Ocular biophotonics. Technologies to understand vision
(with emphasis on Presbyopia & Myopia)

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CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS
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VISUAL OPTICS & BIOPHOTONICS LAB

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7th	Top 5	13.000	121/3
Public research institution at global scale	**European institution by number of actions H2020v**	**People**	**Institutes, centres, units**
14.000	5.000	450	700
Articles published per year	**Ongoing projects**	**Protected technologies**	**PhD Thesis defended per year**

IO

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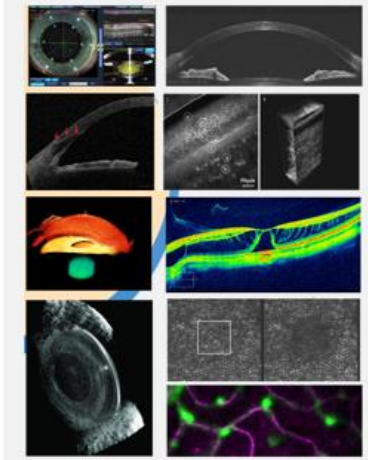


OPTICS

OPTICAL ENGINEERING VISION

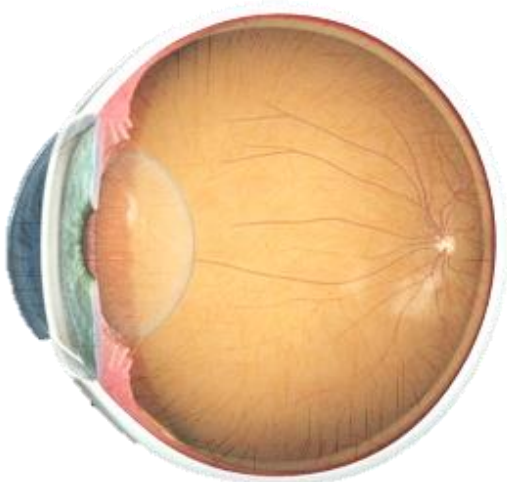
BIOPHOTONICS

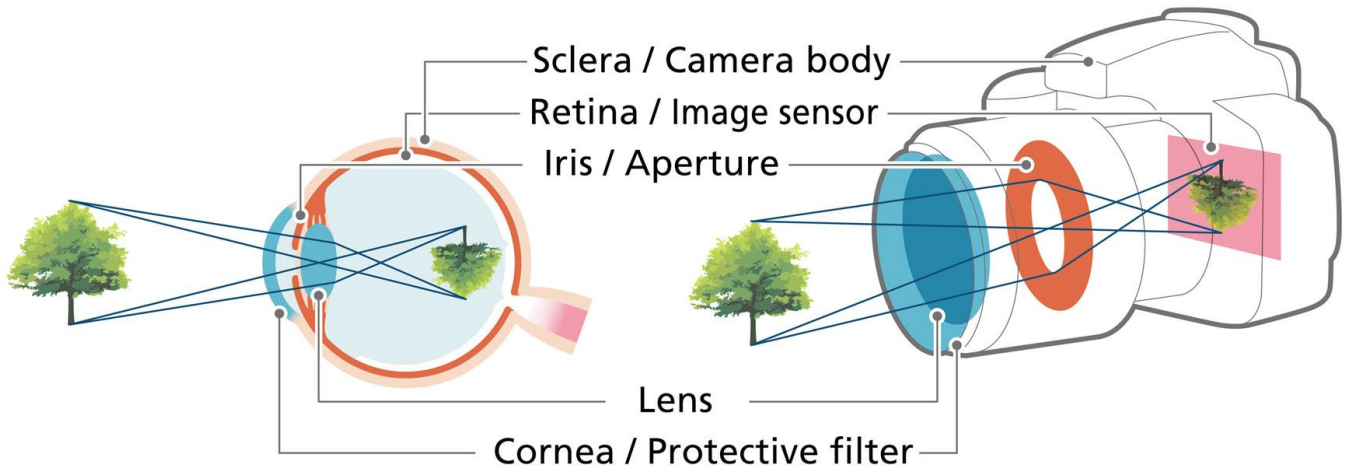
VISUAL OPTICS PHYSICS

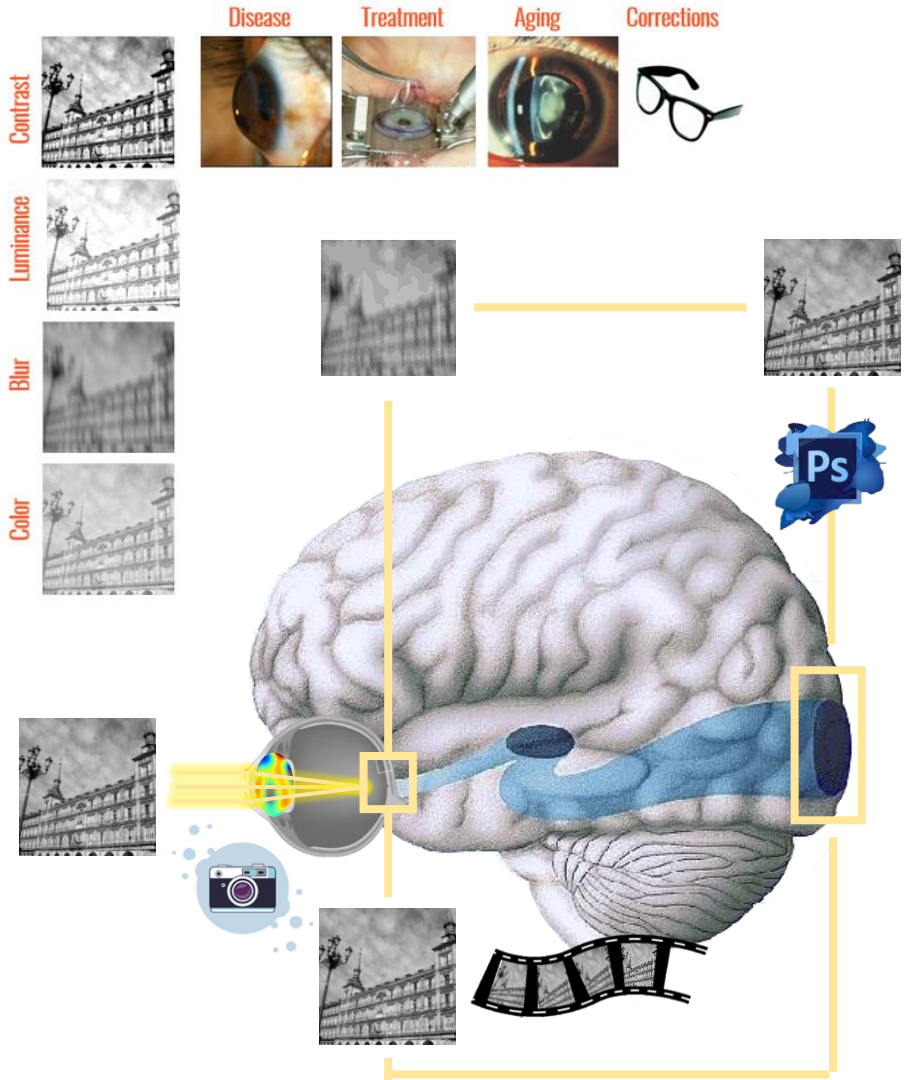
OPHTHALMOLOGY EYE

RESEARCH OPTOMETRY

vision: the eye



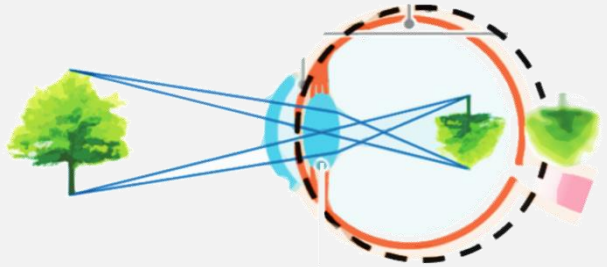




the visual process

few examples

when the camera is too big:
myopia



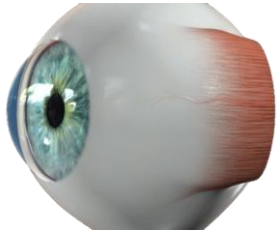
MYOPIA

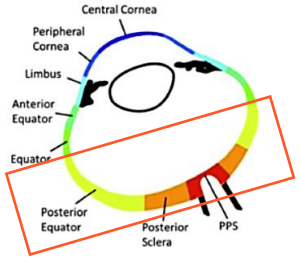
WHY IS EARLY INTERVENTION SO IMPORTANT ?

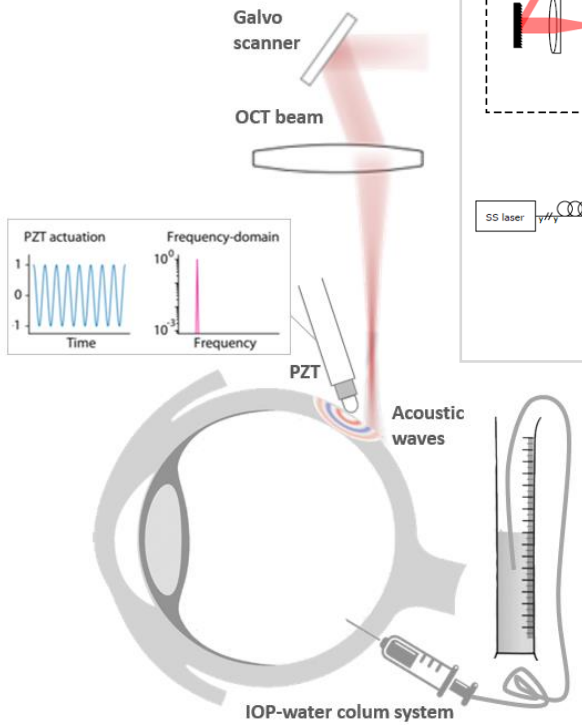
LEVEL OF MYOPIA	CATARACTS	GLAUCOMA	RETINAL DETACHMENT	MYOPIC MACULAR DEGENERATION
-1.00 TO -3.00 D	2X	4X	3X	2X
-3.00 TO -6.00 D	3X	4X	9X	10X
OVER -6.00 D	5X	14X	22X	41X

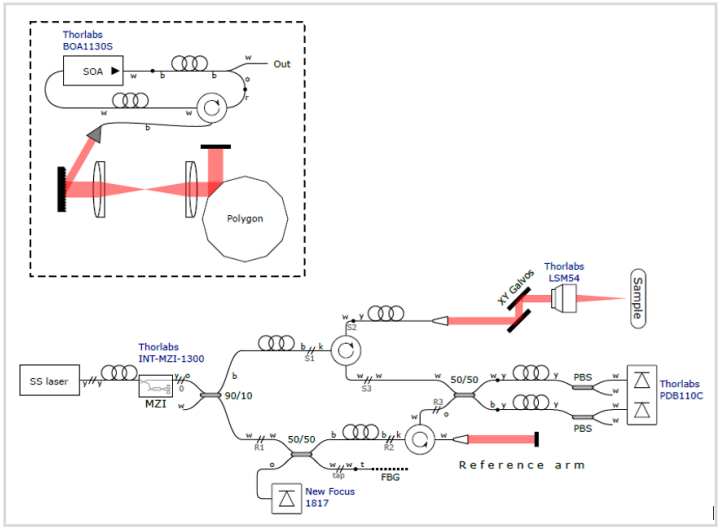
investigating ocular tissues

BIOMECHANICS









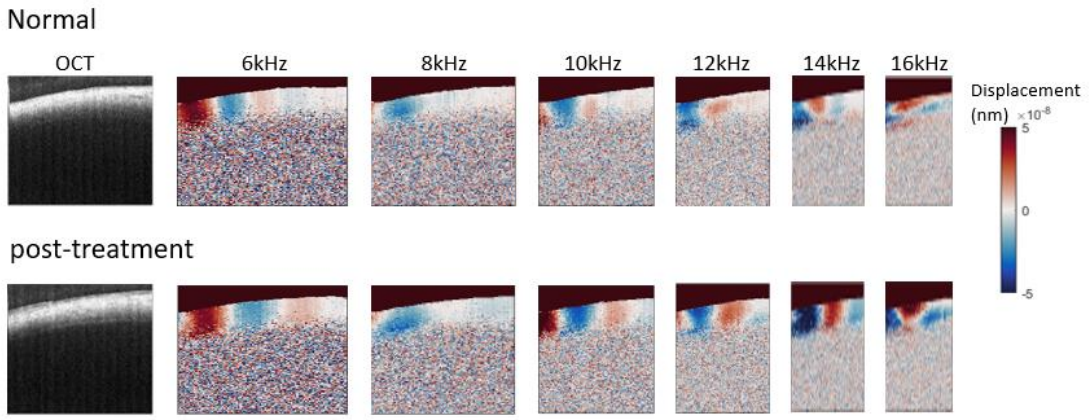
Xu Feng

Guoyang Li

MASSACHUSETTS GENERAL HOSPITAL
Wellman Center for Photomedicine
HARVARD MEDICAL SCHOOL

MECHANICAL PROPERTIES

- OPTICAL COHERENCE ELASTOGRAPHY (OCE)
- Scleral crosslinking (SCXL). Treatment
- ANIMAL MODEL

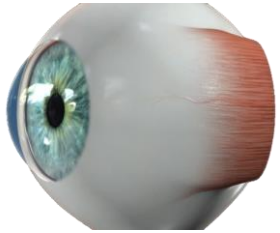


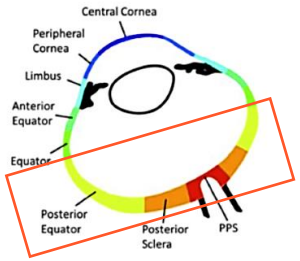
Vinas-Pena et al, Biomed Optics Express, 2022

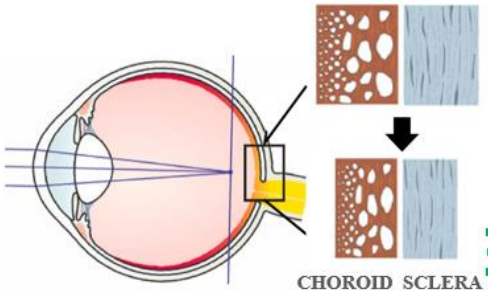
STRUCTURAL IMAGING

SHG MICROSCOPY

and more...







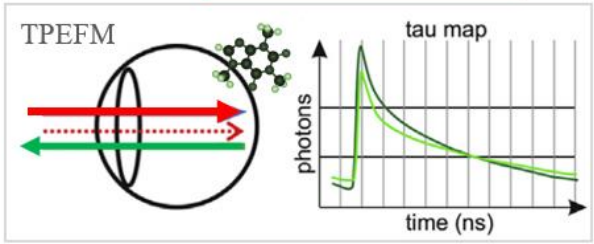
Sangyeon Fred Cho

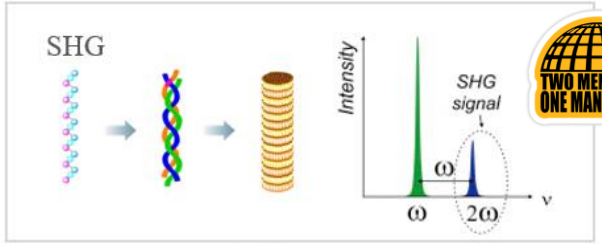
Yoonha Hwang

IVIM TECHNOLOGY

OLYMPUS

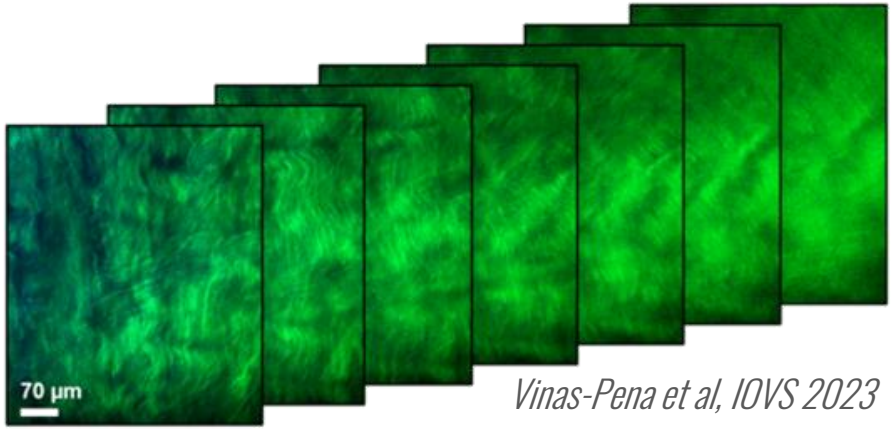
MOLECULAR CHANGES





TWO MEN ENTER ONE MAN LEAVES

STRUCTURAL CHANGES



Vinas-Pena et al, IOVS 2023

STRUCTURAL PROPERTIES

- MULTIPHOTON MICROSCOPY: SHG & FLIM & TPEFM
- Scleral crosslinking (SCXL). Treatment
- ANIMAL MODEL

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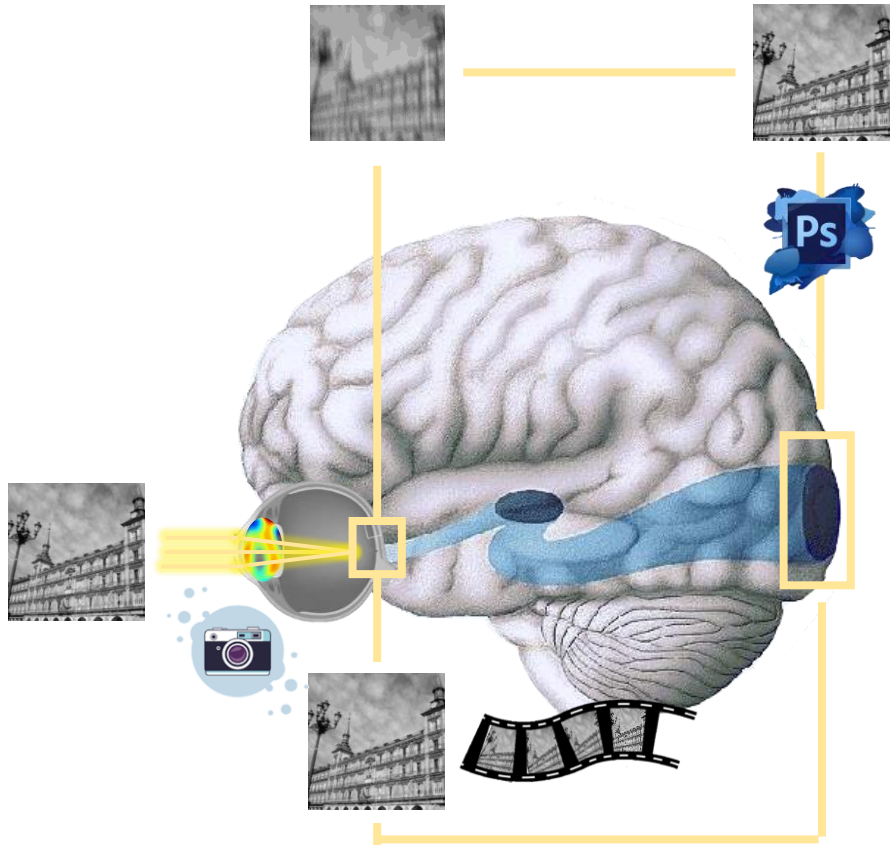
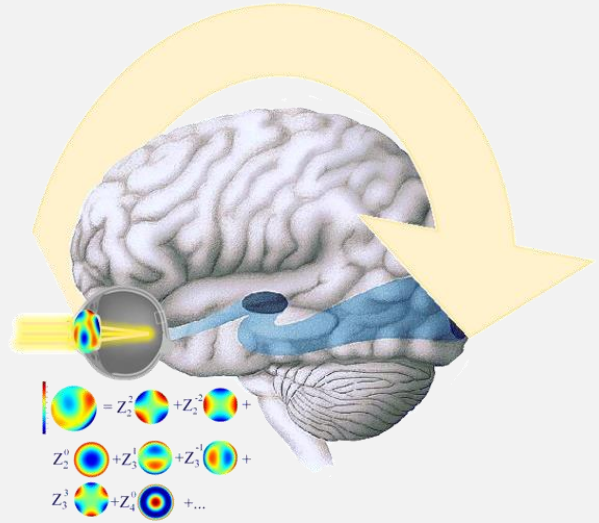
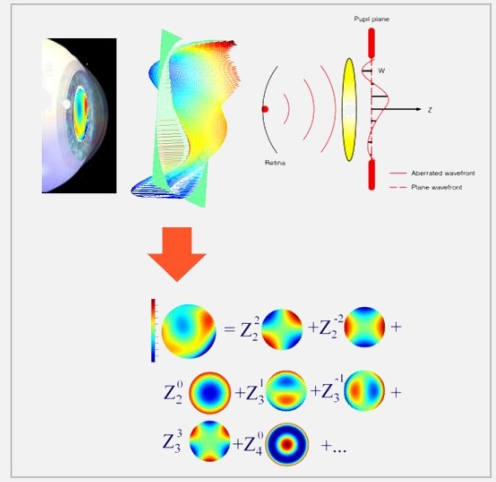


few examples

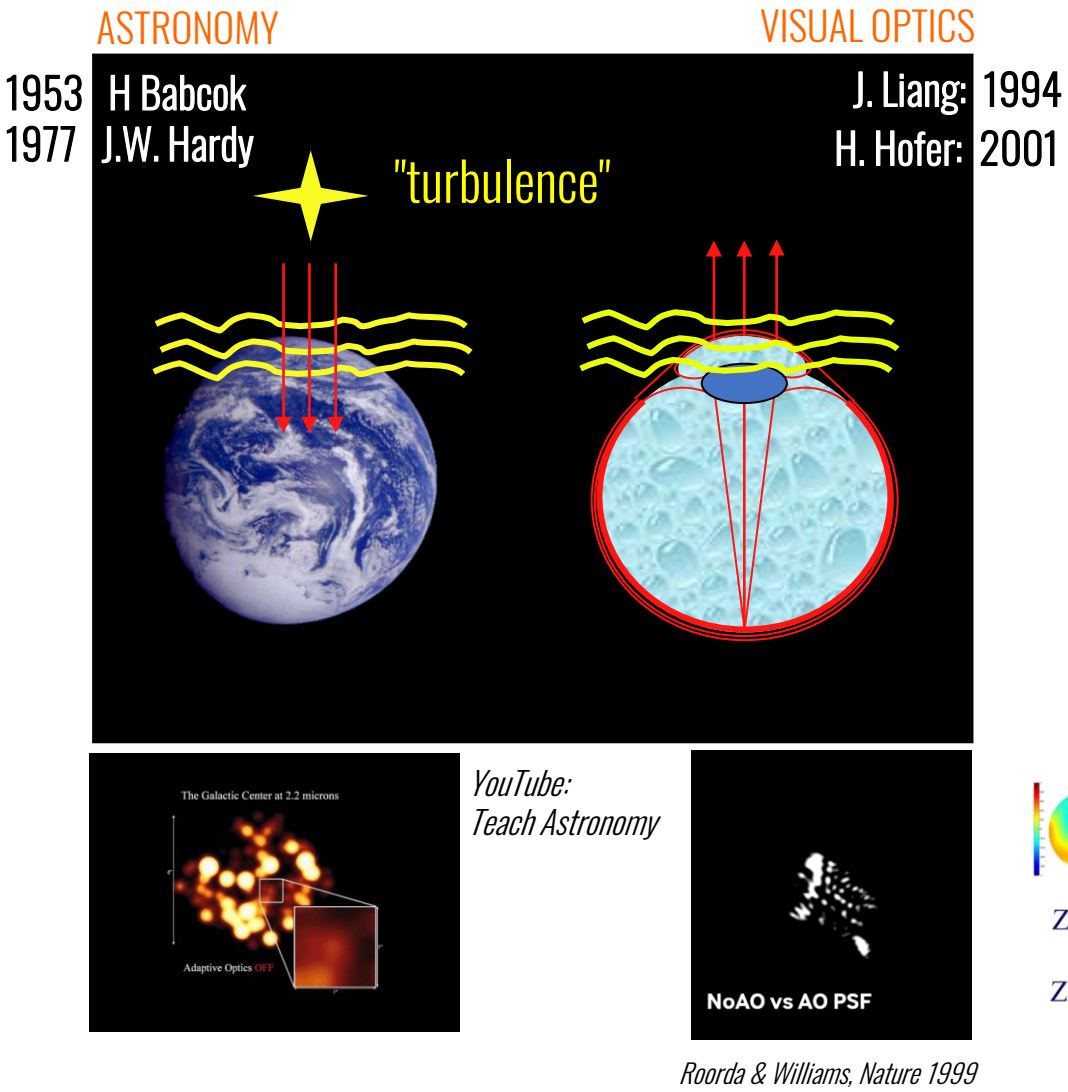
ADAPTIVE OPTICS based visual simulation



WAVEFRONT SENSING

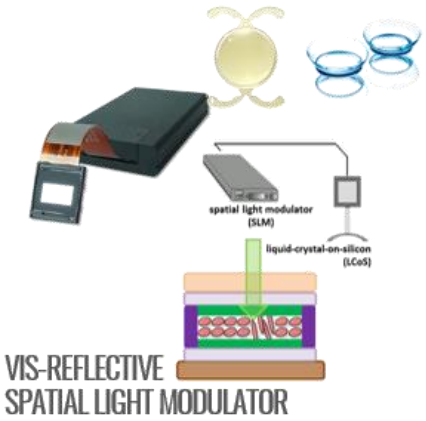


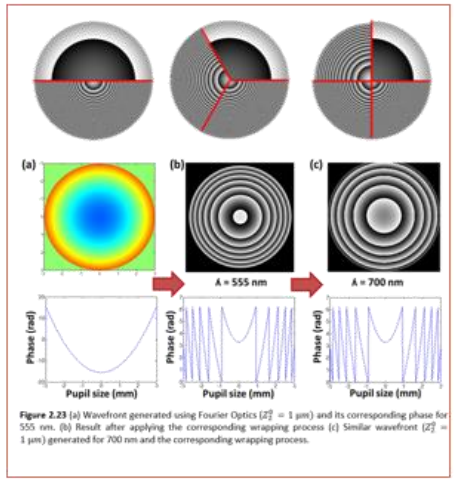
ADAPTIVE OPTICS
based visual simulation

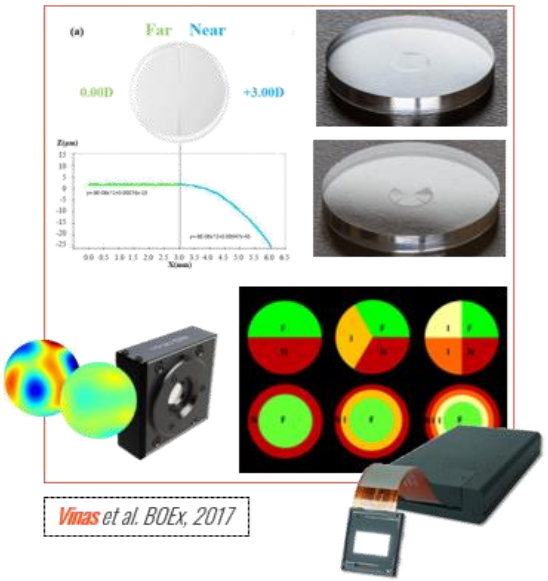


AO based visual simulation

NEW MULTIELEMENT OPTICAL SIMULATION TECHNIQUES



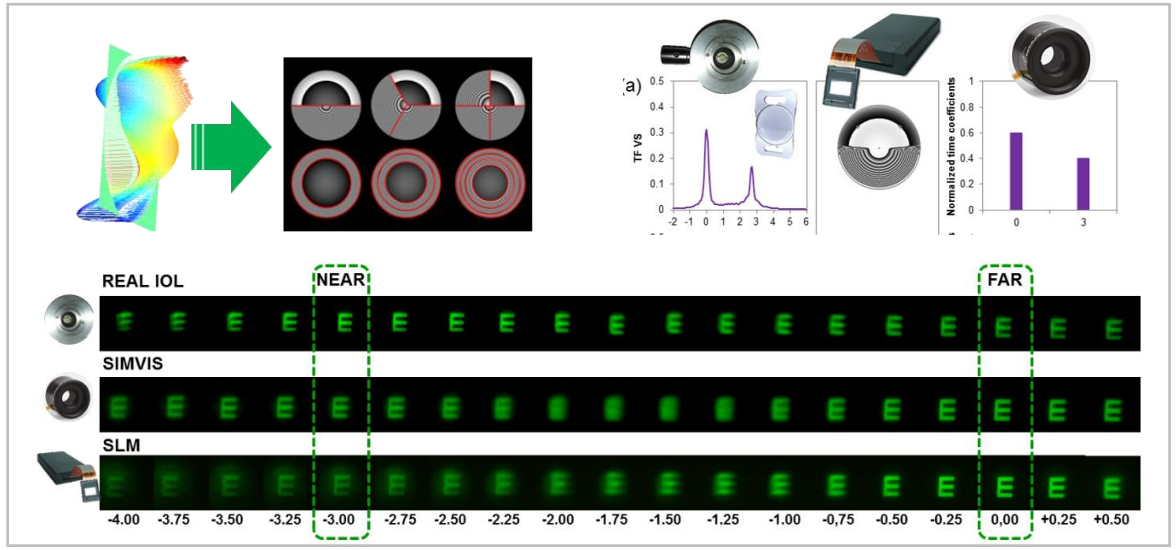




STAAR® SURGICAL

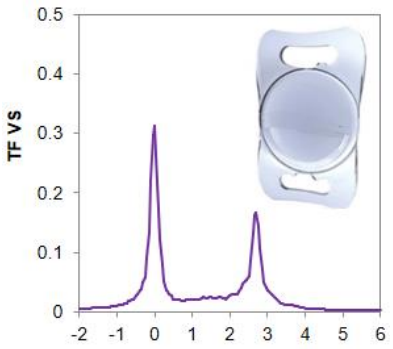
Alcon A Novartis Division

HOYA



ADAPTIVE OPTICS
based visual simulation

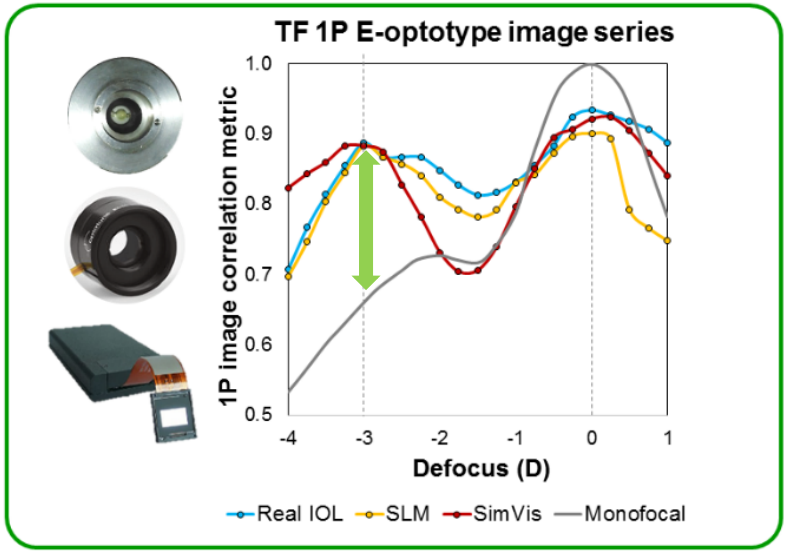
MAPING PHASE MAPS &
COMPLEX OPTICAL DESIGNS



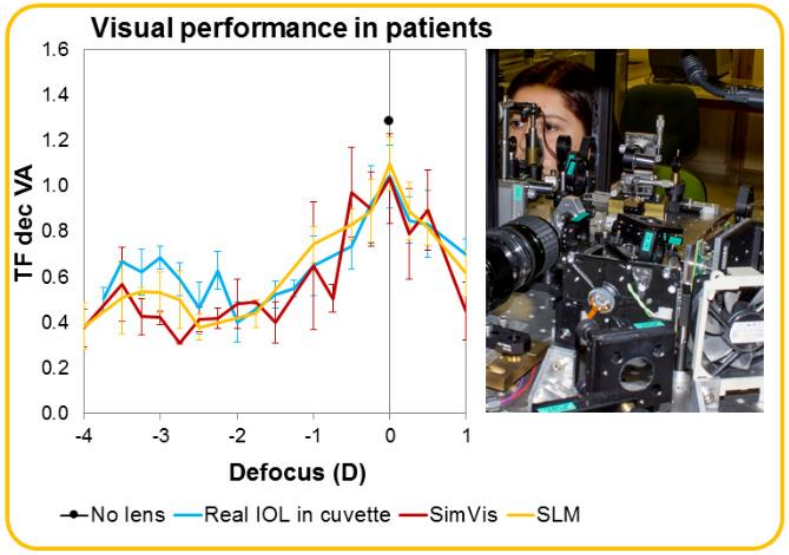
oculentis®

bifocal non-rotationally symmetric refractive multifocal IOL design
[Lentis MPlus LS-313 MF30 (Oculentis)]

ON-BENCH MEASUREMENTS

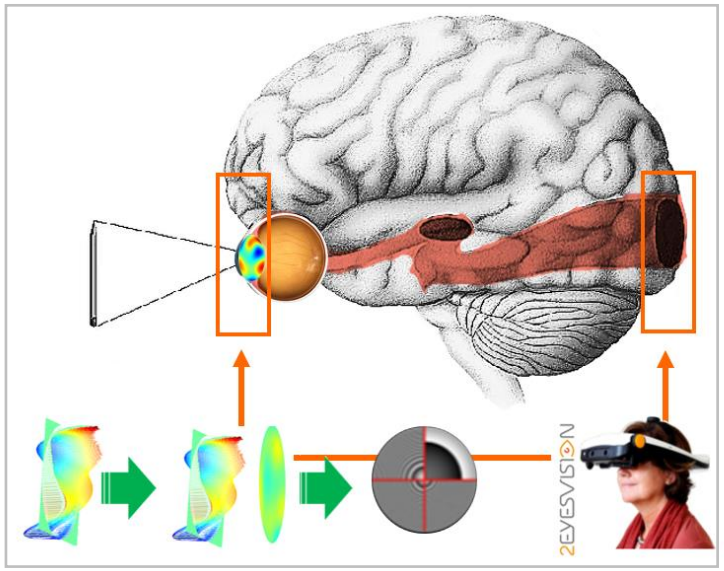


IN VIVO MEASUREMENTS ON PATIENTS

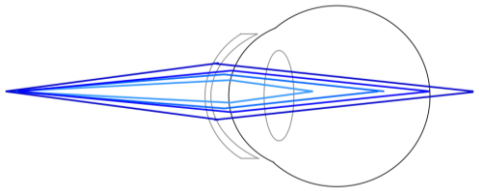


Vinas et al., Sci Reps, 2019

ACTIVE OPTICAL
technologies

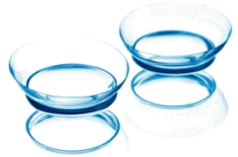


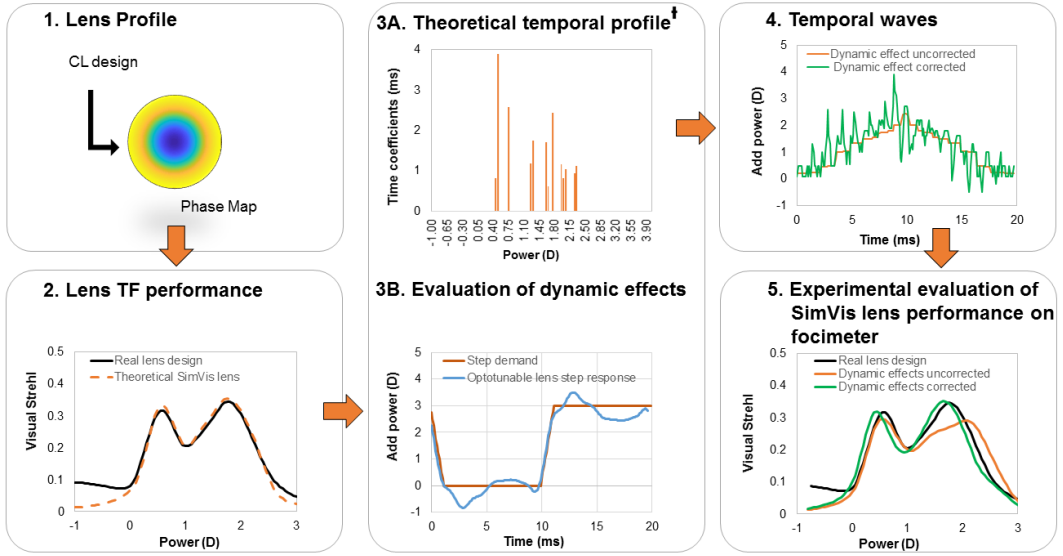
SIMVIS
technology

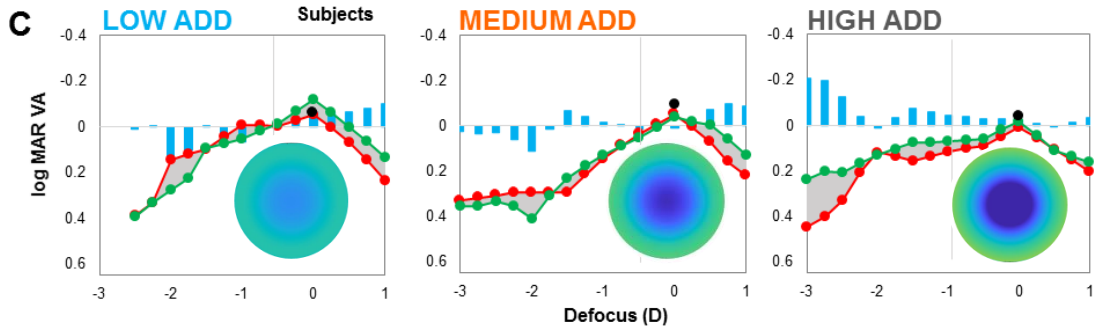


FAR
NEAR

Vinas et al., TVST 2020;
Barcala, Vinas, et al. Cont Lens & Ant Eye, 2022







Johnson & Johnson VISION CARE, INC.

2EYESVISION

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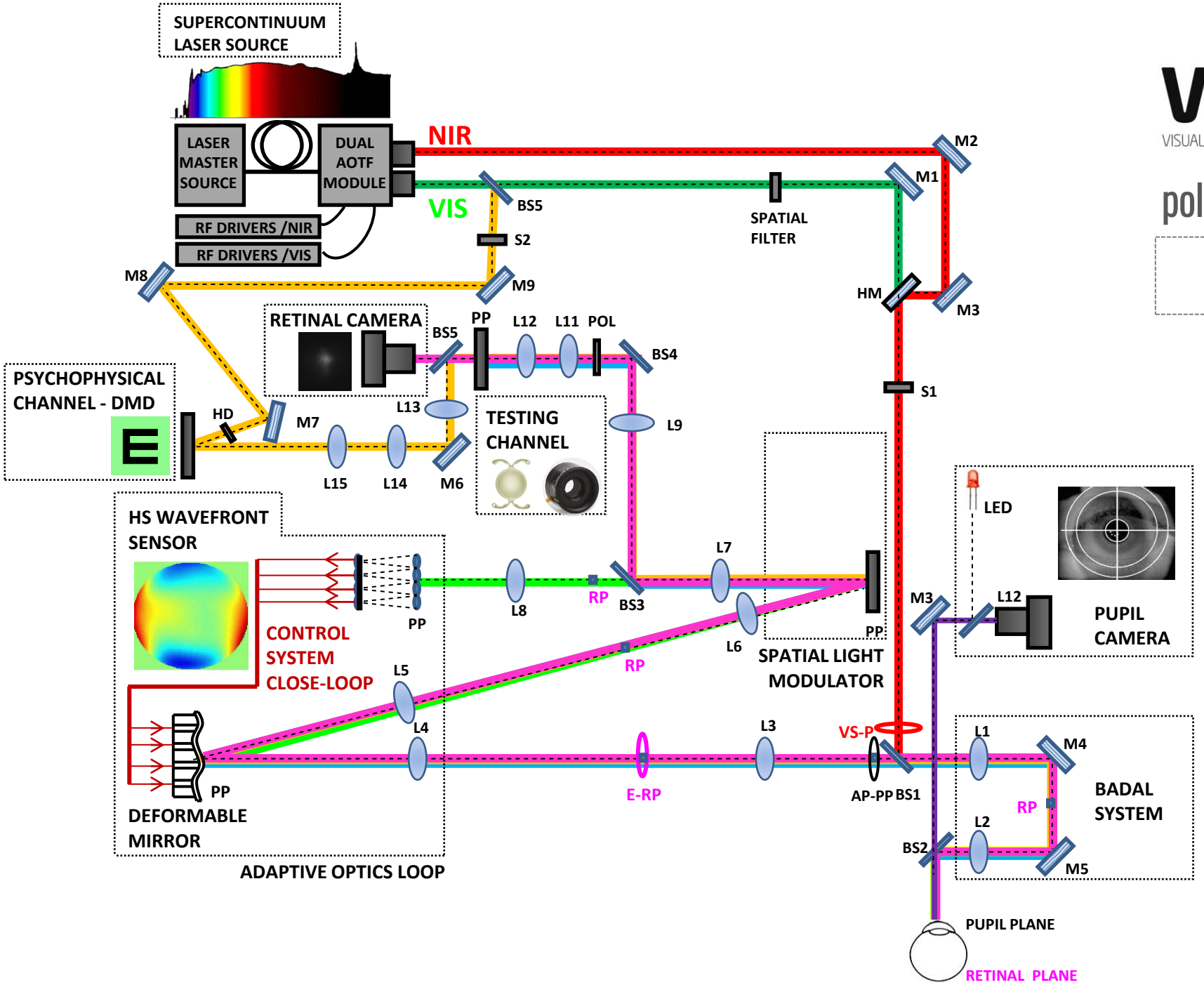
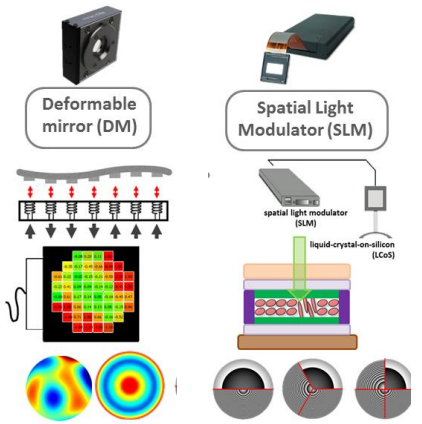
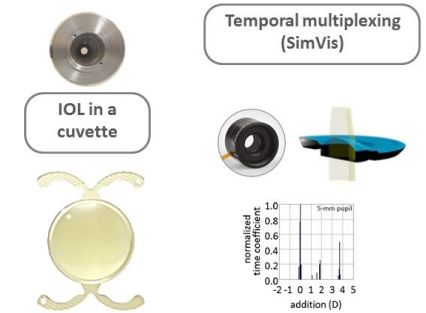
polychromatic AO visual simulator

Vinas et al. BOEx, 2015
Vinas et al., Scientific reports, 2019



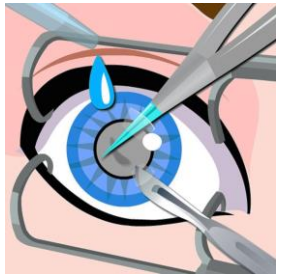




2EYESVISION

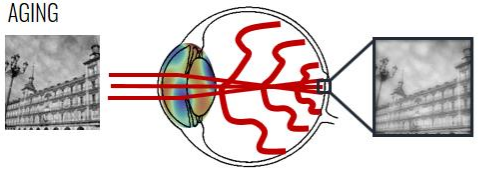
ACTIVE OPTICAL technologies

REVOLUTIONING THE TREATMENT OF PRESBYOPIA WITH NEW OPTICAL TECHNOLOGIES



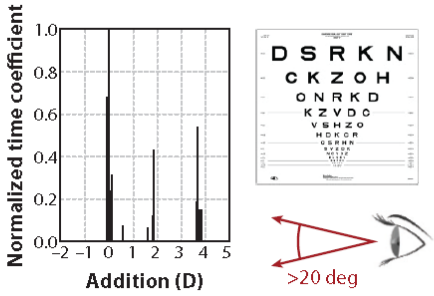
- 1.2B People affected by PRESBYOPIA
- 77K Ophthalmic surgeons
- 22M Cataract surgeries performed every year
- 15% Penetration of last generation multifocal solutions

AGING

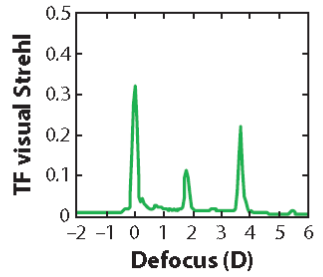


Clinical visual simulator

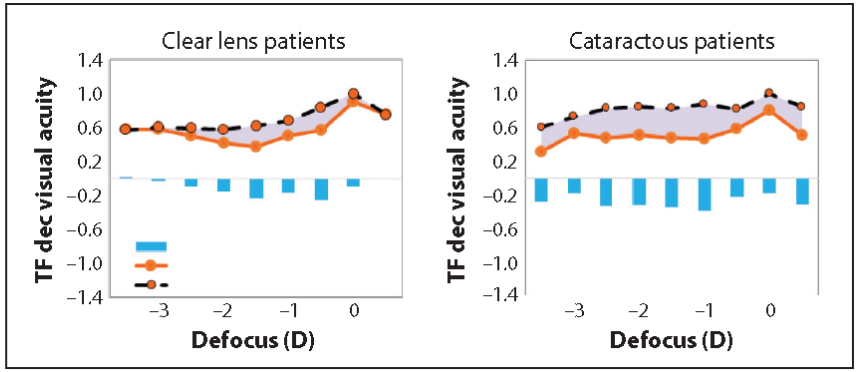
SimVis technology

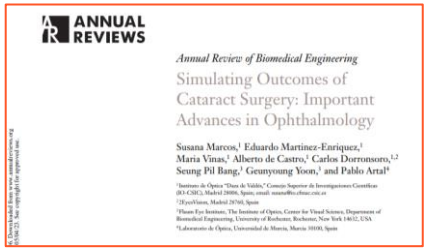


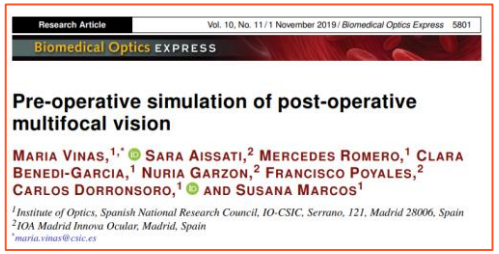
Multifocal IOL



Preoperative simulation of postoperative vision







2EYESVISION
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PhysIOL
Johnson & Johnson VISION CARE, INC.
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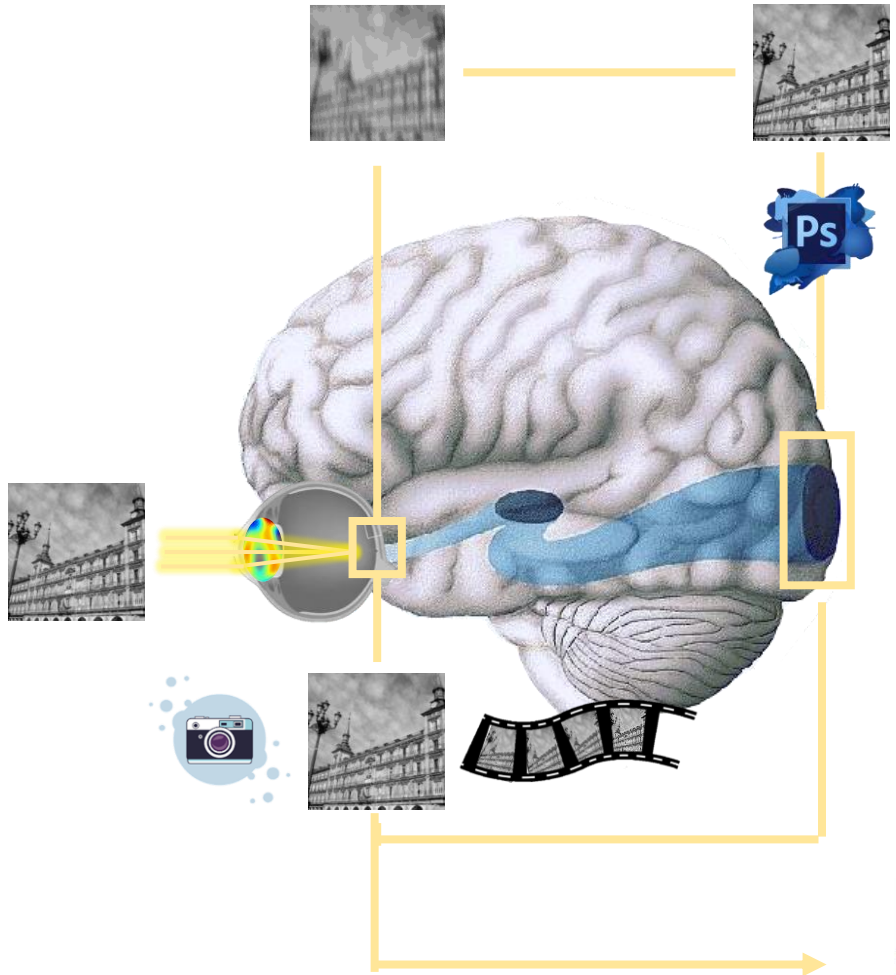
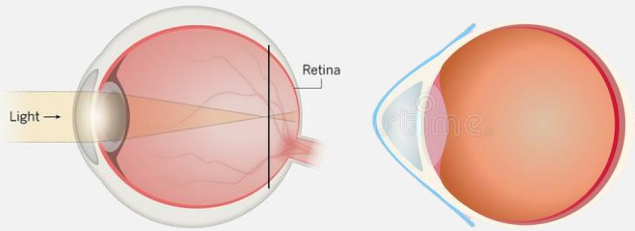
ESSILOR

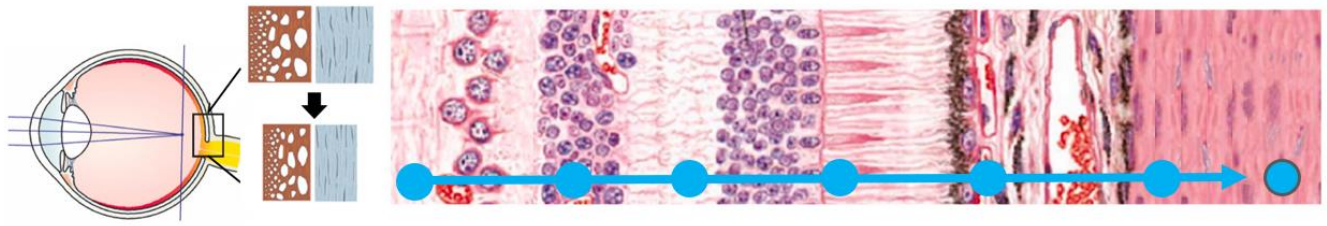


few examples

what triggers eye growth?
emmetropization



VISUAL STIMULUS → RETINAL SIGNALING CASCADE → SCLERAL REMODELING



UNDERSTANDING EMMETROPIZATION

NON-INVASIVE IMAGING TECHNIQUES TO UNDERSTAND THE EMMETROPIZATION PROCESS

UNIVERSITY of ROCHESTER

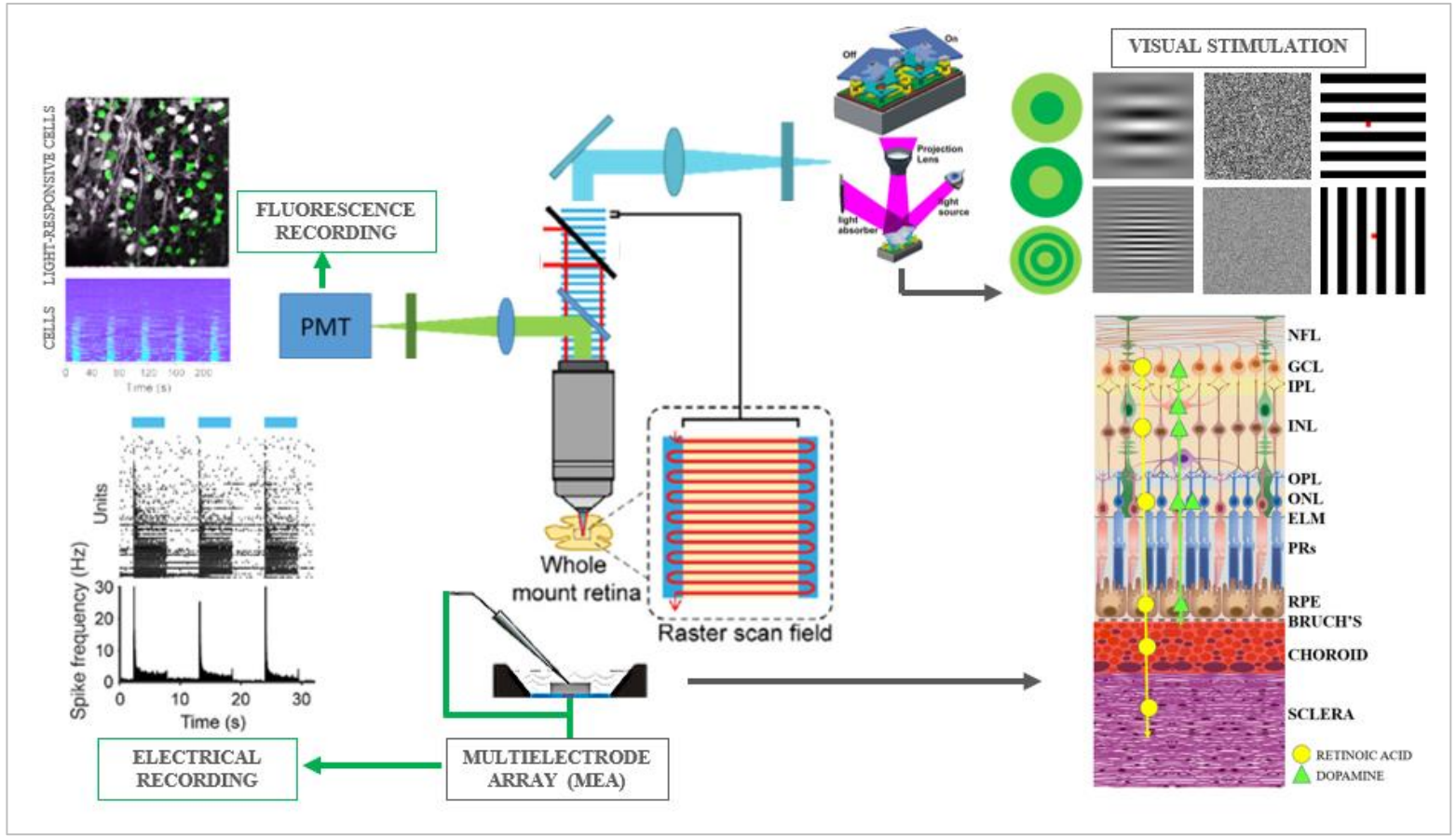
MICHAEL TELIAS, PHD
TELIAS LAB

Texas Instruments

Spectra-Physics

Scientifica

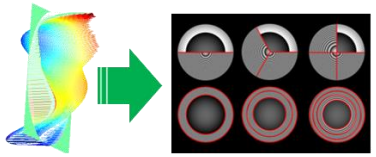
Retinal ganglion cells sensing of optical cues



IN SUMMARY,

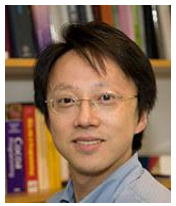
biophotonics for eye research
means multidisciplinar!!

novel imaging tools for scattered tissues
multiphoton microscopy laser sources for *in vivo* imaging
modular microscopes for complex spectral setups
nanoimaging strategies



polychromatic optics design
customizable supercontinuum laser sources (cheap)
clinical & industrial colaborators

acknowledgements



Prof. Andy Yun

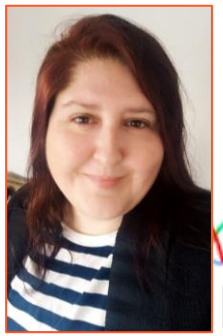
Xu Feng

Guoyang Li

Sangyeon Fred Cho

Yoonha Hwang

H2020-MSCA project 893557-MYOMICRO



PHOTONS4VISION

TEAM

Elena Moreno Rubio
AO team

Millán Pérez Martín
Multiphoton team

Diego Dijkstra
Multiphoton team

FUNDING

RYC2021-034218-I
IP. M Vinas (2023-2027)

CNS2022-135326- GOLDENEYE.
IP. M Vinas (2023-2025)

PID2022-1398400A-I00- MYOFLUOGOLD
IP. M Vinas (2023-2026)

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Consolidación Investigadora 2022

Proyectos Generación de Conocimiento 2022

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Alberto de Castro, PhD
Optical & Visual simulation

Mar Fernández, PhD
Nanoscopy

James Germann, PhD
Multiphoton

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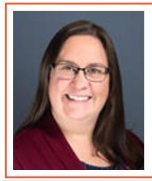

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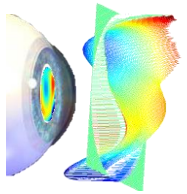
Thank you!



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