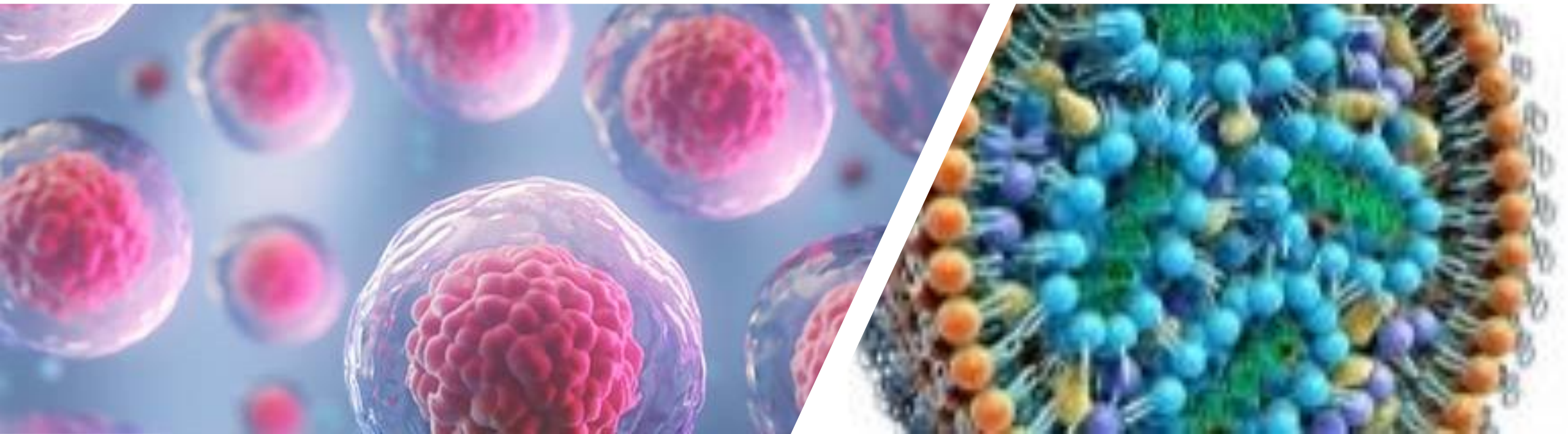


STEFAN C. DE SMEDT

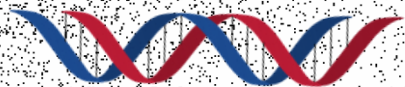
GHENT UNIVERSITY - BELGIUM



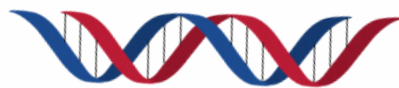


Laboratory for
General Biochemistry
and **Physical Pharmacy**

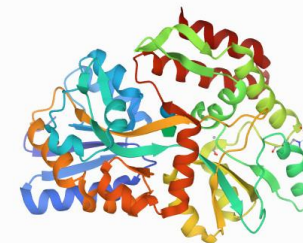
biopharmaceutics
nanomedicines
biophotonics



NUCLEIC ACID DRUGS



PROTEIN DRUGS



ADVANCED DELIVERY BIOTECH COMPOUNDS

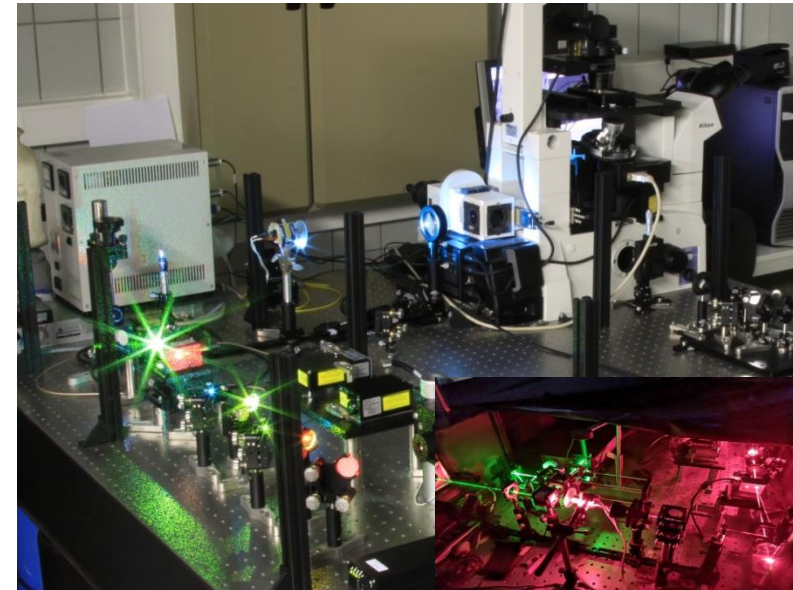
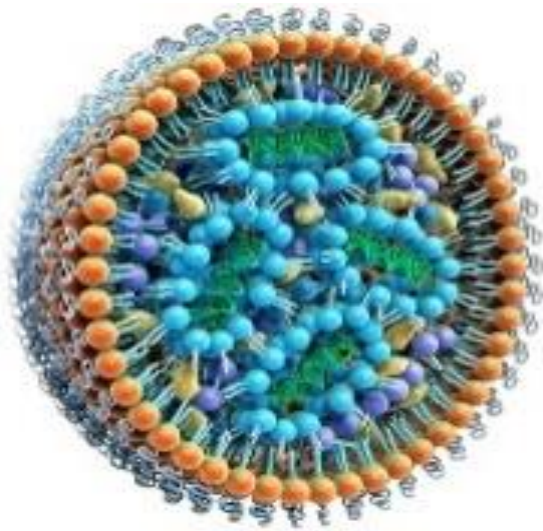


Laboratory for
General Biochemistry
and **Physical Pharmacy**

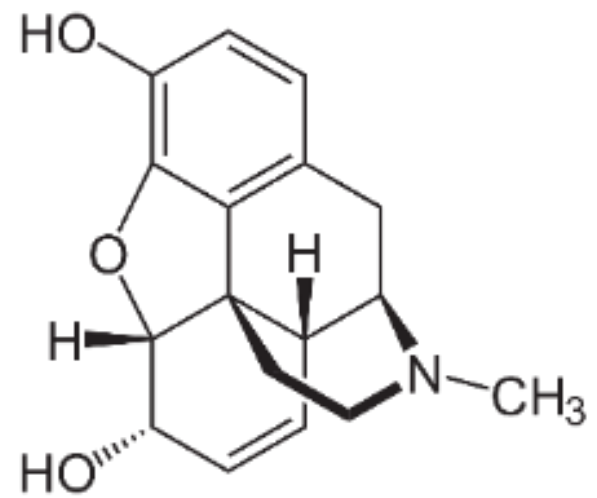
biopharmaceutics

nanomedicines

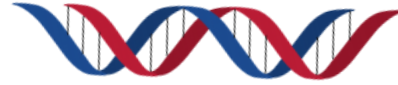
biophotonics



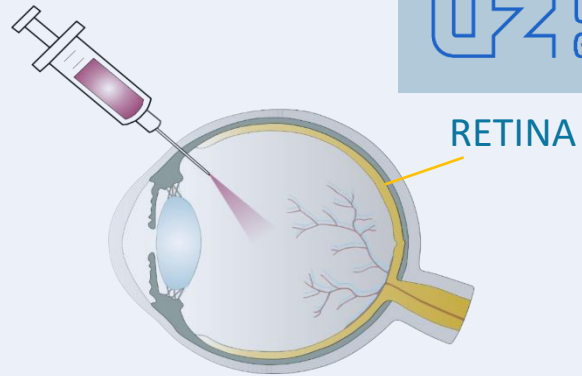
SMALL DRUGS



NUCLEIC ACIDS

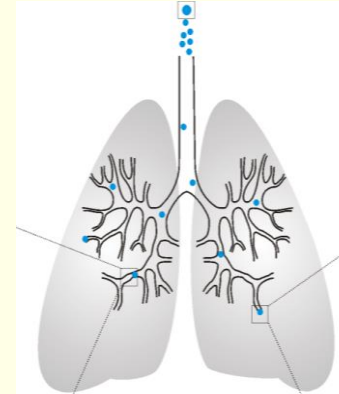


NA DELIVERY FOR **OCULAR** THERAPIES



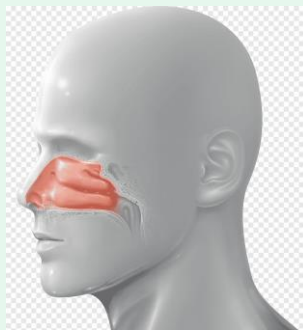
INHERITED RETINAL DISEASES

NA DELIVERY FOR **LUNG** THERAPIES



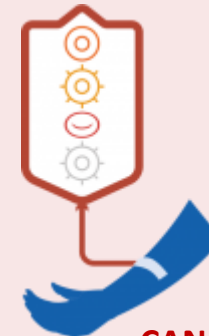
ASTHMA – COPD – CYSTIC FIBROSIS

NA DELIVERY FOR **VACCINATION**



INFECTIOUS DISEASES - CANCER

NA DELIVERY **EX VIVO** - CELL THERAPIES



CANCER



Laboratory for
**General Biochemistry
and Physical Pharmacy**

biopharmaceutics
nanomedicines
biophotonics



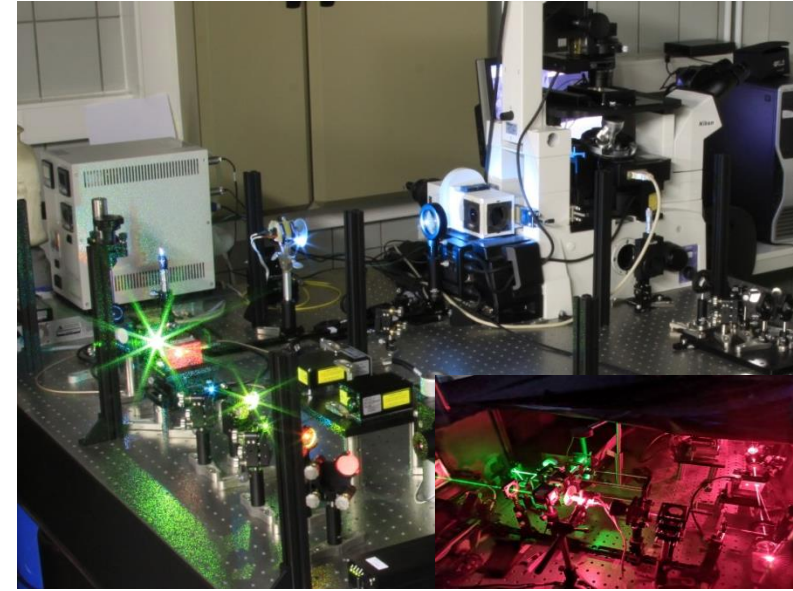
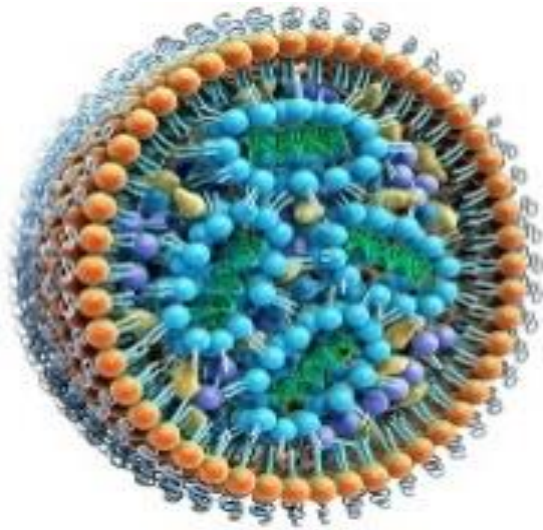


Laboratory for
General Biochemistry
and **Physical Pharmacy**

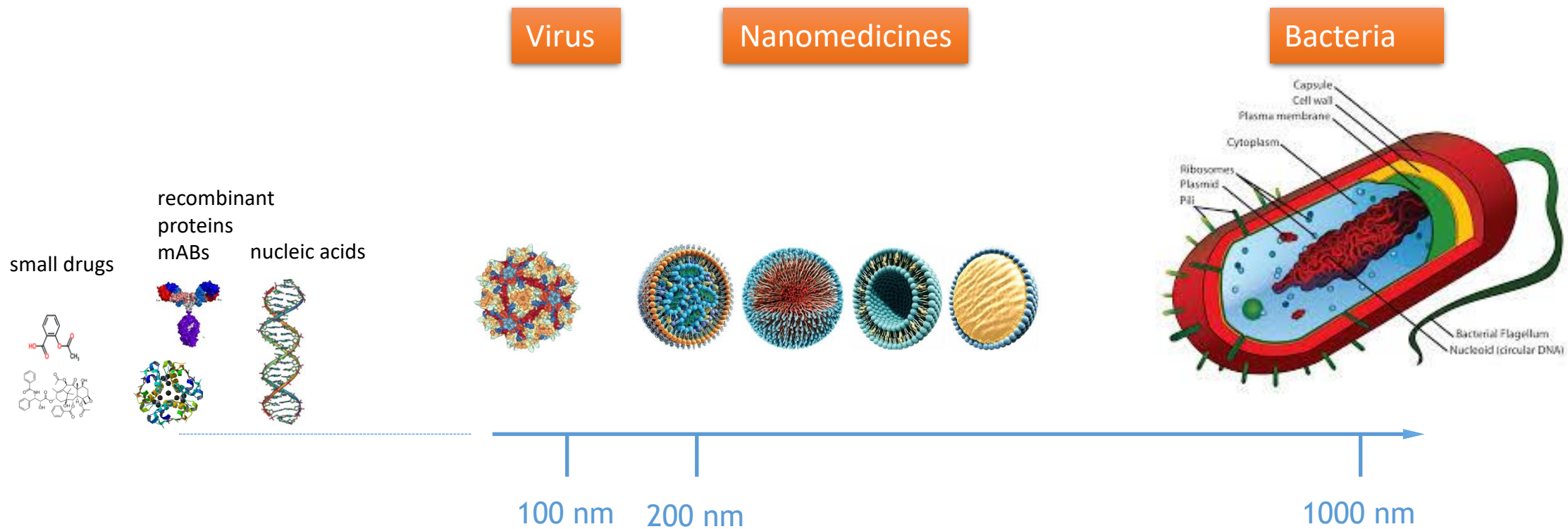
biopharmaceutics

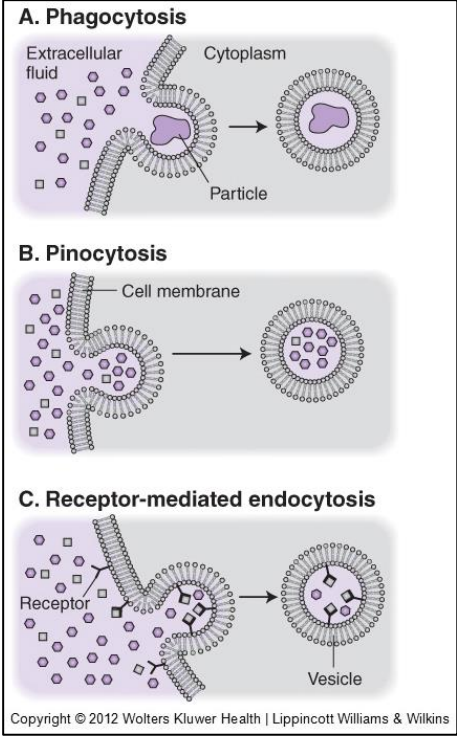
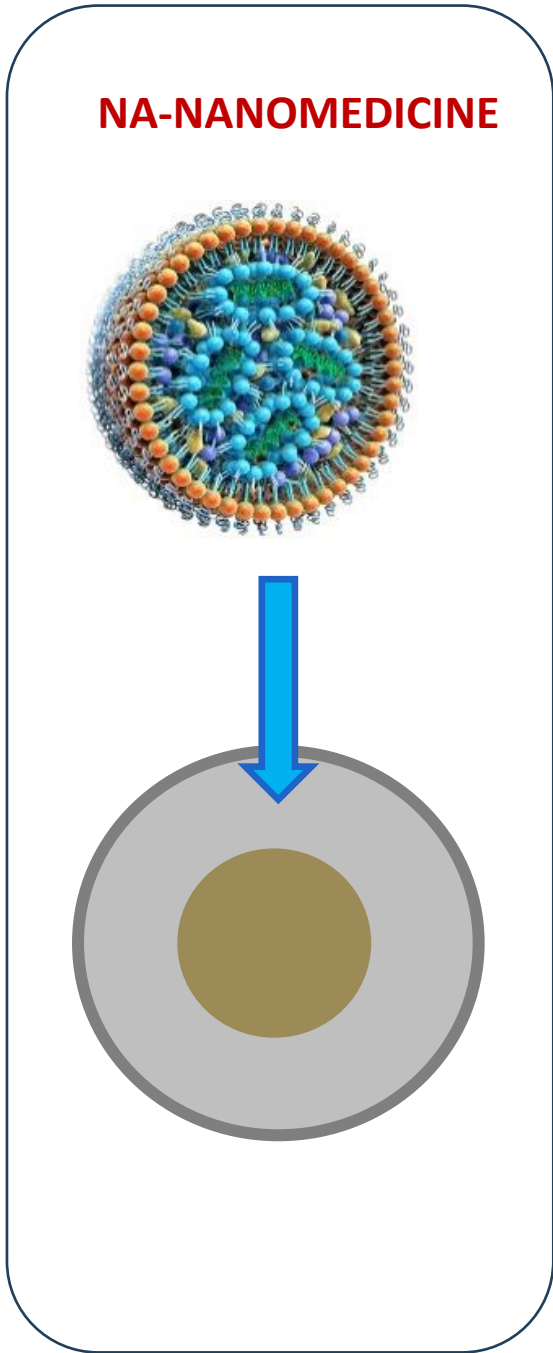
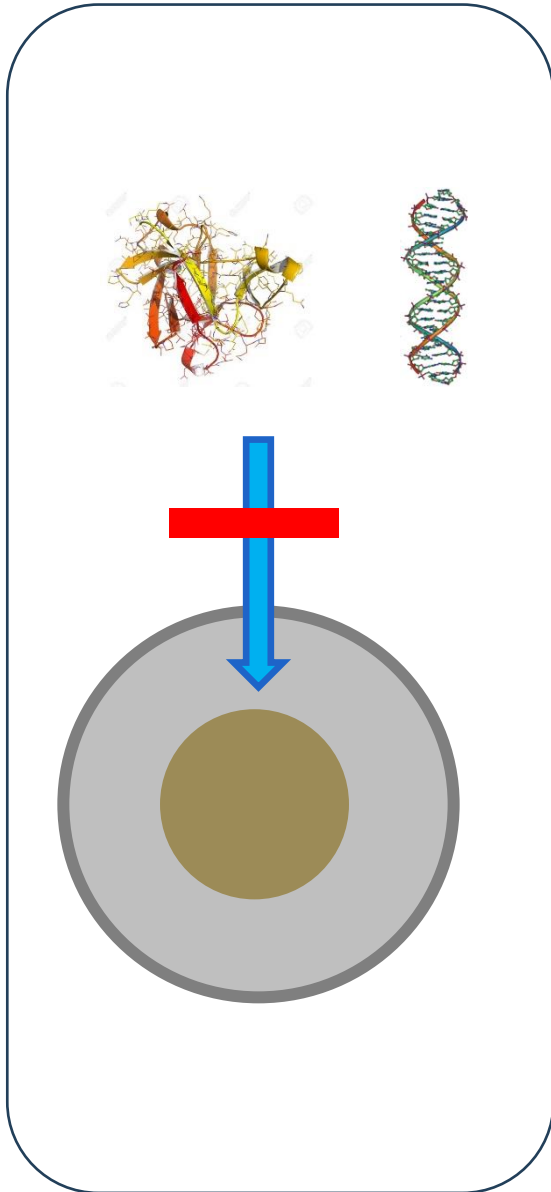
nanomedicines

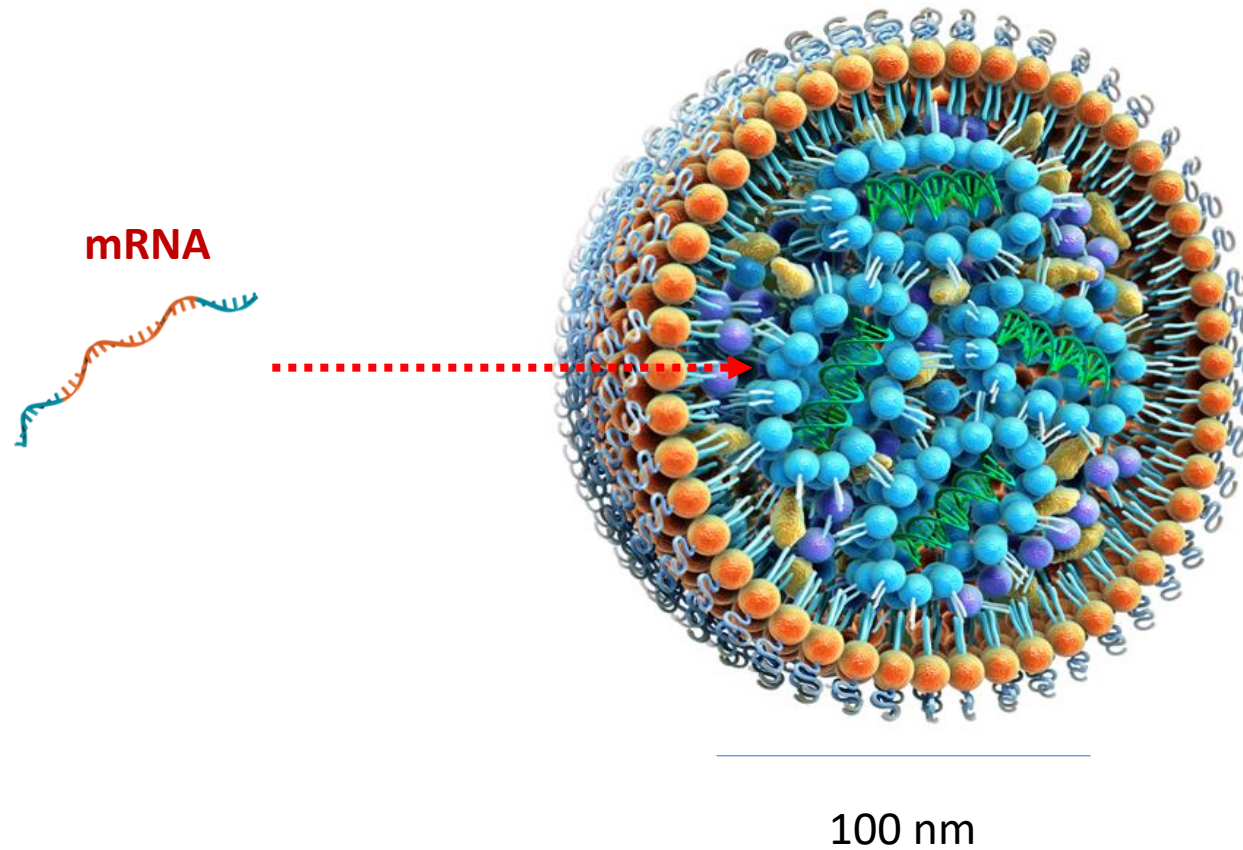
biophotonics



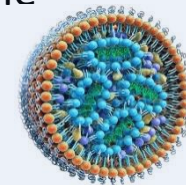








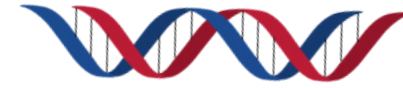
SARS-CoV-2 vaccine
mRNA vaccine
BioNTech
MODERNA
CureVAC



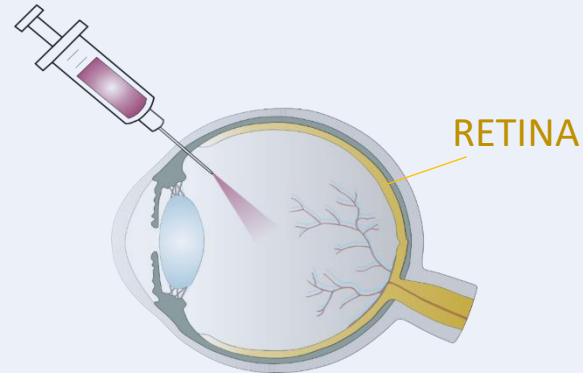
NA-NANOMEDICINE



NUCLEIC ACIDS

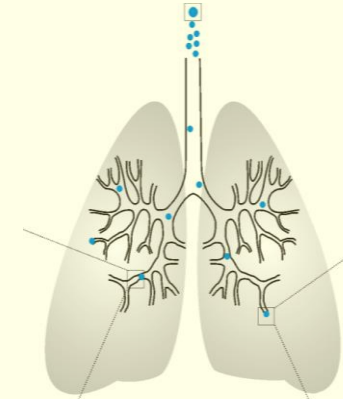


NA DELIVERY FOR OCULAR THERAPIES



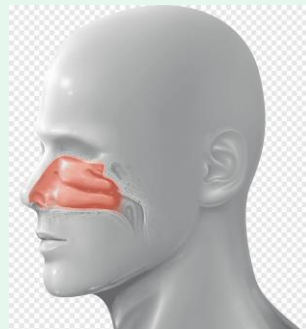
INHERITED RETINAL DISEASES

NA DELIVERY FOR LUNG THERAPIES



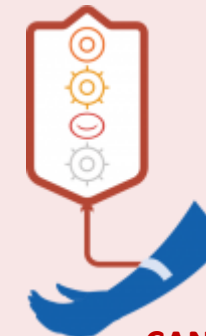
ASTHMA – COPD – CYSTIC FIBROSIS

NA DELIVERY FOR VACCINATION



INFECTIOUS DISEASES - CANCER

NA DELIVERY EX VIVO FOR CELL THERAPIES



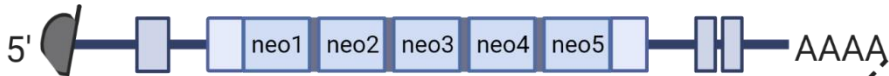
CANCER

Galsomes

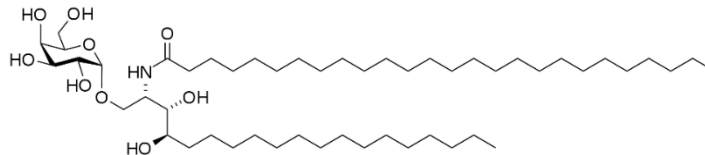
Lipid nanoparticle

Nucleoside-modified mRNA

N1-methylpseudouridine



[4 types of lipids]



Glycolipid: α -Galactosyl-Ceramide
(bacterial origin)

Natural killer T cell ligand α -galactosylceramide enhances protective immunity induced by malaria vaccines.

Gonzalez-Aseguinolaza G et al. J Exp Med 2002

Activation of natural killer T cells by α -galactosylceramide.

Fujii et al. J Exp Med 2003

Utilizing the adjuvant properties of CD1d-dependent NK T cells in T cell-mediated immunotherapy.

Silk JD et al. J Clin Invest 2004

Optimizing NKT cell ligands as vaccine adjuvants.

Carreno LJ et al. Immunotherapy 2014

co-encapsulation:
mRNA antigen + adjuvant

Glycolipid embedded in lipid nanoparticle as smart adjuvant (α -GalCer)

0,01%

Galsomes: for mRNA cancer vaccines

ACS NANO

2019

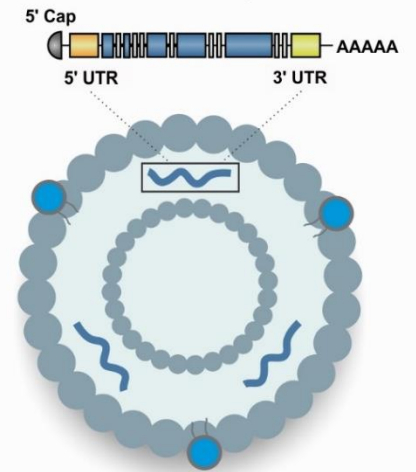
Cite This: ACS Nano XXXX, XXX, XXX–XXX

Broadening the Message: A Nanovaccine Co-loaded with Messenger RNA and α -GalCer Induces Antitumor Immunity through Conventional and Natural Killer T Cells

Rein Verbeke,^{†,‡,§} Ine Lentacker,^{†,‡,§} Karine Breckpot,[§] Jonas Janssens,^{||} Serge Van Calenbergh,^{||,§}
Stefaan C. De Smedt,^{*,†,‡,⊥,§} and Heleen Dewitte^{†,‡,§,⊥}

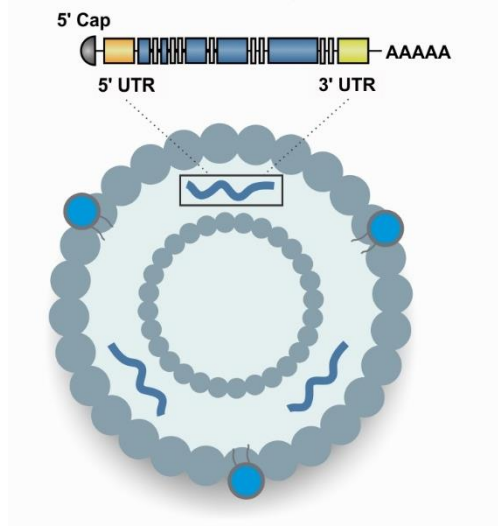
NK-cells

NKT-cells



(10) International Publication Number
WO 2020/058239 A1

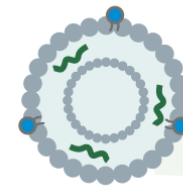
Galsomes as **mRNA cancer vaccines**: future plans



Clinical-grade
Galsomes



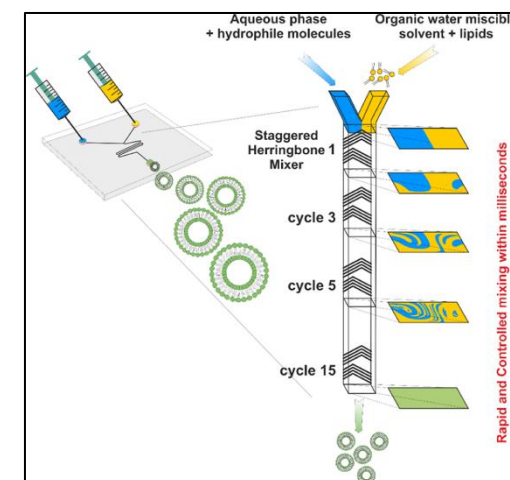
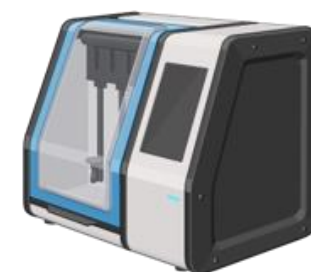
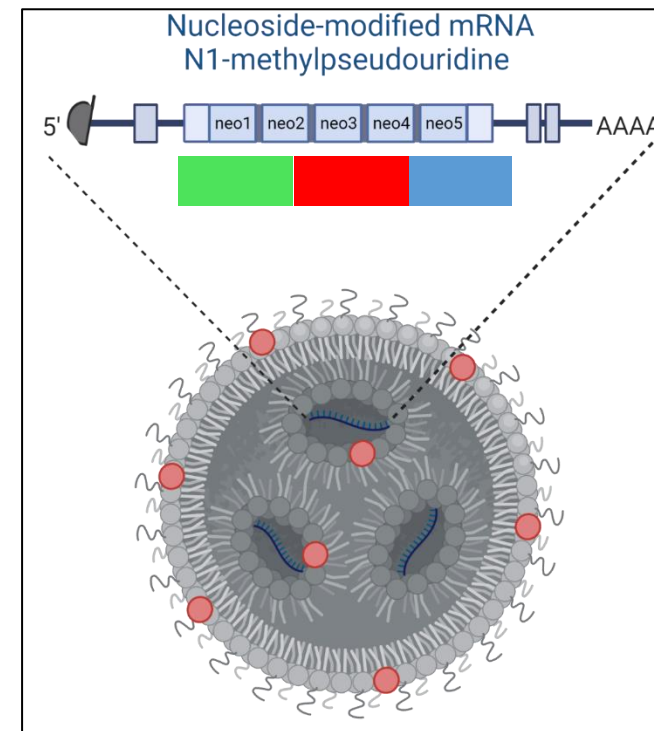
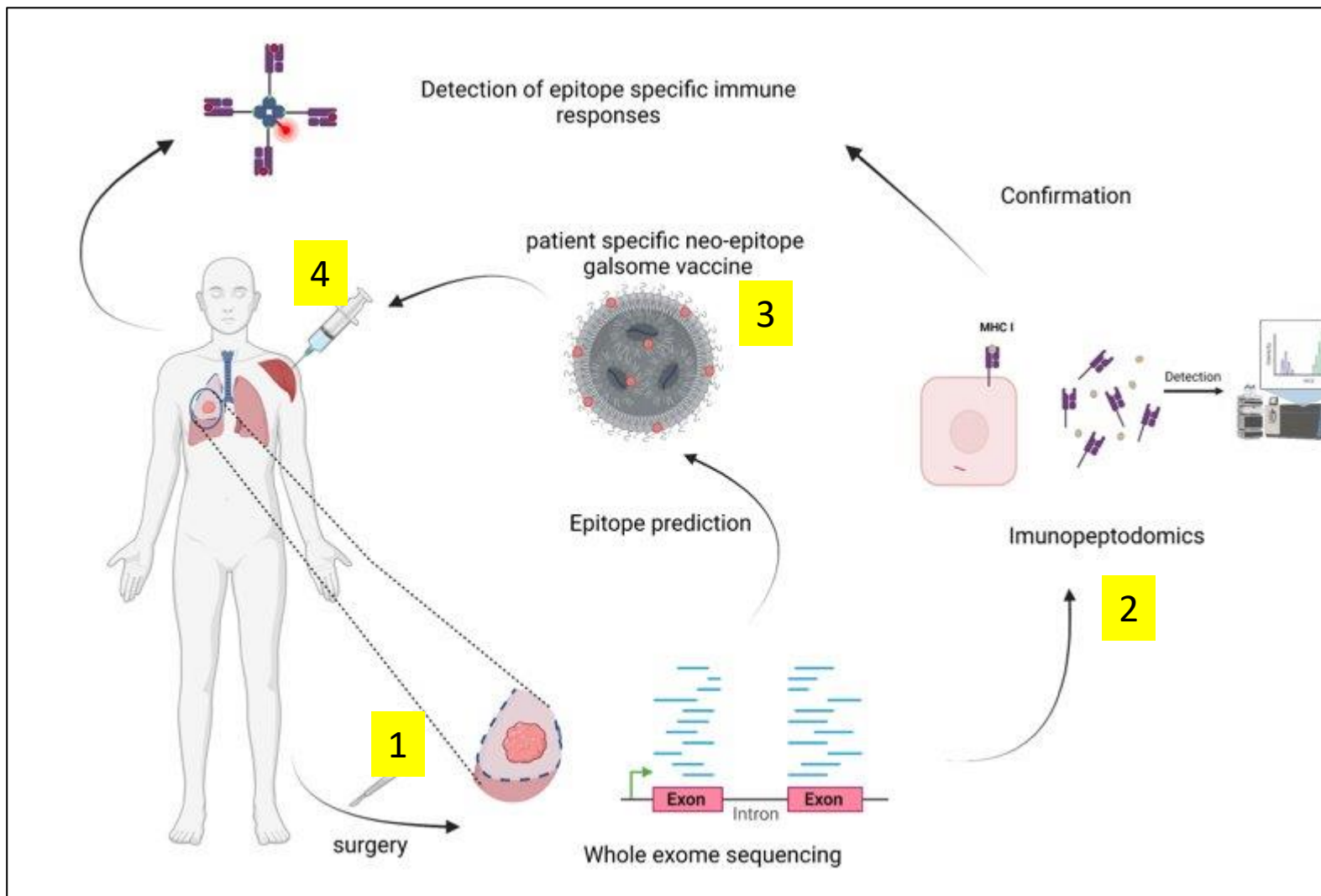
Neo-antigen
Galsomes



Lewis lung carcinoma

Checkpoint
Therapy





Personalized cancer vaccination

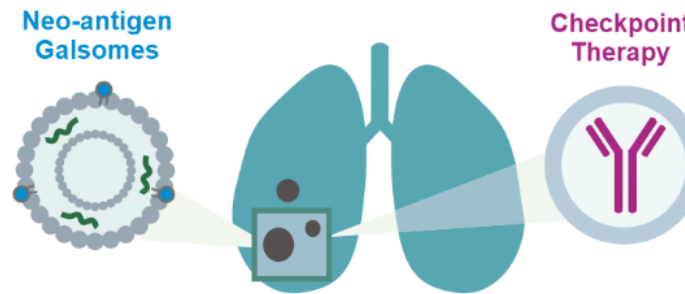
Clinical translation of mRNA Galsomes

Clinical-grade product



- Phase Ia/b clinical trial
- FAMPH consultation
- Safe & scalable end-product
- GMP-compliant production

Phase Ia/b clinical trial in non-small cell lung cancer patients
(i.c.w. UZ Ghent - Prof. B. Vandekerckhove & Prof. K. Vermaelen)



Kom op
tegen Kanker

GALSOMES: for future **mRNA bacterial vaccins**

LISTERIA - food born intracellular pathogen - LISTERIOSIS



nature communications



2022

Article

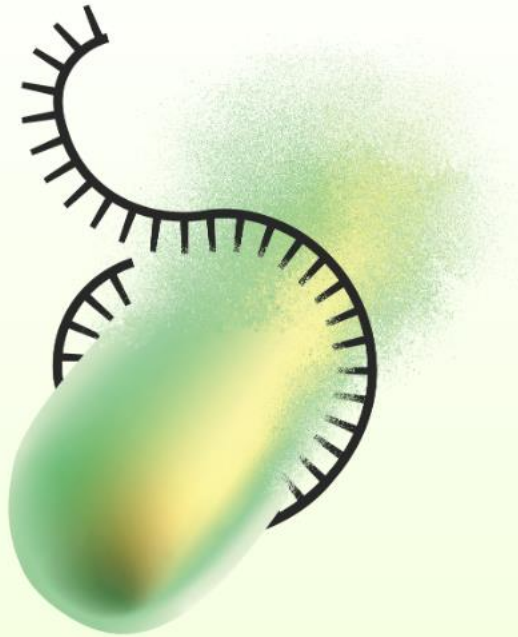
<https://doi.org/10.1038/s41467-022-33721-y>

Immunopeptidomics-based design of mRNA vaccine formulations against *Listeria monocytogenes*

Galsomes as **mRNA bacterial vaccins**: future plans



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Next-Generation Bacterial mRNA Vaccines

Tuberculosis

Buruli Ulcer

Acinetobacter



Preparing for future pandemics

CEPI, the Coalition for Epidemic Preparedness Innovations, is a global partnership working to accelerate the development of vaccines and other biologic countermeasures against epidemic and pandemic threats.

[Find out more](#)

CEPI:
Coalition for Epidemic Preparedness Innovations

a global partnership to accelerate the development of vaccines against pandemic threats



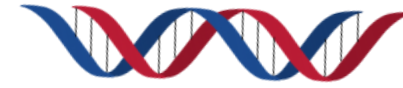
New 'spin freezing' technique could enhance future mRNA vaccines

- Ghent University scientists launch CEPI-funded project 'spin-freezing' vaccines
- The technique could remove the need for frozen storage of mRNA vaccines
- It could also support rapid scale-up of vaccines during future disease outbreaks through continuous vaccine production

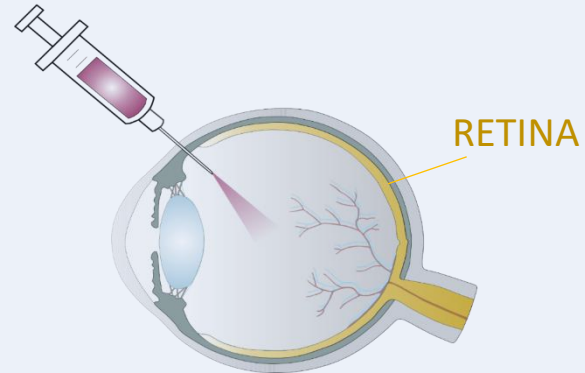




NUCLEIC ACIDS

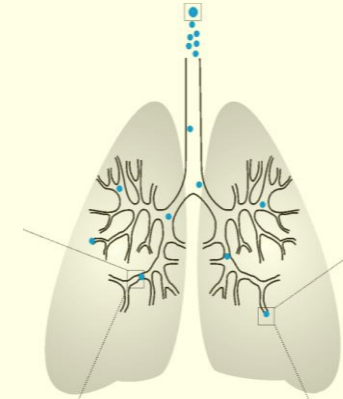


NA DELIVERY FOR OCULAR THERAPIES



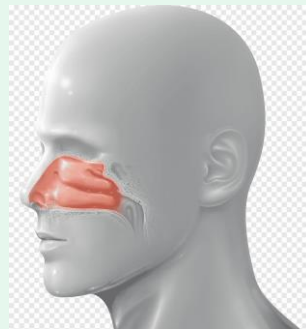
INHERITED RETINAL DISEASES

NA DELIVERY FOR LUNG THERAPIES



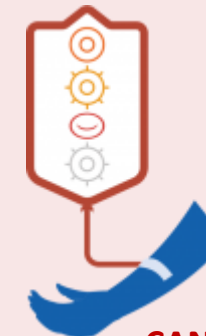
ASTHMA – COPD – CYSTIC FIBROSIS

NA DELIVERY FOR VACCINATION



INFECTIOUS DISEASES - CANCER

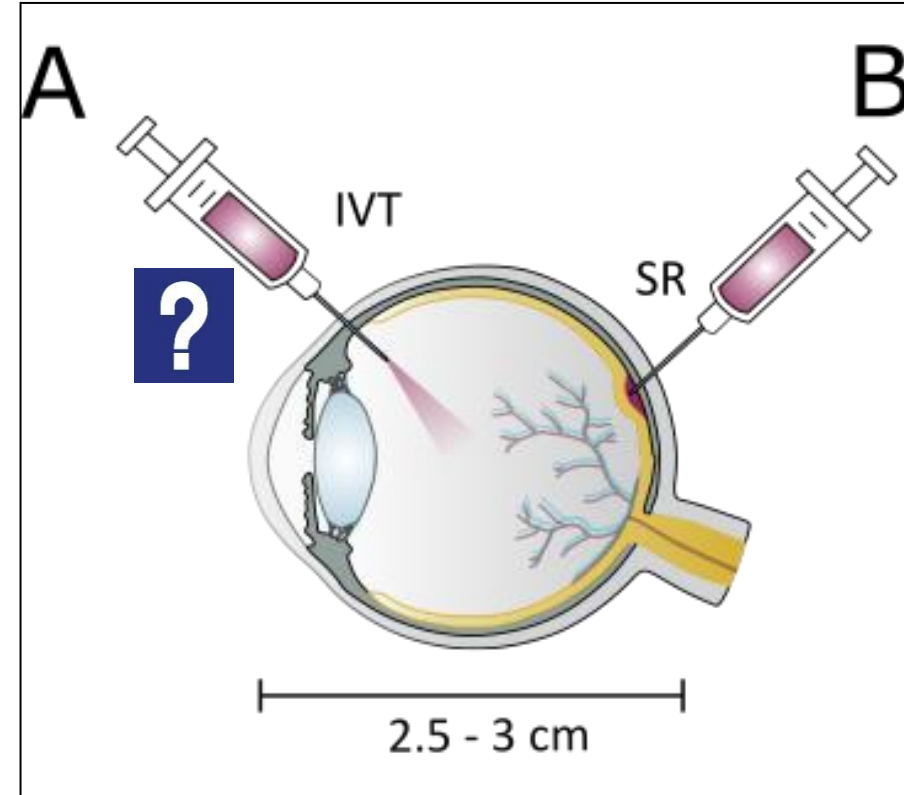
NA DELIVERY EX VIVO FOR CELL THERAPIES

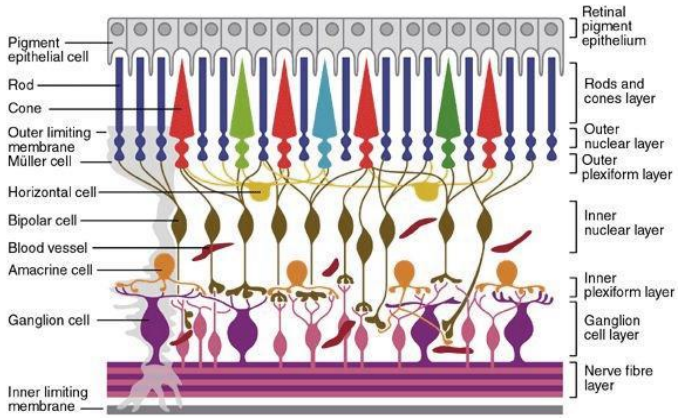


CANCER

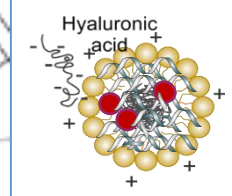
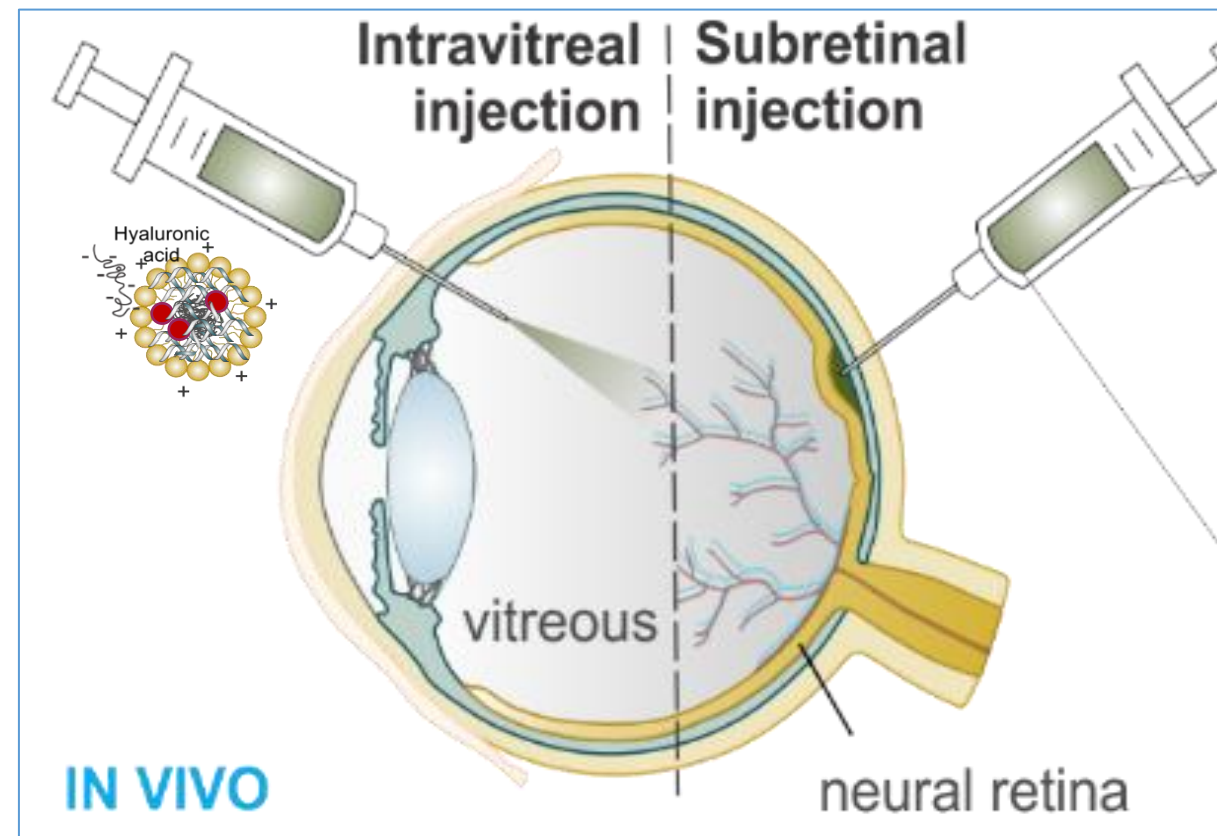


INTRAVITREAL INJECTION NUCLEIC ACIDS





vitreous

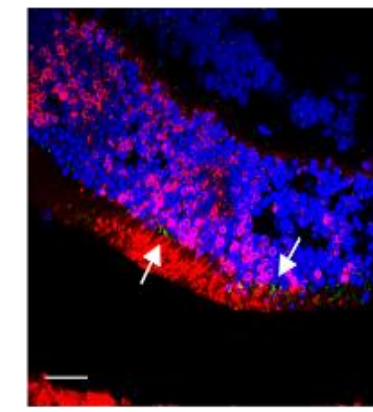
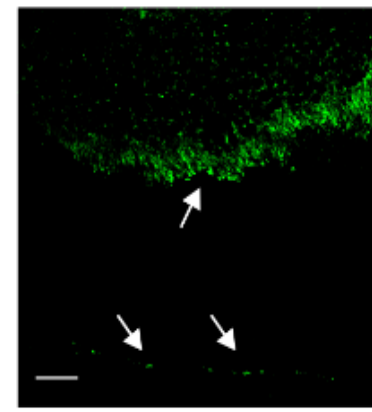
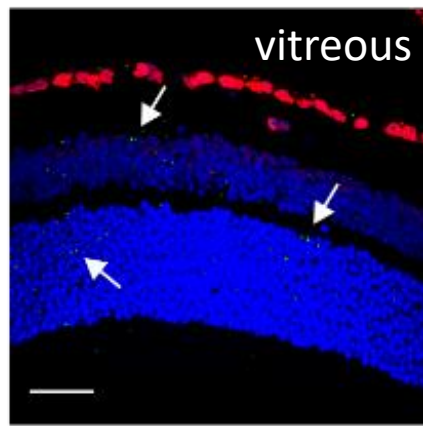
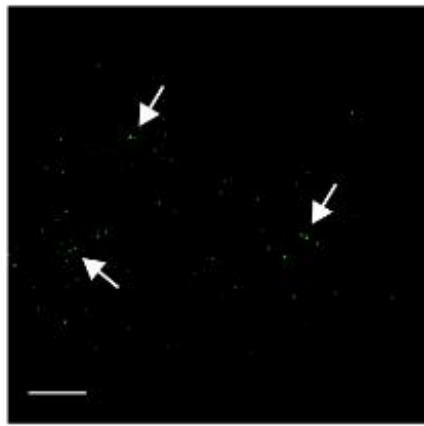


eGFP

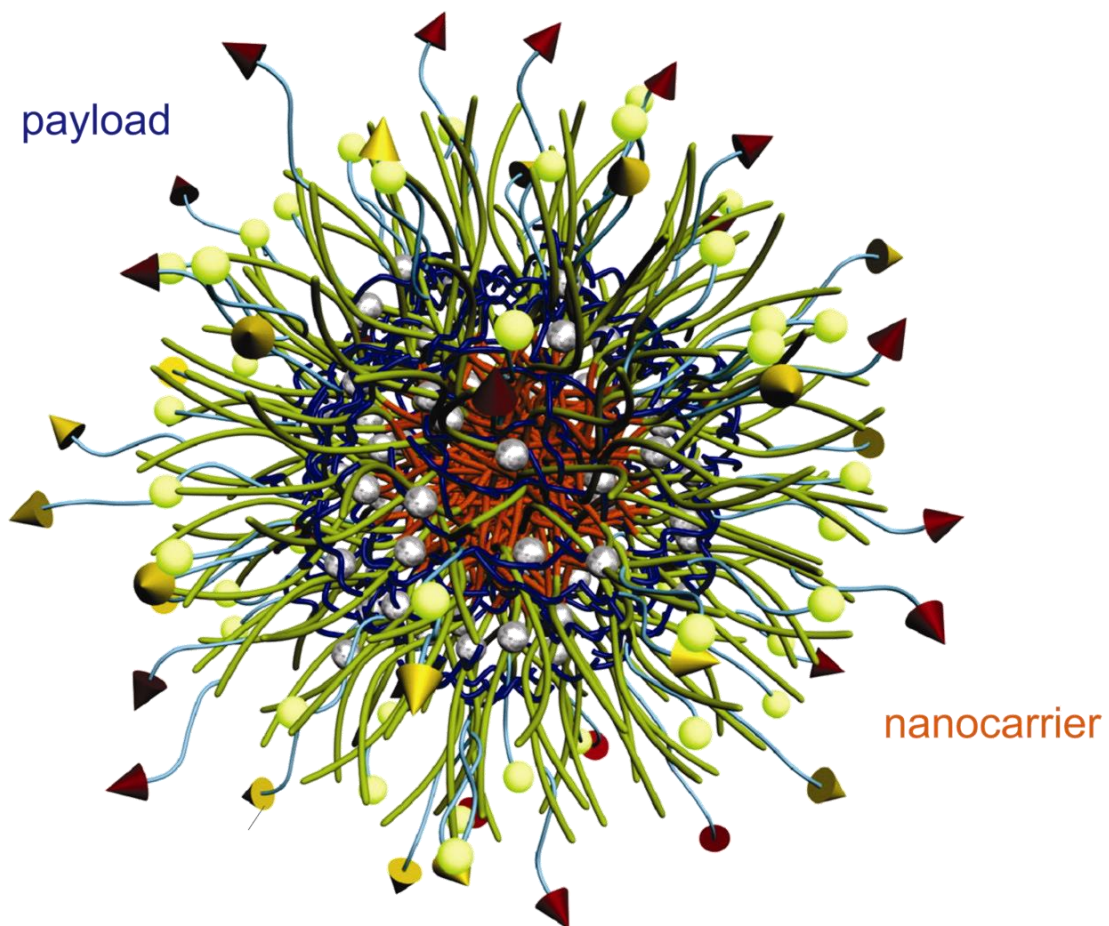
eGFP

Intravitreal

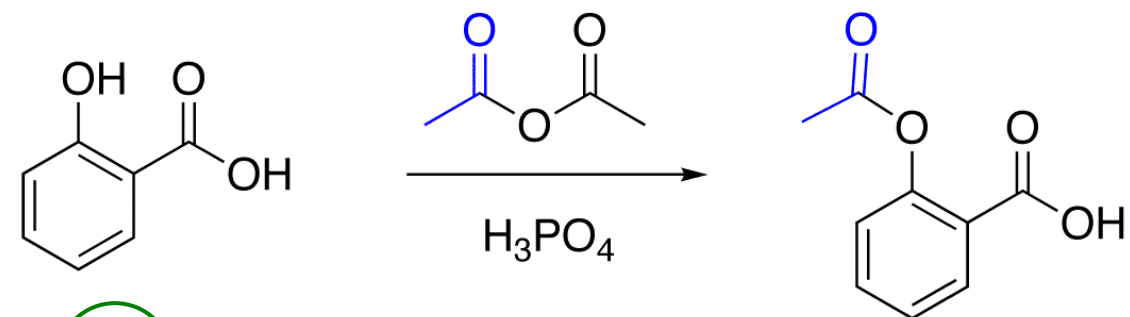
Subretinal



NANOMEDICINES: **HIGHLY COMPLEX DRUGS**



SMALL DRUGS



Easy manufacturing and characterisation!

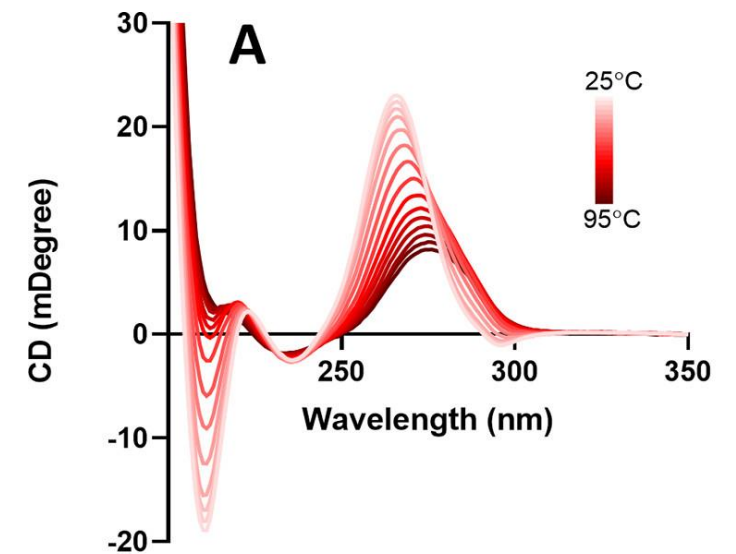
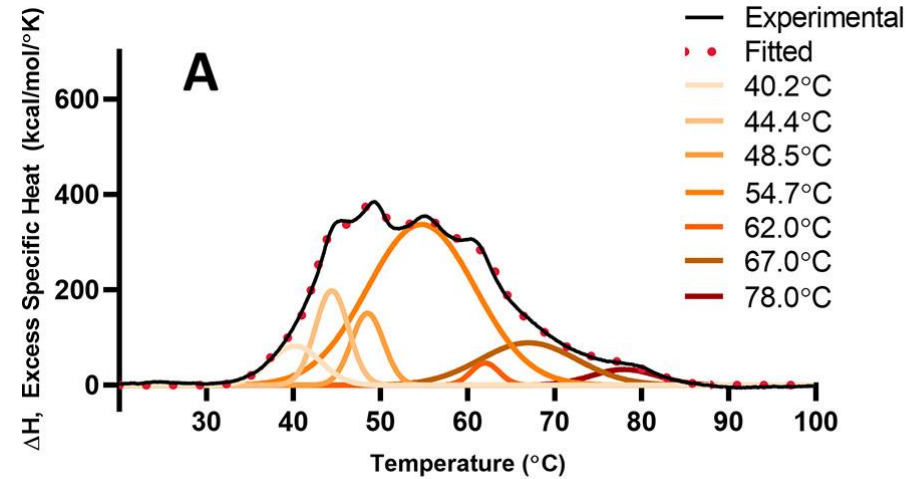
Analytical toolbox:

Understanding the Heterogeneity and Stability of mRNA-LNP Vaccines is Extremely Challenging - but of high importance

DSC
DLS
CD
SEC
AF4
SEM
CE



NanoMedicine
Centre



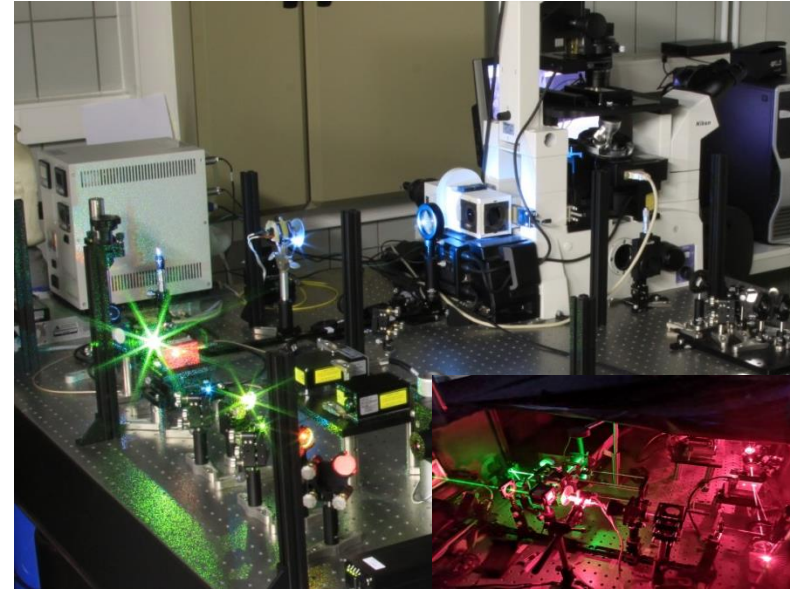
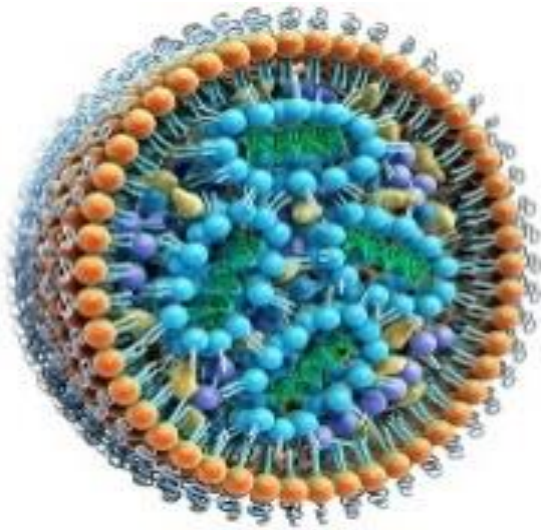


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and **Physical Pharmacy**

biopharmaceutics

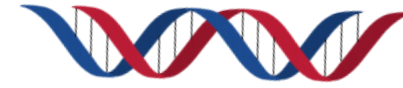
nanomedicines

biophotonics ←

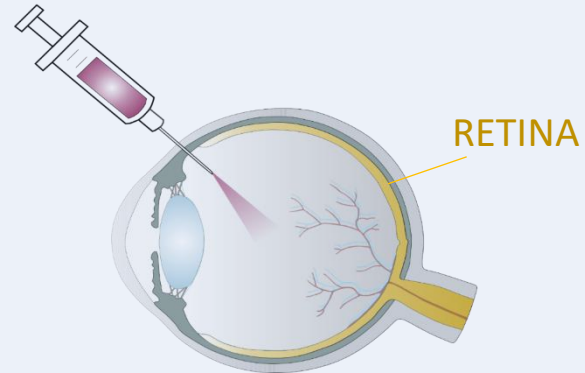




NUCLEIC ACIDS

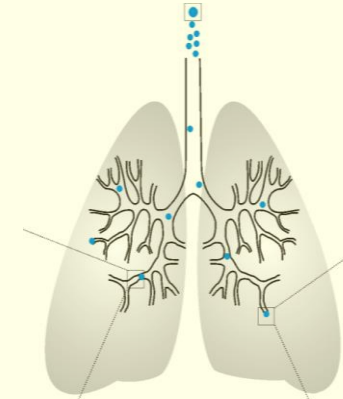


NA DELIVERY FOR OCULAR THERAPIES



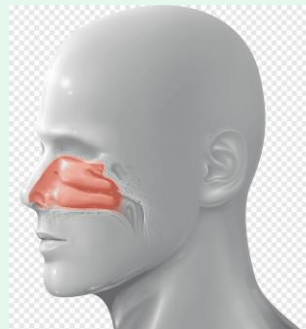
INHERITED RETINAL DISEASES

NA DELIVERY FOR LUNG THERAPIES



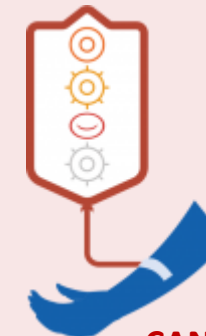
ASTHMA – COPD – CYSTIC FIBROSIS

NA DELIVERY FOR VACCINATION

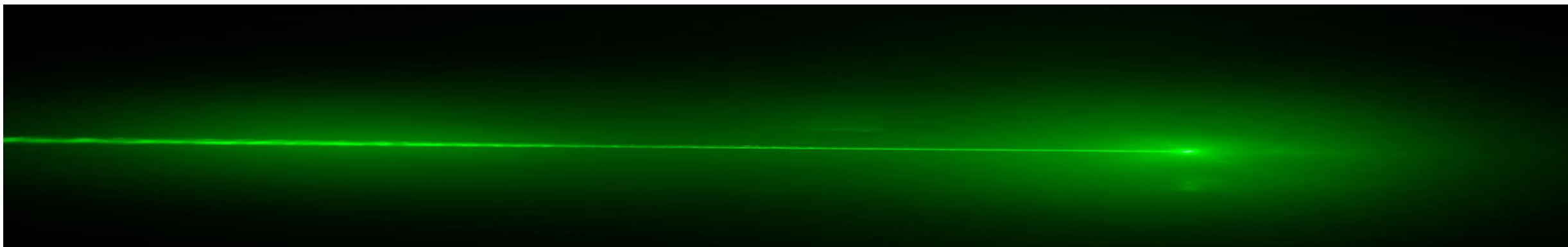


INFECTIOUS DISEASES - CANCER

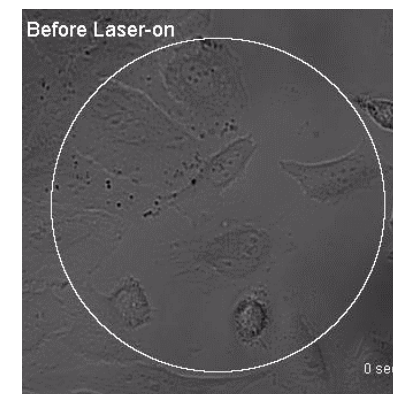
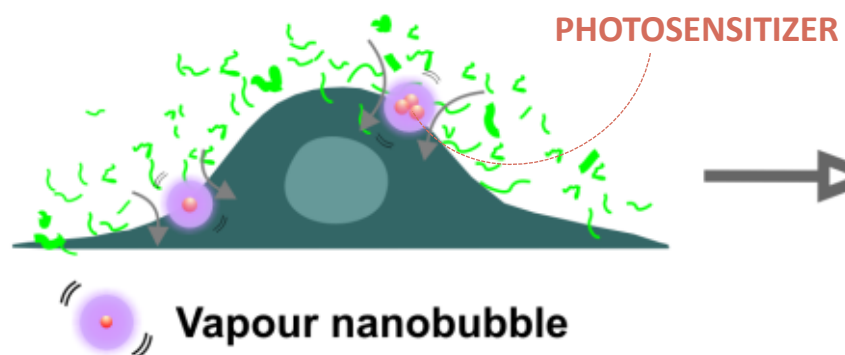
NA DELIVERY EX VIVO FOR CELL THERAPIES



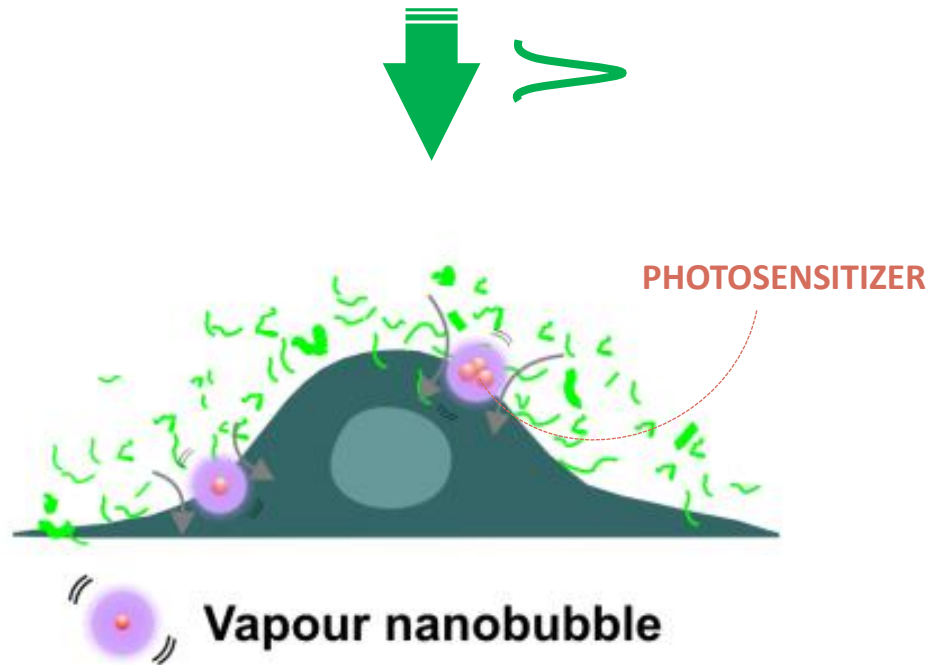
CANCER



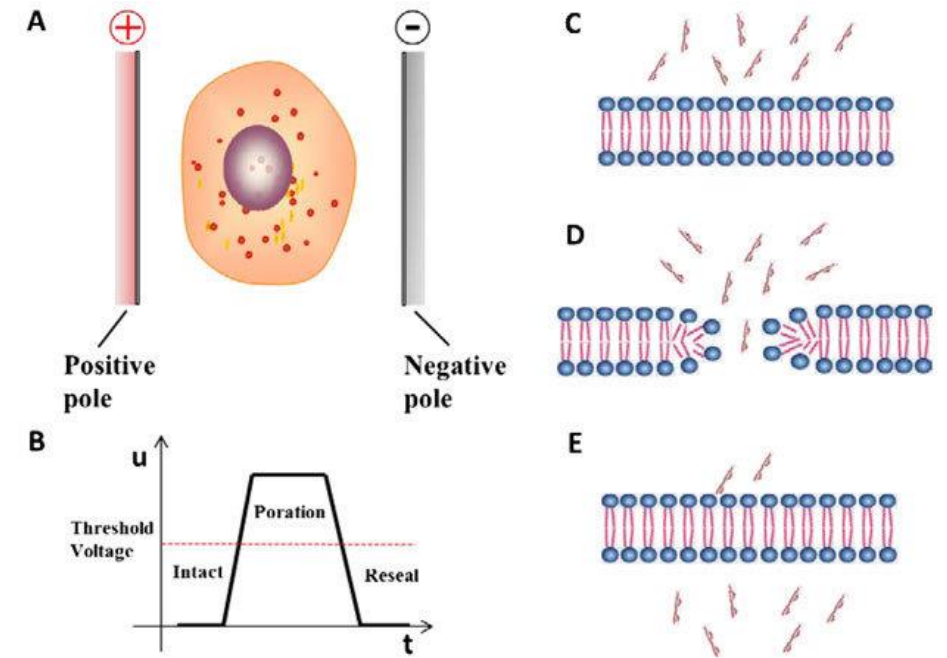
PHOTOPORATION

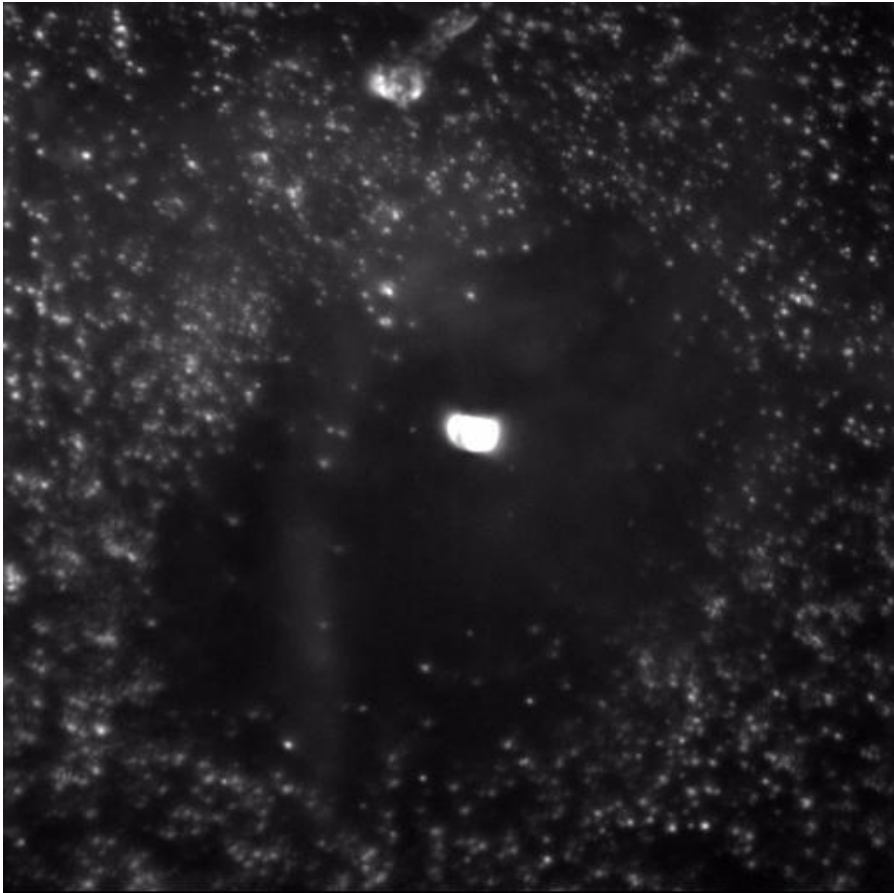
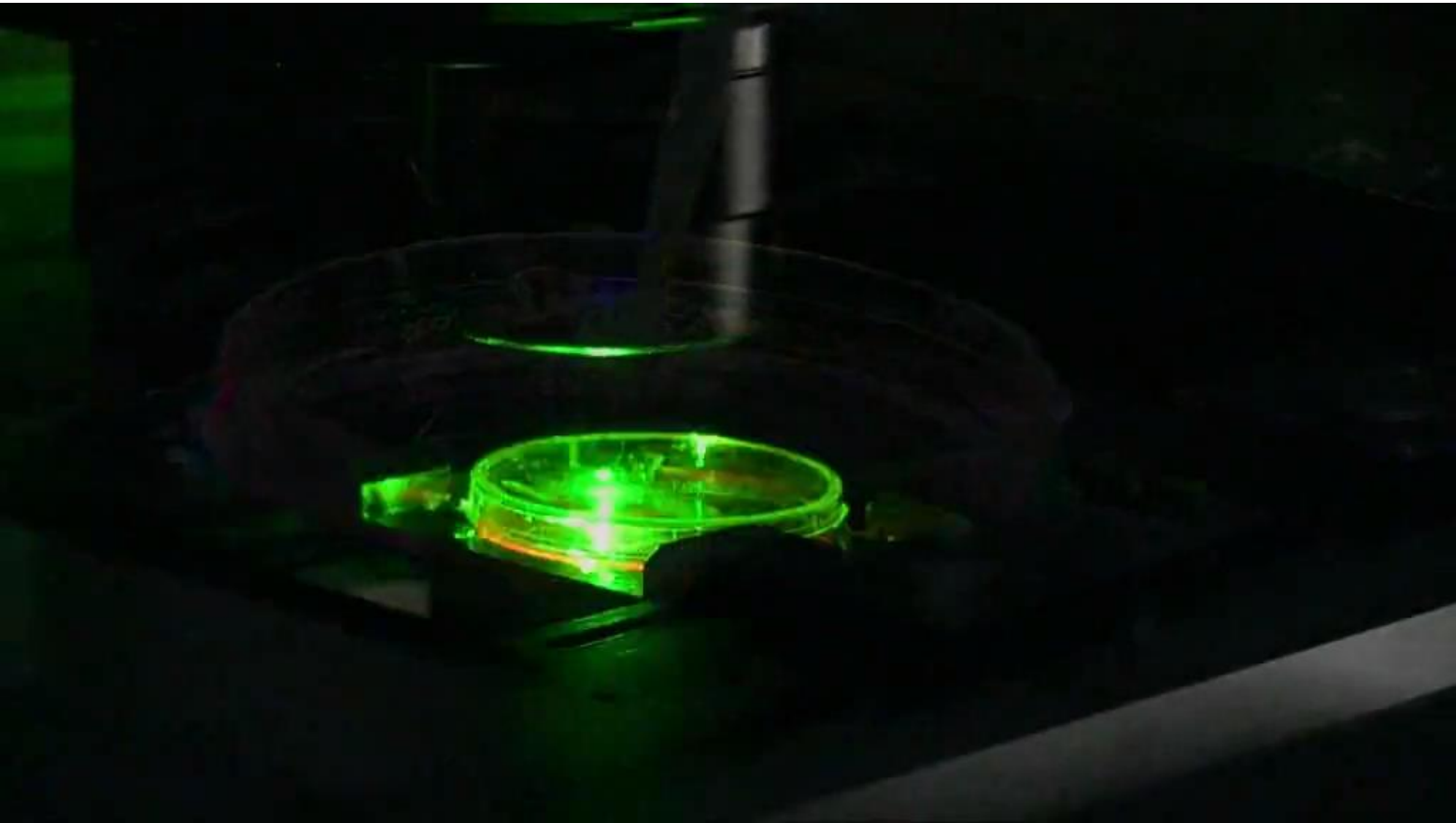
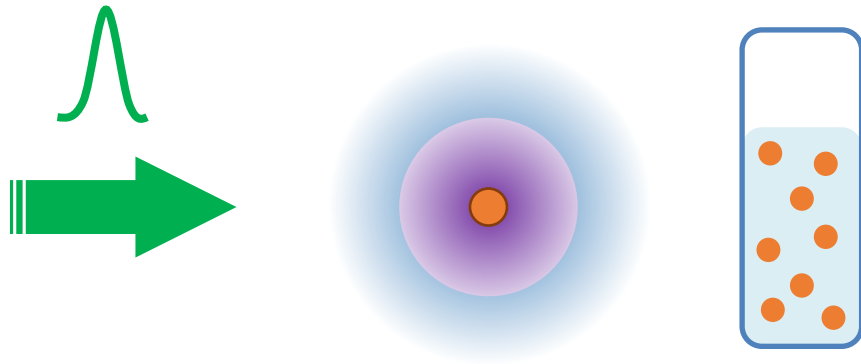


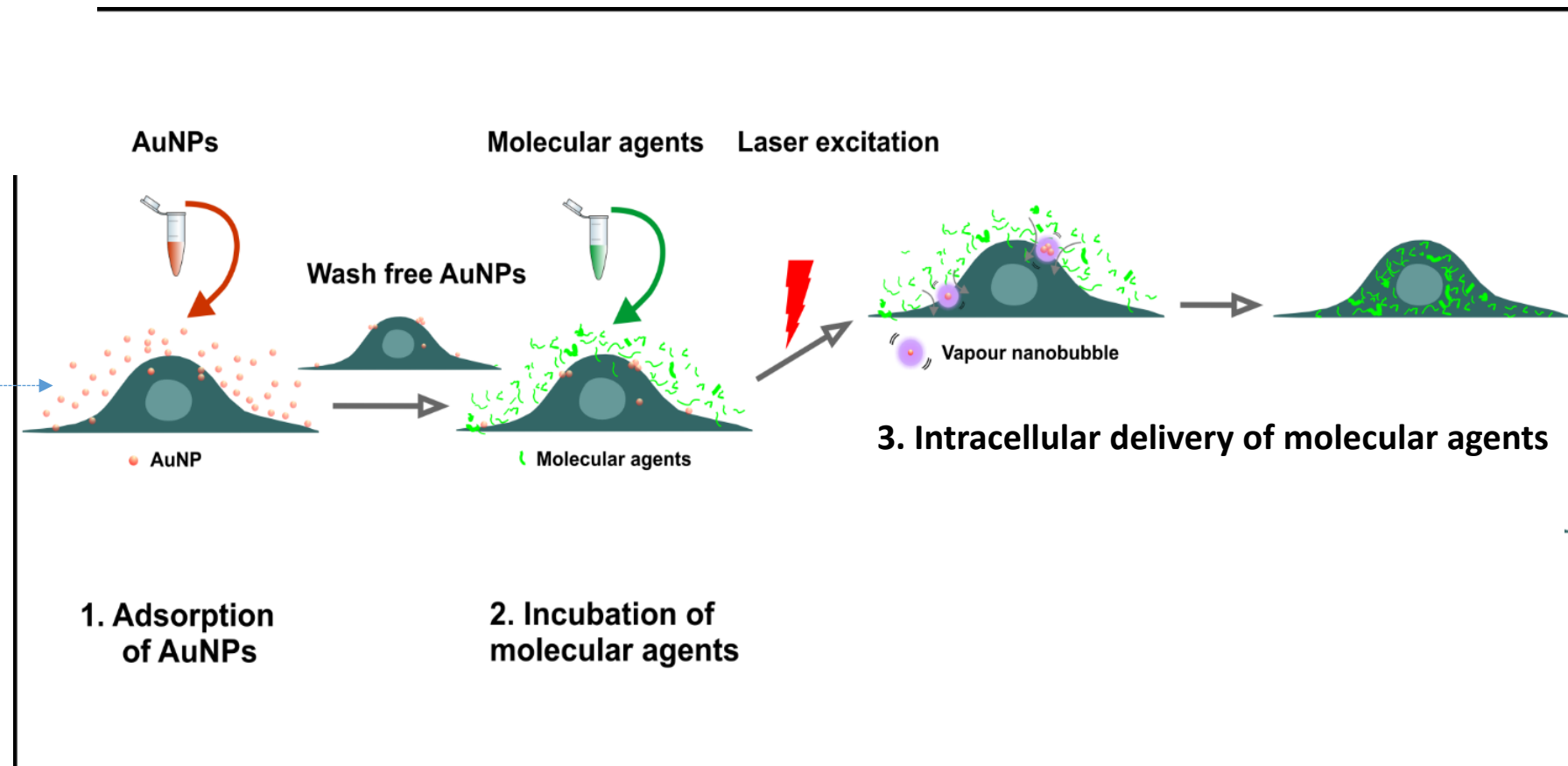
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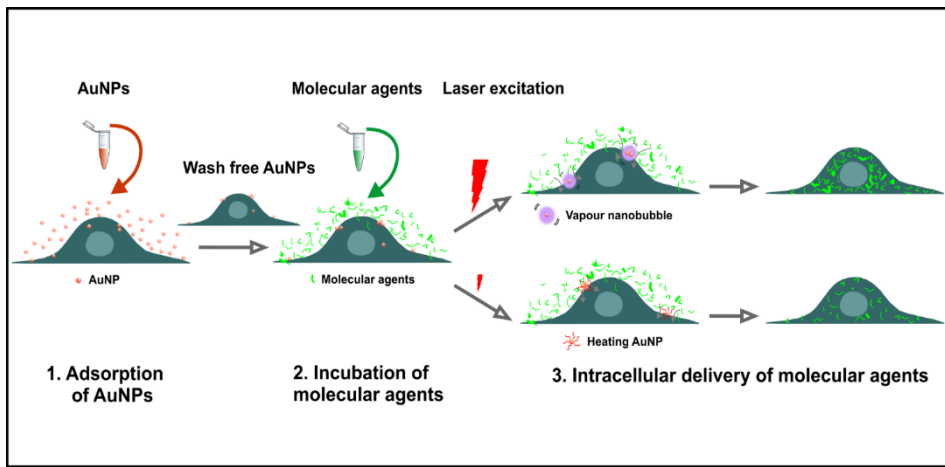


ELECTROPORATION

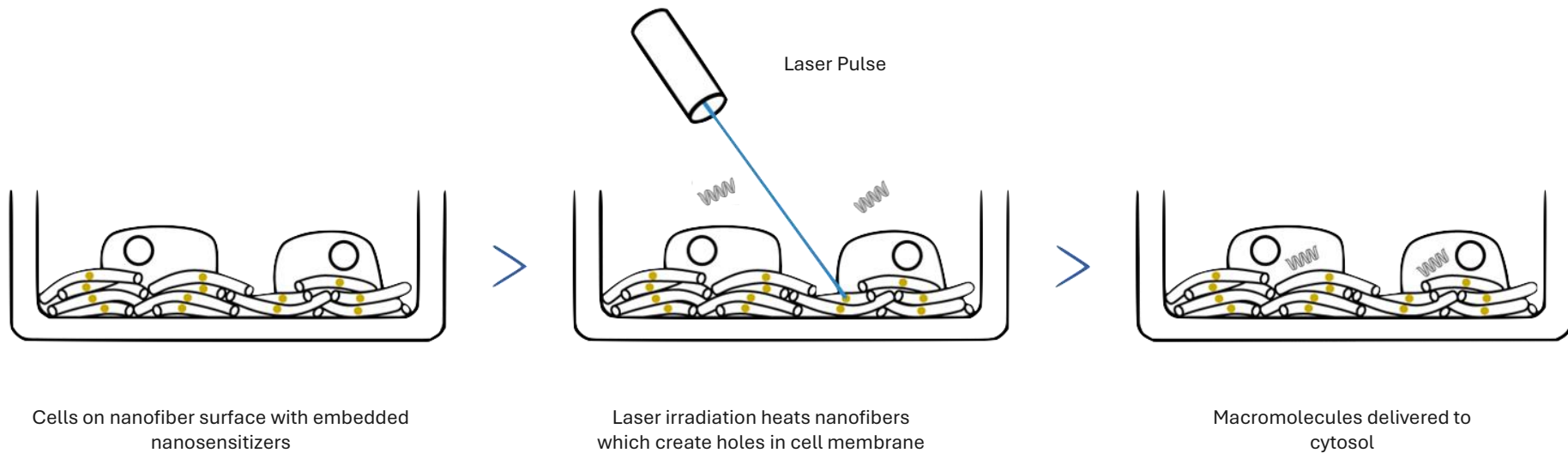








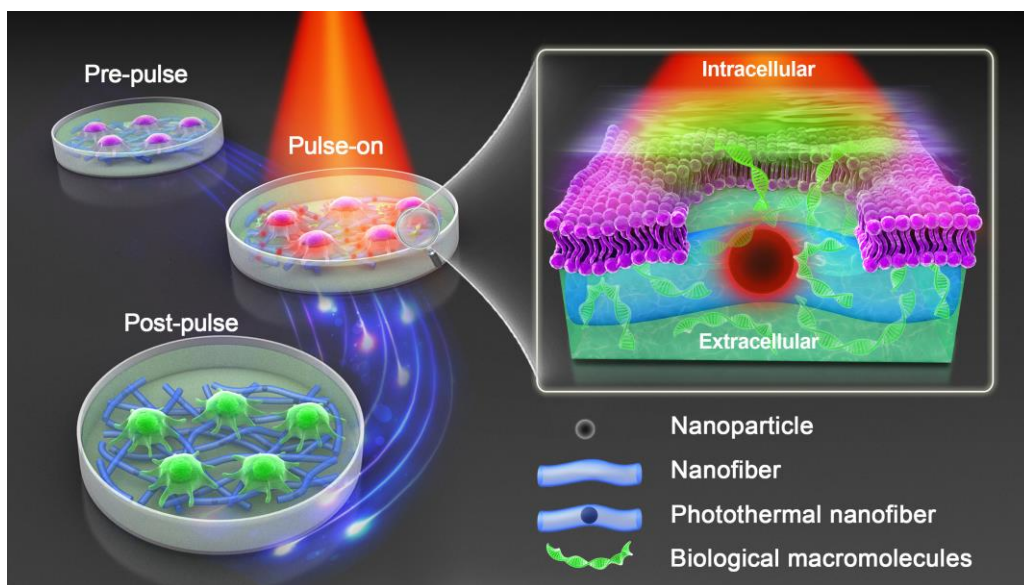
PHOTOPORATION WITH NANOFIBERS



Photothermal Nanofibers Enable Safe Engineering of Therapeutic Cells

R. Xiong et al. *Nature Nanotechnology* 2021

nature
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Article

Photothermal Nanomaterial-Mediated Photoporation

Ranhua Xiong,* Félix Sauvage, Juan C. Fraire, Chaobo Huang, Stefaan C. De Smedt, and Kevin Braeckmans

Cite This: *Acc. Chem. Res.* 2023, 56, 631–643

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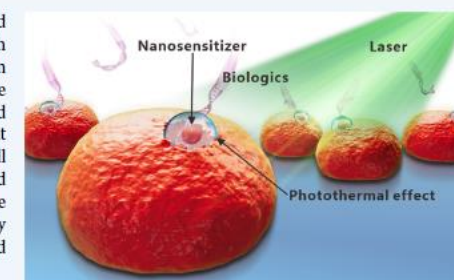
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Article Recommendations

CONSPECTUS: Delivering biological effector molecules in cultured cells is of fundamental importance to any study or application in which the modulation of gene expression is required. Examples range from generating engineered cell lines for studying gene function to the engineering of cells for cell-based therapies such as CAR-T cells and gene-corrected stem cells for regenerative medicine. It remains a great challenge, however, to deliver biological effector molecules across the cell membrane with minimal adverse effects on cell viability and functionality. While viral vectors have been frequently used to introduce foreign nucleic acids into cells, their use is associated with safety concerns such as immunogenicity, high manufacturing cost, and limited cargo capacity.



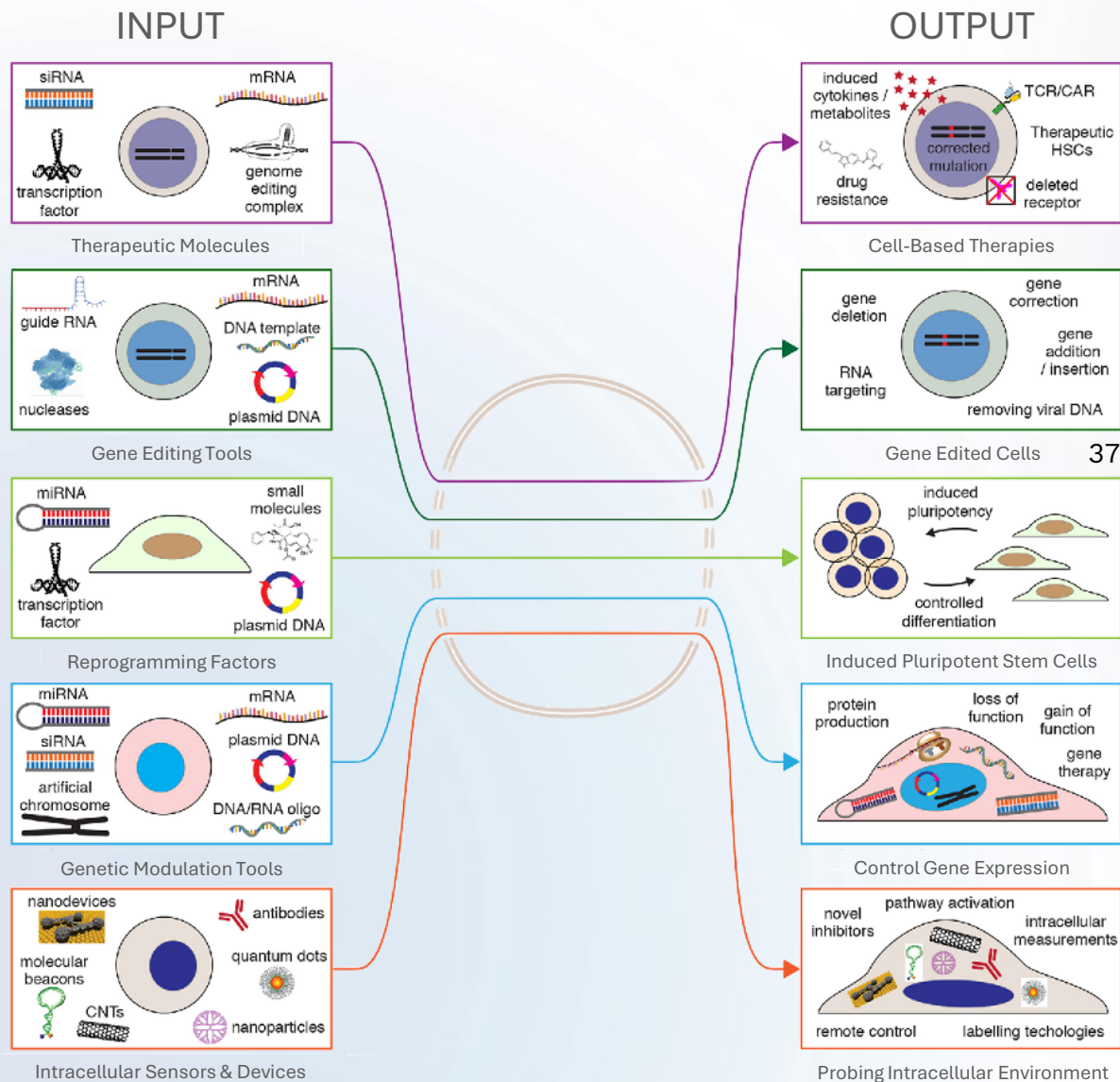


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Biotech driven markets
highly depend on adequate
tools
to deliver macromolecules
into cells





Nature Spin-off Prize

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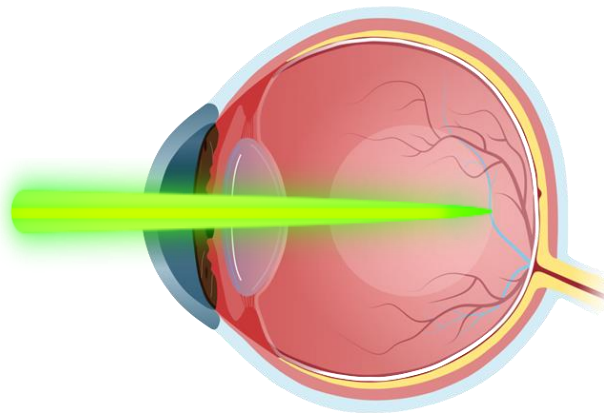
Kevin Braeckmans

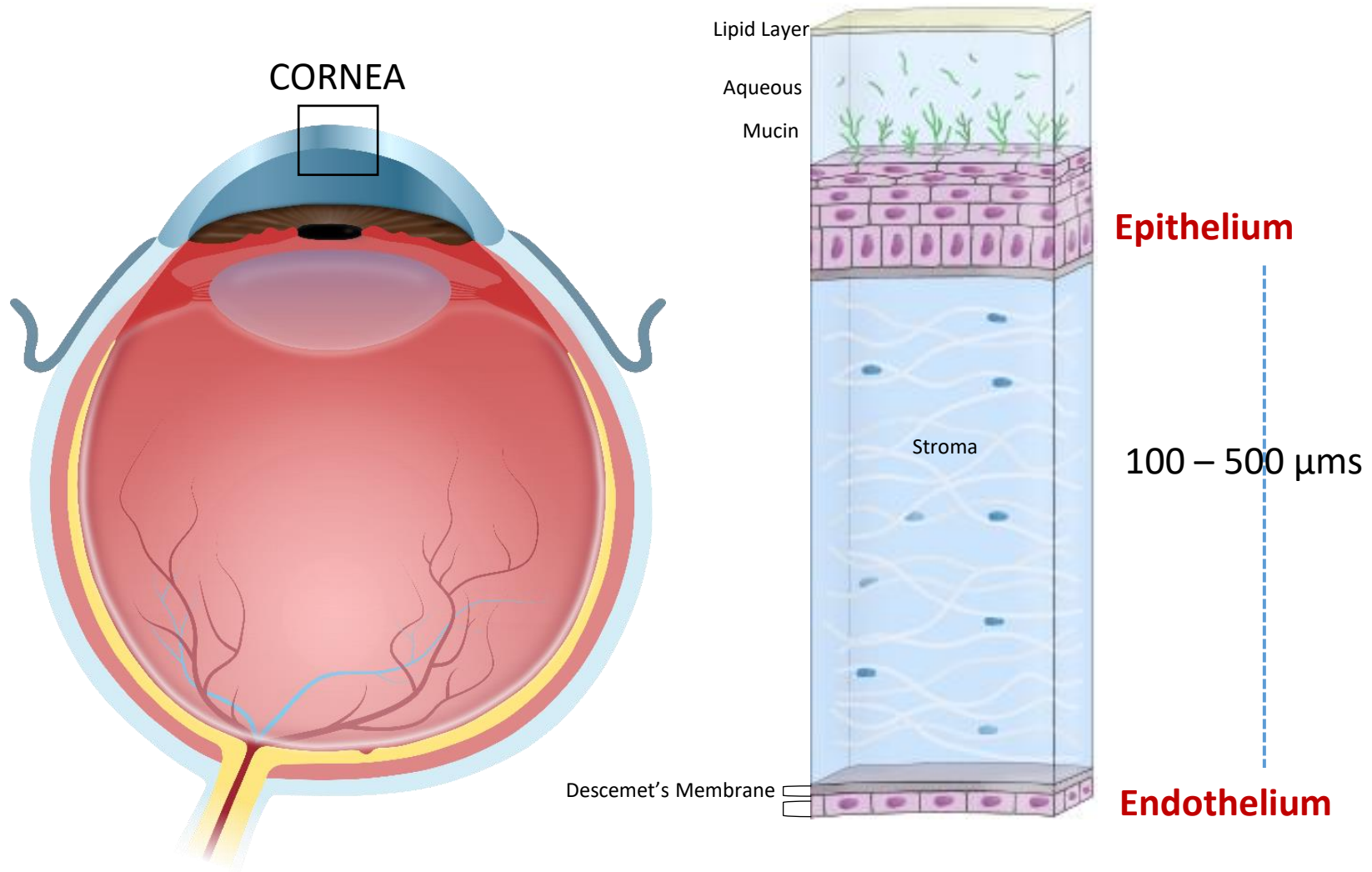
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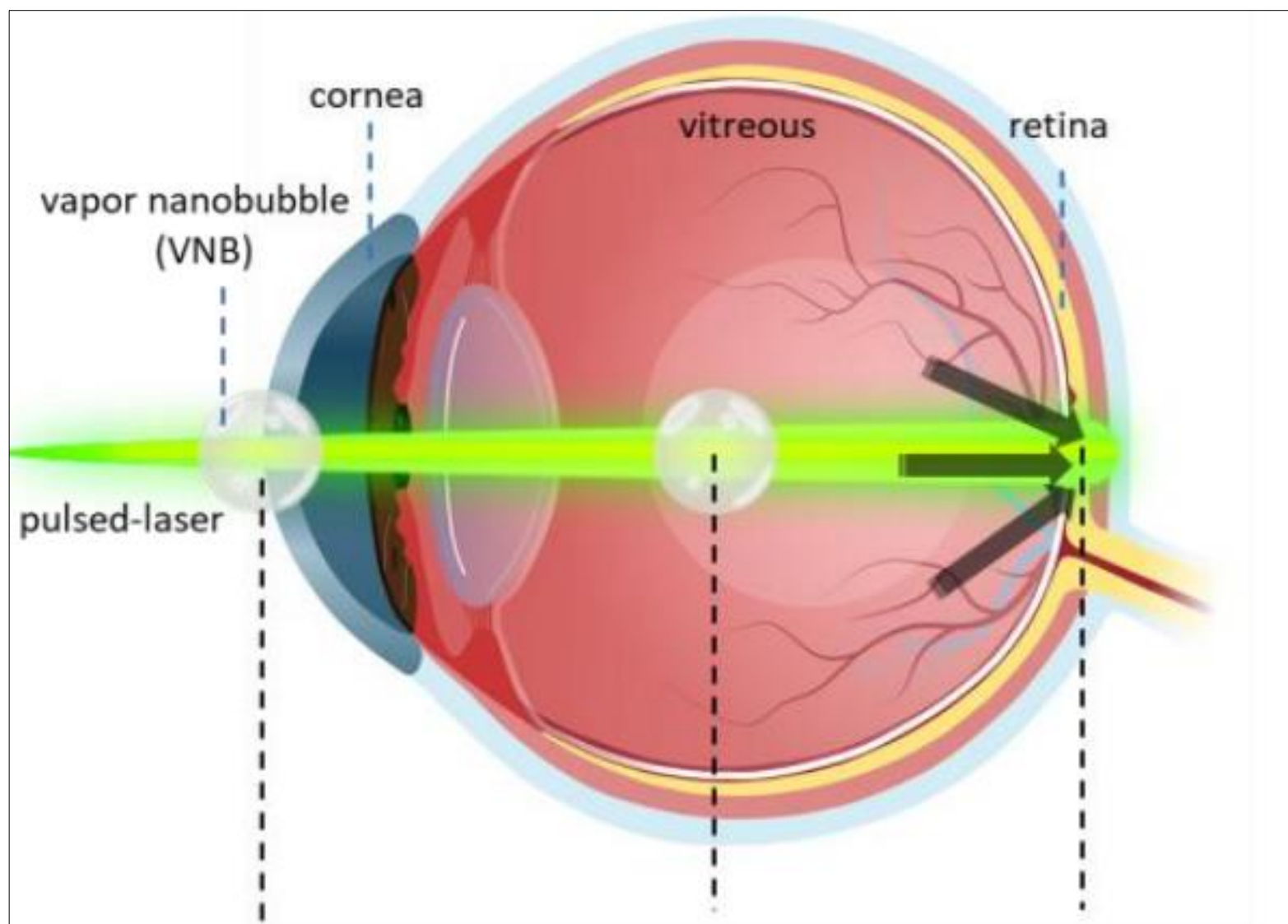
Potential vapor nanobubbles in the treatment of ocular diseases?





LSM03
EFL=36 LW





EYE-FLOATERS



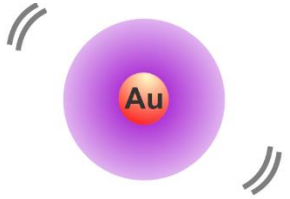


eye-floater (collagen aggregates)



Floaters in vitreous of a patient

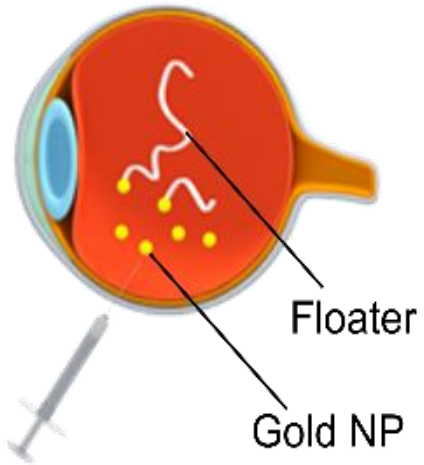
Retina



OUR HYPOTHESIS: nanobubble mediated breackdown of eye floaters?

C

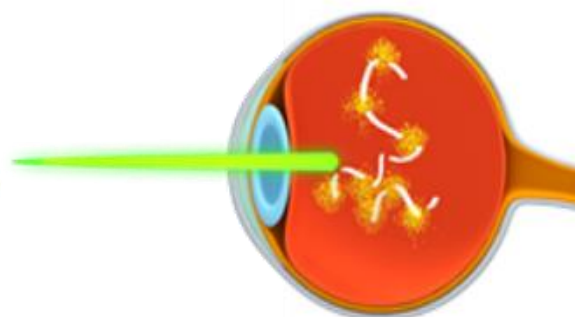
**Intravitreal injection
of gold NPs**



**Binding
to the vitreous opacity**



**Pulsed-laser illumination
of the vitreous opacity**

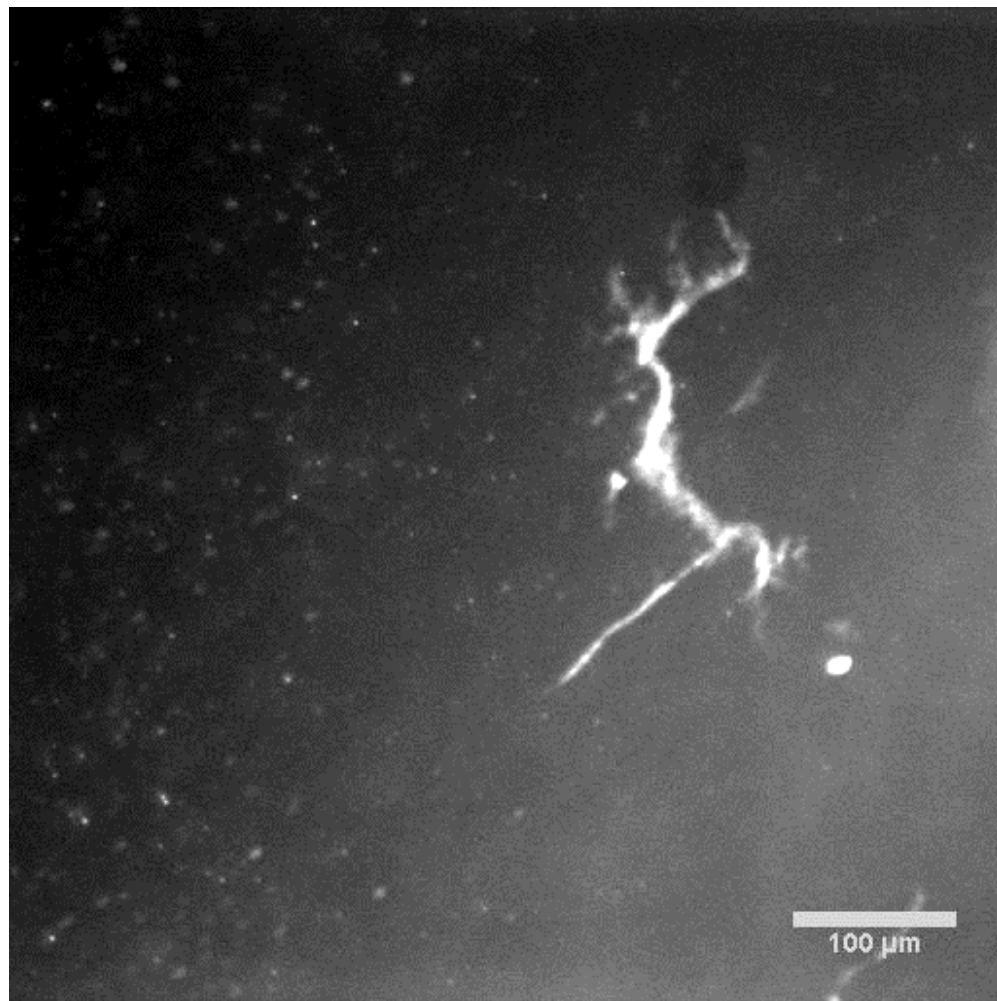


Destroyed opacity



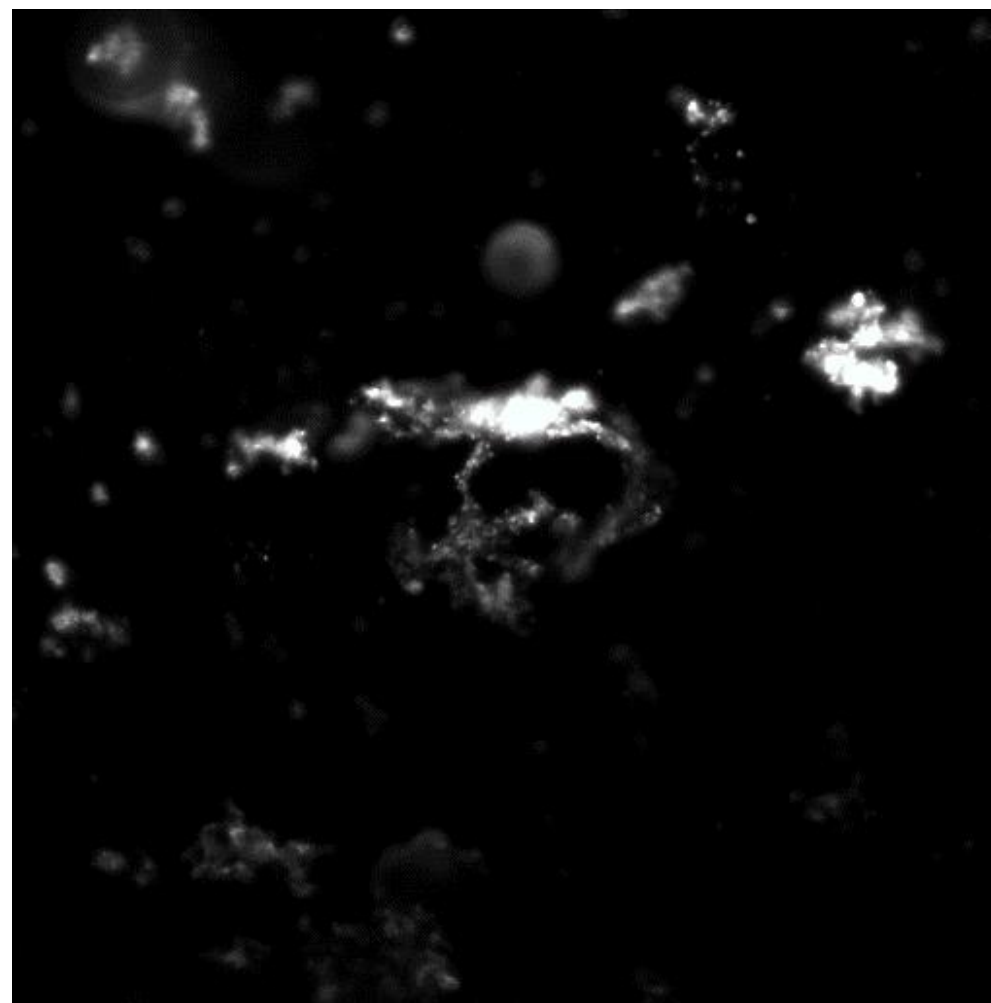
PHOTO-ABLATION

Collagen fibers in vitreous



EX VIVO

Human floaters in vitreous



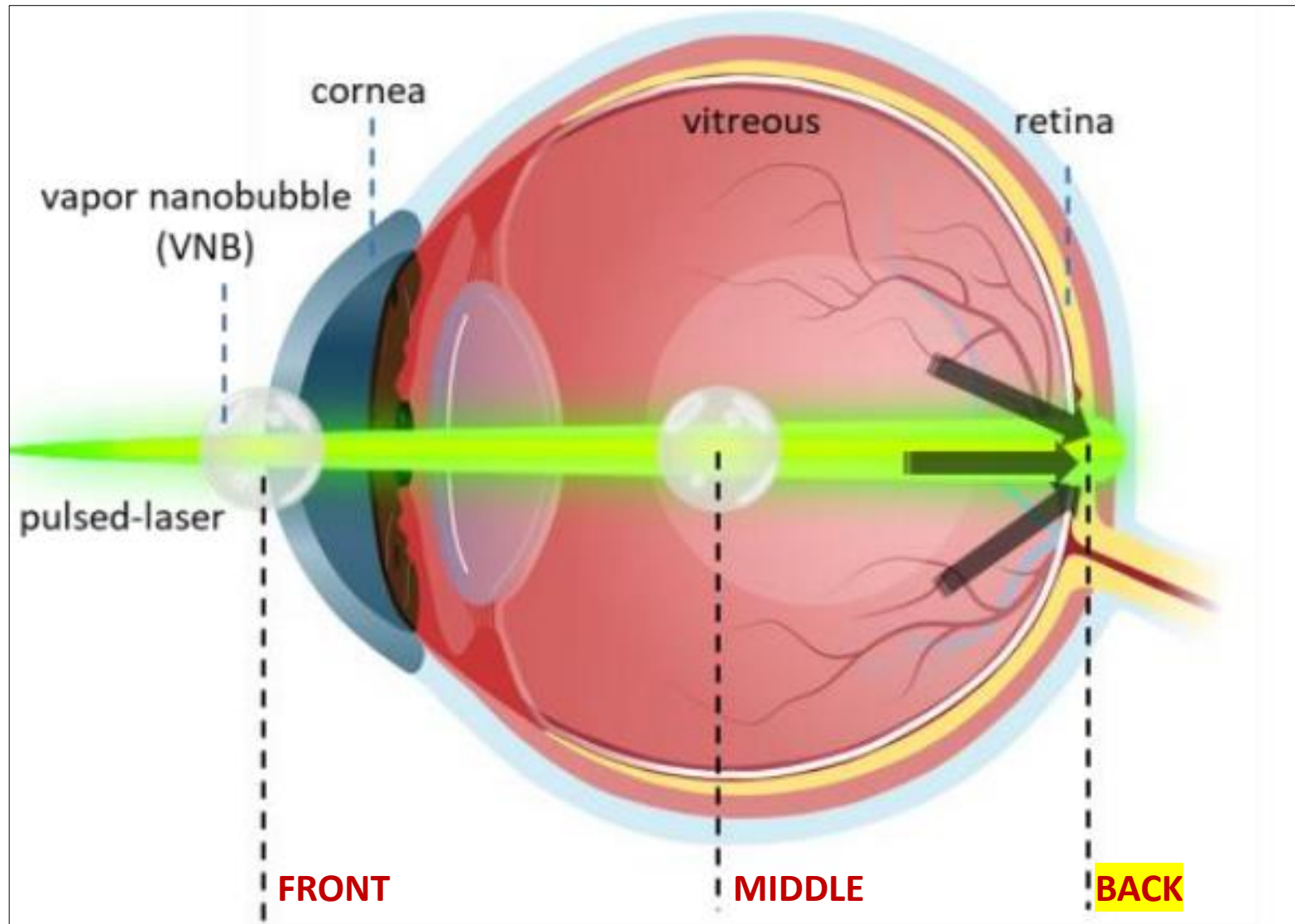
EX VIVO

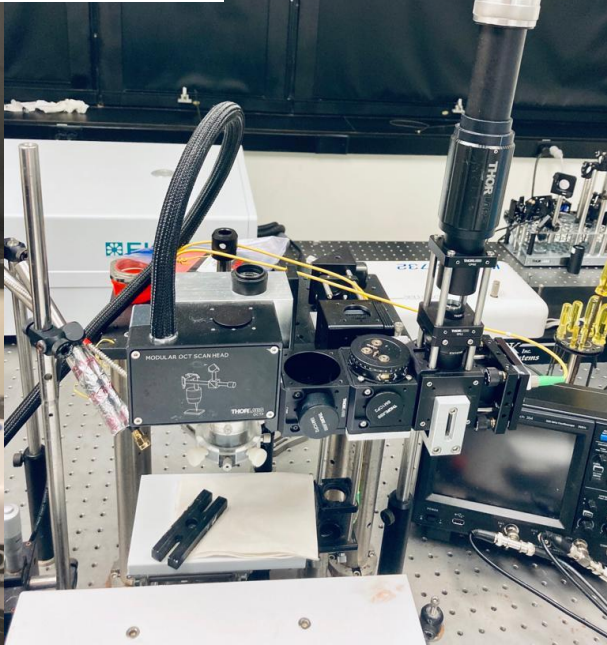
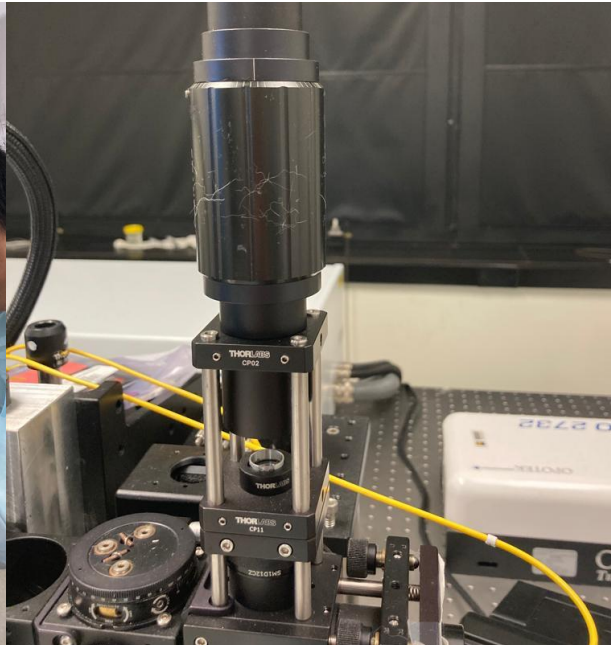
Laser-induced nanobubbles safely ablate vitreous opacities in vivo

Félix Sauvage^{1,10}, Van Phuc Nguyen^{2,3,10}, Yanxiu Li², Aranit Harizaj¹, J. Sebag^{4,5}, Dimitri Roels⁶, Viktor Van Haver¹, Karen Peynshaert¹, Ranhua Xiong⁷, Juan C. Fraire¹, Marie-José Tassignon⁸, Katrien Remaut¹, Yannis M. Paulus^{2,9}, Kevin Braeckmans¹ and Stefaan C. De Smedt^{1,7}

Photoablation of Human Vitreous Opacities by Light-Induced Vapor Nanobubbles

Félix Sauvage,[†] Juan C. Fraire,[†] Katrien Remaut,[†] J. Sebag,^{‡,§} Karen Peynshaert,[†] Michael Harrington,^{||} Frans J. Van de Velde,[⊥] Ranhua Xiong,[†] Marie-José Tassignon,[#] Toon Brans,[†] Kevin Braeckmans,[†] and Stefaan C. De Smedt^{*,†}





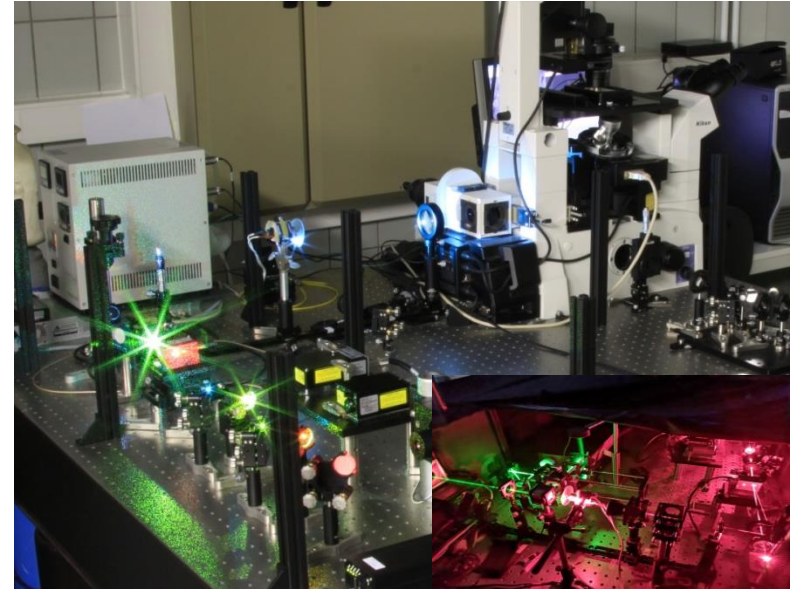
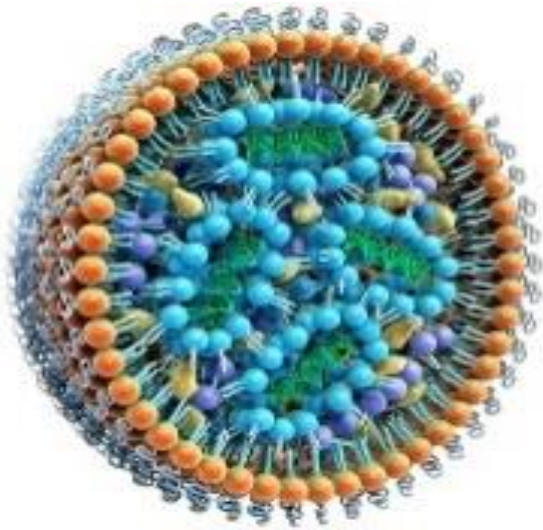


Laboratory for
General Biochemistry
and **Physical Pharmacy**

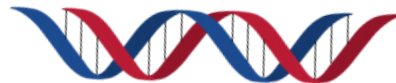
biopharmaceutics

nanomedicines

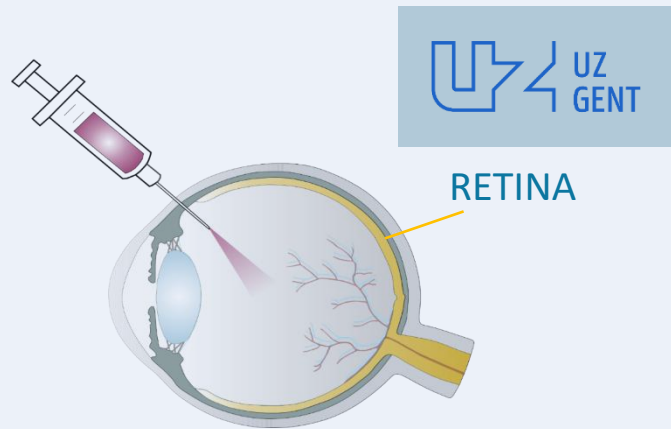
biophotonics



NUCLEIC ACIDS

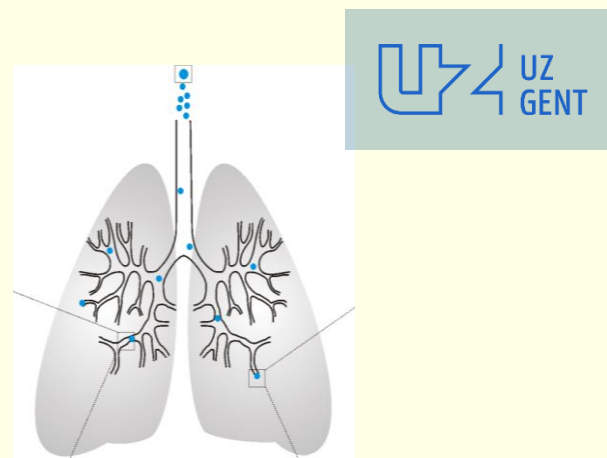


NA DELIVERY FOR **OCULAR** THERAPIES



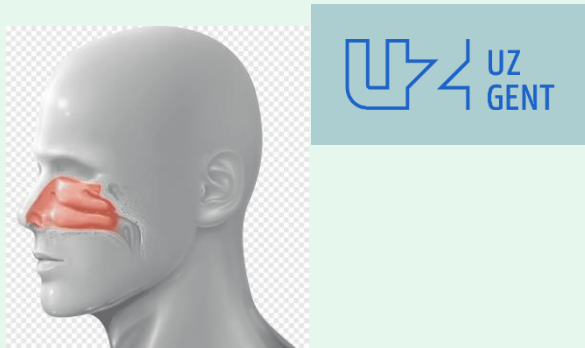
INHERITED RETINAL DISEASES

NA DELIVERY FOR **LUNG** THERAPIES



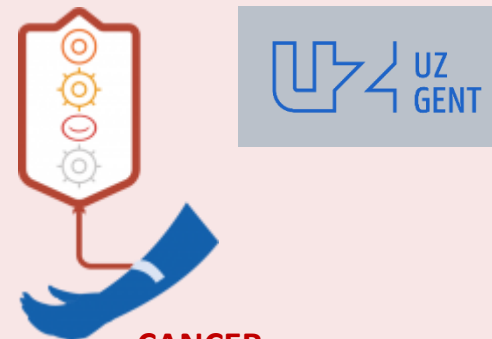
ASTHMA – COPD – CYSTIC FIBROSIS

NA DELIVERY FOR **VACCINATION**



INFECTIOUS DISEASES - CANCER

NA DELIVERY **EX VIVO** FOR CELL THERAPIES



CANCER



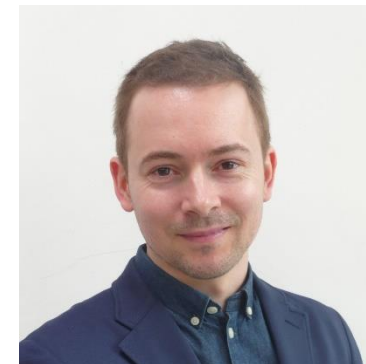
Prof. Katrien Remaut



Prof. Felix Sauvage



Dr. Ine Lentacker



Prof. Koen Raemdonck



Prof. Kevin Braeckmans

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The human mind is like a parachute, it works best when open
Dr. P. Janssen

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SERVICES

The human mind is like a parachute, it works best when open

Dr. P. Janssen - founder of Janssen Pharmaceutica

Quality is not an act, it is a habit

Aristotle



PILLARS FOR A STRONG FUTURE

MECHANICAL **UNDERSTANDING**

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PHARMACEUTICALLY **RELEVANT**

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