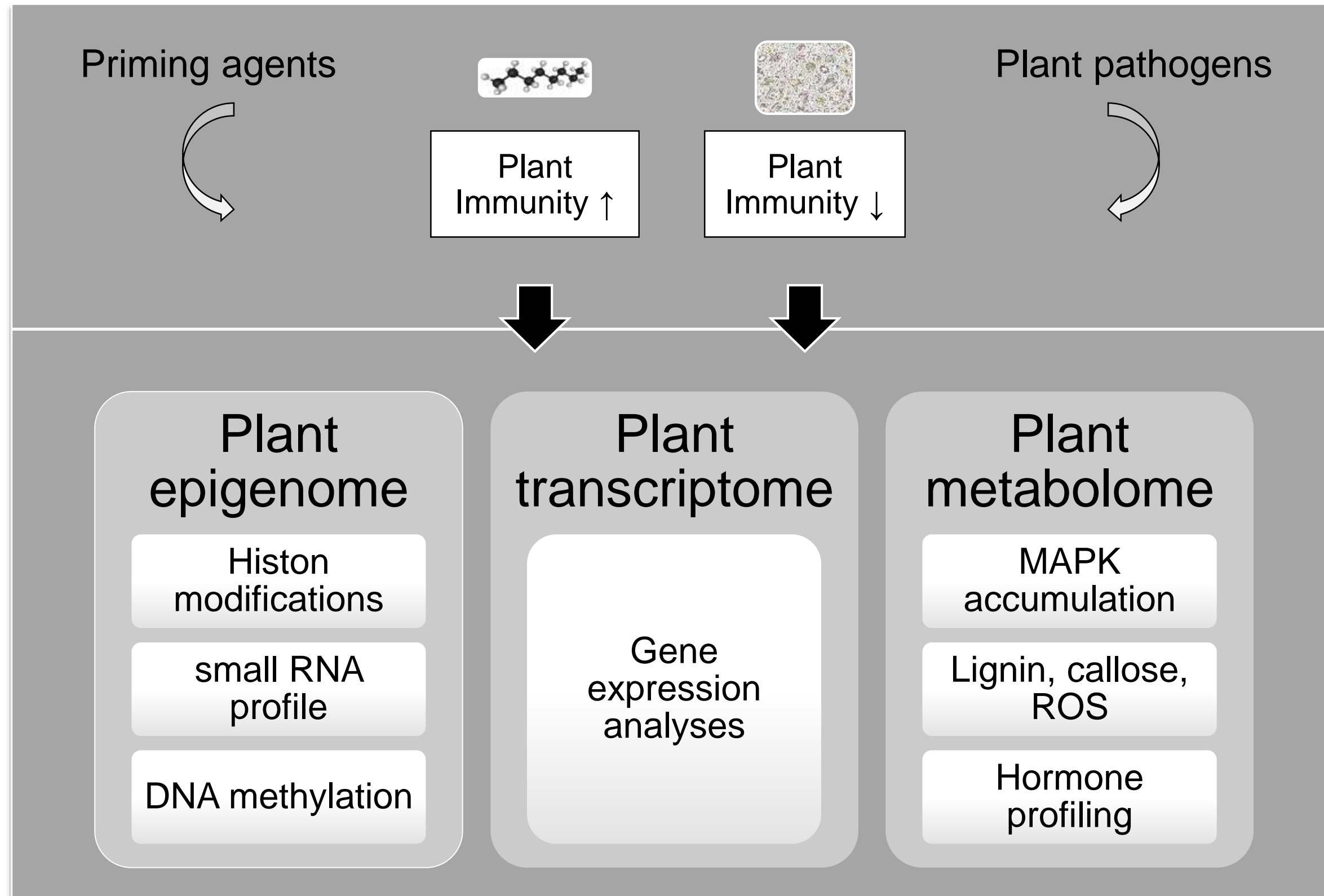
The role of plant hormones in defense and nematode feeding development

Analysis of nematode effectors involved in parasitism

Development of methods to block the compatible plant-parasite interaction.

Development, analysis and consumer acceptance of GMOs







Physiological role of lectins (sugar-binding proteins) in plants ?
Protein-carbohydrate interactions in plant signaling or plant protection.
Protein-RNA interactions



Stress
resistance ?

Inducible plant
defence
mechanisms ?

Stress
Signaling ?

Nanotechnology and material science for bridging photonics, imaging and biotechnology

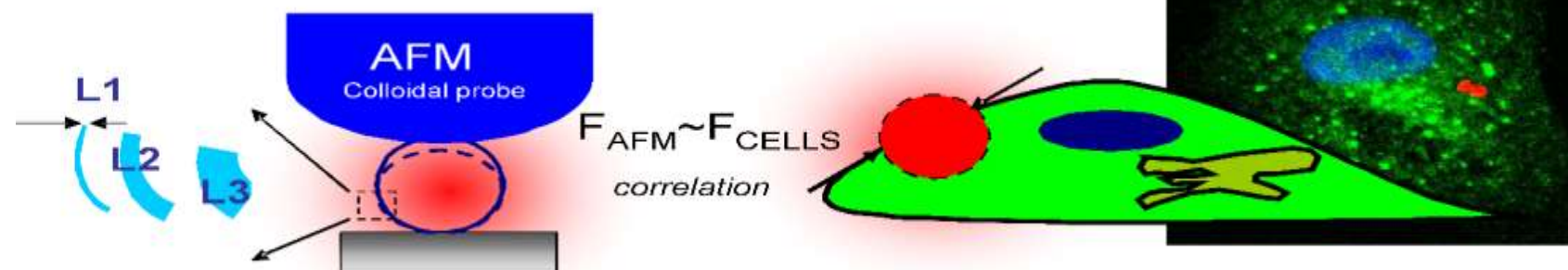
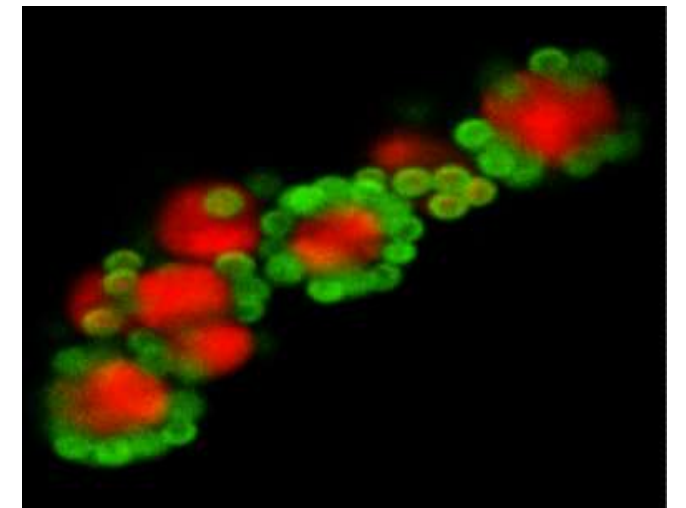
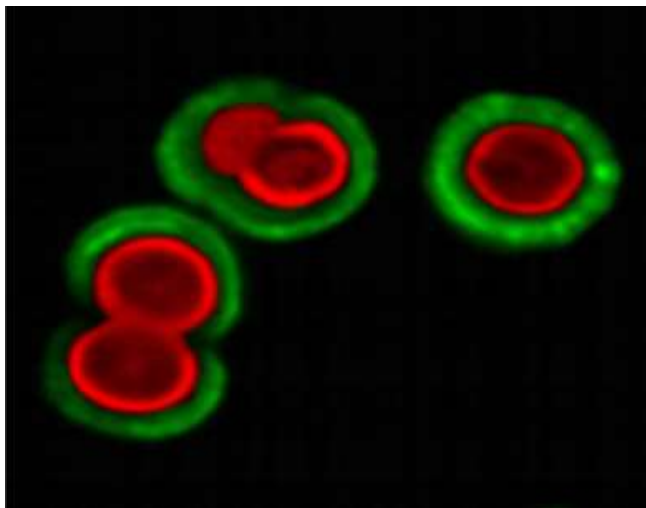
Development of next
generation carriers for
cells and eventually in-vivo

Coatings for tissue
engineering

Label-free Raman and
fluorescence microscopy

AFM applications for
mechanobiology

Calcium carbonate
particles for encapsulation,
protection of enzymes and
environment



Cell biology of
accelerated ageing
diseases (e.g.,
progeria)

Methods: genome
editing, molecular
profiling and deep
coverage microscopy

Radiation induced (neuro-)ageing
in collaboration with
Prof. Sarah Baatout (SCK Mol)



MOBI SERVICES & EQUIPMENT

- Specialised laboratory equipment :
 - PCR, qPCR, pipeting robot
 - Phosphor imager
 - Fully automated fluorescent widefield microscope, incl. cell incubator, micromanipulator, EM-CCD camera, automated multi-parameter image acquisition software
 - Fully automated confocal microscope, incl. cell incubator, 4-channel discrete filters detector, spectral detector, galvano + resonant scanner, automated multi-parameter image acquisition software
 - Raman microscope
 - Fourier Transfer InfraRed spectrometry (FTIR)
 - Atomic Force Microscope (AFM)
 - General purpose (stereo-)microscopes

MOBI SERVICES & EQUIPMENT

- Nematicidal assays, bio-assays with different crops and nematodes
- State-of-the-art microscopy lab for life cell imaging, part of Center for Advanced Light Microscopy



MOBI TOMORROW

Campus Proeftuin N1, mid 2020 ???

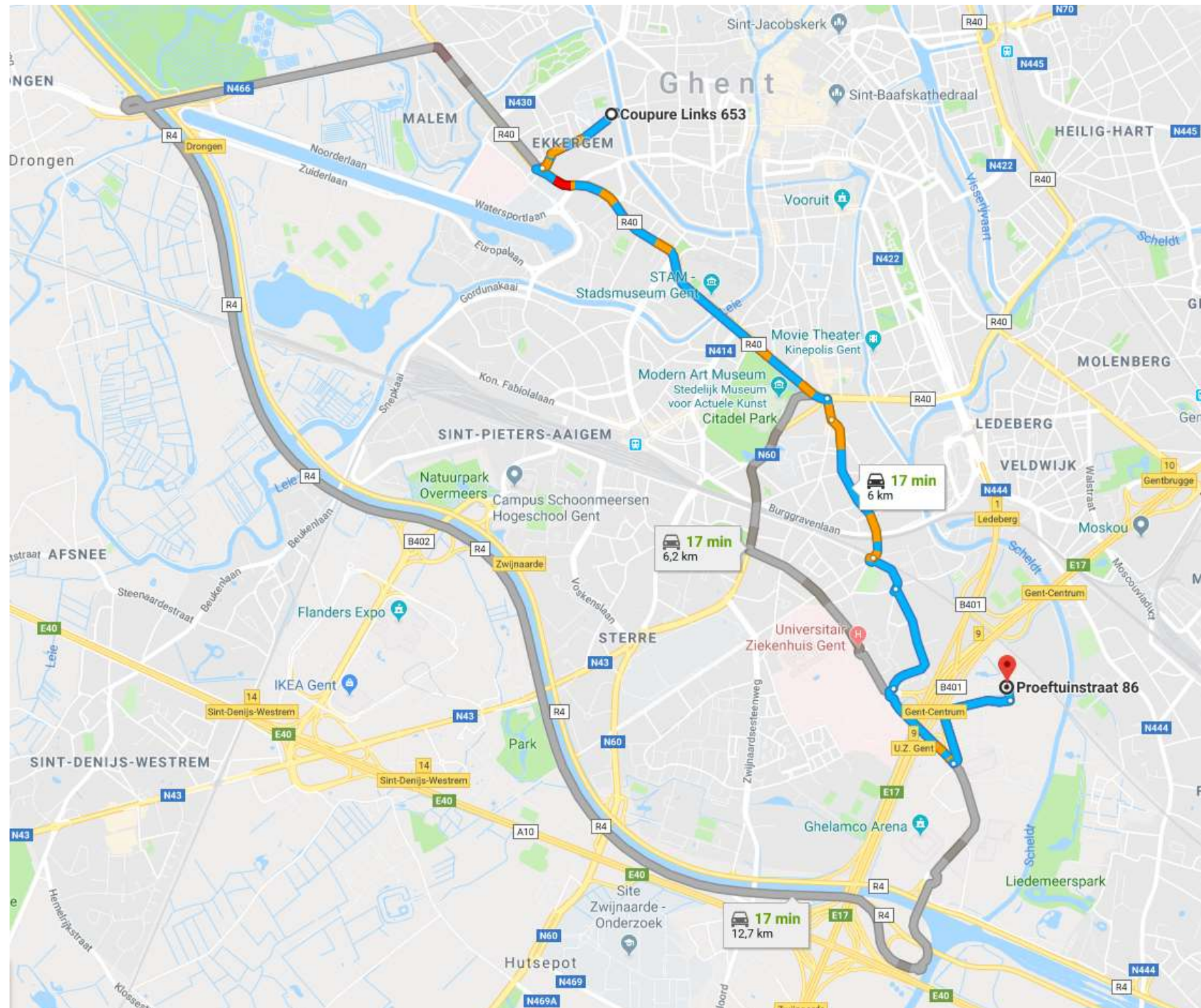


N1



MOBI TOMORROW

Campus Proeftuin N1, mid 2020 ???



SCHOONMEEERSEN

SCHOONMEERSEN STAFF

Professors



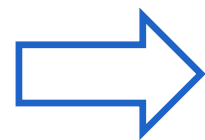
Technical and administrative staff



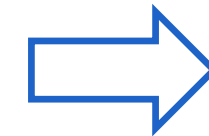
In total 25 persons

SCHOONMEERSEN'S HISTORY

Since AY 2013-2014

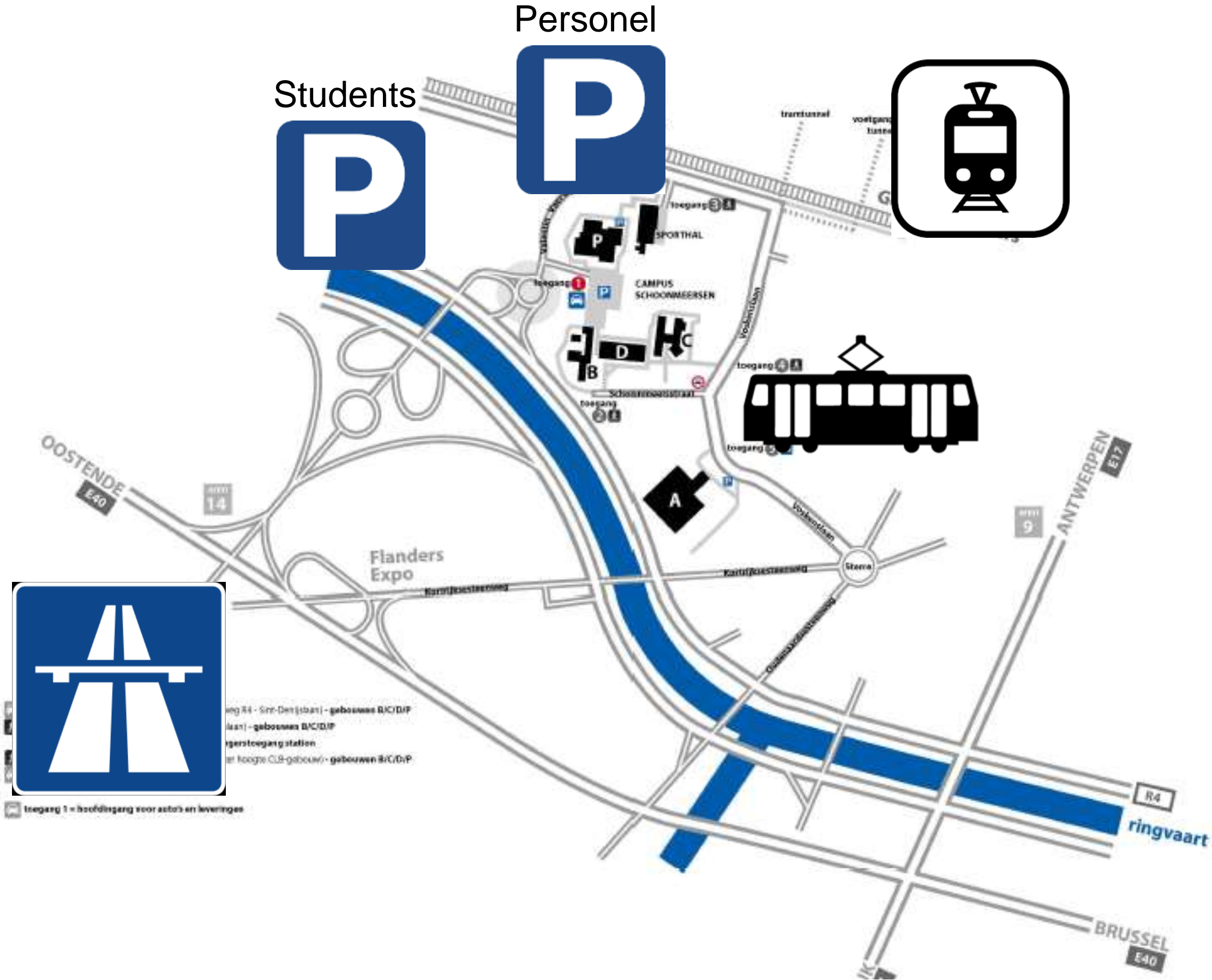


Bachelor of Science in Bioscience Engineering Technology
Master of Science in Biochemical Engineering Technology
Master of Science in Bioscience Engineering Technology of Food Industry



- Boosting of academic research: # researchers +100%, # publications +250% in 5 years
- Education of application engineers: # students +200% in 5 years

SCHOONMEERSEN'S HISTORY



SCHOONMEERSEN'S HISTORY



SCHOONMEERSEN'S HISTORY



SCHOONMEERSEN RESEARCH

Diverse laboratories in the field of biotechnology,
focusing on applied research and
covering diverse work fields of the industrial engineer

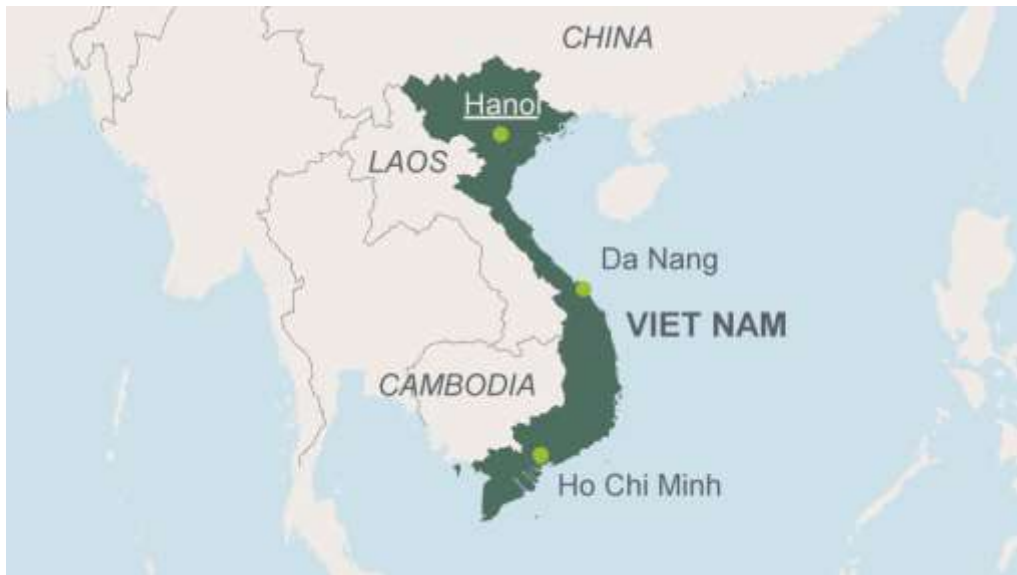
Research domains

- Agro & Food Biotechnology (prof. Kathy Messens)
- Environmental Biotechnology & Applied Microbiology (prof. Leen De Gelder)
- Enzyme Engineering & Synthetic Biology (prof. Yves Briers)
- Brewing Technology (prof. Jessika De Clippeleer)

PROF.

KATHY MESSENS

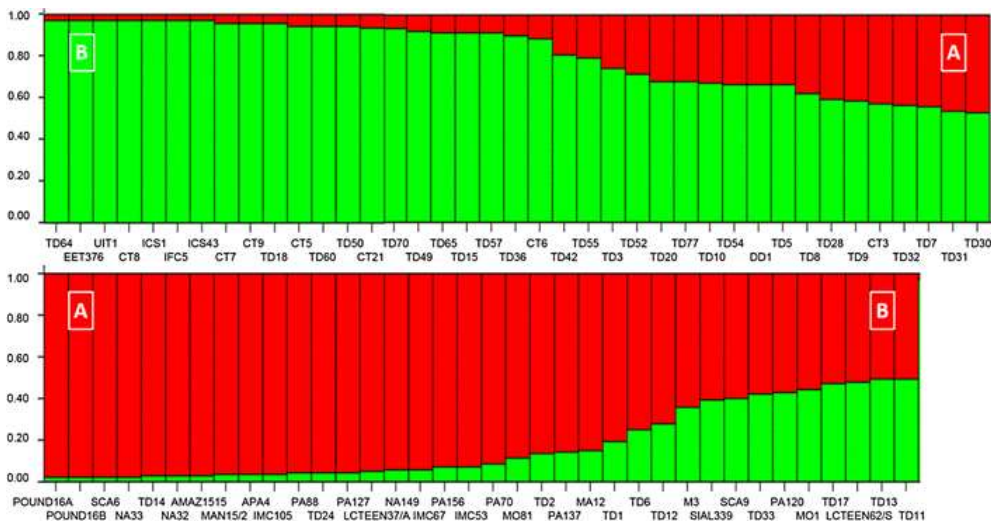
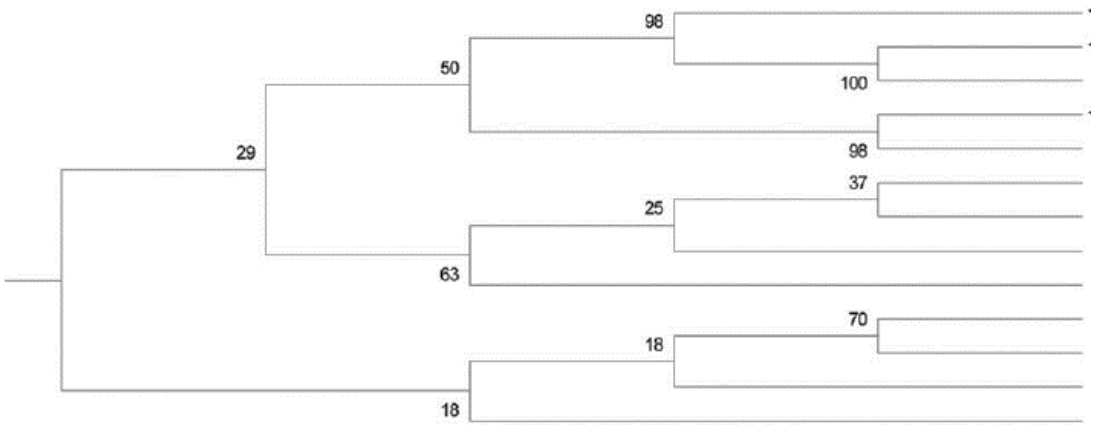
PHYLOGENETIC TYPING AND MOLECULAR CHARACTERIZATION OF CACAO VARIETIES



Viet-Nam



Ecuador



PROF.

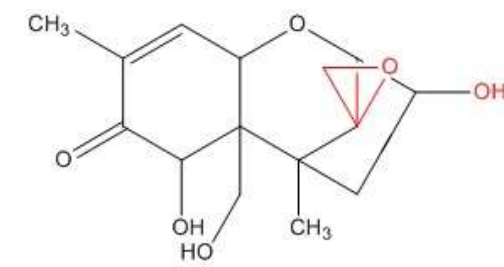
LEEN DE GELDER

ENVIRONMENTAL BIOTECHNOLOGY & APPLIED MICROBIOLOGY

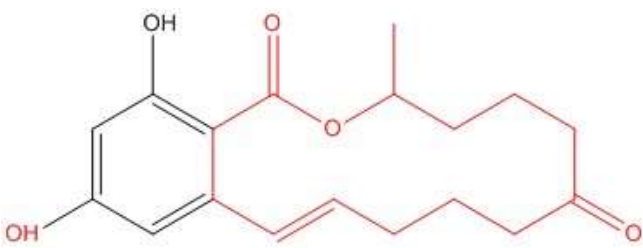
APPLICATION OF STRAINS AND ENRICHMENT CULTURES FOR:

Biodegradation and detoxification

MYTOX



50 mg/L DON

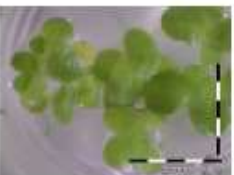


Sterile control ¹



32 ± 3 ^b

Soil

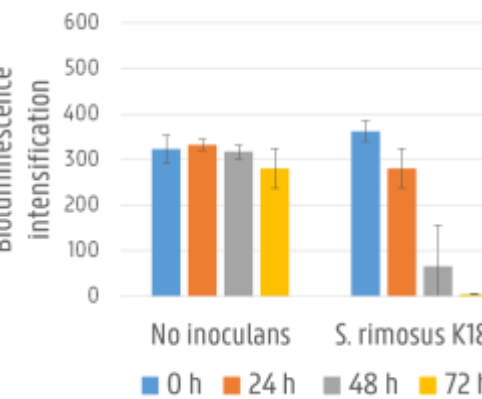
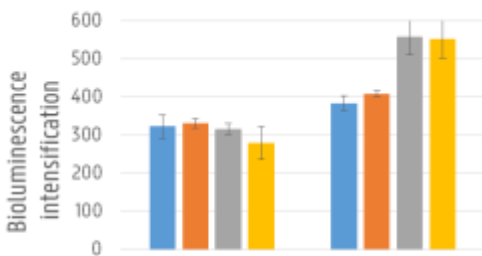


90 ± 3 ^a

Activated sludge



83 ± 3 ^a



Biostimulants and biocontrol

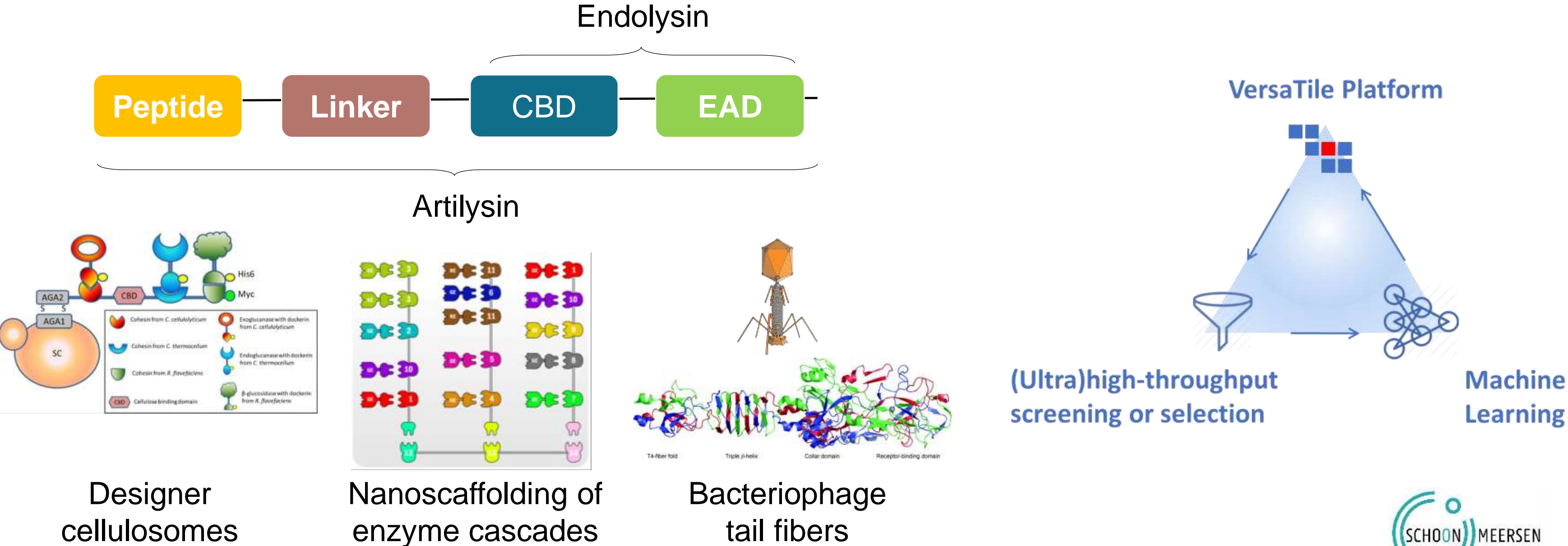
Cropfit



SCHOONMEERSEN RESEARCH

PROF.
YVES BRIERS

SYNTHETIC BIOLOGY OF MODULAR PROTEINS WITH APPLICATIONS IN MEDICAL, INDUSTRIAL AND AGRICULTURAL INDUSTRY



PROF.

JESSIKA DE CLIPPELEER

BREWING TECHNOLOGY

APPLIED-TECHNOLOGICAL STUDIES



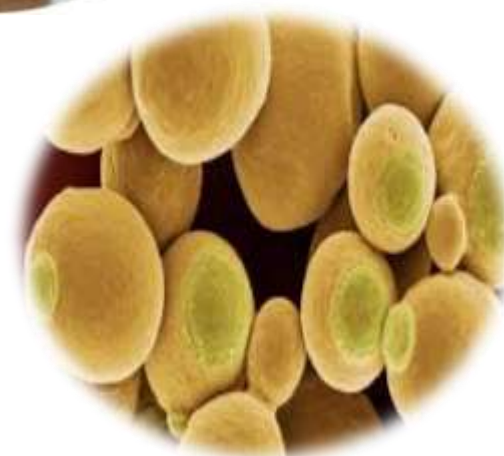
FUNDAMENTAL ASPECTS



Influence of the raw materials
and brewing practices



on the quality and
stability of our beers



Factors affecting wort fermentation

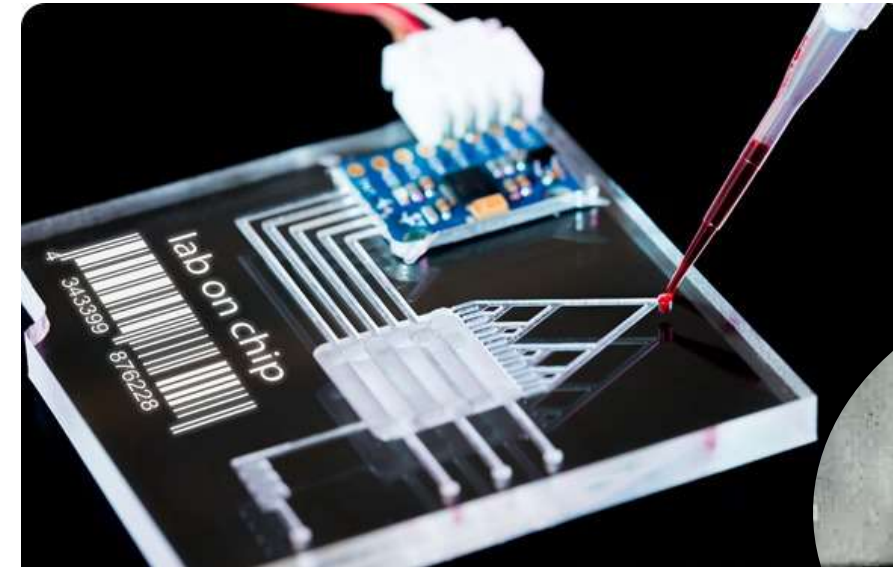
Monitoring brewer's yeast behaviour
during fermentation

Defining promising targets
for significant prolongation
of beer flavour stability

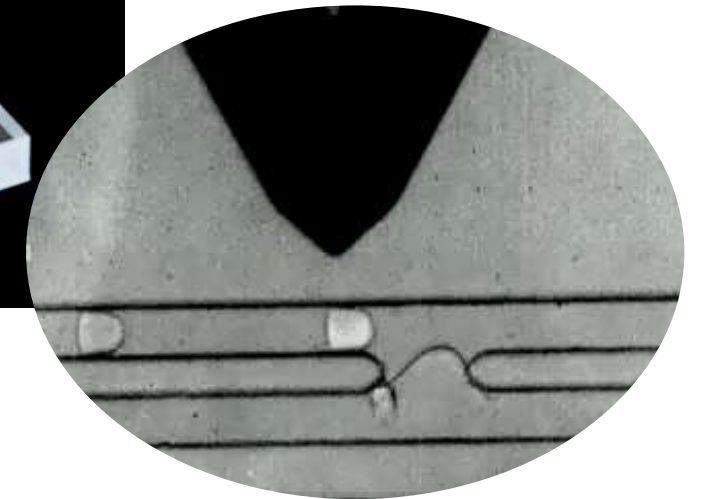
SCHOONMEERSEN SERVICES & EQUIPMENT



Brewery pilot installation



Lab on chip – microdroplet platform
(under construction)

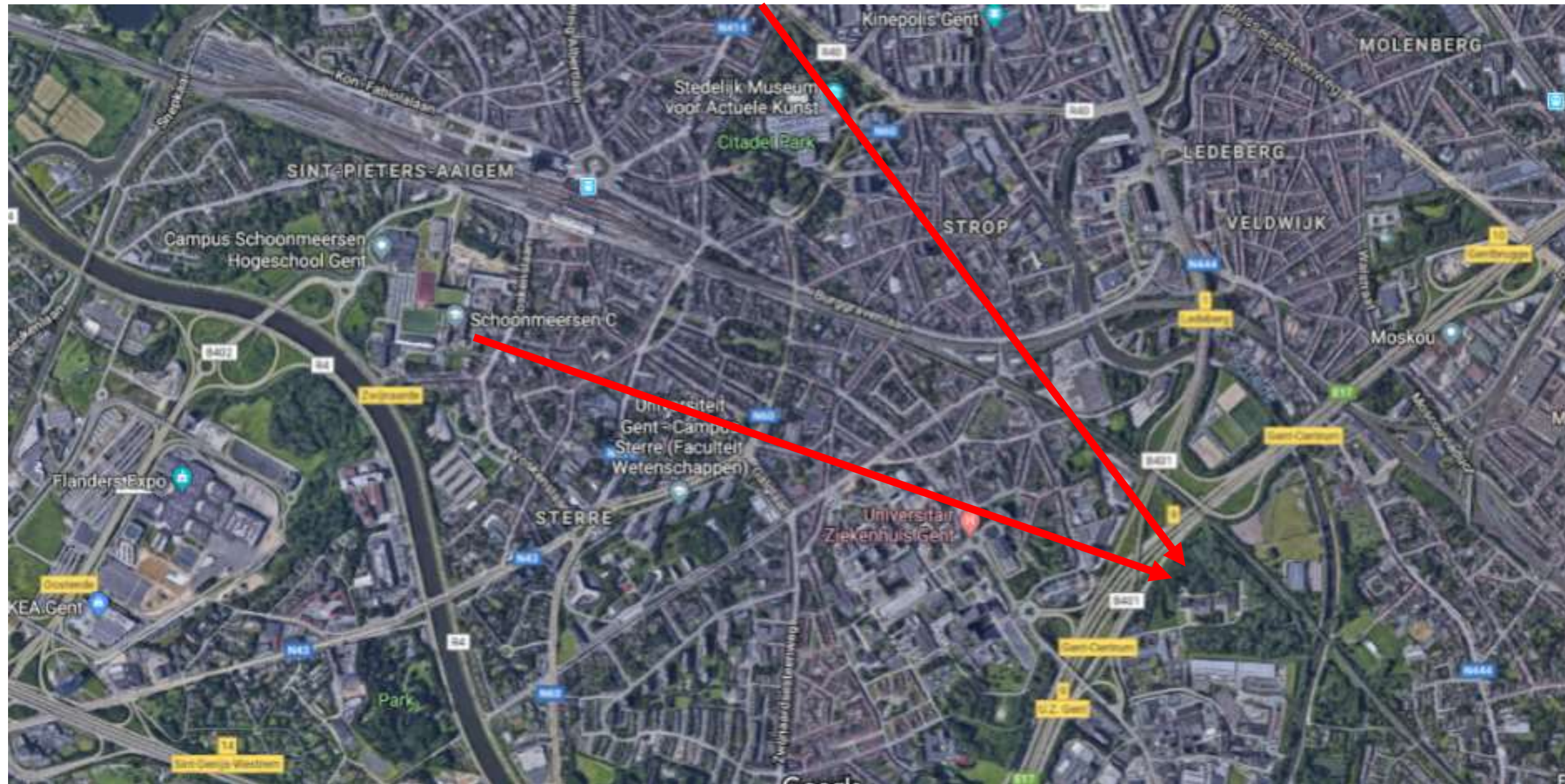


Capillary electrophoresis for DNA
fingerprinting and sugar profiling



Pilot installation for waste water treatment

SCHOONMEERSEN TOMORROW



2023: Move to Campus Proeftuin (2nd wave): Ultimate integration