Emergence

A Foundation for Synthetic Biology in Europe

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2nd Advisory Board Meeting
Hongkong, October 10, 2008

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What is EMERGENCE?

EMERGENCE is a COORDINATION ACTION funded by the EU-FP6 NEST PATHFINDER program.

Duration: Dec 2006- Nov 2009 (36 months)

Volume: 1.5 Mln €

Purpose: (next page)

Synthetic Biology

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“Synthetic biology has emerged as a very recent but highly promising approach to re-organizing the scientific biological endeavour by integrating central elements of engineering design.“

“..., synthetic biology aims at no less than revolutionizing the way we do bioengineering today.“

“However, such an endeavour requires urgently a coordination effort from the very beginning in order to point the transitions into the most promising directions.“

Who is EMERGENCE?

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1. ETH Zurich: *Jörg Stelling, Sven Panke* (Bioinformatics, bioprocess eng.)
2. CSIC (Madrid, ES): Victor de Lorenzo (Microbial mol. biol)
3. CNIO (Madrid, ES): Alfonso Valencia (Bioinformatics)
4. HZI (Braunschweig, D): *Vitor Martins dos Santos* (Met. engineering)
5. DSM (Basel, CH): *Luis Pasamontes* (Industrial applications)
6. UCL (London, UK): Nicolas Szita (Microfluidics)
7. Geneart AG (Regensburg, D): *Ralf Wagner* (DNA synthesis)
8. CRG (Barcelona, E): Luis Serrano (Systems biology)
9. UCAM (Cambridge, UK): *Jim Haseloff* (Plant biology)
10. EP (Paris, F): *Alfonso Jaramillo* (Comp. protein design)

Associated

MIT (Cambridge, USA): *Randy Rettberg* (iGEM)

Plus:
The SynBio Community in Europe

EMERGENCE wants to

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Provide the means for

- the community to identify itself and network with each other

Provide the means to

- identify crucial topics for the development of SB
- mature these topics and make them “actionable“
- agree on best practices/strategies for these topics

Provide flagship projects to visualize crucial concepts

- bioinformatics infrastructure
- standardizations for promoters

Provide the means to address other central issues

- education
- the industry/academic interface

Serve as an umbrella for “associated” SynBio projects:
SYNBIOSAFE, TESSY, SYNBIOCOMM

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EMERGENCE aims to LEAD TO:

- A clear and actionable concept on how to continue developing SB in the future (what is the research needed most?)

- Convincing and useful demonstrator projects

- A clear perspective on industrial expectations and the potential of SB for industry and whether we can/want meet this perspective

- A broader student base

- An improved communication with the public

Σ: an identifiable and fundable research field whose community is on the way to fully realizing the disruptive potential of Synthetic Biology

… in an interactive process in which the community uses the CA towards these goals.

A brief history of Syn Bio in Europe;

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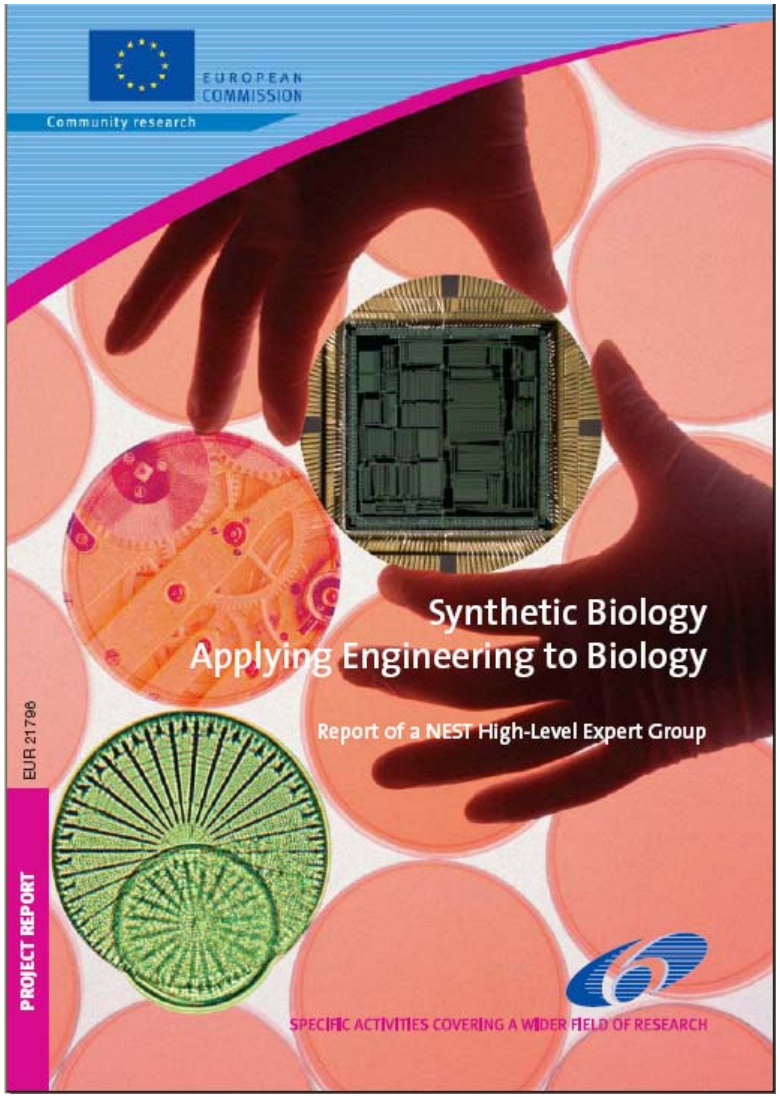
2004: First EU NEST Call

"The core of this vision is that, drawing on the *knowledge developed in biology* and *adapting engineering design and production principles* that have been developed in the Information and Communication Technology arena, it is possible now to set off the *creation of essentially artificial (i.e. "synthetic") systems* using biological engineering design principles *with unprecedented power and efficiency*. These systems will be intended for diverse uses throughout the economy, in areas such as health, energy, environment or materials"
(1st reference document)

<u>STREPS:</u>
EEUROBIOSYN: A modular platform for biosynthesis of complex molecules
HYBLIB: Human monoclonal antibodies froma library of hybridomas
NEONUCLEI: Self-assembly of of synthetic nuclei: key modules for semibiotic
NETSENSOR: Design and engineering of gene networks to respond to and correct alterations in signal transduction pathways

<u>SSA:</u>
SYNBIOLOGY: An analysis of Synthetic Biology research in Europe and North America



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2005: Second EU NEST Call

STREPS:

NANOMOT: Synthetic biomimetic nanoengines: A modular platform for engineering of nanomechanical actuator building blocks

PROBACTYS: Programmable bacterial catalyst

ORTHOSOME: An orthogonal episome: An artificial genetic system based on a novel type of nucleic acids

SSA:

SYNBIOCOM: Towards a European Synthetic Biology community

EU HLEG-report “Synthetic Biology – Applying Engineering to Biology”
ftp://ftp.cordis.europa.eu/pub/nest/docs/syntheticbiology_b5_eur21796_en.pdf

2006: Third EU NEST Call

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STREPS:
SYNTHCELLS: Approaches to the bioengineering of synthetic minimal cells
FUSYMEM: Functionalized synthetic membranes for GPCR based sensing
COBIOS: Engineering and COntrol of BIOlogical systems: a new way to tackle complex diseases and biotechnological innovation
CELLCOMPUT: Biological computation built on cell communication systems
BIONANOSWITCH: A biological nanoactuator as a molecular switch for Biosensing
BIOMODULAR H2: Engineered modular bacterial photoproduction of H2

SSA:
TESSY: Towards a European strategy for synthetic biology
SYNBIOSAFE: Safety and ethical aspects of synthetic biology

CA:
EMERGENCE: Consolidating the base for Synthetic Biology in Europe

Σ:
13 STREPS
3 SSAs
1 CA
Ca. 120 researchers

Syn Bio @ Europe is (already) alive and kicking

iGEM 2008:

23 European Teams

http://www.igem.org

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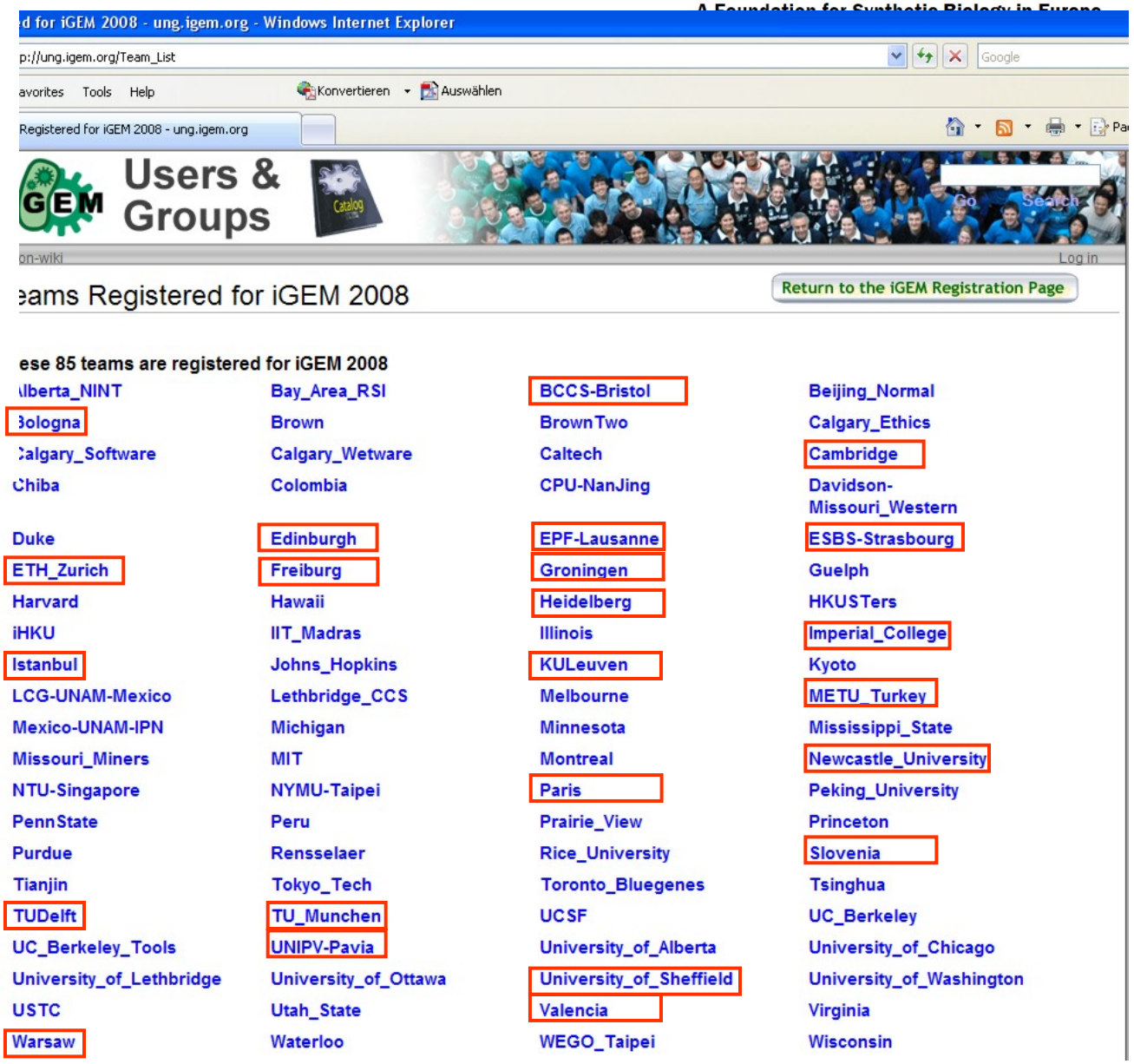
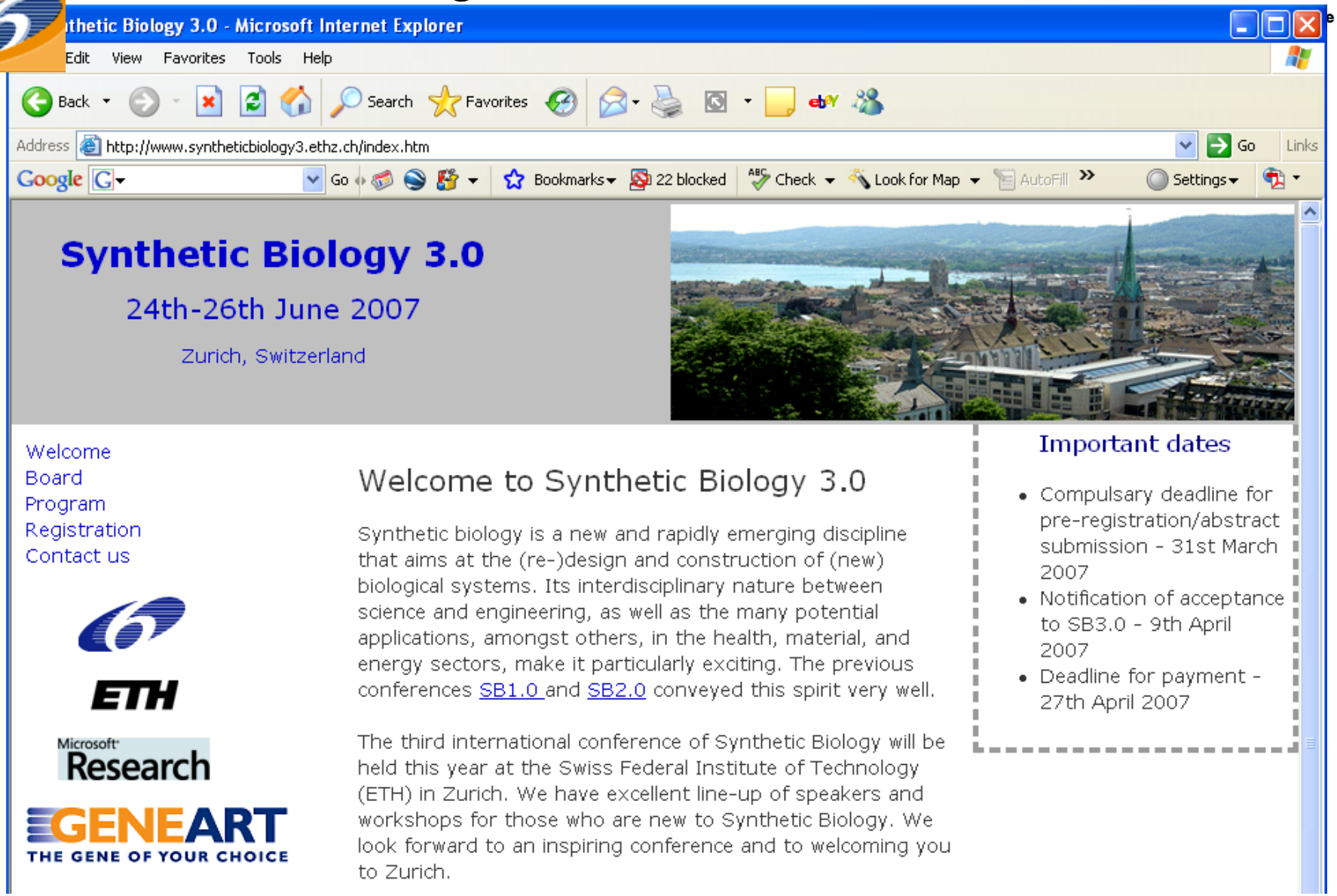


Syn Bio @ Europe is alive and kicking



Syn Bio @ Europe is alive and kicking

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Synth Bio meetings in 2007&8:

- 10/2006 “Synthetic approaches to cellular functions”, HZI, G
- 02/2007 BBSRC Workshop in Synthetic Biology, Wroughton, UK
- 02/2007 Bologna Winterschool „Bioinformatics in Systems and Synthetic Biology“, I
- 06/2007 SB 3.0, Zurich, CH
- 08/2007 9th functional genomics meeting; Synthetic Biology, Sw
- 10/2007 Systems and Synthetic Biology Network, UK
- 11/2007 ESF Conference on Synthetic Biology, Barcelona, ES
- 04/2008 BioFine, Freiburg, Germany
- 04/2008 BioSysBio, UK
- 05/2008 Workshop on Synthetic Biology and Marine Genomics, P
- 06/2008 Workshop on design in SynBio, F
- 08/2008 ICSB – Special Session on SynBio, Sw

Workshop Synthetic Biology, Groningen, NL, 6.-8.11.2008
Wellcome Trust Workshop, London, UK, 3./4.11.2009

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Academic Institutions:

Imperial, UK: Institute of Systems and Synthetic Biology
ETHZ, CH: Department of Biosystems Science and Engineering
Genopole & U Evry: Institute of Systems and Synthetic Biology
U Edinburgh, UK: Synthetic Biology Institute
U Freiburg, G: Center for Biological Signalling Studies

NEST FP6: 25 Mln €
FP7: TARPOL Coordination Action for SynBio in Environmental Sciences

UK: BBSRC/EPSRC Call for Research Networks in SynBio, 0.9 Mln £
UK: ITI Translational Research Call, 10 Mln £

EMERGENCE communication

www.emergence.ethz.ch

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Communication/outreach:

Get in contact with the EMERGENCE WP leaders!!
(V. Martins dos Santos, S. Panke, A. Valencia, V. de Lorenzo, R. Wagner)

Via the EMERGENCE website: www.emergence.ethz.ch

Via the EMERGENCE Newsletter (subscription via emergence webpage)

Via the various meetings – interact with the EMERGENCE participants

Via the EMERGENCE meeting support (WP1), see emergence webpage, or talk to Vitor Martins dos Santo

Via the EMERGENCE Advisory Board

The EMERGENCE advisory board:

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Invited: all NEST project leaders
Plus: any PI who feels she/he can contribute there

Goal: The advisory board as a reference group to critically analyze and deliver input to the work of the CA

Strategy: To have the EMERGENCE team meeting with the advisory board at regular intervals and exchange

Particular topics: The developments pertaining standardization, data acquisition/storage, curing, characterization of parts, databases, protocols, etc.

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1.5 Mln € to work on:

WP1: **General networking activities** (Victor Martins dos Santos)

WP2: **Attracting talents to Synthetic Biology in Europe** (Sven Panke)

WP3: **European IT infrastructure for Synthetic Biology** (Jörg Stelling)

WP4: **Standardization of promoter components through formatting and categorization of working states** (Rafael Rocha)

WP5: **Building the academic/industry interface (incl. IP rights)** (Ralf Wagner)

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Questions Introduction?

EMERGENCE: A foundation for Synthetic Biology in Europe

WP1: General Networking activities

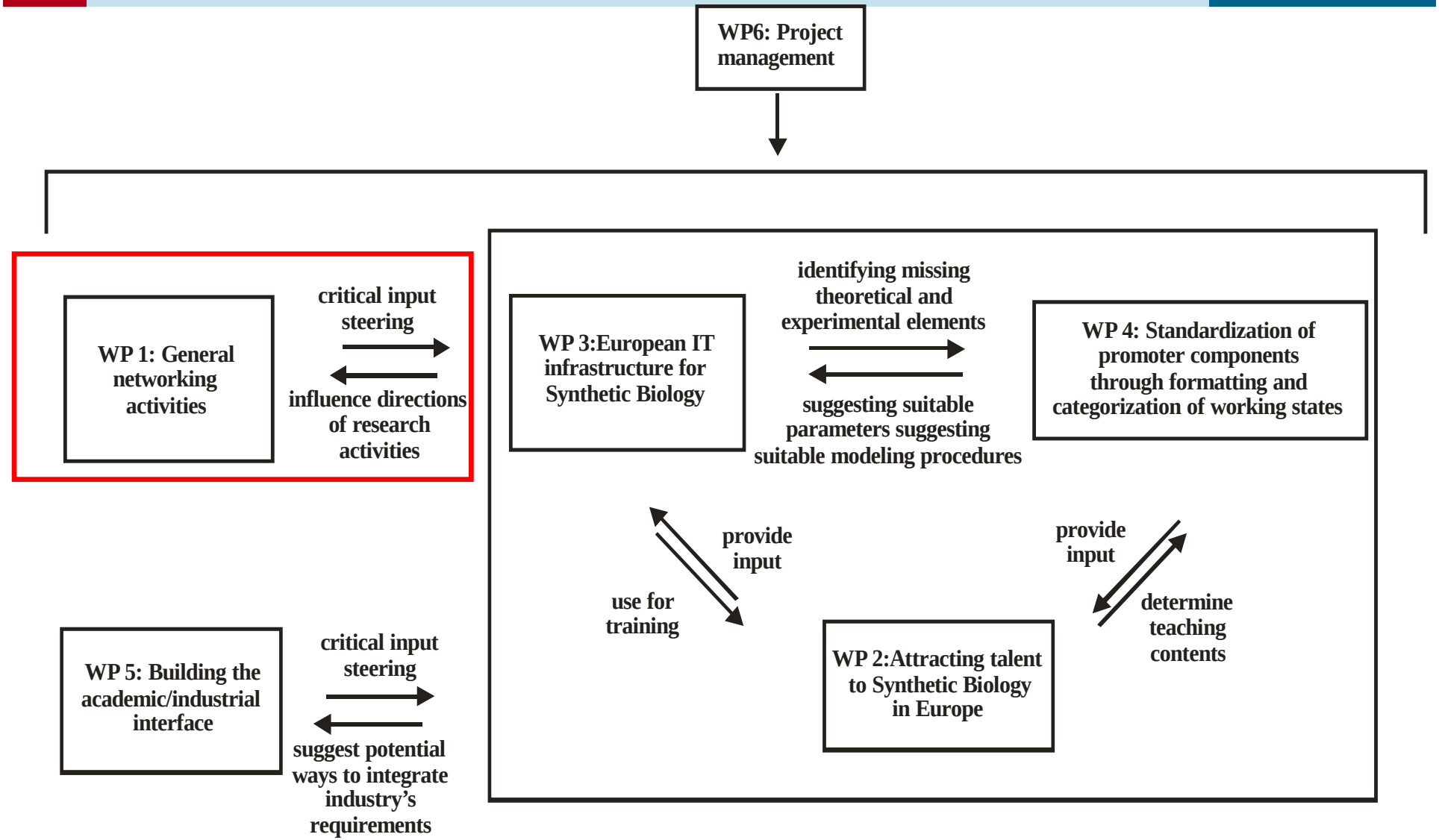
Fostering a community of knowledge

Vítor Martins dos Santos

Systems and Synthetic Biology Group

Helmholtz Centre for Infection Research
Braunschweig, Germany

Project Structure



WP1: General Networking Activities

Objectives:

To establish a networking platform for current and future synthetic biology projects

b) To rapidly organize workshops for urgent issues in European synthetic biology

c) To implement a Europe-wide, cross-disciplinary framework for discussion on the possibilities, needs, limitations, and implications of synthetic biology.

d) To foster interactions with extra-European initiatives, with special emphasis on US, the Mid-East and Asia: Global knowledge space

Description of Tasks I

Task 1: ***Developing, maintaining, and evaluating a standardized meeting structure*** that allows efficient review and distribution of the conclusions obtained at individual meetings.

Overarching, jointly with WP Management

Task 2: ***Hosting workshops on development of the European IT infrastructure for synthetic biology, design tools for synthetic biology, and/or standardization of biological parts.***

Jointly with WP3 (IT infrastructure), WP4 (Design tools and Biological parts), Standardisation Issues (Overarching)

Description of Tasks II

Task 3: *Establishment of study groups on specific subjects relevant to synthetic biology*

“Foundational” technologies, including e.g. high-throughput genome minimization,
DNA synthesis),
potential of genetic circuits, modularity in proteins, handling noise & error
propagation in biological systems,
robustness in biological systems,
transferability of engineering foundations
……..

Description of Tasks II

Task 4: ***Platform for organizing thematic workshops/courses/meetings, resulting from maturation of study groups into specific workshops***, courses, or small scientific meetings, or from initiatives from members of the advisory board or the steering committee.

Task 5: ***EMERGENCE will promote exchange and training visits between European and overseas participants***, in particular with the Middle East and Asia, including:

•invitations for a number of leading scientists in the field to participate in study groups;
•seeking actively to participate in similar initiatives in those countries; and inclusion of Middle Eastern/Asian researchers in the EMERGENCE
•communication and dissemination pipelines.
•The participation of senior European synthetic biology scientists in Asian meetings will be particularly encouraged.

Deliverables Month 1-18

D1.1: Material and rules for standardized meeting structure in place for the first time (month 3). Responsible: HZI

D1.2: Report on the first workshop on development of the European IT infrastructure for synthetic biology (month 8) Responsible: HZI

D1.3: Report on the first workshop for design tools for synthetic biology (month 4) Responsible: CNIO

D1.4. Report on recommendations of the intra-consortium expert group on suitable promoter standardization formats (month 12) Responsible: CNB

Deliverables 18-36 month

D1.5: Updated material for the appropriate section in the quarterly Synthetic Biology Newsletter regarding tasks 2, 3, and 4 (months 3, 6, 9, 12, etc): Responsible ETH

D1.6. Report on workshop on foundations of measurement statistics in synthetic biology (month 24)

D1.7. Document identifying “common European-Asian interests and ways to develop them” or similar document in place and signed by extra-European and European groups/organizations involved in synthetic biology (month 32)

Milestones and expected results

M1.1. **Recommendations for the European IT infrastructure for synthetic biology** are discussed and recommendations issued (month 3)

M1.2. **Recommendations for design tools on the IT infrastructure** are discussed and recommendations issued (month 4)

M1.3 **First experiences with the study group format** are reviewed by the steering committee after 6 months and by advisory board and steering committee after 12 months and the format is adapted, if necessary (month 6, 12)

M1.4. **Recommendations on standardization of biological parts** are discussed (month 11)

M1.5. **Recommendations on measurement systems in synthetic biology** are discussed (month 24)

M1.6. Steering committee and advisory board decide whether the **critical mass in Europe-Asian relations in synthetic biology** has been reached and drafting a “common interests” document is going to be useful (month 24)

D1.1 - Material and rules for standardized meeting structure

Web-based template document:

Definition of the theme and Scope

The need for the SynBio community and goals

Implementation plan (size, mode, participants

Timeline

Financing possibilities

Process:

Submission to Steering committee (WP-leaders, Coordinator)

Eg. IT: A. Valencia; Teaching: Sven P.; INdustry: L. Pasamontes

D1.1 - Material and rules for standardized meeting structure: examples themes

Tier	Theme	Number of Participants	Length	Contribution to Emergence	Deliverable	Estimated Cost (€)	Financial contribution requested (€)	WP

Tier means 1 - initial, 2 - follow-up or 3 - full meeting
WP means the Work package to which the proposed meeting would contribute

minimal genomes / minimal systems

what to measure / how to measure?

design concepts
how can we handle “systems“ (made of parts)?

context-independent biological systems/modules

microfluidics technologies / single cell measurents

D1.2 -Report on the first workshop on development of the European IT infrastructure for synthetic biology

Workshop Computational Infrastructure and Methods for Synthetic Biology

The 9th Annual BioPathways Meeting

Vítor Martins dos Santos
Vincent Schachter
Vincent Danos
Joanne Luciano
Aviv Regev
Eric Neumann

July 19-20, 2008
Satellite Meeting ISMB 2008
Toronto, Canada

7:30 – 8:30	**Registration**	
8:30-8:45	Vítor Martins dos Santos, Helmholtz Center for Infection Research, Braunschweig, DE	Opening remarks
Session 1 & Analysis : **Databases & Software Tools** Chair: Vítor Martins dos Santos		
8:45-09:30	Trey Ideker, University California San Diego, USA	Mapping pathways through integration of physical and genetic interactions
9:30-10:15	Peter Karp, AI.SRI, Menlo Park, USA	The MetaCyc and BioCyc database collection
10:15-10:45	**Coffee Break**	
10:45-11:30	Phillip Bourne, University California San Diego, USA	The role of biopathways in drug repositioning and determining side effects
11:30-12:00	Geoffrey Winsor, Simon Fraser University, CA	InnateDB - Facilitating Systems Level Analyses of the Mammalian Innate Immune Response
12:00-12:30	Jennifer Gardy, Centre for Microbial Diseases & Immunity Research, University of British Columbia, CA	Cerebral 2.0: A Cytoscape plugin for the network-based visualization of datasets from multiple experimental conditions
12:30-13:30	**Lunch**	
Session 2: Network Reconstruction & Analysis Chair: Eric Neumann, Teranode		
13:30-14:10	Rune Linding – Institute for Cancer Reseatrch, London, UK	Constructing in vivo phosphorylation networks
14:10-14:50	Terry Gasterland, University California at San Diego, USA	Examining Cell Cycle Control Networks at Single Cell Resolution
14:50-15:30	Kobi Benenson, Harvard University, Cambridge, USA	Molecular automata: from concepts to applications
15:30-16:00	**Coffee Break**	
16:00-16:35	Ran Kafri, Harvard Medical School, Boston, USA	Functional redundancies - an evolutionarily conserved control element in signal transduction and metabolism
16:35-17:05	Tijana Milenković, Nataša Pržulj, University California Irvine, USA	From network structure to biological function in protein-protein interaction networks
17:05-17:35	Jean Krivine, Harvard Medical School, Boston, USA	Rule-based modeling of large protein networks
17:35-18:15	Peer Bork, EMBL, Heidleberg, DE	Get the most out of your metagenome: computational analysis of environmental sequence data
General Discussion		
18:15-18:30	**Network analysis, Databases & Tools**	

Session 3 : Computational Methods and Infrastructure for Synthetic Biology Chair: Kobi Benenson, Bauer Centre		
8:30-9:00	Vitor Martins dos Santos, Helmholtz Center for Infection Research, Braunschweig, DE	EMERGENCE: a Foundation for Synthetic Biology in Europe
9:00-9:40	Randy Rettberg, MIT, Cambridge, USA	Synthetic Biology Based on Standard Parts: Design Competitions and Catalogs
9:40-10:15	Ildefonso Cases, CNIO, Madrid, ES	Bioinformatics tools to help in the design of biological systems
10:15-10:45	**Coffee Break**	
10:45-11:25	Shoshana Wodak, Hospital Sick Children, Toronto, CA	Identifying meaningful pathways in metabolic networks without the help of chemistry
11:25-12:00	David Gilbert, University of Glasgow, UK	A behaviour driven approach to design and implementation in Synthetic Biology
12:00-12:30	Martijn van Iersel, University of Maastricht, NL	WikiPathways, pathway creation and online collaboration
12:30-13:30	**Lunch**	
Session 4: Evolution of pathways and networks Chair: Joanne Luciano, MITRE		
13:30-14:15	Chris Sander, Sloan-Kettering, New York, USA	Systems biology modeling
14:15-14:50	Edwin Wang, National Research Council, McGill University, Montreal, CA	Principles of microRNA regulation of cellular networks
14:50-15:30	Chris Myers, Cornell University, USA	Sloppiness in cellular networks
15:30-16:00	**Coffee Break**	
15:30-16:05	Matthew de Jongh, Hope College, Holland (MI), USA	Generation and Refinement of Metabolic Reaction Networks in the SEED
16:05-16:35	Andrey Ptitsyn, Colorado State University, Fort Collins, USA	The Structure of Biological Pathways in Time
16:35-17:10	Zhenjun Hu, Boston University, USA	Metagraph: a new graph structure for multiple-scale visualization and modeling of biological networks/pathways
17:10-17:45	Pedro Beltrao, University California San Francisco	Evolution of Cellular Networks
Round Table Discussion		

D1.3 - **Report on workshop for design tools for synthetic biology** (CNB)

Satellite meeting to the ESF – EMBO on SynBio

November 2007

(Alfonso, Jörg, Randy, etc)

Report finished (CNIO)

D1.4 - **Report on recommendations of the intra-consortium expert group on suitable promoter standardization formats** (CNB)

VDL – Report ready in website

Silva-Rocha R, de Lorenzo V.
Mining logic gates in prokaryotic transcriptional regulation networks.
FEBS Lett. 2008 Apr 9;582(8):1237-44.

D1.4 -Updated material for the appropriate section in the quarterly Synthetic Biology Newsletter regarding tasks 2, 3, and 4

Frauke Greve / Sven Panke

Newsletters Dec 2006, June 2007, Dec 2008, June 2009

Includes list of conferences, research highlights, press releases, funding activities

Activities towards Task 4 (European Networking)

EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

UNIVERSITAT DE BARCELONA

RESEARCH CONFERENCES

ESF-UB Conference in Biomedicine

European Conference on Synthetic Biology (ECSB): Design, Programming and Optimisation of Biological Systems

Hotel Eden Roc, Sant Feliu de Guixols • Spain
24-29 November 2007

Chair: **Alfonso Valencia**, CNIO Madrid, ES
Co-Chairs: **Natalio Krasnogor**, University of Nottingham, UK
- **Sven Panke**, ETH, Zürich Institute of Process Engineering, CH
- **Victor de Lorenzo**, Centro Nacional de Biotecnologia, Madrid, ES

www.esf.org/conferences/07241

Activities towards Task 4 (European Networking)

Series of Workshops on different aspects of SynBio:

-Biofine (Tessy), Freiburg April 10, 2008

-Genopole (Jaramillo), 26-27 June, 2008

-IRGC Workshop Session on the Risk Governance of Synthetic Biology (26 & 27 June - Geneva, Switzerland)

-Stakeholder meeting Roadmap SynBio (Tessy), 10 June 2008

-ESF workshop on Minimal Systems (with A. Moya), in planning

Etc.....

Activities towards Task 4 (Global Networking)

Workshop on:

Synthetic Aproaches to Cellular Functions, Tokyo, 13 October 2006

Organised jointly by D. Kige (JP), H. Ueda (JP), D. Endy (US), Martins dos Santos („EU“)

About 120 worldwide attendants, 50+ posters. NEST-PATHFINDER SB projects presented. Overwhelming reaction

Future networking activities Asia

Sino-German Exploratory Workshop on Synthetic Biology, Hangzhou, China, 2008. Couple to Probactys (EU) and perhaps other projects

To be organised jointly with Huanming Yang (Beijing Genome Institute, CN)

Exchange of students/ scientists:

China (2 students 7 month each plus 2 scientists 1 week in 2007)

India (2 Students 4 month each, plus scientist 1 week 2008)

Explorative project in Israel on digital evolving microbial communities

Indian - EU workshop on Synthetic Biology (September 2009)

ESF-JSPS Frontier Science Conference Series for Young Researchers (Synbio tentative for 2009)

Future activities, other

Questions WP1?

Workpackage 2

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ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

WP 2: Attracting talents to Synthetic Biology in Europe

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1. ETH Zurich (Zurich, CH): Panke, WP leader
2. UCAM (Cambridge, UK): Jim Haseloff
3. EP (Paris, F): Alfonso Jaramillo

Overview WP 2 activities

1. Establishment of an “Education focus group“
2. Two summer schools (including wet-lab)
3. A European MSc-program for SynBio
4. Spreading the word: an internet resource at “The IET”

Education focus group

Alfonso Jaramillo, EP
Jim Haselhoff, UCAM
Gos Micklem, UCAM
Chris French, Edinburg
Sven Panke, ETHZ

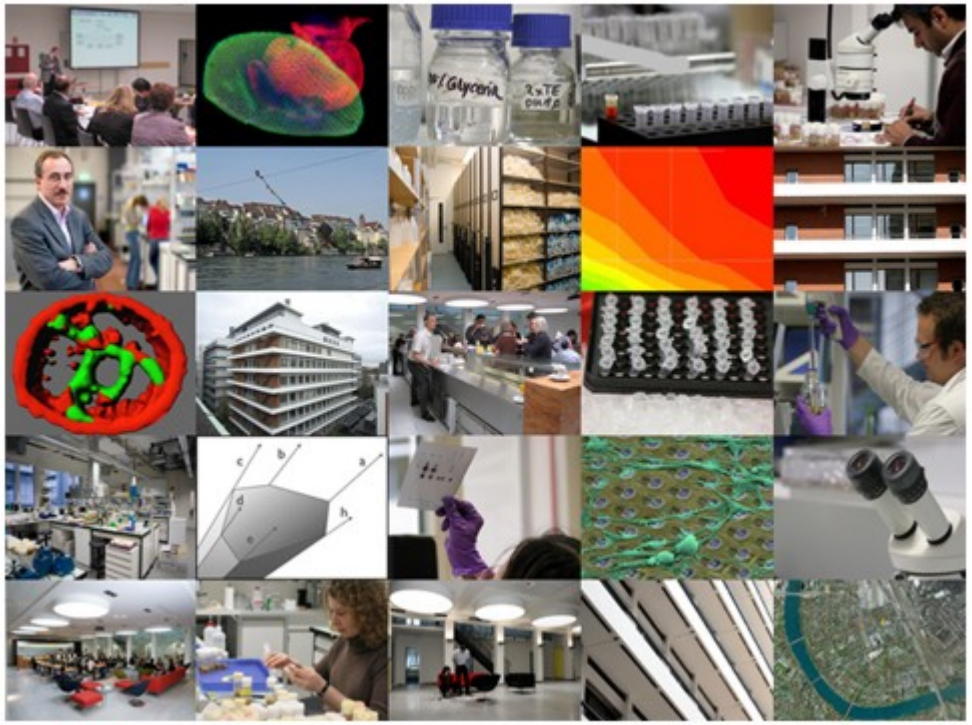
Summer school:

Sumer school 1
1-13.June 2009, ETHZ BSSE
Basel, Switzerland

Structure:
a) Scientific lectures on eminent topics in SynBio
b) 3 twin theory/wet-lab sections over the 2 weeks

Currently inviting instructors and lecturers

Summer school 2:
Summer 2010, part of TARPOL



European Master on Synthetic Biology

Alfonso Jaramillo

Ecole Polytechnique

INSTITUTE OF SYSTEMS AND SYNTHETIC BIOLOGY (ISSB)

Genopole®-Univ. Evry

Schedule

- **November 2007.** Proposal to French ministry.
- **February 2008** Dissemination of M2SB
- **April 2008** Ministry approval IMBI-M2SB
- **September 2009** Start courses.
- **October 2009** Finish proposal for *quadriennal*.
- **March 2009** Proposal Erasmus Mundus.

M2SB

Francois Kepes
Alfonso Jaramillo

- Introduction to genomical biology (optional)
- Fundamental concepts of computer science (optional)
- Introduction to mathematics for biology (optional)

- Design, construction and characterization of biological parts and devices
- Language and modelling for design in systems and synthetic biology
- Molecular modelling: protein interactions and protein design
- An integrated and spatial view of the cellular machinery:
  from biology to modelling
- Symbolic approaches to genetic regulatory networks
- Integrated modelling for physiology
- Practice of genetic engineering
- Modelling and engineering networks of molecular interactions
- Introduction to machine learning for network inference
- Statistical analysis of biological sequences and gene expression

“Spreading the word”: an educational internet resource at “The IET”

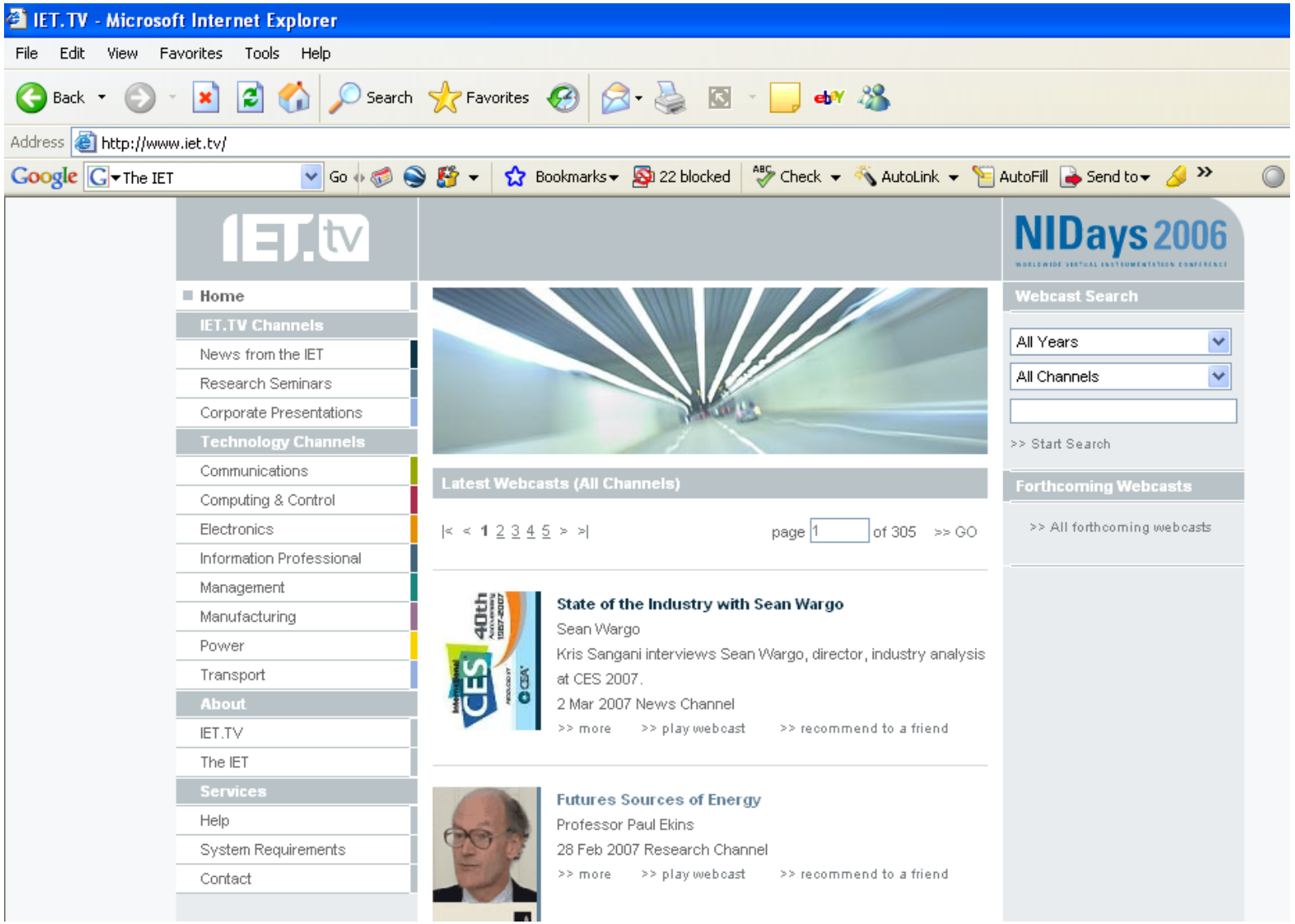
http://www.theiet.org/
The Institution of Engineering and Technology was formed by the Institution of Electrical Engineers (IEE) and the Institution of Incorporated Engineers (IIE) and now has more than 150,000 members worldwide. It is the largest professional engineering society in Europe and the second largest of its type in the world.

Goal:
- Downloadable teaching materials
- Video presentations
- Online reviews
- Technical articles
- Example: a server at http://www.iet.tv will provide dual screen, streaming video containing review and technical material. The resource will be available free of charge.

http://www.theiet.org/synbio
http://tv.theiet.org/channels/research/1552.cfm

The IET: Addressing/educating laymen audiences

The IET: Providing new channels for communication with the public



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Questions WP2?

WP3: IT Infrastructure for Synthetic Biology

Jörg Stelling

joerg.stelling@bsse.ethz.ch

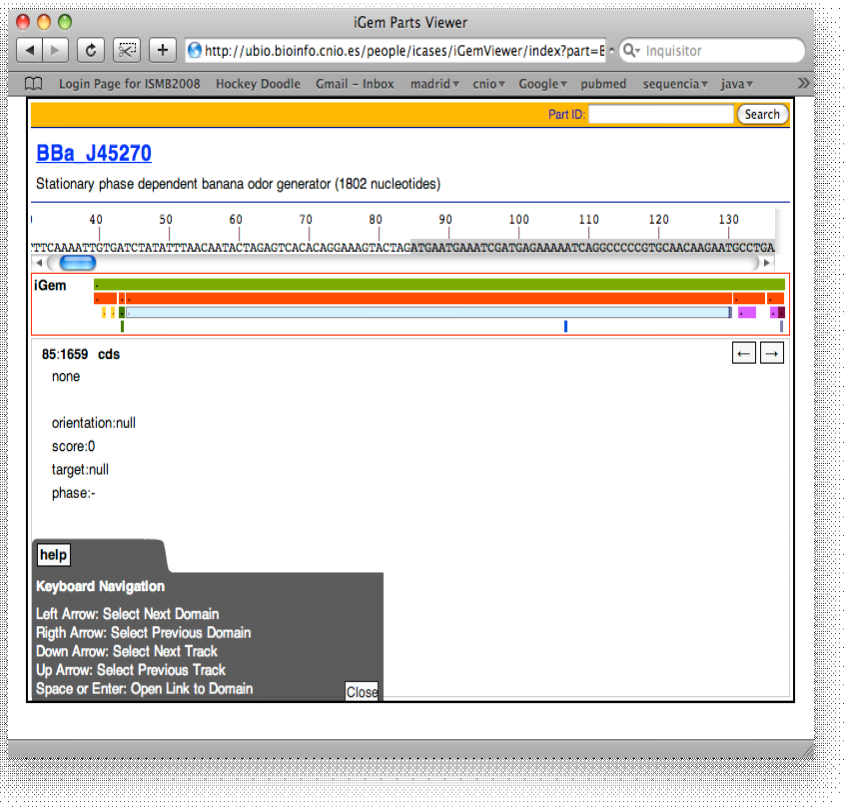
EMERGENCE SAB Meeting

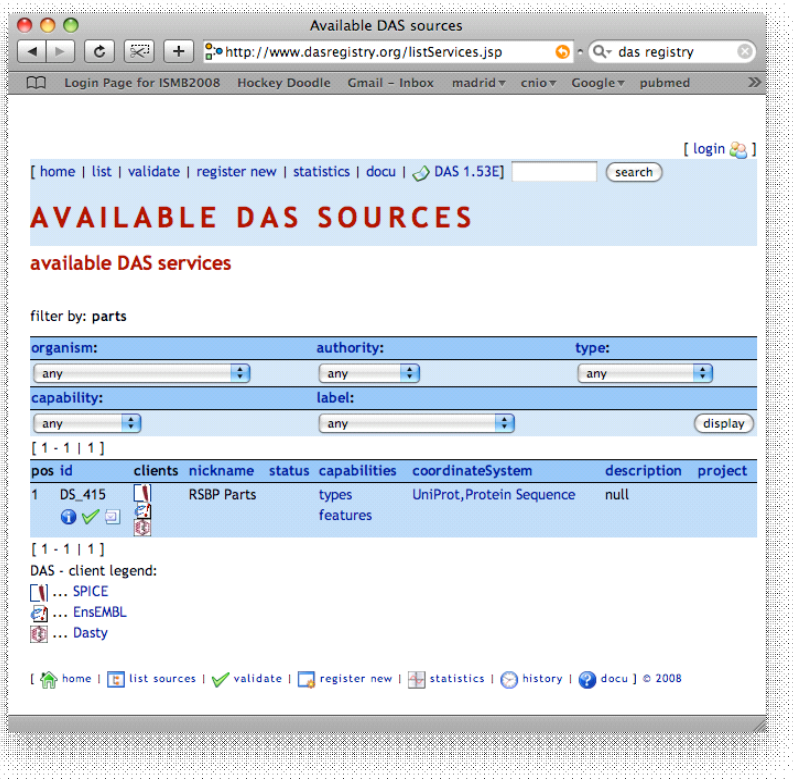
Hong Kong, October 2008

WP3: Aims and Tasks

- **Specific aims and responsibilities:**
  - Information integration via (an instance of) the MIT Registry of Standardized Biological Parts (**CNIO, CGR, GBF**).
  - Methods and tools for model-based parts and systems design (**CGR, ETHZ**).
  - Tools for gene synthesis and assembly (**Geneart**).
- **IT infrastructure: Integrated work-flow for the design of synthetic genetic circuits similar to 'traditional' engineering disciplines.**

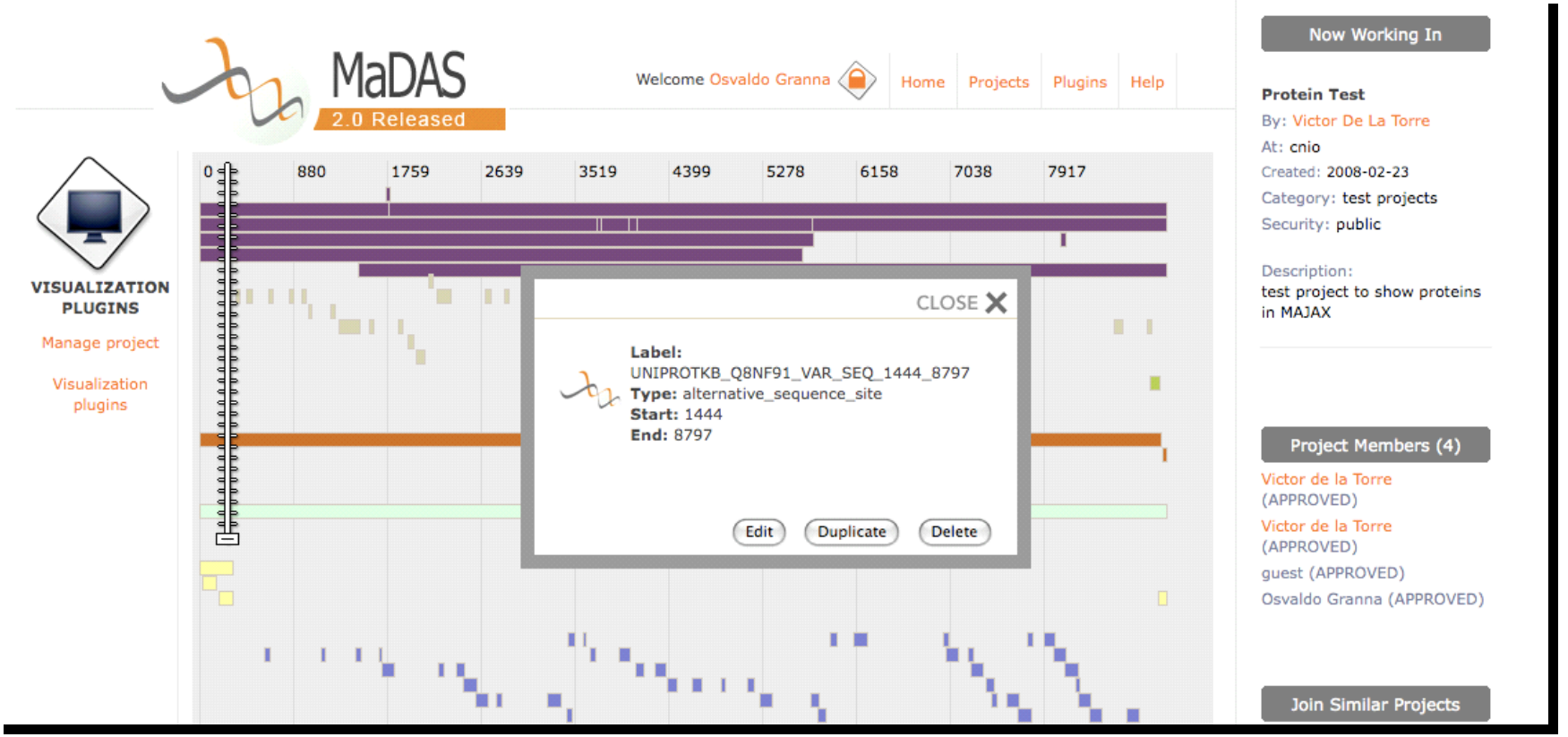
Status: Information Integration (1)





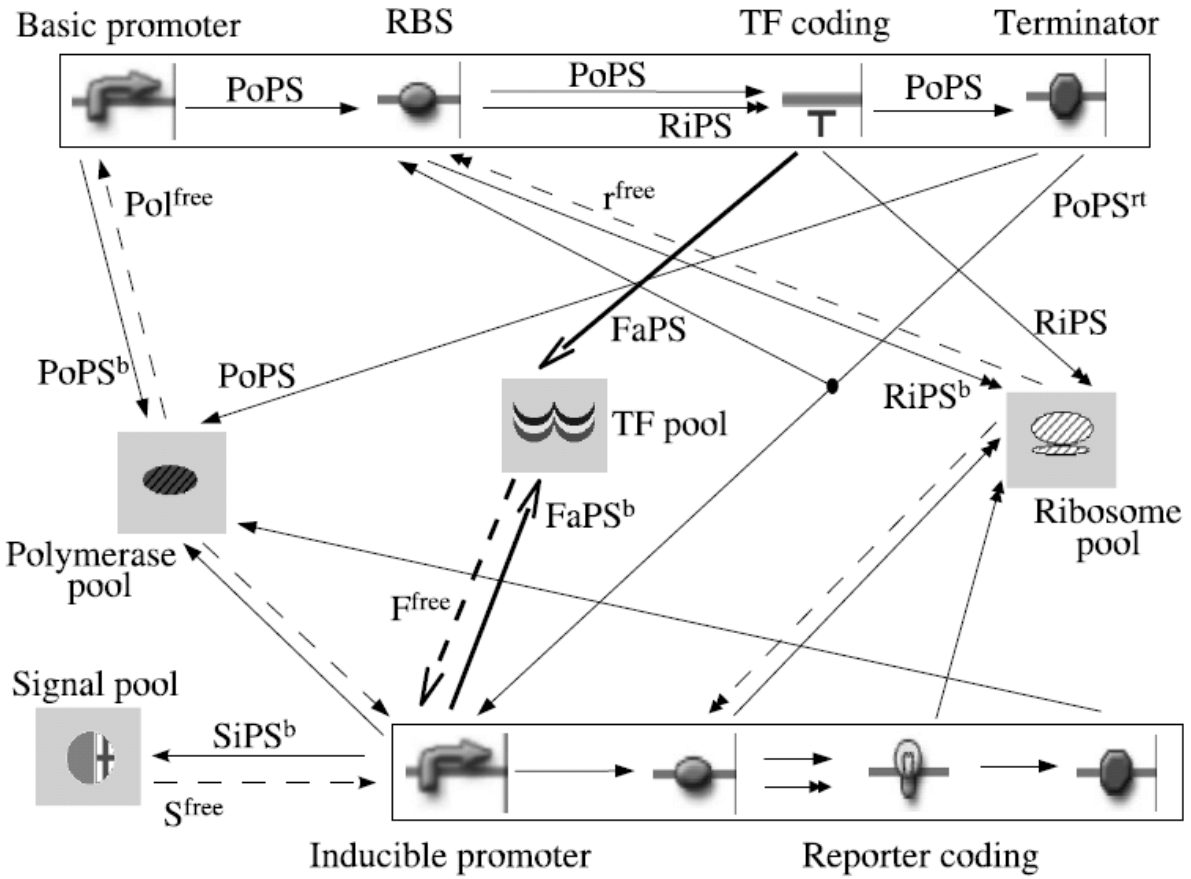
- Information distribution tools and methods are needed for integration, visualization and processing.
- Approach: Infrastructure based on DAS protocol (prototypes for Parts reference server, annotation server based on Uniprot).

Status: Information Integration (2)



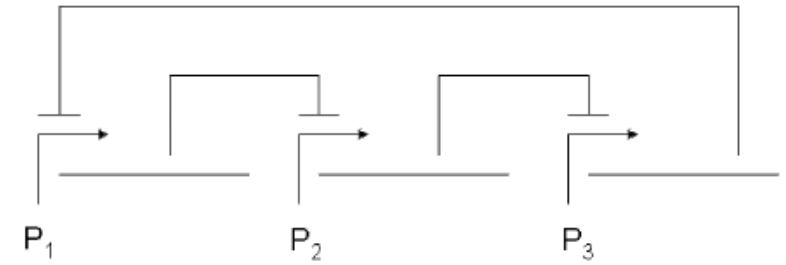
- Multi-user annotation system MaDAS 2.0 for collaboration.
- Limitation: Standard vocabularies and formats lacking.
- Limitation: Low-level distribution method needed (e.g. SQL).

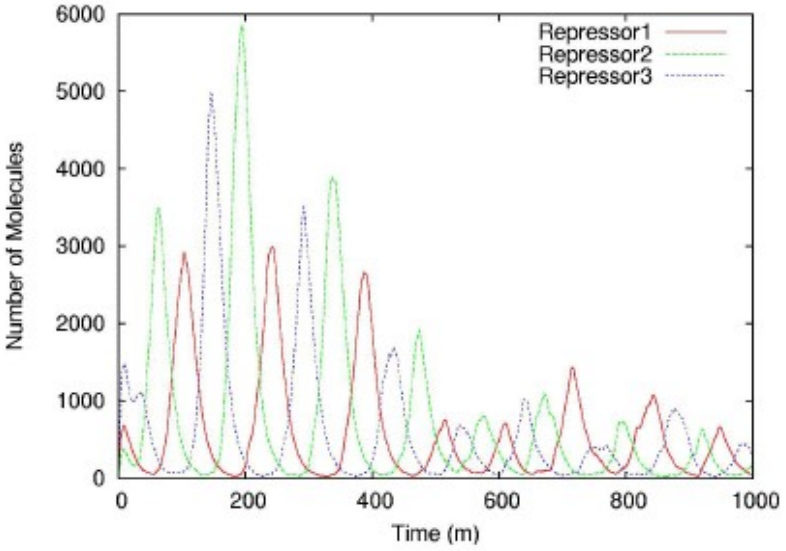
Status: Model-based Design (1)

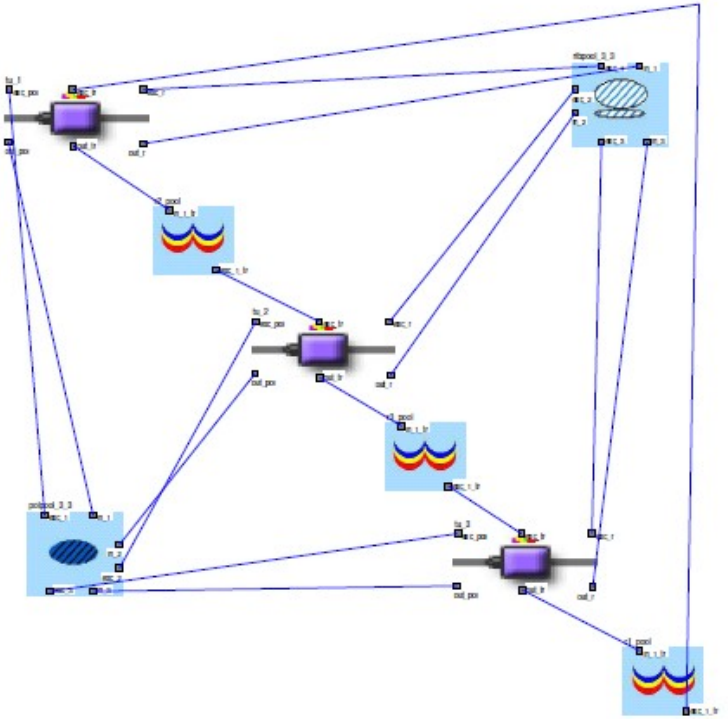


- Key challenges: Composability and functional composition.
- Composability: Standardized methods for modular and hierarchical aggregation of parts (and models thereof).

Status: Model-based Design (2)







- Model library for standard biological parts incorporated into 'drag&drop' modeling software (ProMoT, MPI Magdeburg).
- Limitations: Functional composition and automatic design.

WP3: Perspectives

- **Forward integration into tool chain:**
  - Links between registry, annotation / database system, parts and systems modeling & simulation; expansions of all of the above technical capabilities.
  - Standardized interfaces and parts characterizations.
- **Current bottlenecks for proof-of-principle:**
  - Unclear relationships with MIT Registry: To be solved.
  - Insufficient information on parts and systems: WP4 and integration of *in silico* predictions / literature mining.

"Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful."

G.E. Box (Statistician)

Questions WP3 ?

Refactoring the *Pseudomonas* TOL transcriptional circuit

Rafael Silva-Rocha and Víctor de Lorenzo

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Centro Nacional de Biotecnología - CSIC - Madrid

Molecular Environmental Microbiology Laboratory

SB4 - Hong Kong

2008

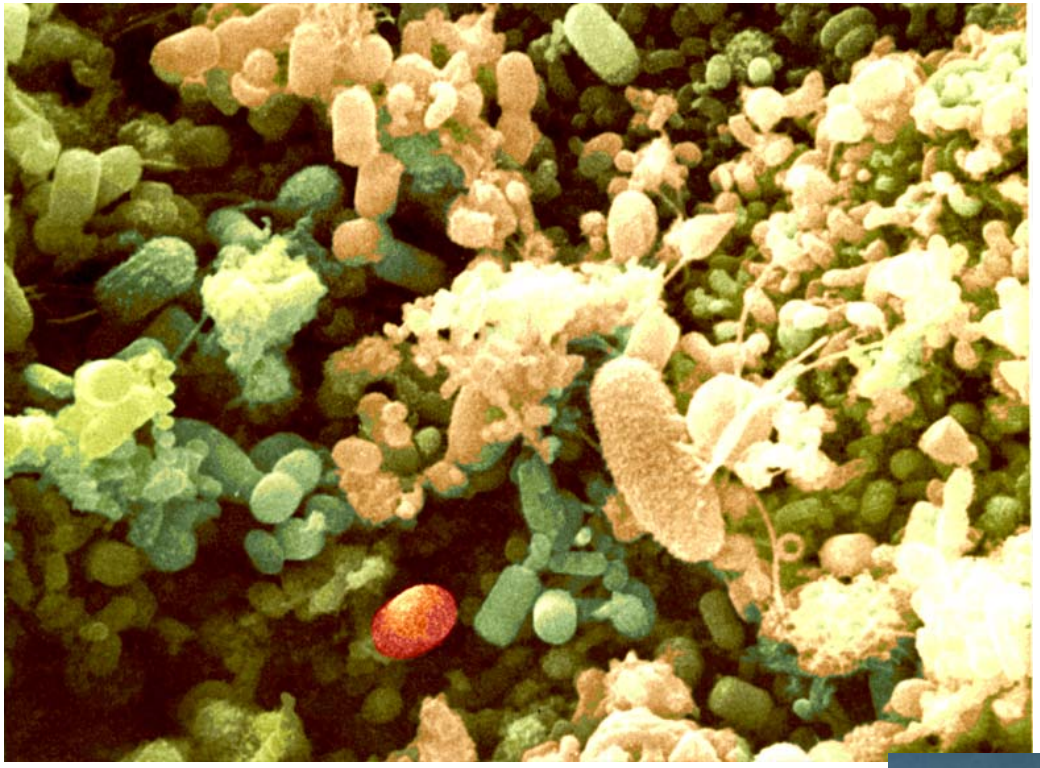
Environmental Microbiology

Bioremediation

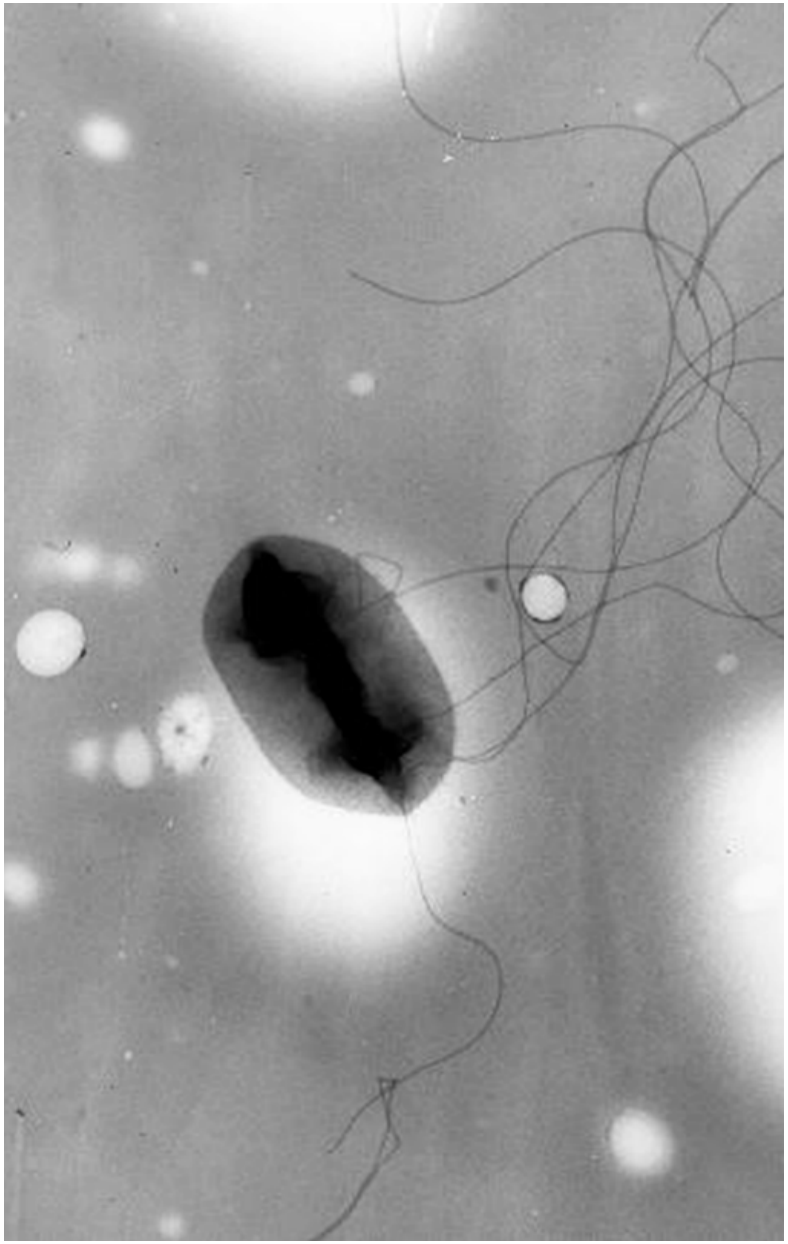
Pseudomonas putida mt-2

TOL plasmid pWW0

Our interest site

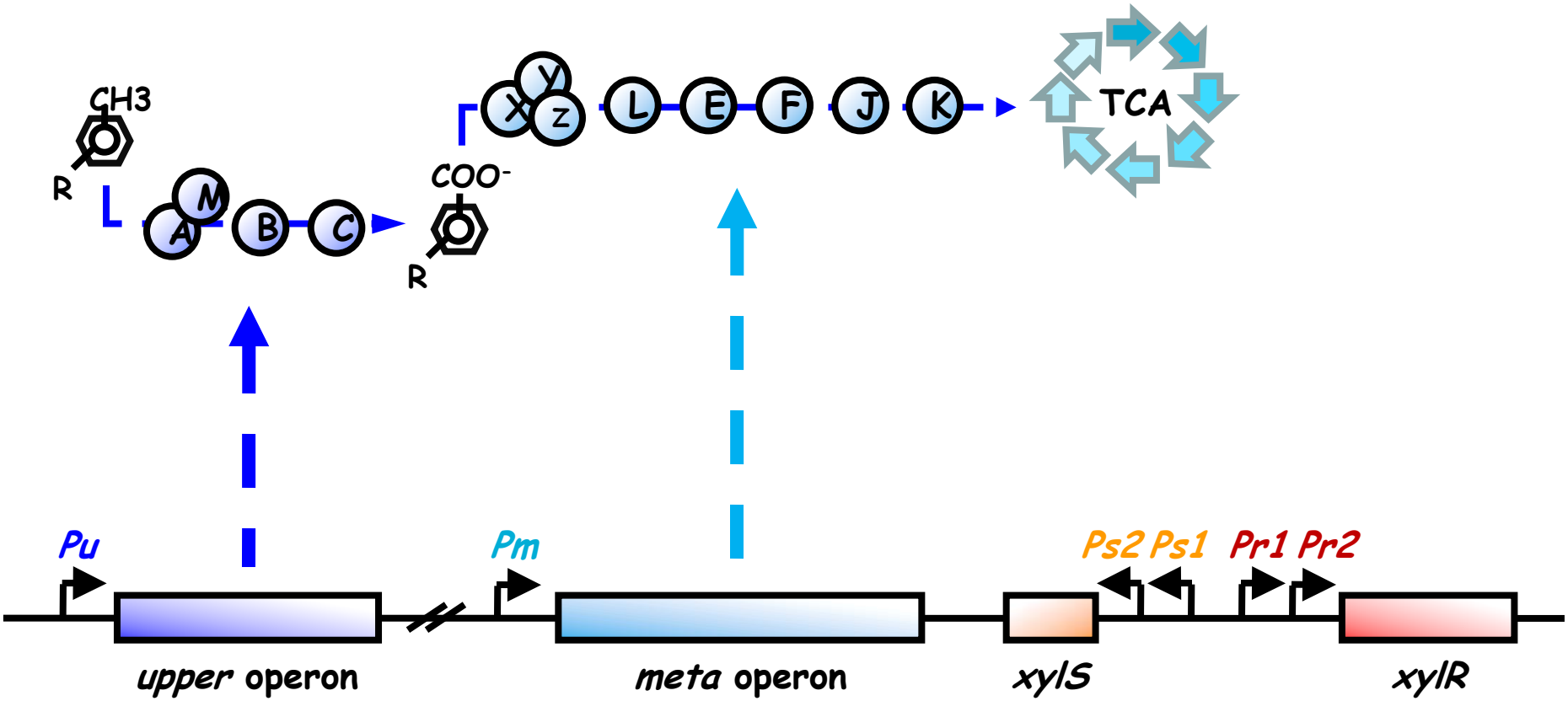


Toluene degradation



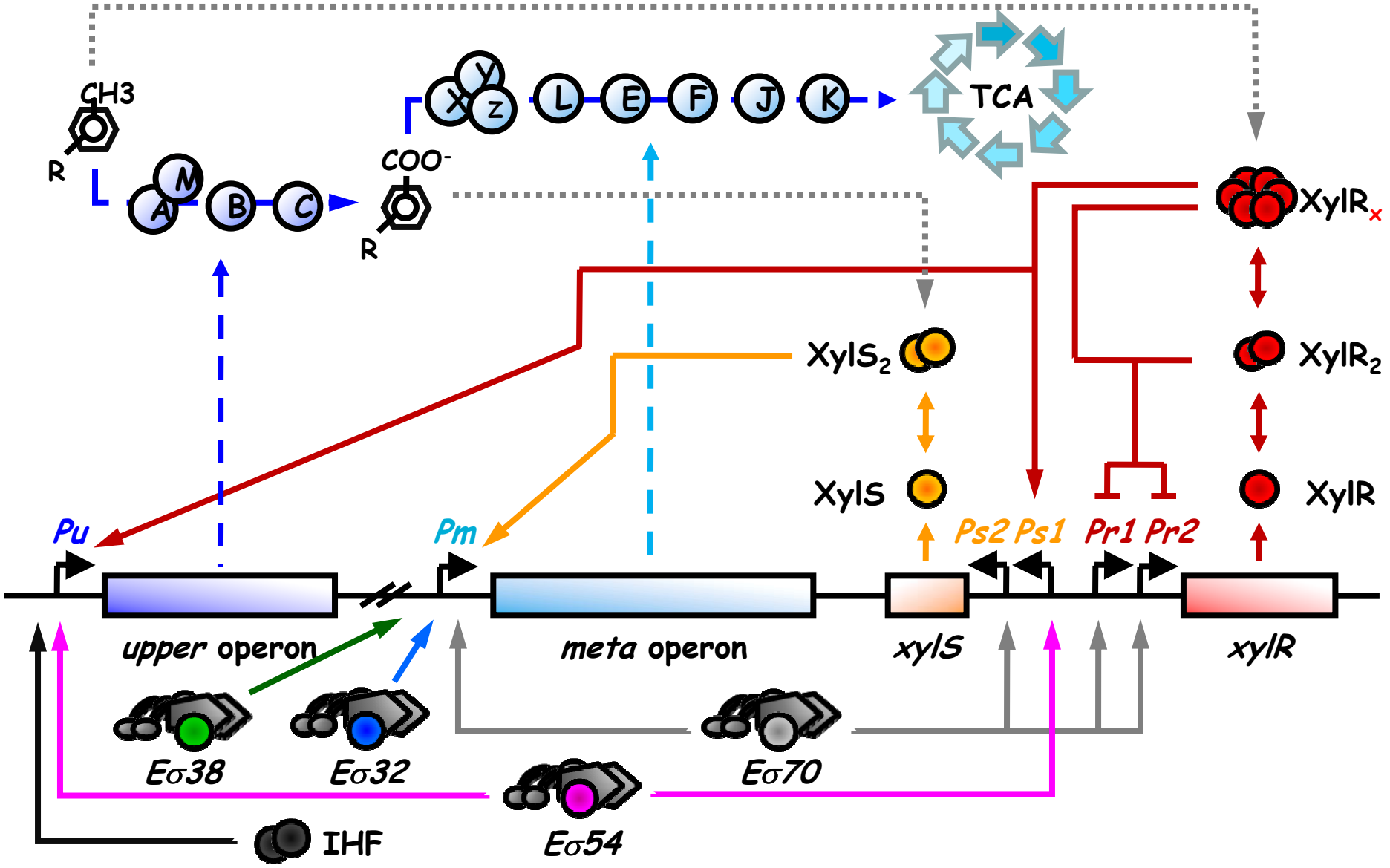
Pseudomonas putida mt-2

The TOL pathway



pWW0 plasmid

The TOL Circuit

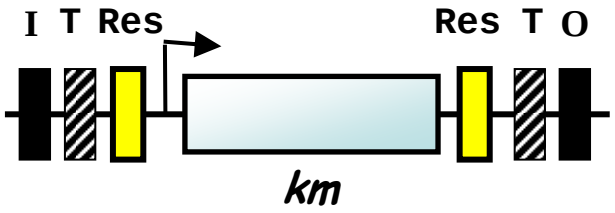


P. putida SB part I:

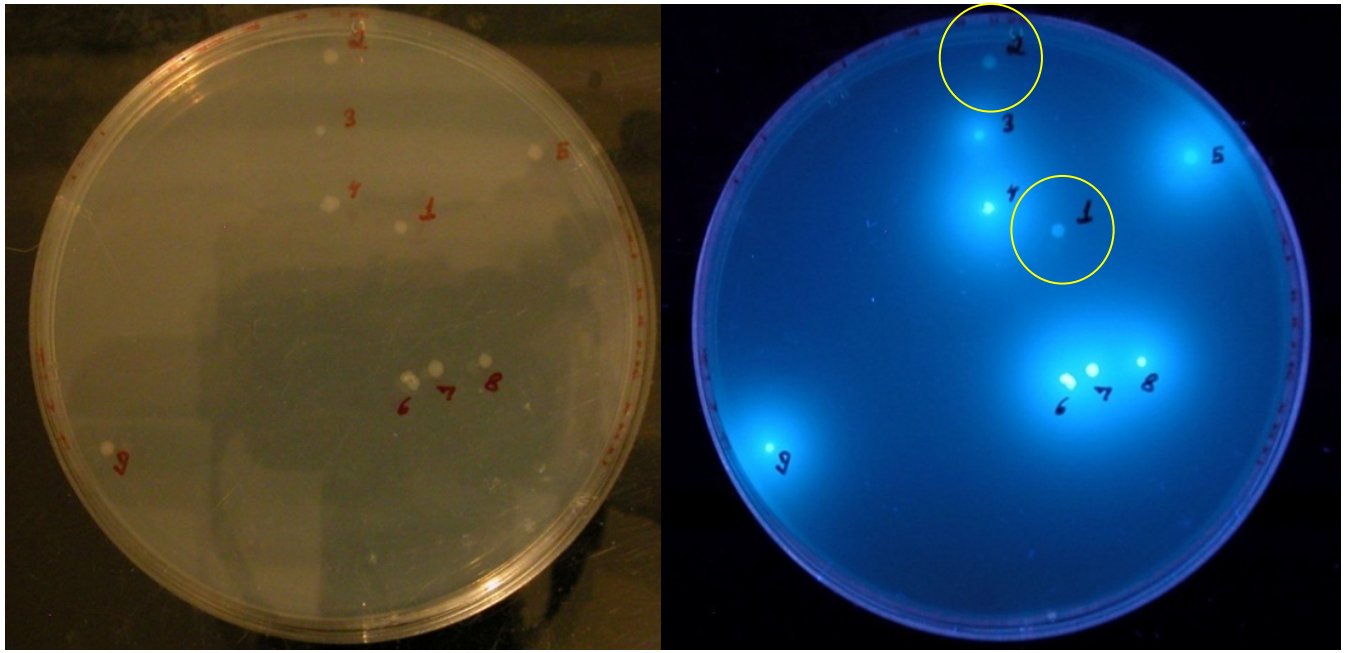
- *P. putida* for laboratory
  - Create a non-fluorescent *P. putida* strain

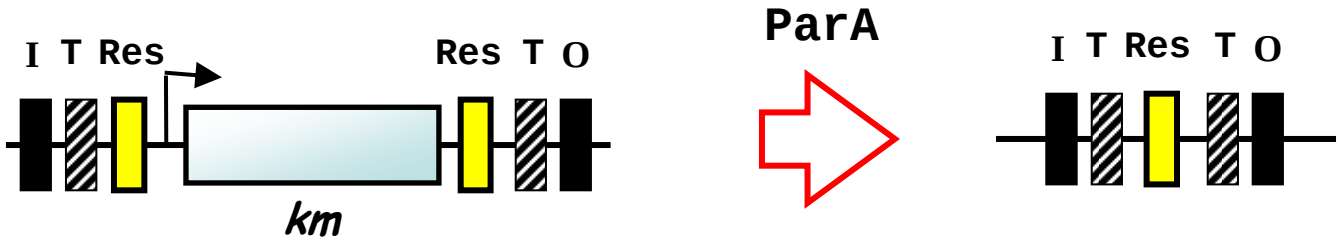
Random mutagenesis in *P. putida* KT2440

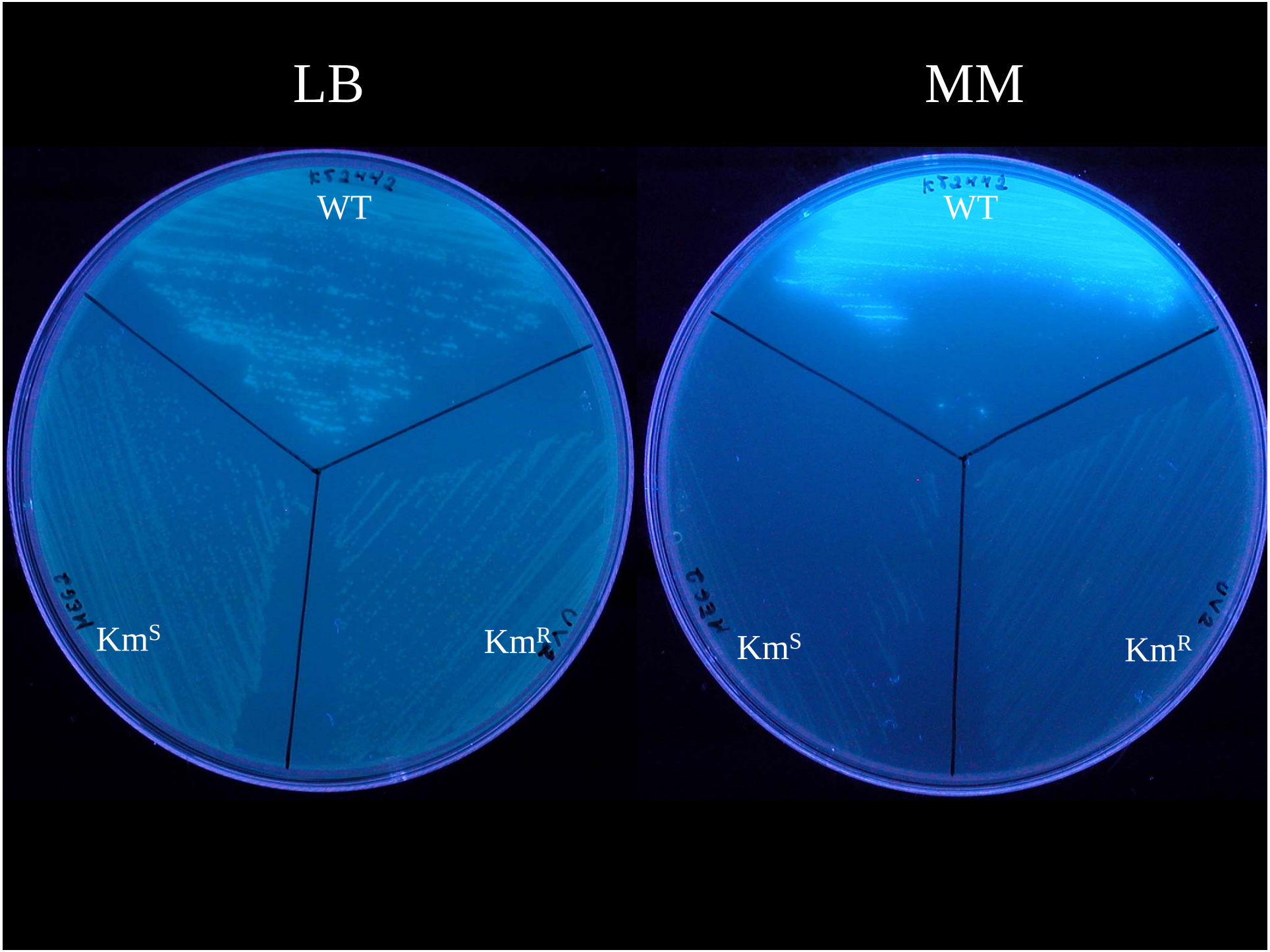
miniTn5-Res Km



de las Heras *et al* 2008



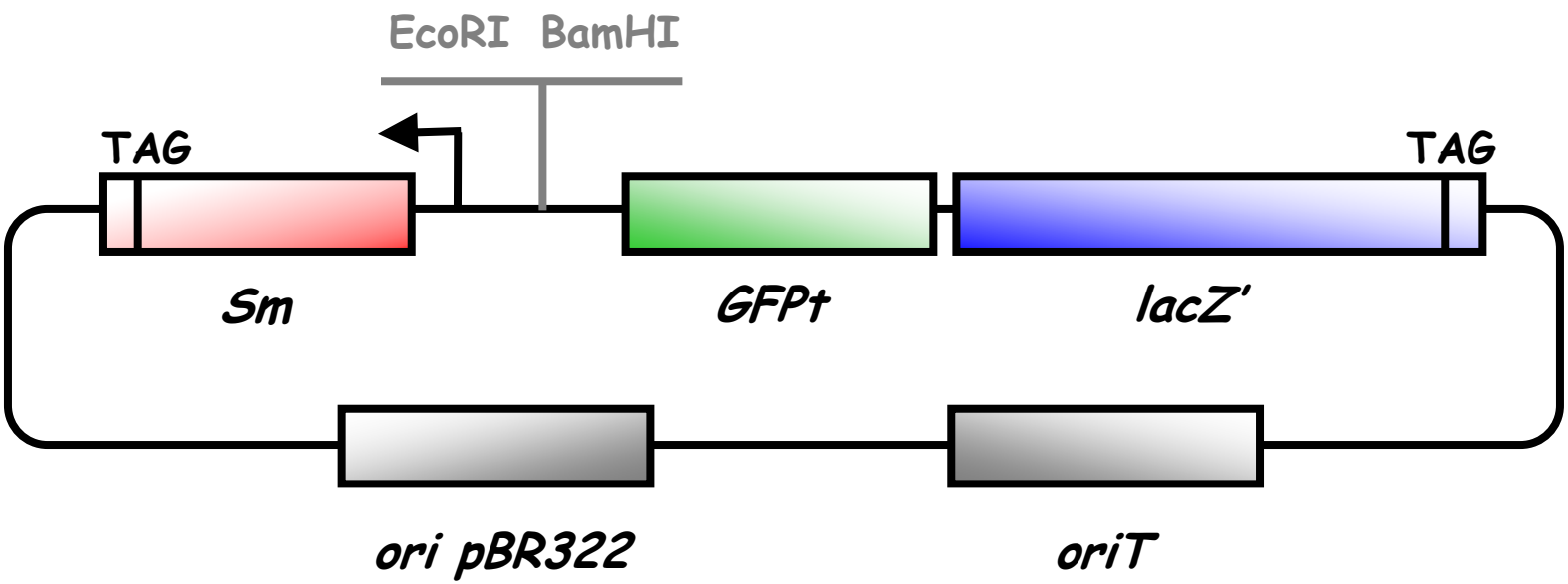



LB
MM
WT
WT
Km^S
Km^R
Km^S
Km^R

P. putida SB part II:

- Standardization of Promoters
  - Create a system for *P. putida* promoter quantification
  - Monocopy promoter measurement
  - High-throughput screening (GFP)

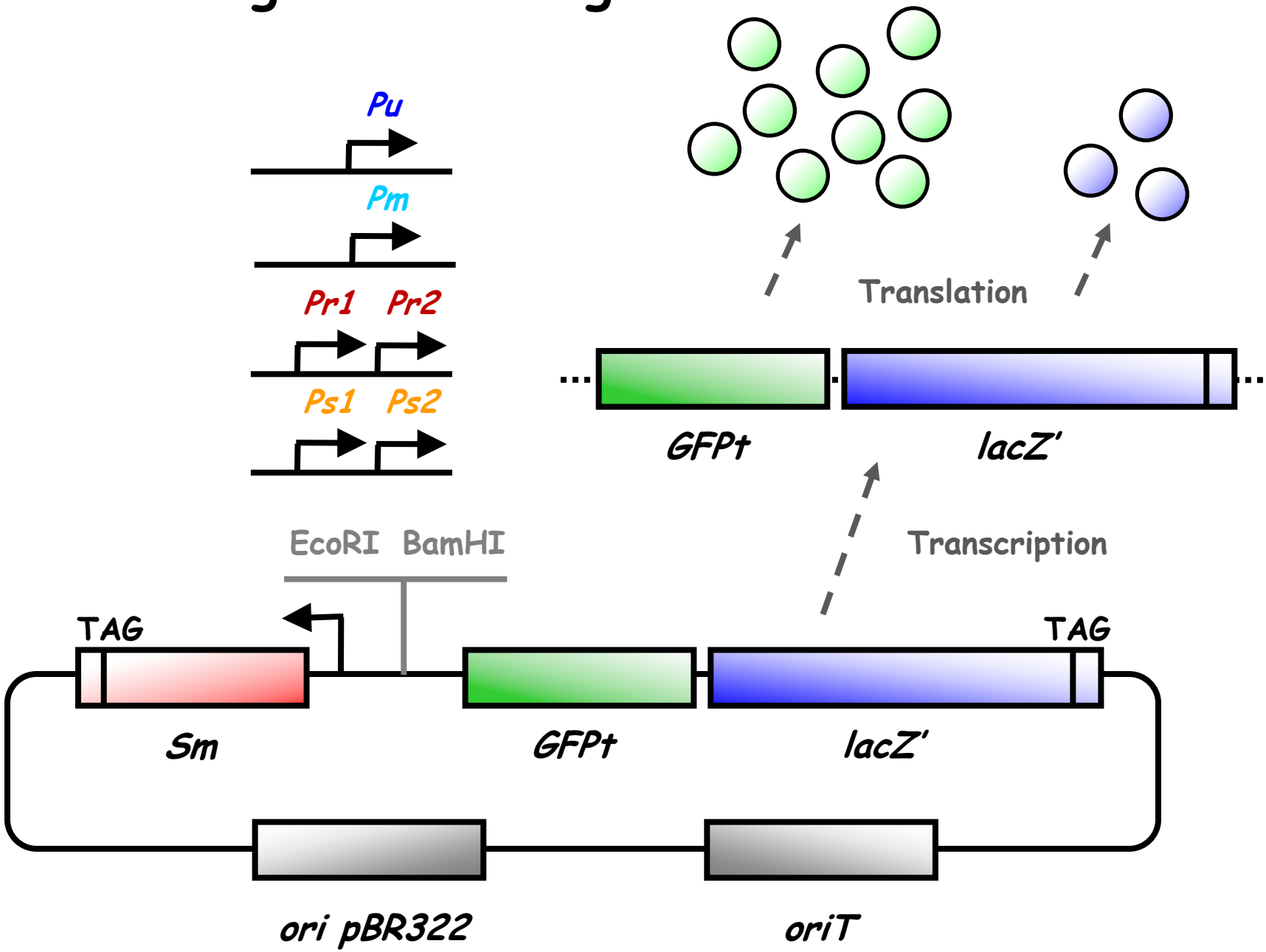
The pRV1 system



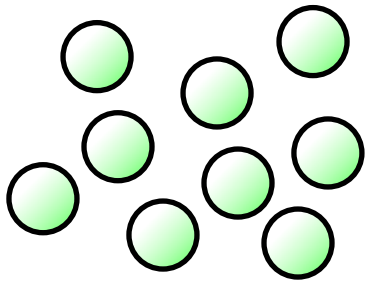
pRV1
8.2 Kb

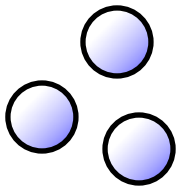
E. coli CC118*supF*

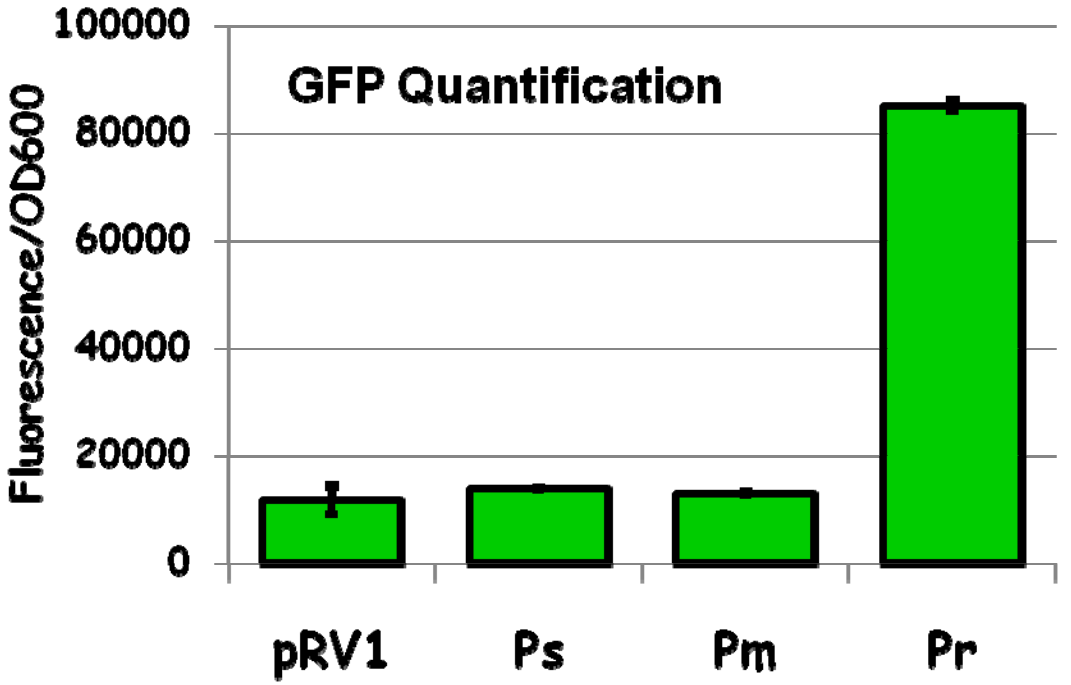
Standardizing the building blocks

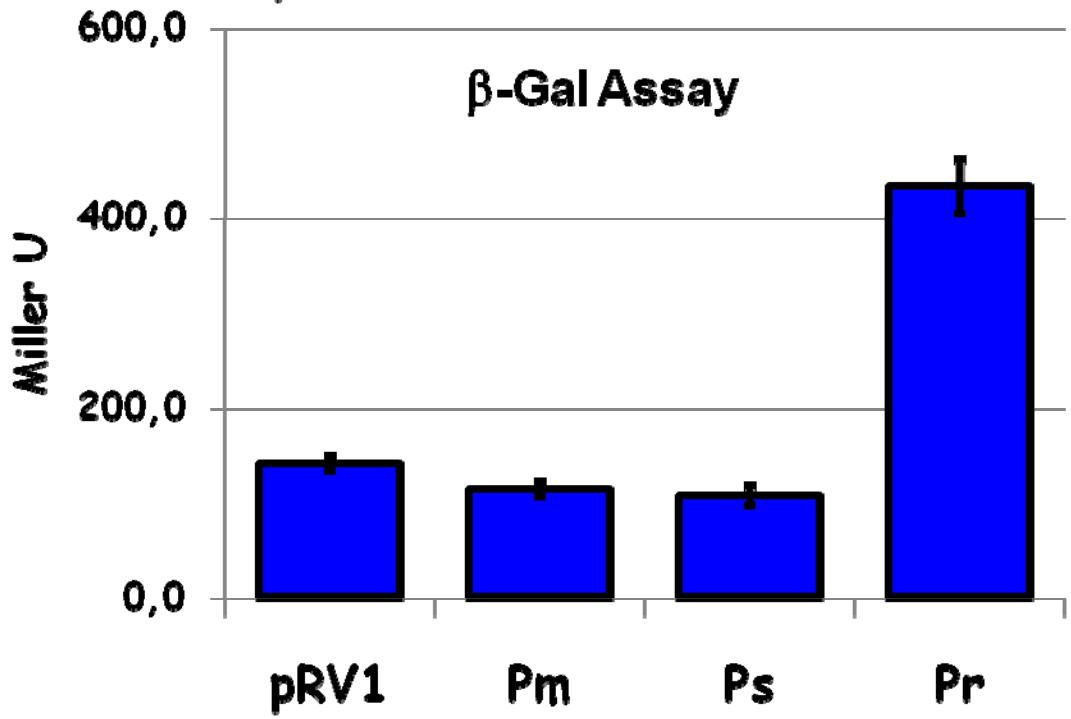


Bicistronic reporter

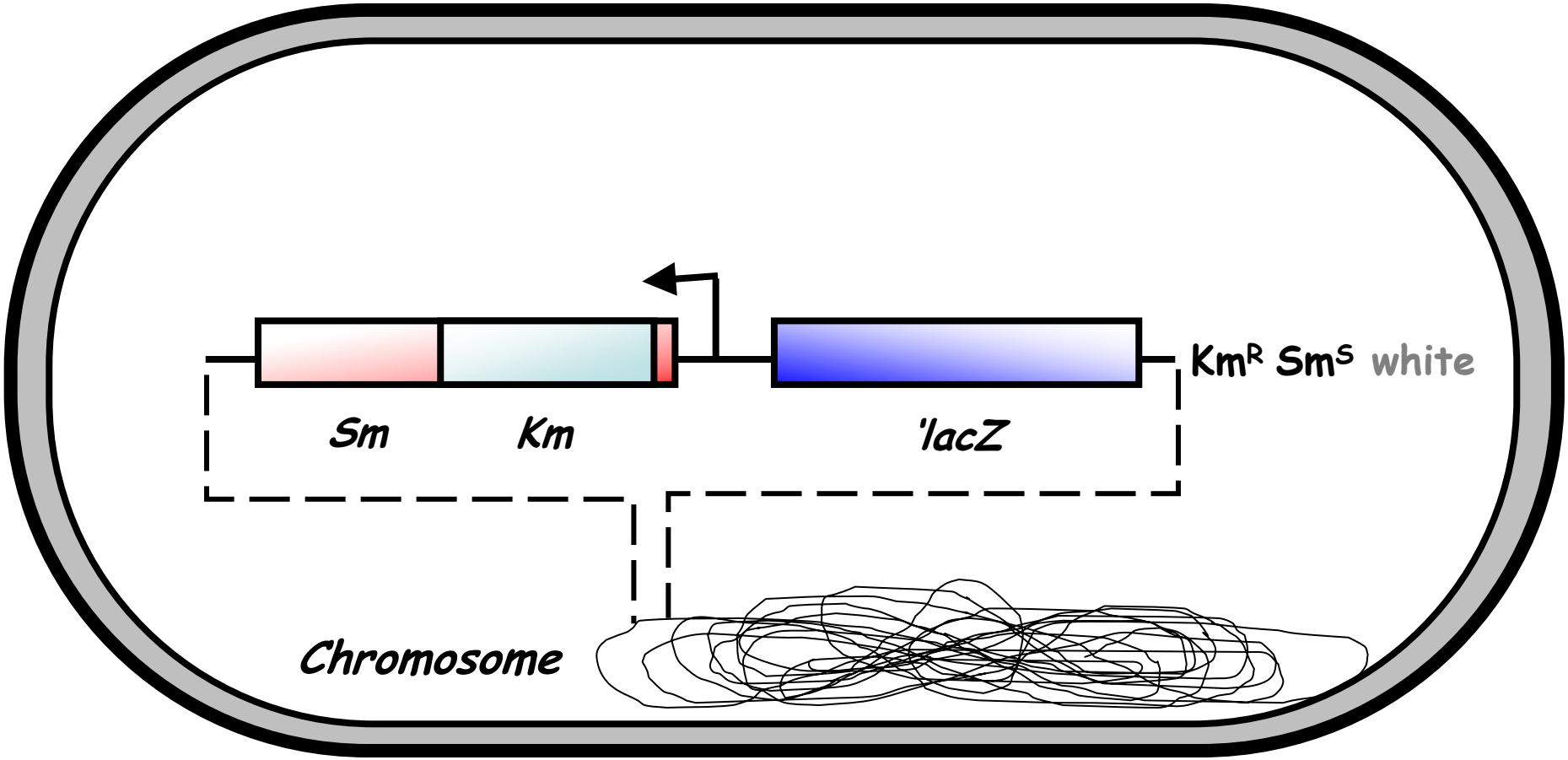






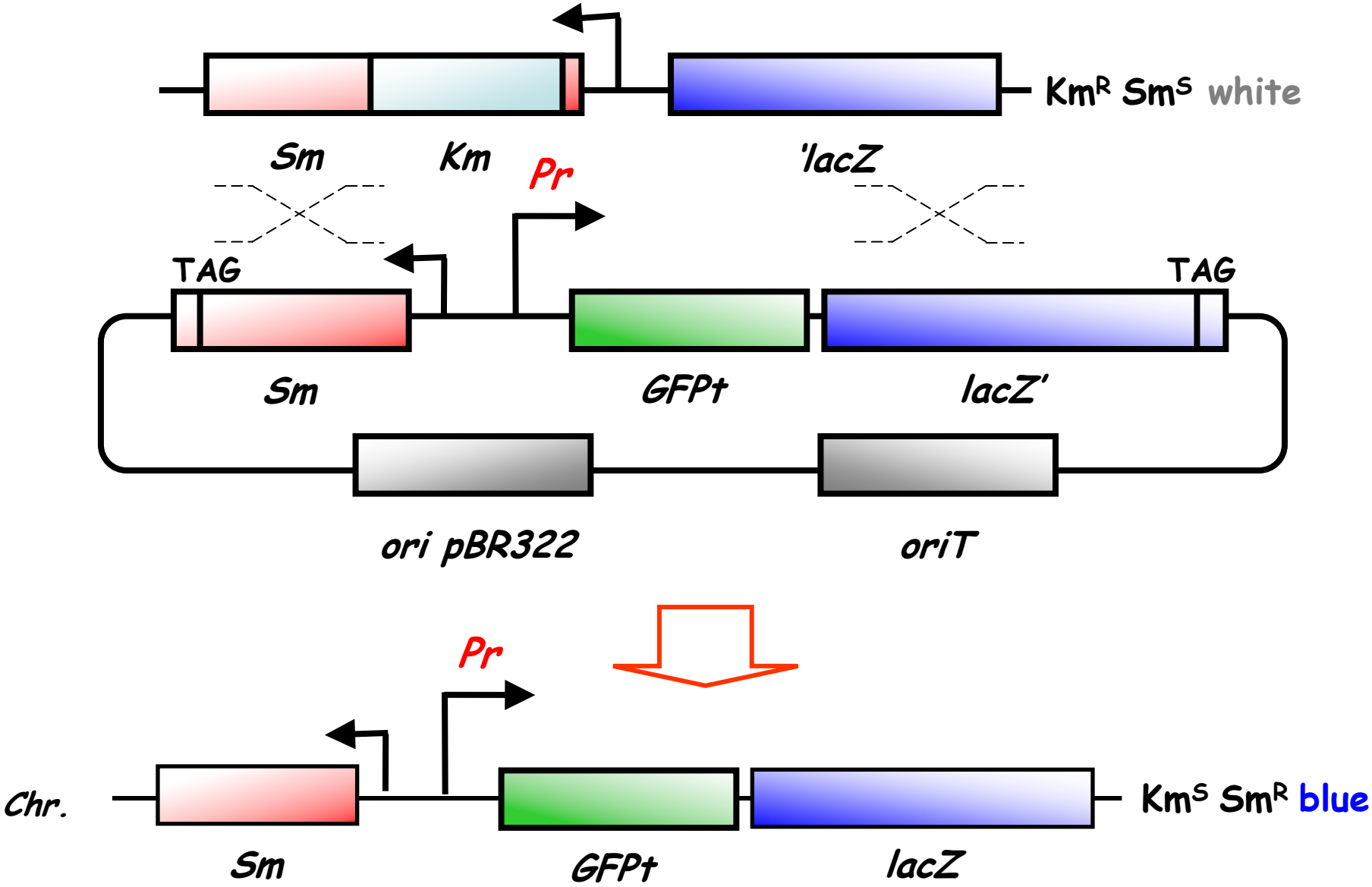


Chromosomal homology fragment (*P. putida* KT2440)



pLOF –hom.fg. (miniTn10), Kesser *et al* 1992.

Homologous recombination



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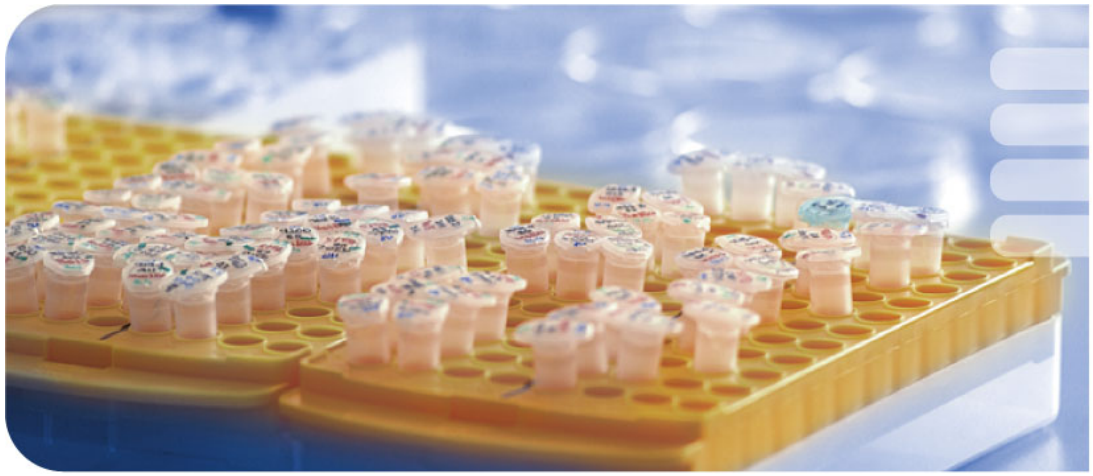
Questions WP4

GENEART
THE GENE OF YOUR CHOICE



EMERGENCE Meeting Hong Kong - October 2008

Workpackage 5: Building the Academia-Industry interface

Frank Notka, Ralf Wagner, October 2008

Workpackages 3 and 5: Deliverables

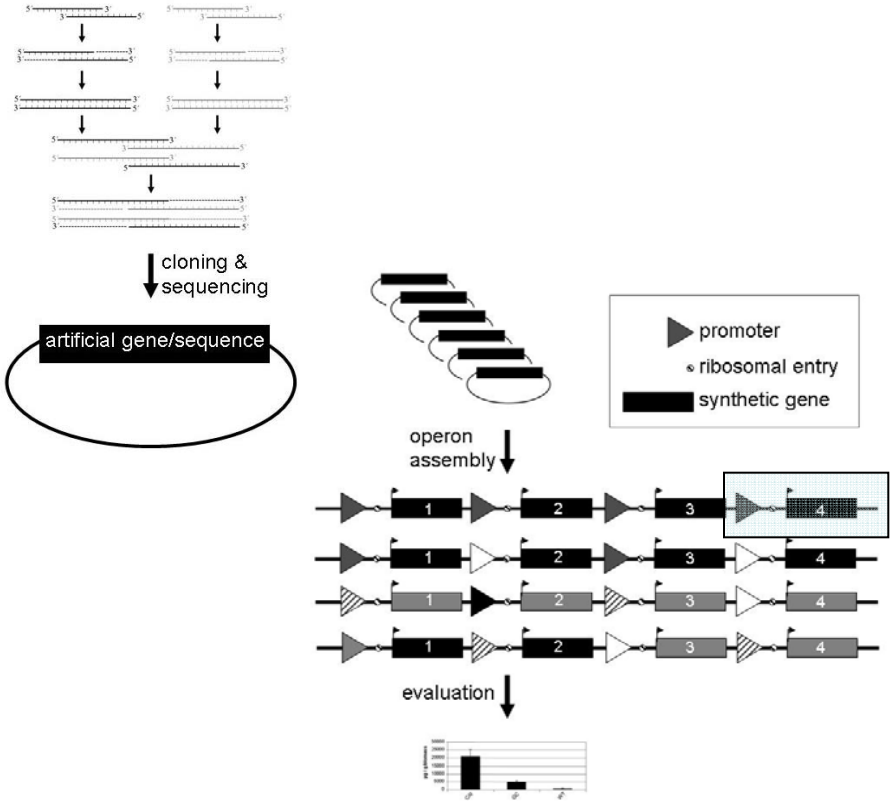
Deliverable		Progress
3.4	Document describing the proof-of-concept study exploiting the integrated workflow for genetic circuit design	In progress
5.1	Reports on two industry workshops - to define the priorities of the European industry in the field of synthetic biology, and - to evaluate the fit of the European synthetic biology projects with the industry needs	Delay (involvement in 10/07) 1. report in preparation
5.2	Reports on two workshops (associated to industry-relevant scientific conferences) to teach the industry in synthetic biology concepts and tools	SynBio 4.0 session on Industrial Biotechnology
5.3	Position paper on the priorities of the European industry in the field of synthetic biology, evaluation of fit with current EU synthetic biology projects, and decision on how to address the potential gaps	In progress
5.4	Intermediate and final report on status of discussion regarding IP strategy in the field of synthetic biology, originating from company internal assessments and summarizing the ideas on IP-management (same workshops as in D5.1)	Delay 1. report in preparation

Workpackage 3
European IT Infrastructure for SB

GENEART
THE GENE OF YOUR CHOICE

Strategies and tools for gene synthesis and assembly:

Gene sized segments can be assembled from synthetic oligonucleotides allowing maximum freedom for rational operon design. Differently designed elements in operons can be evaluated and optimized



I) Gene-design ☑
- high flexibility
- adaptation to host
- interchangeable parts

II) Synthesis capacities ☑
- up to 2 mio bp/month
- expanding automation platform
- introduction of Laboratory Information Management System (LIMS)

III) Variants of coding/regulatory elements ☑
- epigenetic control
- metabolic control

IV) Functional circuit design ☐
- cooperative task

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Strategies and tools for gene synthesis and assembly:

Provide a strategy to evaluate parts in regard of biosecurity in order to avoid miss-use

BioInformatics @ Geneart: Providing highest biosecurity level

Initial check of gene synthesis:

(1) Country of customer (K-List, Embargo states)
(2) Nature of customer (HADDEX List)
(3) Nature of sequence (Internal data-base, blast)

Involvement of regulatory authorities/guidelines (BAFA and Australia group)

Check for associated pathogenicity/toxicity (dual-use components)

Based on these information a Go/No-Go decision is made

Workpackage 5
WS IP issues (16.06.2008)

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THE GENE OF YOUR CHOICE

Objectives:
- Discuss open source policy and role of patents
- Provide a basis for discussion in Industry WS

➡ **Provide ideas for an IP-strategy that would promote integration of the European industry into the development of Synthetic Biology**

Participants
Experts from different IP related disciplines:

- Technology and innovation management (J. Henkel, TUM)
- Patent - industry (K. Schwander, DSM; C. Ludwig, Geneart)
- Patent - public (B. Rutz, EPO)
- Development (S. Panke, ETH; L. Pasamontes, DSM)
- Technology provider (R. Wagner, F. Notka, Geneart)

Workpackage 5: IP WS
Take-home messages:

The realization of an European Registry involving the European industry is possible

IP-relevant parts should not be excluded

What we should think about:

Standard MTA

Information management system

Involving funding agencies

Workpackage 5

WS Define needs and interests of Industry (25.06.2008)

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Objectives:

- Definition SB
- Attract Industry to European SB
- Link Academia & Industry
- Address IP issues

→ **Promote the Integration of Industry into the European SB development**

Participants

Experts from leading European industries covering:

- Chemistry (Lonza, Novozymes, DSM)
- Pharma (AstraZeneca, F. Hoffmann-La Roche)
- Environment/Biomaterials (Metabolic explorer, Heurisco)
- Biotechnology (Lifewizz) and

European academic Synthetic Biology exponents (Helmholtz-Allianz Systembiologie, Helmholtz-Zentrum für Infektionsforschung)

Workpackage 5: Industry WS
Take-home messages:

Gain more visibility by presenting successful and relevant applications

Strategic top down approach recommended

Push the buttons of politicians and investors

A clear bias in development

Procaryotic development much more advanced:
Metabolic pathways, Biofuels & fine chemicals, Biodetectors

Big Pharma: Too early for our engagement

Prefer small cooperation strategies
Slow process due to extensive negotiations

Redirect contacts

Address smaller companies
Include regulatory and IP manager
Involve other types of Industries

Open Source policy

Clear tendency towards non-open solutions
IP regulation a major issue

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End of WP5

Planned activities in the second period:

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2009:
- Continue work on showcases, promoter formatting (V. de Lorenzo, L. Serrano), IT infrastructure (A. Valencia)
- 2nd Academia/Industry workshop
- IP-strategy development
- Summer school 1 (EMERGENCE)
- Scientific workshop on formatting transcription (Gourse, Busby, Aiba, Buck), Mallorca, Spain (V. de Lorenzo)
- Promoting EU-Asia exchange

2010
Summer school 2 (TARPOL)

And… your workshops and other activities!!

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www.gydb.uv.es/tarpol/

Topics on the European SB Agenda: Funding

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Current opportunities 1

EU FP7:
Area 2.3.6 Emerging trends in biotechnology

KBBE-2009-3-6-05: Synthetic biology for biotechnological applications
Call: FP7-KBBE-2009-3

Collaborative Project (small or medium-scale focused research project)

Topics on the European SB Agenda: Funding

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Current opportunities 2

EMERGENCE submitted a theme proposal to the ESF EUROCORES Program beginning of June:

Synthetic Biology: Engineering Complex Biological Systems (EUROSYNBIO)
(Coverage of (essentially) the entire field of European SynBio)

EUROCORES: Similar to EU projects (international projects) but funded by national funding agencies, typical projects: 5 PIs, 3 years, total volume of all accepted projects: up to 10 Mln € (depends on how many national agencies participate)

Proposal EUROSYNBIO got selected in September

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Final DRAFT CALL submitted to ESF two days ago – Call goes out to national funding agencies TODAY

IMMEDIATE NEXT STEPS: YOUR FUNDING AGENCY NEEDS TO DECIDE WHETHER IT WANTS TO PARTICIPATE IN THE PROJECT!

NEXT STEPS:

a) **<u>You are in a country which has participated in the original proposal</u>: Contact your national co-proposer to strengthen his case in talking to the national agencies**
b) **<u>You are not in a country that did not particpate</u>: Find out who is in charge for ESF contacts at your national funding agency and start convincing them that there is a case for your country to participate (preferably by pointing out many of the scientists in your country that might be interested).**
c) **Next deadlines (tentative):**
    a) **Mid December, agencies decide**
    b) **March/April: deadline for proposal submission**

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To learn more about EUROCORES:

http://www.esf.org/eurocores

To study the Draft Call: go to EMERGENCE website

www.emergence.ethz.ch

Topics on the European SB Agenda: Community

Discussion

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Topics on the European SB Agenda: Research Agenda

Discussion

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Topics on the European SB Agenda: Knowledge Transfer

Discussion

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Topics on the European SB Agenda:
iGEM

Discussion

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Topics on the European SB Agenda:
Outreach US-EU-Asia

Discussion

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Thank you for your input!

www.emergence.ethz.ch