IBEC Presentation

Kick-off Meeting
Barcelona, 31st May 2018

Overview:
Institute for Bioengineering of Catalunya
Nanoscopy for nanomedicine group
IBEC's involvement in the THERACAT project

IBEC

Institute for Bioengineering of Catalonia

EXCELENCIA SEVERO OCHOA

Institute for Bioengineering of Catalonia (IBEC)

Engineering solutions for health

IBEC
Institute for Bioengineering of Catalonia
EXCELENCIA SEVERO OCHOA

Who are we?

The Institute for Bioengineering of Catalonia (IBEC) is a **multidisciplinary research centre** in **bioengineering** and **nanomedicine**

IBEC's missions...

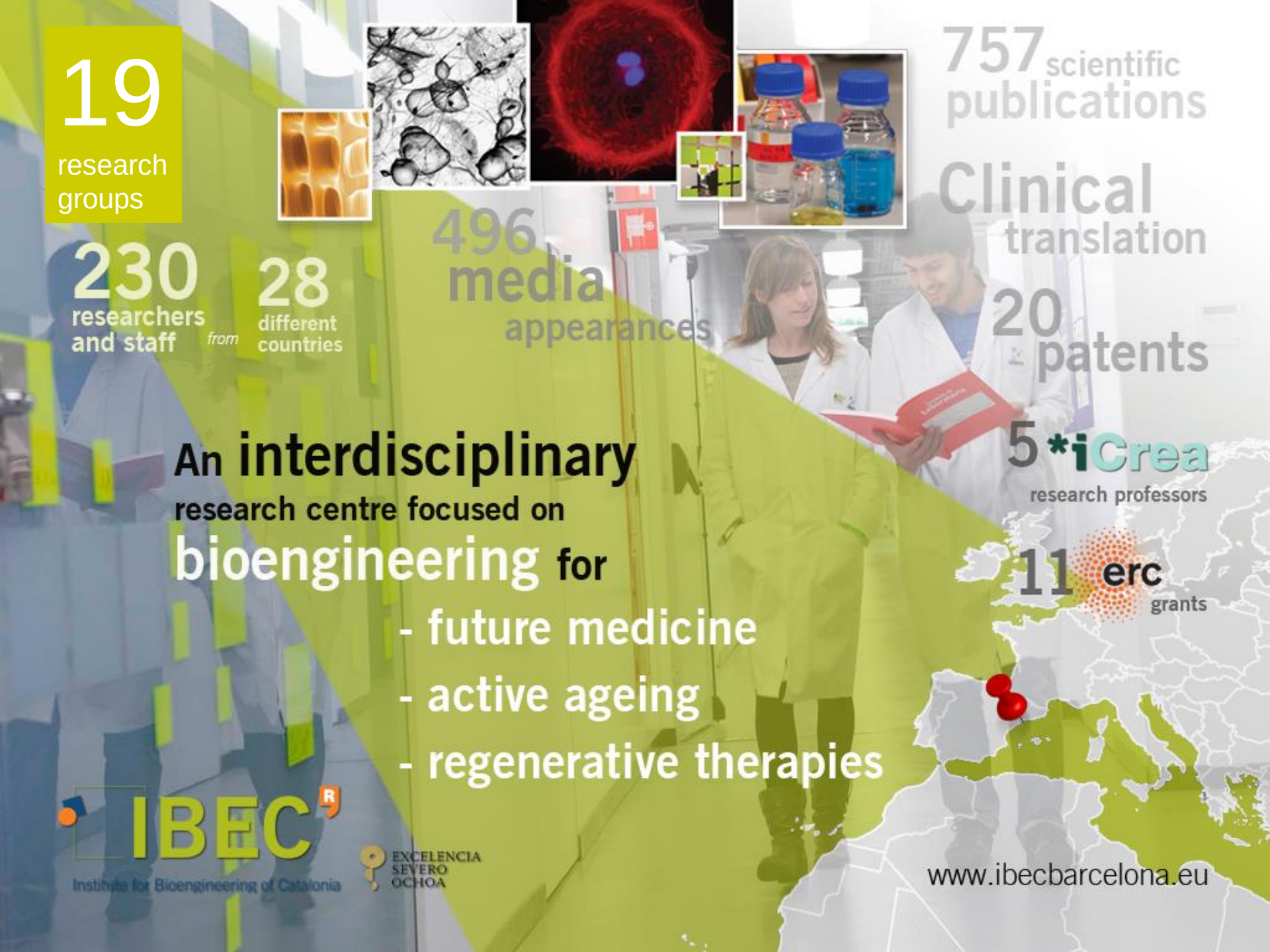
Basic and interdisciplinary research in bioengineering and nanomedicine

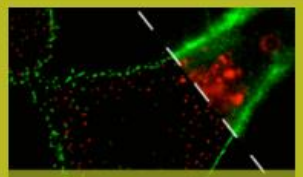
Knowledge and technology transfer to the biomedical sector

Collaborations with international academia, hospitals and industry

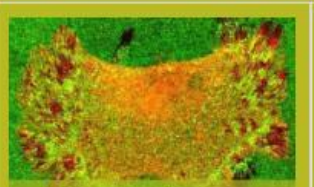
Training the next generation of experts in healthcare technology

Improving health and quality of life


19
research groups
757 scientific publications
Clinical translation
230 researchers and staff from 28 different countries
496 media appearances
20 patents
An interdisciplinary research centre focused on bioengineering for
- future medicine
- active ageing
- regenerative therapies
5 *iCrea research professors
11 erc grants
IBEC
Institute for Bioengineering of Catalonia
EXCELENCIA SEVERO OCHOA
www.ibecbarcelona.eu

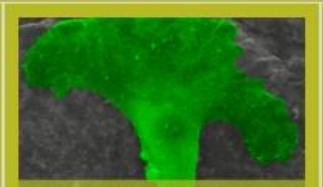


Nanoscopy for nanomedicine group
(Dr. Lorenzo Albertazzi)

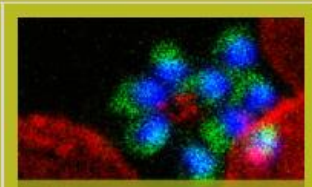


Molecular dynamics at cell-biomaterial interface group
(Prof. George Altankov)

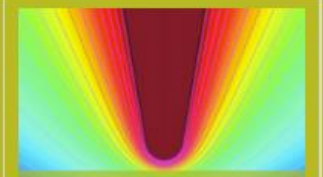
Mechanics of development and disease group
(Dr. Vito Conte)



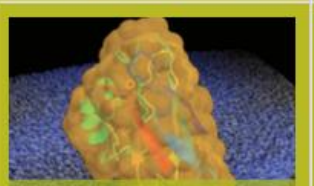
Biomaterials for regenerative therapies group
(Dr. Elisabeth Engel)



Nanomalaria (Joint group IBEC/ISGlobal)
(Dr. Xavier Fernández-Busquets)



Nanoscale bioelectrical characterization group
(Dr. Gabriel Gomila)



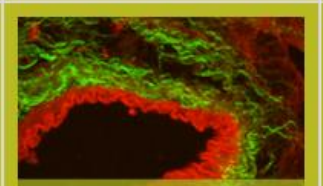
Nanoprobes and nanoswitches group
(Prof. Pau Gorostiza / Prof. Fausto Sanz)

Biomedical signal processing and interpretation group
(Prof. Raimon Jané)

Signal and Information Processing for Sensing Systems group
(Dr. Santiago Marco)

Biomimetic systems for cell engineering group
(Dr. Elena Martínez)

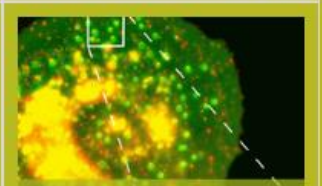
iPSCs & activation of endogenous tissue programs for organ regeneration
(Dr. Núria Montserrat)



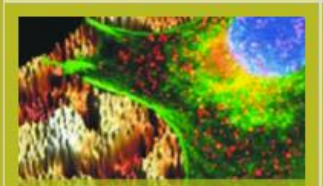
Cellular and respiratory biomechanics group
(Prof. Daniel Navajas)

Biosensors for bioengineering group
(Dr. Javier Ramon)

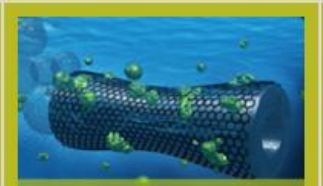
Molecular and cellular neurobiotechnology group
(Prof. José Antonio del Río)



Cellular and molecular mechanobiology group
(Dr. Pere Roca-Cusachs)

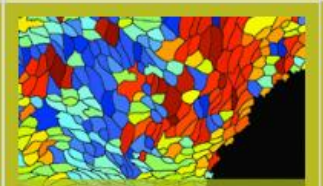


Nanobioengineering group
(Prof. Josep Samitier)



Smart nano-bio-devices group
(Prof. Samuel Sánchez)

Bacterial infections: antimicrobial therapies group
(Dr. Eduard Torrents)



Integrative cell and tissue dynamics group
(Prof. Xavier Trepat)

19 IBEC groups


Group Leader @ IBEC Barcelona


Associate Professor @ TU/e
PHILIPS

Nanoscopy for nanomedicine @ IBEC

Silvia Pujals
Pietro Delcanale

Natalia Feiner
Maria Arista
Edgar Fuentes
Roger Riera
Adrianna Glinkowska
Madhura Murar

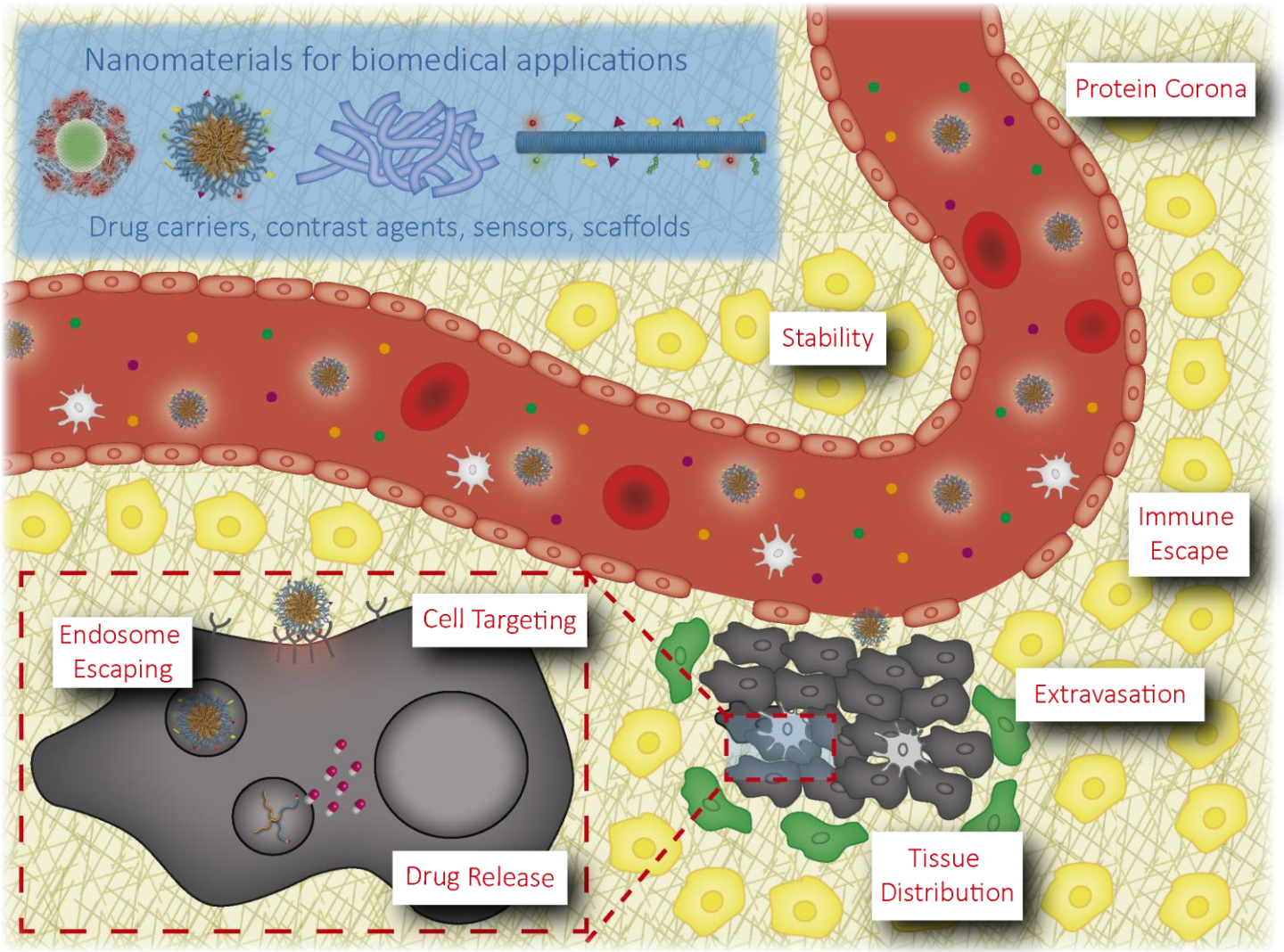
Christian Vila
Bernat Miret
Roger Riera
Alis Olea
Sergi de la Cruz
Boris Arts
Adrià Terradellas

Alicja Kosiorowska
Javier repito
Akim Kobothov
Gaia Pacassoni
Tania Rodriguez
Rens Meijers

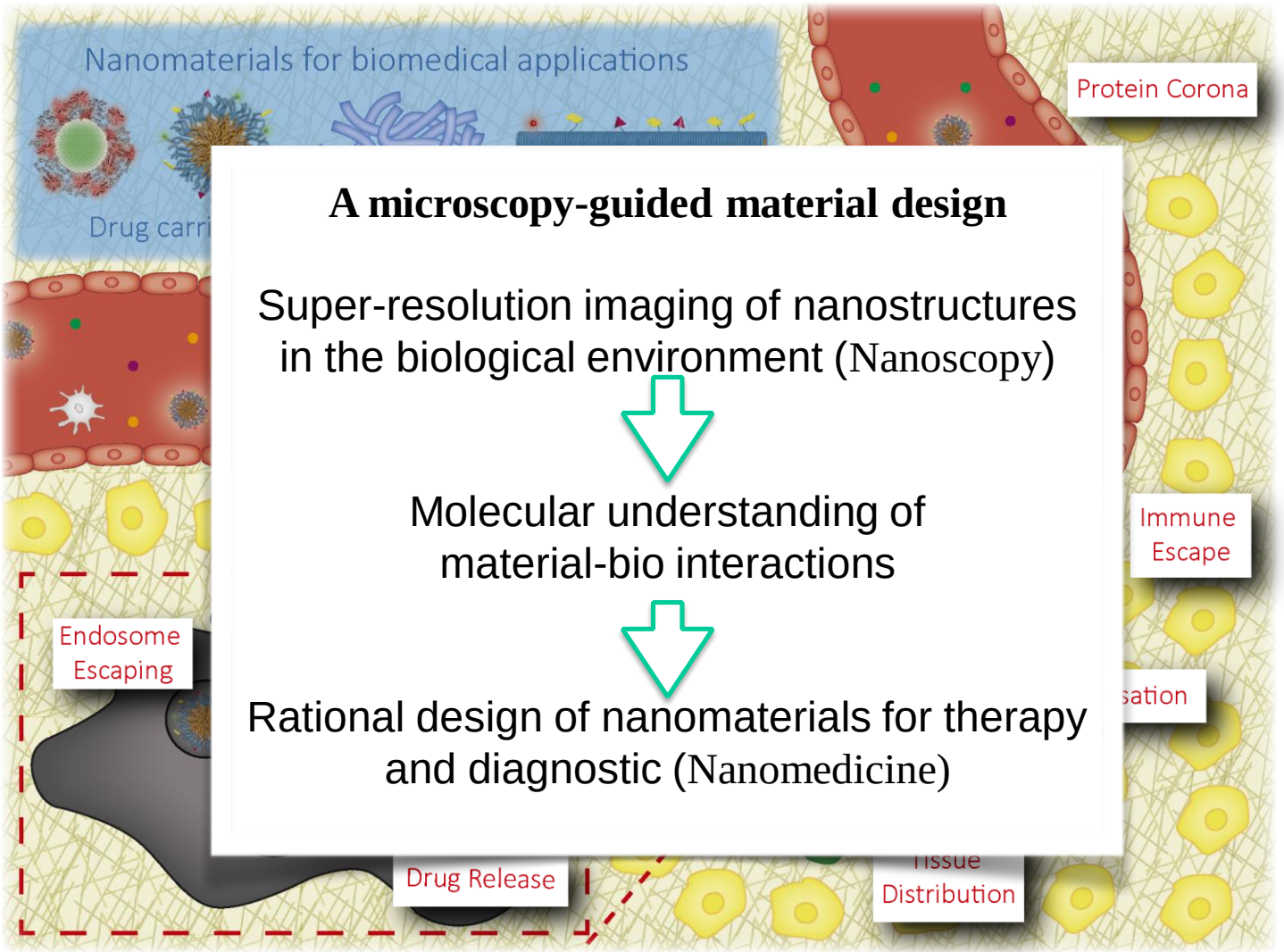
Institut de bioenginyeria de Catalunya

Bio-orthogonal catalysis for cancer therapy

European Training Network THERACAT



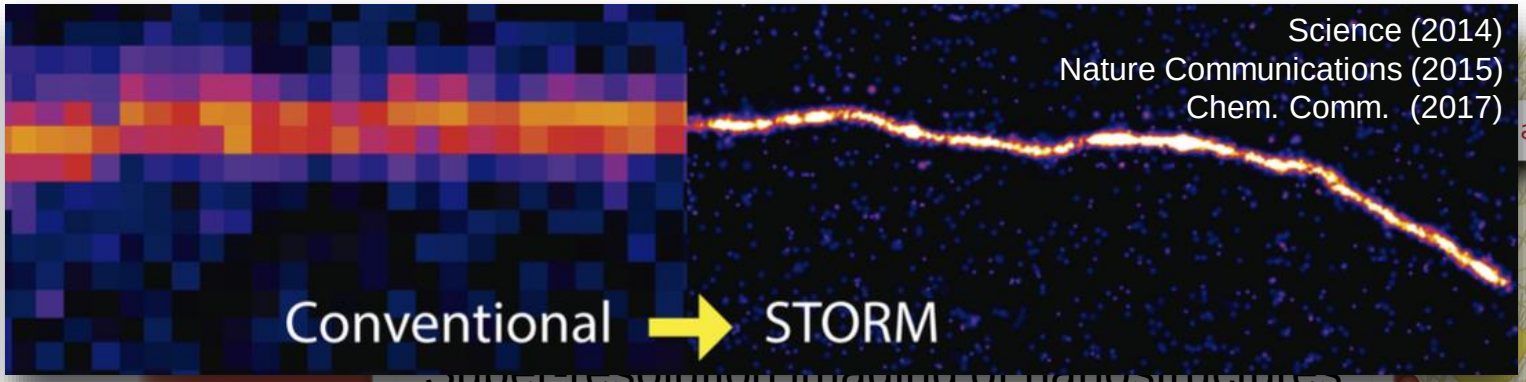
Innovative Training Networks (ITN)-Marie Sklpdpowska-Curie Actions
H2020-MSCA-ITN-2017 (THERACAT-765497)


Nanomaterials for biomedical applications
Drug carri
Protein Corona
Immune Escape
Endosome Escaping
Drug Release
Tissue Distribution
A microscopy-guided material design
Super-resolution imaging of nanostructures in the biological environment (Nanoscopy)
Molecular understanding of material-bio interactions
Rational design of nanomaterials for therapy and diagnostic (Nanomedicine)

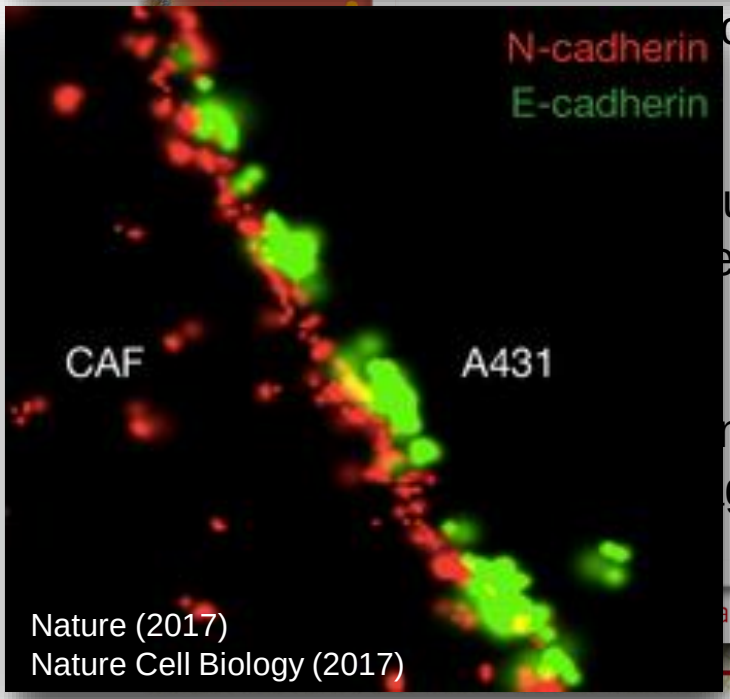
Institut de bioenginyeria de Catalunya

Bio-orthogonal catalysis for cancer therapy

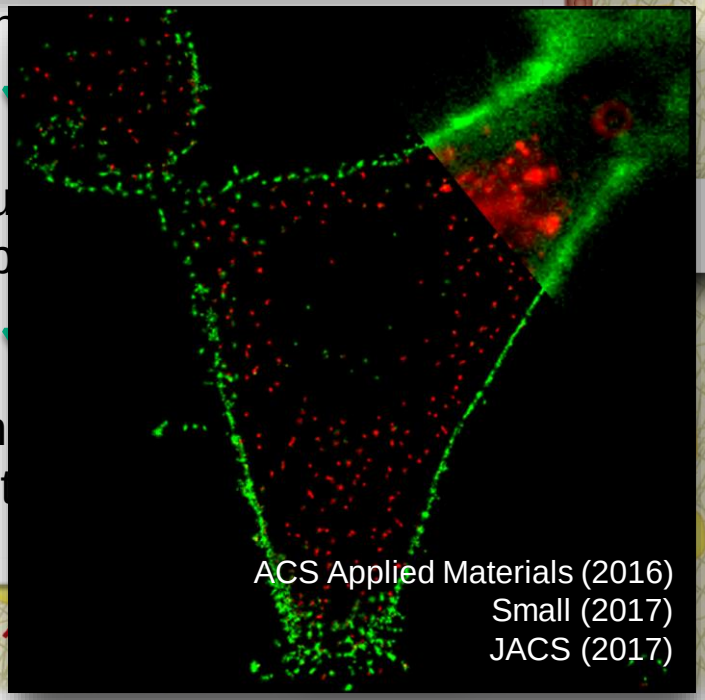
European Training Network THERACAT



Science (2014)
Nature Communications (2015)
Chem. Comm. (2017)



Nature (2017)
Nature Cell Biology (2017)



ACS Applied Materials (2016)
Small (2017)
JACS (2017)

Nanoscopy for nanomedicine

RESEARCH FOCUS OF THE GROUP

(i) Synthesis and characterization of self-assembled drug carriers

(ii) Developing super-resolution methods to study materials in vitro and in biological media

(iii) Understand material-cell interactions at the single molecule level

(iv) Microscopy-guided design of new cancer therapies

Nanoscopy for nanomedicine

RECENT ACHIEVEMENTS RELEVANT TO THE THERACAT PROJECT

JACS JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Article

Cite This: J. Am. Chem. Soc. 2018, 140, 3423−3433

pubs.acs.org/JACS

Catalytically Active Single-Chain Polymeric Nanoparticles: Exploring Their Functions in Complex Biological Media

Yiliu Liu,[#,†] Sílvia Pujals,[#,‡] Patrick J. M. Stals,[†] Thomas Paulöhrl,[†] Stanislav I. Presolski,[†] E. W. Meijer,[†] Lorenzo Albertazzi,[*,‡] and Anja R. A. Palmans[*,†]

[†]Laboratory for Macromolecular and Organic Chemistry and Institute for Complex Molecular Systems, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands

[‡]Institute for Bioengineering of Catalonia (IBEC), The Barcelona Institute of Science and Technology, Carrer de Baldiri Reixac 15-21, 08028 Barcelona, Spain

Nanoscopy for nanomedicine

RECENT ACHIEVEMENTS RELEVANT TO THE THERACAT PROJECT

JACS

JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

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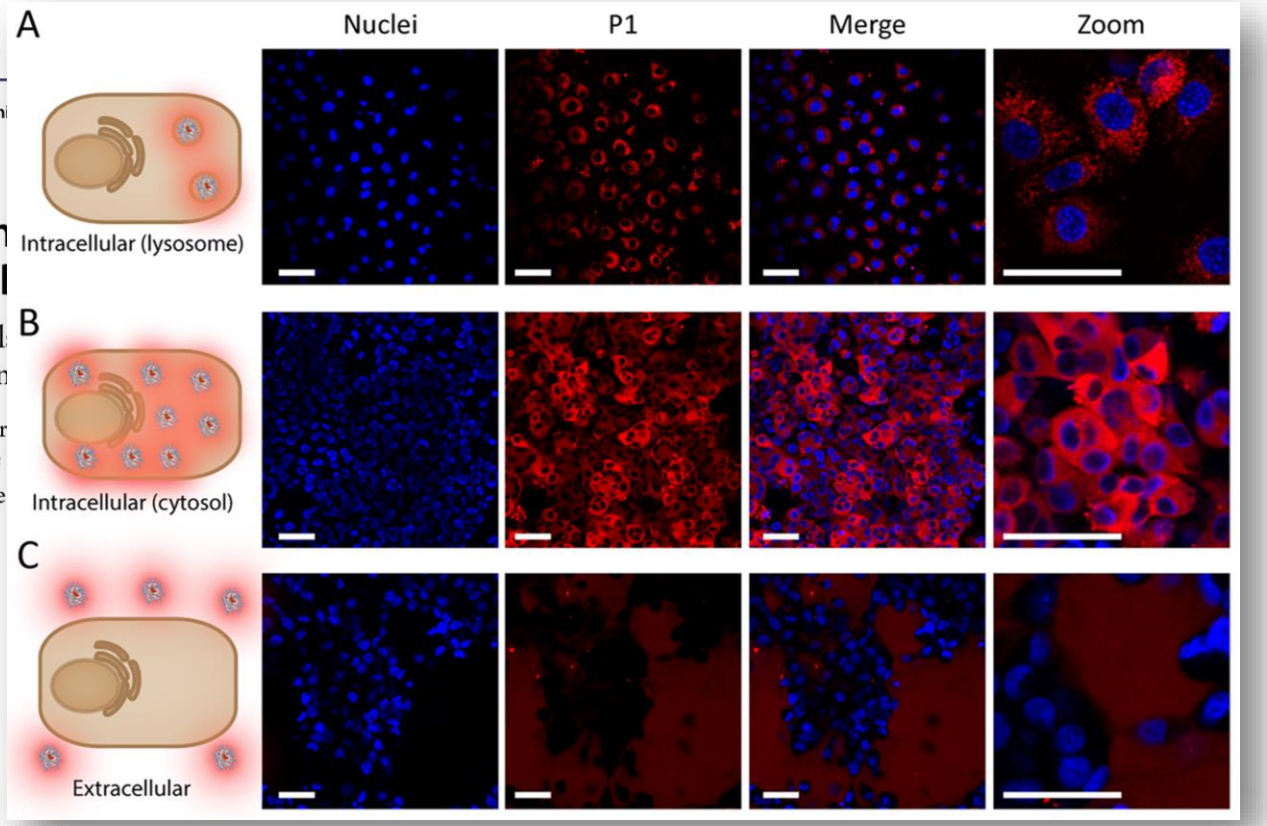

Nanoscopy for nanomedicine

RECENT ACHIEVEMENTS RELEVANT TO THE THERACAT PROJECT

JACS JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Article

Cite This: J. Am. Chem. Soc. 2017, 139, 16677-16687

pubs.acs.org/JACS

Micellar Stability in Biological Media Dictates Internalization in Living Cells

Natalia Feiner-Gracia,[†,⊥] Marina Buzhor,[‡,§,⊥] Edgar Fuentes,[†,⊥] Sílvia Pujals,[†] Roey J. Amir,[*,‡,§,∥] and Lorenzo Albertazzi[*,†]

[†]Institute for Bioengineering of Catalonia (IBEC), The Barcelona Institute of Science and Technology, Baldiri Reixac 15-21, 08028 Barcelona, Spain

[‡]Department of Organic Chemistry, School of Chemistry, Faculty of Exact Sciences, Tel-Aviv University, Tel-Aviv 6997801, Israel

[§]Tel Aviv University Center for Nanoscience and Nanotechnology, Tel-Aviv University, Tel-Aviv 6997801, Israel

[∥]BLAVATNIK CENTER for Drug Discovery, Tel-Aviv University, Tel-Aviv 6997801, Israel

Nanoscopy for nanomedicine

RECENT ACHIEVEMENTS RELEVANT TO THE THERACAT PROJECT

JACS
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

Article

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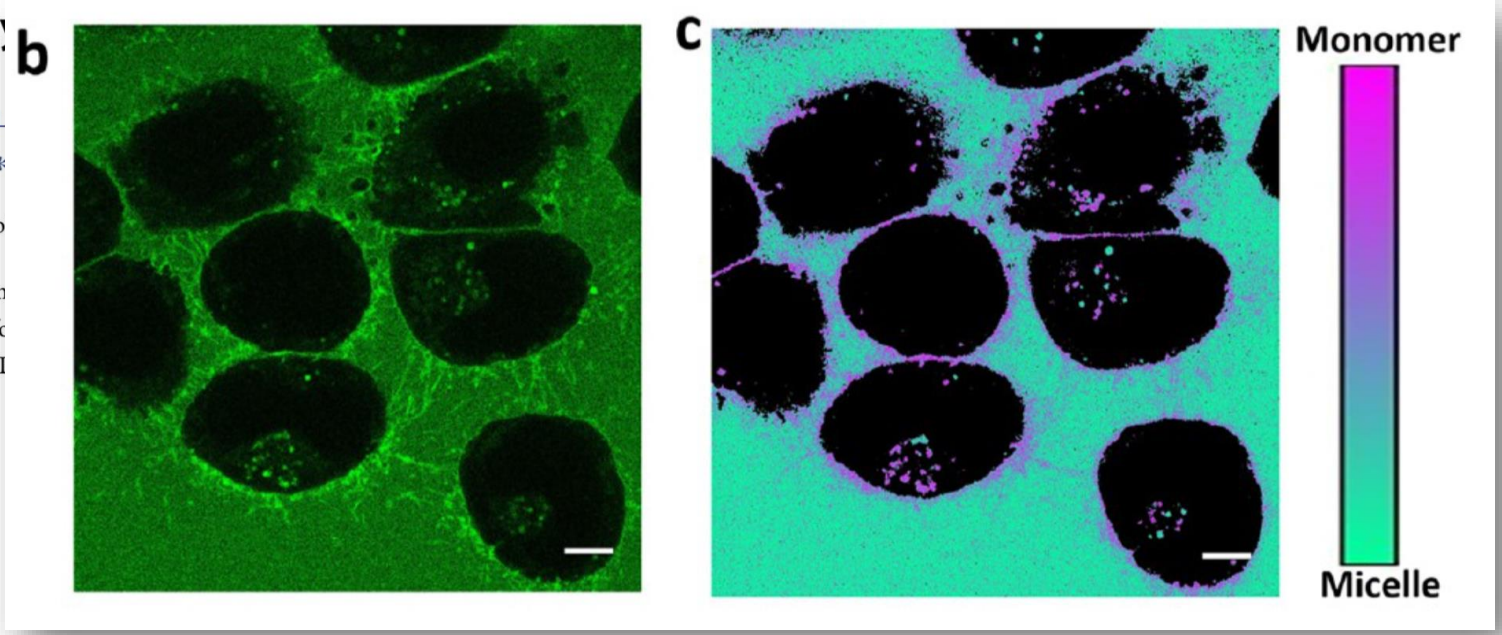
Micellar Stabilit
Living Cells

Natalia Feiner-Gracia,[†,⊥]
and Lorenzo Albertazzi*[

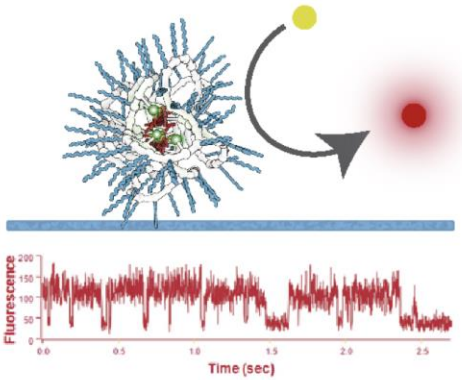
[†]Institute for Bioengineering o
Barcelona, Spain
[‡]Department of Organic Chem
[§]Tel Aviv University Center fo
[∥]BLAVATNIK CENTER for I



IBEC's involvement in the THERACAT project

ESR 6 - IBEC	Single molecule imaging of prodyes activation	PhD: Yes	Deliv.: 2.2, 2.3	Start date: M6	Duration 36	WP2

Objectives: **1.** Synthesis of prodyes; **2.** Develop a method for single catalytic events imaging and measure of the turnover rate and stability of nanocatalyst; **3.** Measure and compare different families of natural and synthetic catalysts.



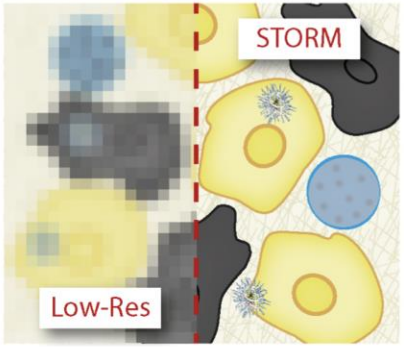
Description: ESR6 will develop a super resolution method to test at the single molecule level the catalytic efficiency of the nanomaterials proposed in THERACAT. Catalytically-activable prodyes (e.g. rhodamines and cyanines) will be synthesize to probe the efficiency of the catalyst developed in WP1. We anticipate that measuring catalytic activity and the single molecule level is crucial for synthetic structures due to the heterogeneity induced by the polydispersity in the synthesis. Individual catalyst will be anchored on a glass surface and a prodye substrate added to the solution. Single fluorescence events will be observed at any catalytic conversion using a TIRF microscope. The time profile of such events will provide information of the catalytic efficiency, turnover and stability of the catalyst and the distribution of such properties among a large population of nanostructures. A variety of structures created in WP1 (ESR1-4) will be tested and compared with natural enzymes.

IBEC's involvement in the THERACAT project

ESR 7 - IBEC	Super resolution imaging of catalytic nanoparticles delivery	PhD: Yes	Deliv.: 3.2, 3.3	Start date: M9	Duration 36	WP3

Objectives: **1.** Develop a method for STORM nanocatalyst imaging; **2.** Imaging the localization and amount of nanocatalyst in different models; **3.** STORM imaging of prodye activation in different models.

Description: ESR7 will use super resolution imaging to track the delivery and the activity of nanocatalysts in different biological models. Super resolution microscopy allows for multicolour imaging in cells and tissues with 20 nm resolution and is therefore an ideal tool to study the interactions of nanostructured materials with living matter. Different nanostructures (e.g. ESR1-4) will be labelled with Cyanine dyes suitable for Stochastic Optical Reconstruction Microscopy (STORM) and administered to i) culture of cancer cells; ii) 3D models of tissue environment (ESR9). At the desired time point the sample will be fixed and imaged with STORM revealing with high accuracy the localization and amount of catalyst that reach the target. With an analogous procedure, we will be able to localize and quantify the amount of activated prodye in different biological model simply using a STORM-compatible prodyes.



Planned secondments: **BGX** – imaging of gel models (M21, 3 months); **TAU** – in vivo and ex vivo imaging of catalysis (M30, 4 months).	**Expected results (deliverables)**: Protocol for nanocatalyst STORM imaging (D3.2); Data on nanocatalyst localization in cell and 3D cultures (D3.2); Map of catalytic activity in cells and tissues (D3.3)

IBEC's involvement in the THERACAT project

PI: **Dr. Lorenzo Albertazzi**

PM: **Dr. Rosa Miralles**

PM: **Dr. Javier Adrian**

Innovative Training Networks (ITN)-Marie Sklpdpowska-Curie Actions
H2020-MSCA-ITN-2017 (THERACAT-765497)

IBEC's involvement in the THERACAT project

IBEC Research responsabilities

WP4: Prodrugs design and synthesis

Task 4.2. Synthesis of fluorescent dyes such (rhodamines, cyanines) protected with propargyl/allyl groups (ESRX-IBEC)

Task 4.3. Spectroscopic (bulk) and microscopic evaluation (single molecule) study of catalysis. (ESRX-IBEC)

D4.2. Set of 2-3 fluorescent prodyes. Delivery Month 28

WP5: In vitro delivery and imaging

Task 5.2. Fluorescence and super resolution optical imaging of carriers' interactions with cancer cells (ESRX-IBEC).

Task 5.3. Test the efficiency of prodrug conversion in 2D and 3D cancer models (ESRX-IBEC)

D5.2. Description of the structure-activity relations of the materialcell interactions. Delivery Month 30

WP6: In vivo evaluation

Task 6.3. Use intravital optical and PET imaging to study catalyst localization and efficacy (ESRX-IBEC).

IBEC's involvement in the THERACAT project

IBEC Research responsabilities

Training events:

1. Introducing the THERACAT & How to plan a PhD. Month 12 (IBEC: Scientific Communication)
2. Chemical synthesis & catalysis. Month 18 (IBEC: Entrepreneurship/translation: IP/exploitation)
3. Drug delivery & microscopy. Month 24 (IBEC: Microscopy techniques in biomedical research)
4. Getting ready for the next career step. Month 36 (IBEC: organizer)

Secondments at IBEC:

ESR3-TEVA. 4 Months. To be scheduled (around M18). NP imaging.
ESR8-TUE. 4 Month. To be scheduled (around M21). STORM imaging of SCPN delivery.
ESR9-BGX. 4 Months. To be scheduled (around M36). imaging gels with STORM.
ESR13-TAU. 4 Months. To be scheduled (around MM21). imaging of ex-vivo samples.

Network Meetings:

Kick-off Meeting. Month 1. Barcelona. May 2018.
Final Meeting. Month 36. Barcelona. Month 36 (April 2021).
Final Meeting. Month 48. Barcelona. Month 48 (April 2022).

IBEC's involvement in the THERACAT project

IBEC Management responsabilities

WP1: Ethics Requirement (WPL)
D1.1. A - Requireement Nº 1. Delivery Month 12
D1.2. NEC - Requireement Nº 2. Delivery Month 12
D1.3. HCT - Requireement Nº 3. Delivery Month 12

WP2: Management and coordination (WPL)
D2.1. Network meeting minutes (Kick off). Delivery Month 1
D2.2. Consortium agreement. Delivery Month 2
D2.3. Supervisory Board of the Network. Delivery Month 2
D2.4. Network meeting minutes (Meeting 1). Delivery Month 12
D2.6. Progress Report. Delivery Month 13
D2.7. Network meeting minutes (Meeting 2). Delivery Month 24
D2.8. Network meeting minutes (Meeting 3). Delivery Month 36
D2.9. Network meeting minutes (Meeting 4). Delivery Month 48
D2.10. Final Management economic and scientific reports. Delivery Month 48

WP7: Training

D7.1. Personal Career Development Plans. Delivery Month 10
D7.3, 5,7,10,13. ESRs periodic short reports and AC recommendations (M12). Delivery Month 12,18,24,30,36
D7.8, 12. Updated Personal Career Development Plans. Delivery Month 24, 36
D7.10. ESRs periodic short reports and AC. Delivery Month 30
D7.14. Personal Employment Plans. Delivery Month 40

WP8: Dissemination and outreach

D8.4. THERACAT video. Delivery Month 24
D8.5. General press articles submitted to EU magazines. Delivery Month 30
D8.7. THERACAT conference. Delivery Month 42
D8.9. General press articles submitted to EU magazines. Delivery Month 48

Milestones:

MS1. Guidelines for recruitment and assessment of ESRs, PCDPs, etc. Month 4
MS2. Assessment Commissions. Month 6
MS4. ESRs Recruitment and PCDPs. Month 12
MS5. ESR local doctoral studies, Month 12
MS6. Project Check. Month 12
MS7. Synthesis of the first prodye. Month 18
MS10. Establishments of the protocol for super resolution imaging in cells. Month 18
MS14 Midterm project assessment. Month 24