Imperial College London

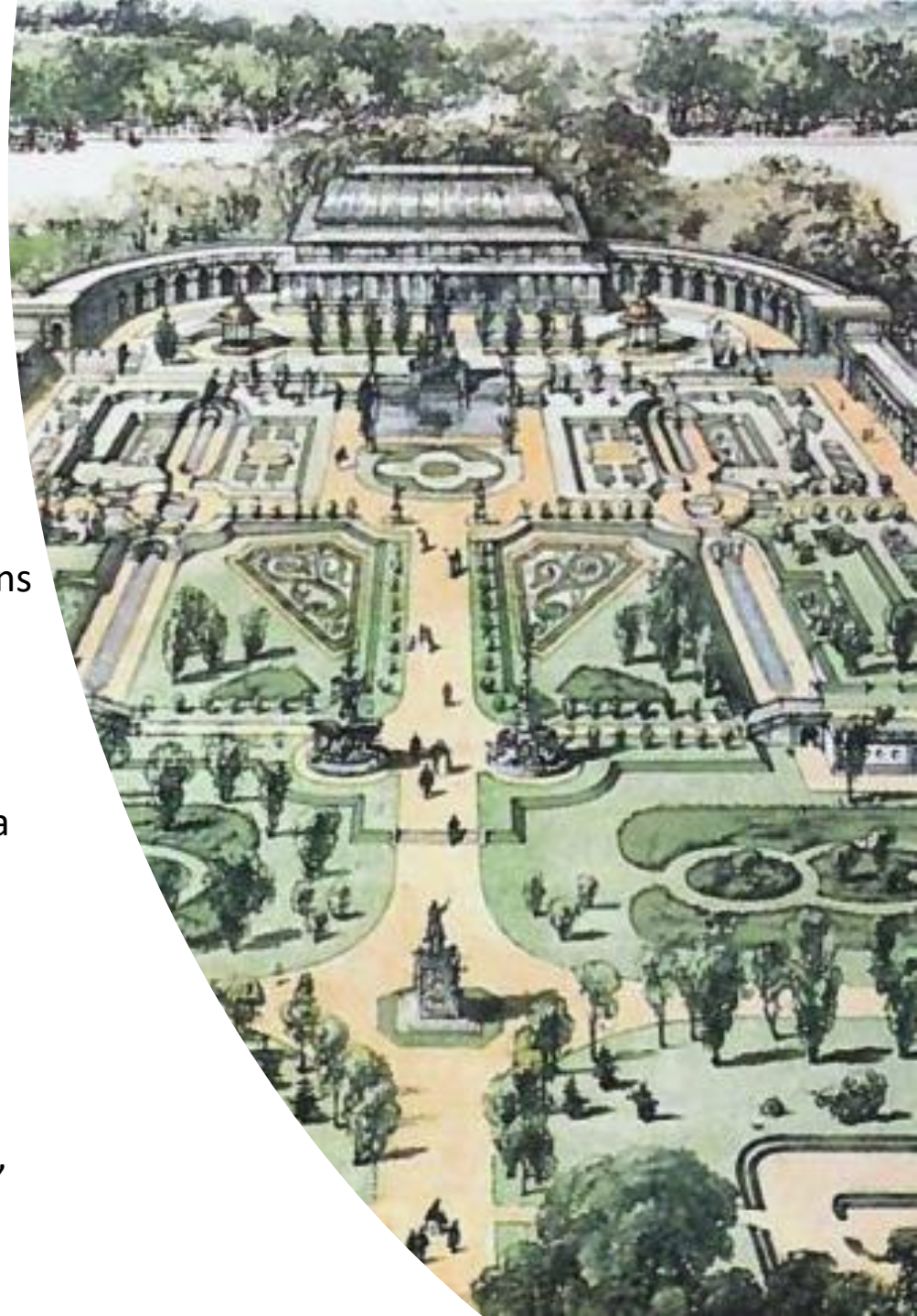
IC CSynB

Rodrigo Ledesma-Amaro

The College…

A bit of History

- The Great Exhibition – 1851
- Prince Albert wanted to “increase the means of industrial education and extend the influence of science and art”
- Great success: continued displaying ‘miscellaneous displays of science and art’
- 1872 - Prince Albert’s vision was to create a great educational centre
- Royal School of Mines was persuaded to move onto the estate, where the Royal College of Science was later created
- Today: Imperial College London, Royal College of Art, Royal College of Music, Science Museum, Natural History Museum, Royal Albert Hall



South Kensington Campus

Campuses


Central London
Central Middlesex
Hammersmith
White City
St Mary's
South Kensington
Royal Brompton
Chelsea and Westminster
Charing Cross
Central Way
Acton Lane
B4492
Willesden Junction
Old Oak Lane
Park Royal Rd
Western Avenue
A40
North Acton
Victoria Road
Scrubs Lane
A219
Wormwood Scrubs
Old Oak Common Lane
East Acton
Du Cane Road
Westway
ACTON
Old Oak Road
A4020
The Vale
Uxbridge Road
BBC Television Centre
Wood Lane
White City
SHEPHERD'S BUSH
West Cross Route
A3220
NOTTING HILL
Notting Hill
Notting Hill Gate
Pembridge Road
Queensway
Bayswater Road
Craven Hill
Lancaster Gate
Holland Park Avenue
Kensington Palace
Hyde Park
Kensington Gardens
KENSINGTON
Kensington High Street
Kensington Road
High Street Kensington
Royal Albert Hall
Exhibition Road
V & A Museum
Natural History & Sci. Museums
Queen's Gate
Cromwell Road
Gloucester Road
South Kensington
Goldhawk Road
A402
HAMMERSMITH
Shepherd's Bush Rd
Olympia
Hammersmith Road
A315
Glenthorne Rd
King Street
Hammersmith
Talgarth Road
West Cromwell Rd
Earl's Court Road
Earl's Court
Baron's Court
Old Brompton Rd
Dovehouse Street
Sydney St
Fulham Road
CHELSEA
King's Rd
West Brompton
Fulham Broadway
Cheyne Walk
Battersea Bridge
Great West Road
A4
CHISWICK
Great West Rd
Ellesmere Rd
Hogarth La.
Hammersmith Bridge
Fulham P
Dawes Road
PADDINGTON
Maida Vale
A5
Harrow Road
Paddington
Praed Street
Sussex Gardens
Westway
A40

New Campus – £3bn - 2020

Faculties and Departments

Faculties and departments [edit]

Imperial is organised through a network of faculties and departments:[75]

Faculty of Engineering

- Aeronautics Engineering
- Bioengineering
- Chemical Engineering
- Civil & Environmental Engineering
- Computing
- Design engineering
- Earth Science & Engineering
- Electrical & Electronic Engineering
- Materials
- Mechanical Engineering

Faculty of Medicine

- Medicine
- Surgery and Cancer
- Institute of Clinical Sciences
- National Heart and Lung Institute
- School of Public Health

Faculty of Natural Sciences

- Centre for Environmental Policy
- Chemistry
- Life Sciences
- Mathematics
- Physics

Imperial College Business School

- Finance
- Innovation & Entrepreneurship
- Management

Imperial College London

Some numbers:
17500 students
9500 UG
8000 PG
3700 Academics
3900 Admin

Top 10 worldwide ranking
14 nobel laureate
3 medal Fields

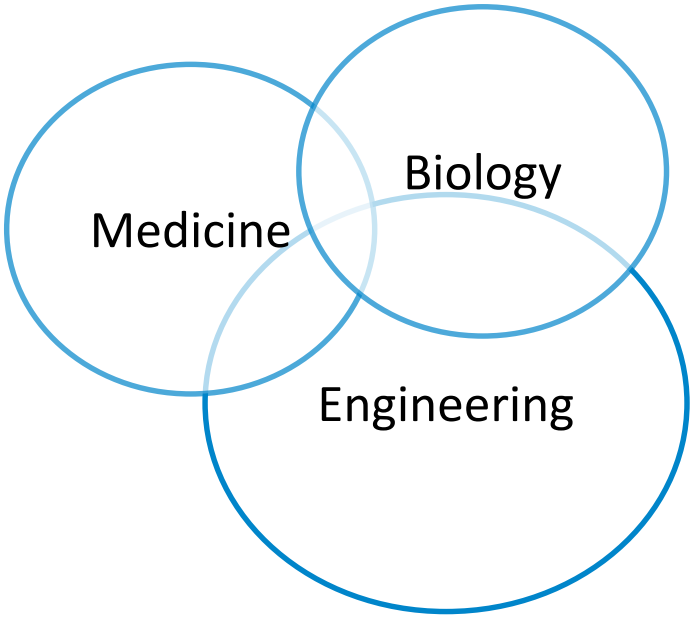
The Department of Bioengineering…

Department of Bioengineering

Engineering for Medicine
- Biomedical Engineering
- Engineering in Medicine

Engineering for Life Sciences
- Molecular Bioengineering
- Synthetic Biology
- Engineering Biology
- Biological Engineering

Engineering inspired by Medicine and the Life Sciences
- Biomimetics
- Bionics



Neurotechnology and robotics

Dr Anil Bharath
Computational models of vision, both biological and artificial

Professor Martyn Boutelle
Biosensors for neuroscience; clinical monitoring of the traumatised brain

Dr Paul Chadderton
Synaptic and network mechanisms of sensory processing

Dr James Choi
blood-brain barrier opening, trans-cranial ultrasound focussing

Dr Claudia Clopath
Computational neuroscience

Professor Manos Drakakis
Circuits and systems for and from biology

Dr Aldo Faisal
Machine and biological learning, human augmentation

Professor Dario Farina
Man-machine interfaces, biological signal processing,neural control of movement, neurorehabilitation

Dr Rylie Green
Neural interfaces, BMIs and neuromodulation

Dr Andrei Kozlov
Auditory neuroscience and biophysics

Professor Holger Krapp
Systems neuroscience in insects: multisensory integration, sensorimotor transformation

Dr Huai-Ti Lin
Neuromechanics and Bio-inspired Technologies

Dr Danny O'Hare
Electrochemical biosensors for neuroscience

Dr Tobias Reichenbach
Biophysics of hearing and sensory neuroscience

Dr Christoper Rowlands
Summary to be provided

Professor Simon Schultz
Neural coding; information processing in the mammalian cortical circuit

Dr Mengxing Tang
Ultrasound imaging of brain structure and function

Computational and theoretical modelling

Professor Etienne Burdet
Neurotechnology and robotics

Dr James Choi
Modelling of ultrasound interactions with acoustic particles and biological tissue

Dr Claudia Clopath
Computational neuroscience

Dr Aldo Faisal
Data-rich modelling, computational neuroscience

Dr Angela Kedgley
Orthopaedic biomechanics and control of musculoskeletal systems

Dr Chiu Fan Lee
Biophysics of pattern formation

Professor James Moore Jr
Lymphatic and cardiovascular biomechanics, mass transport in immunology

Dr Niamh Nowlan
Developmental biomechanics

Dr Tom Ouldridge
Principles of biomolecular systems

Professor Kim Parker
Arterial hemodynamics and cardiac mechanics

Dr Tobias Reichenbach
Biophysics of hearing and sensory neuroscience

Professor Simon Schultz
Computational neuroscience; information theoretic neural data analysis

Dr Guy-Bart Stan
Analysis and control of nonlinear dynamical networks; synthetic biology

Dr Reiko Tanaka
Translational systems biology, control and dynamical systems

Dr Jennifer Tweedy
Mathematical modelling, biofluid mechanics and biocontinuum mechanics

Regenerative medicine and biomaterials

Dr Ben Almquist
Bionanotechnology and biomaterials for wound repair and tissue engineering

Professor Anthony Bull
Design and development of ligament, cartilage and meniscus replacement tissues

Professor Colin Caro
Vascular stenting

Dr Adam Celiz
Biomaterials for tissue repair and regeneration

Dr Rylie Green
Tissue engineered implants for bionics, neurotechnology and cardiac devices

Dr Claire Higgins
Cell therapies for tissue repair, stem cell differentiation, skin and hair follicle regeneration

Dr Huai-Ti Lin
Neuromechanics and bio-inspired technologies

Professor James Moore Jr
Cardiovascular and lymphatic biomechanics and device development

Dr Danny O'Hare
Biocompatible endovascular stents

Dr Tom Ouldridge
Biomolecular systems

Professor Molly Stevens
Stem cells, bioactive scaffolds and tissue regeneration

Molecular and cellular bioengineering

Dr Adam Celiz
Determination of mechanisms of biomaterial-driven tissue repair and regeneration

Dr Tom Ellis
Synthetic biology, engineering cells and regulatory gene networks

Dr Claire Higgins
Cell reprogramming via extracellular or intracellular mechanisms

Professor Richard Kitney
Engineering biology, synthetic biology, biological standards and data sharing

Dr Andrei Kozlov
Cell and molecular biophysics to examine the cell microrheology

Dr Sylvain Ladame
Chemical biology of nucleic acids, protein-DNA interactions in transcription regulatory mechanisms

Dr Rodrigo Ledesma-Amaro
Metabolic engineering, synthetic biology, microbial communities

Dr Tom Ouldridge
Theoretical principles of molecular systems with nucleic acids

Dr Darryl Overby
Cellular biophysics, microenvironmental regulation of cellular behaviour, pharmacology & signalling

Dr Guy-Bart Stan
Analysis & control of nonlinear dynamical networks, modelling, synthetic biology

Dr Reiko Tanaka
Translational systems biology, control and dynamical systems

- History
  - 1963 The engineering in medicine labs
  - 1989 Centre for biological and medical systems
  - 2001 Dept Bioengineering
- Teaching
  - Molecular Bioengineering
  - Biomedical Engineering
- Facilities
  - 3D printing
  - Mechanical workshop
  - Electronics
  - Tissue culture, Histology, Genomics, Microbiology
  - Microscopy, imaging

The Centre…

Imperial College Centre for Synthetic Biology

IC CSynB

IC CSynB

Context: The Bioeconomy

Synthetic Biology is an underpinning discipline for advances in the UK Bioeconomy, currently worth ~£220Bn GVA

BBSRC Bioscience facts and figures, 2017

Imperial College
Centre for Synthetic Biology

Expanded Imperial College Centre for Synthetic Biology

Synthetic Biology in the UK

2009 – 2017: EPSRC Centre for Synthetic Biology and Innovation (Freemont, Kitney)

2012: A Synthetic Biology Roadmap for the UK

2012: Synthetic Biology Leadership Council

2012 – : Synthetic Biology for Growth programme: £102M

- Synthetic Biology Research Centres
- DNA Foundries
- BBSRC and EPSRC Centres for Doctoral Training (CDTs)
- Synthetic Biology Seed Fund (UKI2S, Midven)

2013 – : SynbiCITE, National Centre for Industrial Translation in Synthetic Biology

2016: BioDesign for the Bioeconomy Roadmap

2017 – : Imperial College Centre for Synthetic Biology (Baldwin, Stan)

IC CSynB

Main Objective and Ethos

Provide academic leadership and vision for synthetic biology at Imperial College, whilst developing an open, inclusive and collaborative environment for the best interdisciplinary research and ideas to flourish

IC CSynB

Structure and Management

Start of activities: December 2017

Directors: Geoff Baldwin & Guy-Bart Stan

Management Board:

Geoff Baldwin
Paul Freemont
John Heap
Mark Isalan
Patrik Jones
James Murray
Guy-Bart Stan
Tom Ellis
Dick Kitney
Tom Ouldridge
Karen Polizzi

Working with:

SynbiCITE
The London DNA Foundry
SynBIC student society

Members

IC CSynB

Life Sciences

Geoff Baldwin
Hugh Brady
George Christophides
Alain Filoux
John Heap
Mark Isalan
Patrik Jones
James Murray
Peter Nixon
Tony Nolan
Jorg Schumacher
Giovanni Senna
Mike Sternberg
Nikolai Windbichler

Chemistry

Oscar Ces
Yuval Elani

Bioengineering

Adam Celiz
Tom Ellis
Claire Higgins
Richard Kitney
Sylvain Ladame
Rodrigo Ledesma Amaro
Tom Ouldridge
Guy-Bart Stan
Molly Stevens
Reiko Tanaka

Medicine

Paul Freemont
Ramesh Wigneshweraraj

Chemical Engineering

Francesca Ceroni
Peter Dimaggio
Cleo Kontoravdi
J Krishnan
Karen Polizzi
Nilay Shah

Mathematics

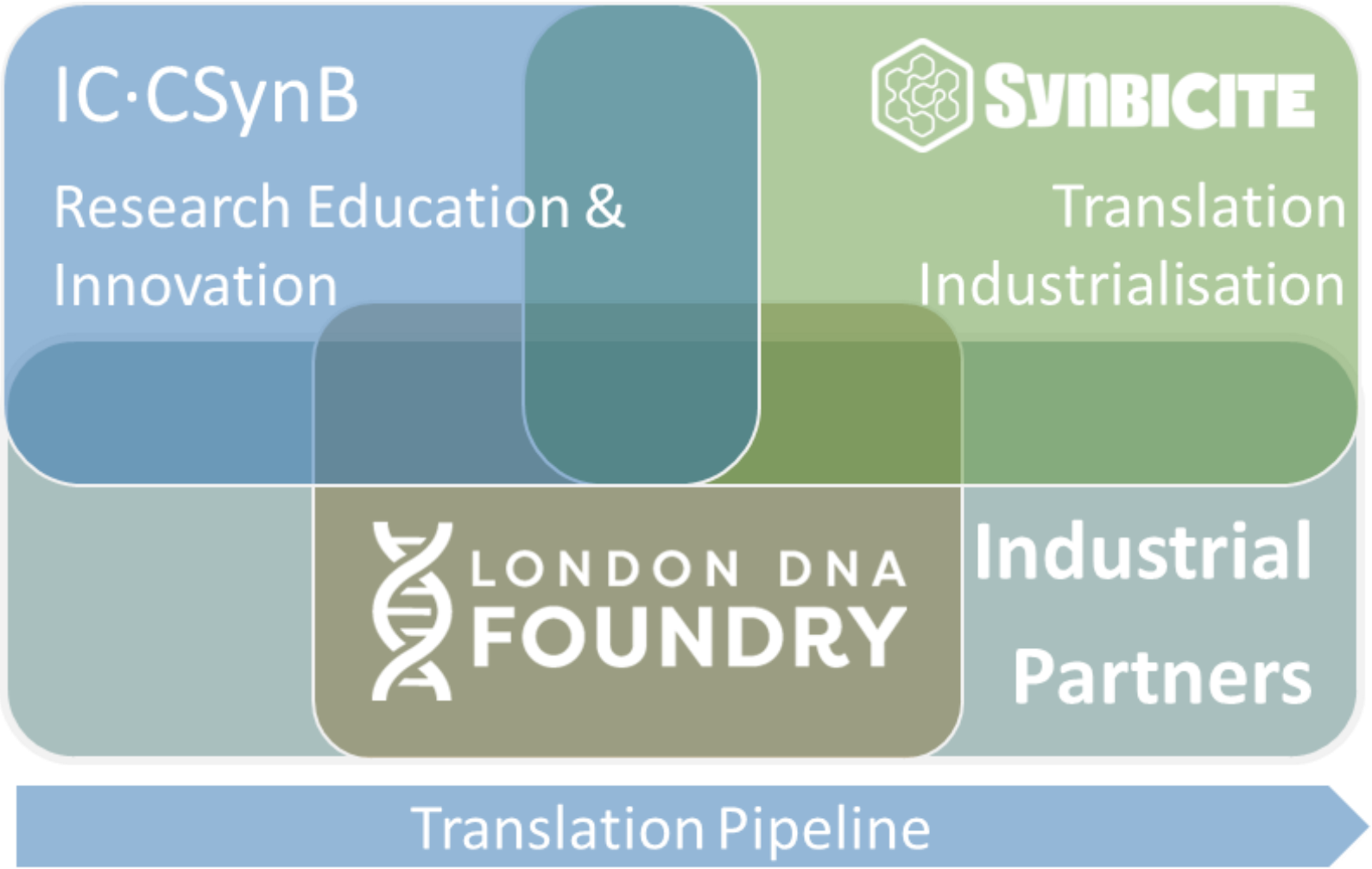
Mauricio Barahona
Diego Oyarzun
Vahid Shahrezaei

Computing

Stephen Muggleton

38 Members, 7 Departments, 3 Faculties

Integration and Interactions



Imperial College London

Imperial College Centre for Synthetic Biology

SynbiCITE

The UK's National Translation Centre for Synthetic Biology
Translation and Innovation Hub
Imperial College White City

Professor Paul Freemont @paulfreemont
Professor Richard Kitney @rkitney
Co-Founders and Co-Directors of SynbiCITE
www.synbicite.com

SynbiCITE
SYNTHETIC BIOLOGY INNOVATION COMMERCIAL AND INDUSTRIAL TRANSLATION ENGINE

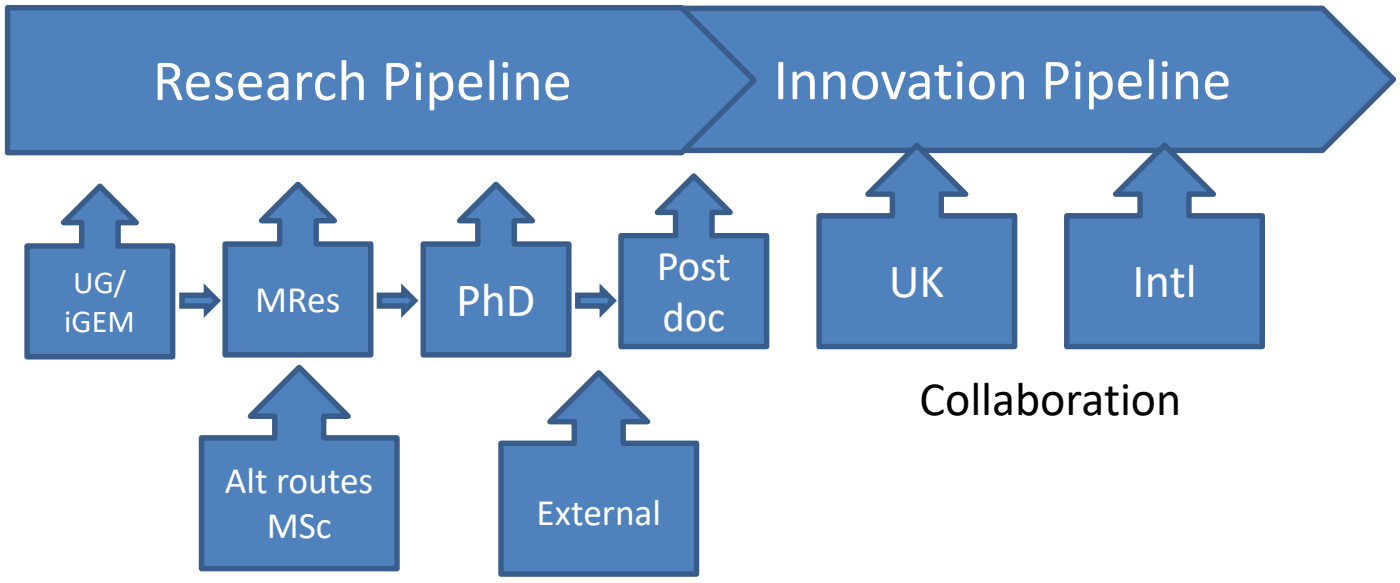
The Translation Pipeline

Companies
Licensing

Imperial College Centre for Synthetic Biology

SYNBICITE
SYNTHETIC BIOLOGY INNOVATION COMMERCIAL AND INDUSTRIAL TRANSLATION ENGINE

CustoMem
CAPTURE INNOVATION



LabGenius

Cellibero

BlueGene Technologies

CAGEN

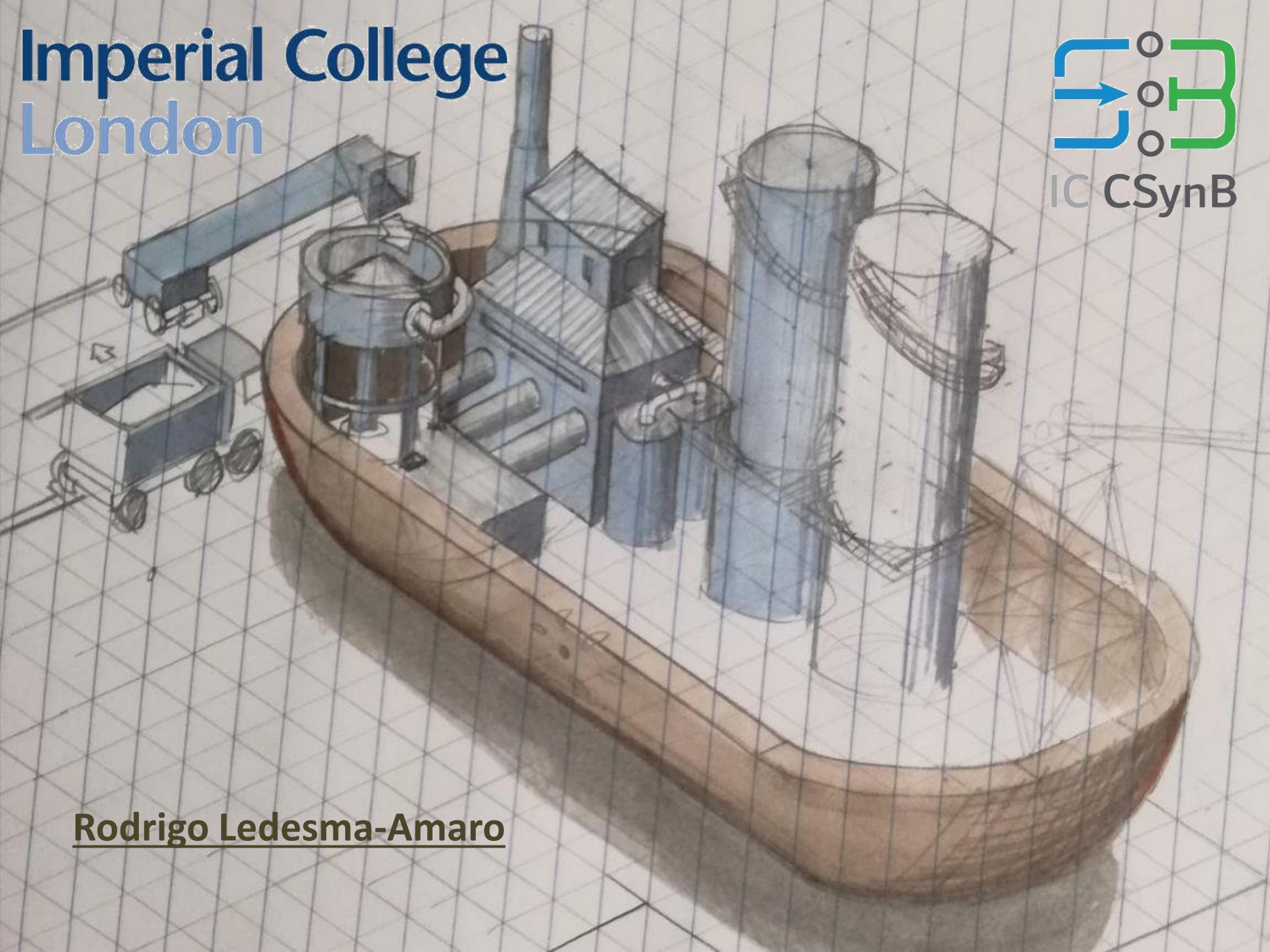
Phytoform Labs

Activities

- **World-Leading Research in Synthetic Biology**
  - Ceroni, Stan, Ellis, *Burden-Driven Control of Gene Expression*, Nature Methods, 2018
  - Isalan, *Phage-Based Directed Evolution*, Nature Protocols, 2018
  - Jones, *Conversion of CO2 into fuels*, Metabolic Engineering, 2018
  - Nolan, *Gene-drive population control in mosquitoes*, Nature Biotech, 2018
  - Windbichler, *CRISPR Genome-Editing in Drosophila*, Scientific Reports, 2018

- **Extensive Engagement Activities**
  - Heap and Polizzi advised *Lloyd's of London* – Emerging Risk Report
  - Freemont spoke at *New Scientist Live Festival of Ideas* (6,000 attendees)
  - Ouldridge advised the *Science Policy Centre at the Royal Society*
- **Regular Activities**
  - Postdoc/PhD fortnightly seminars/meetings
  - PI fortnightly meetings, forward thinking scoping/collaboration
  - Seminar series
- **MRes in Systems and Synthetic Biology**
  - 118 graduates over 10 years; 60% go on to PhD
- **Imperial iGEM Team 2018: PixCell**

The Group…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IC CSynB
Rodrigo Ledesma-Amaro

The Lab

Current members

Huadong (postdoc)
Tigran (postdoc)
Amrit (PhD student)
Lucie (PhD student)
Alicia (PhD student)
Jingjing (PhD student)
Alice (PhD student)
Luis (MEng)
Auxtine (MEng)
Nishta (MRes)
Eric (MRes)
Harry (MRes)
Gemma (MRes)

Funders

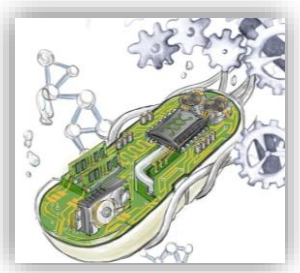
BBSRC
fgen
C1net gas fermentation
Kaesler Nutrition
CustoMem SUSTAINABLE PURITY
Imperial College London
EPSRC
ACIES BIO
evolva
VideraBio Visionary by Design

Research

Interface synthetic biology and metabolic engineering

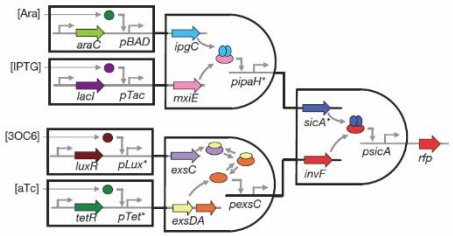
Application of cutting-edge synbio tools for strain engineering

What?

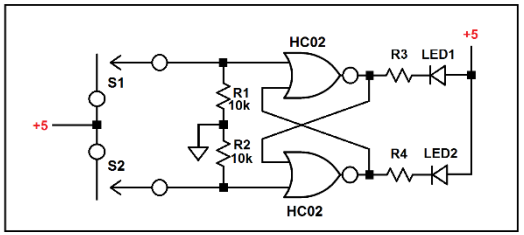


Synthetic biology

Making biology an engineering discipline
- Controllable
- Predictable
- Standardized
- Modular

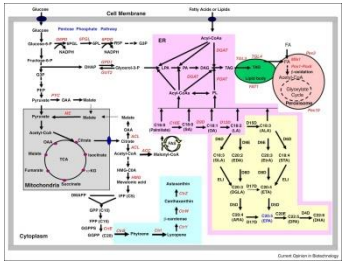


Electrical Engineering

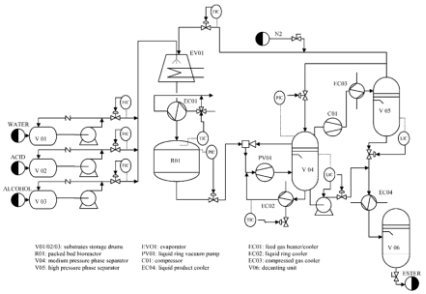


Metabolic Engineering

Engineering cell factories for the biological manufacturing of:
- Fuels, chemical and pharmaceutical products
- Endogenous and Heterologous compounds
- Natural and Non-Natural compounds

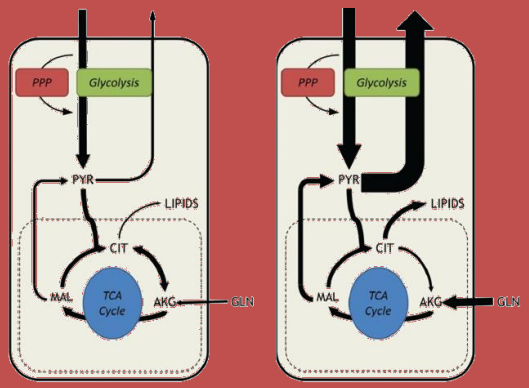


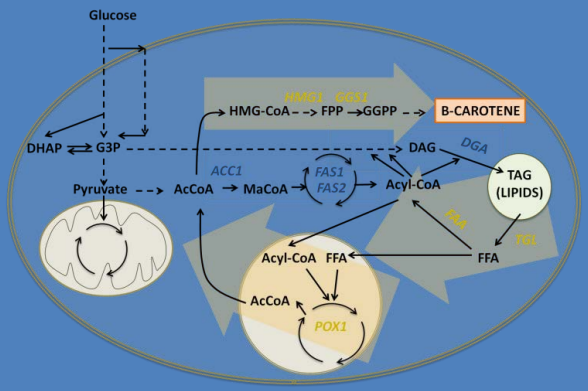
Chemical Engineering



Main research lines

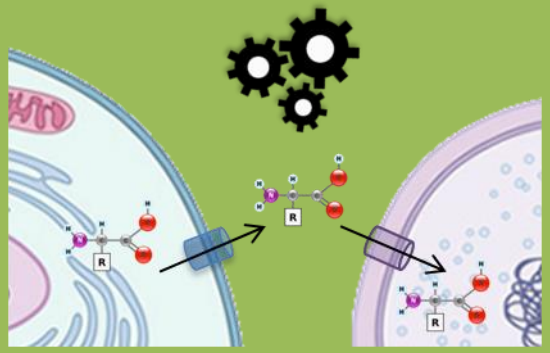
New Synthetic Biology tools for metabolic engineering





Engineering bioproduction in non-conventional microorganisms

Microbial communities in biotechnology And biomedicine



Geodesy at ICL?

Thank you for your attention