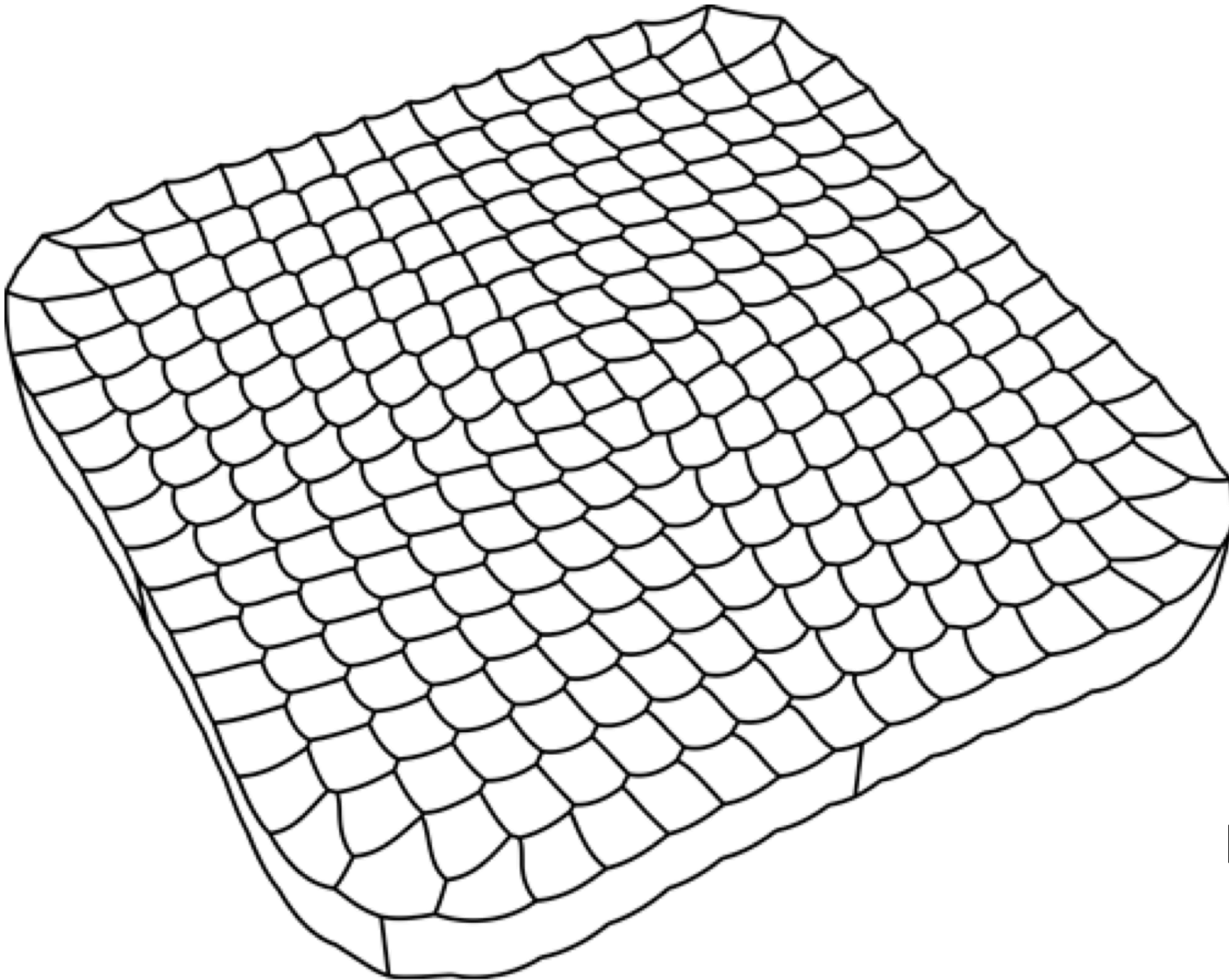




FMLA OPTICS FOR VR AND MR

Presenter: Rubén Mohedano

Authors: Limbak team

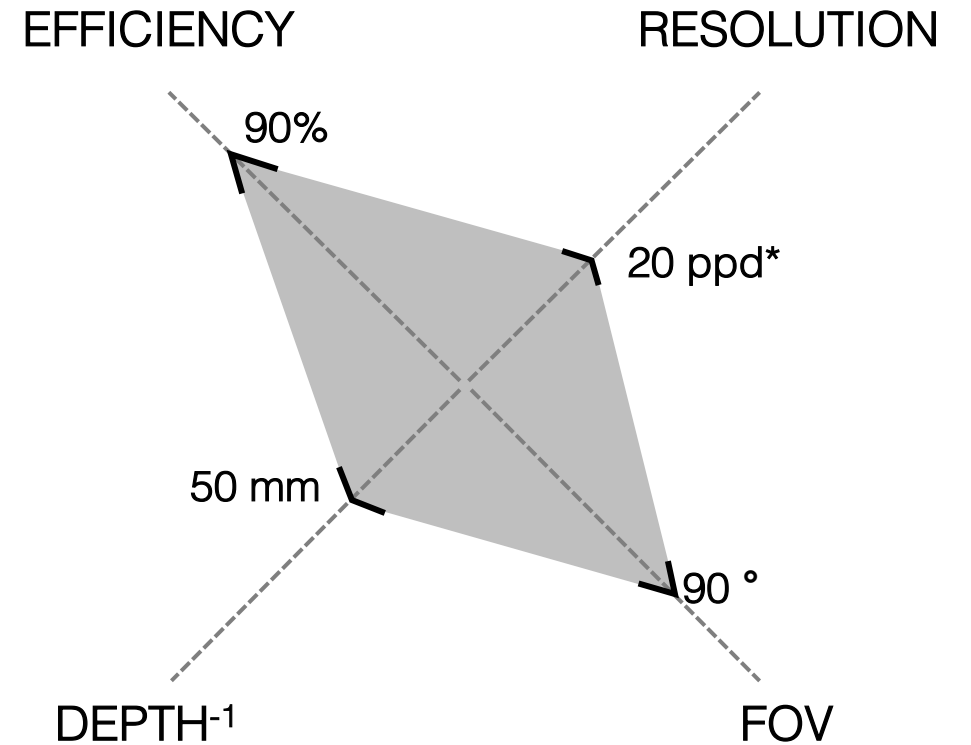
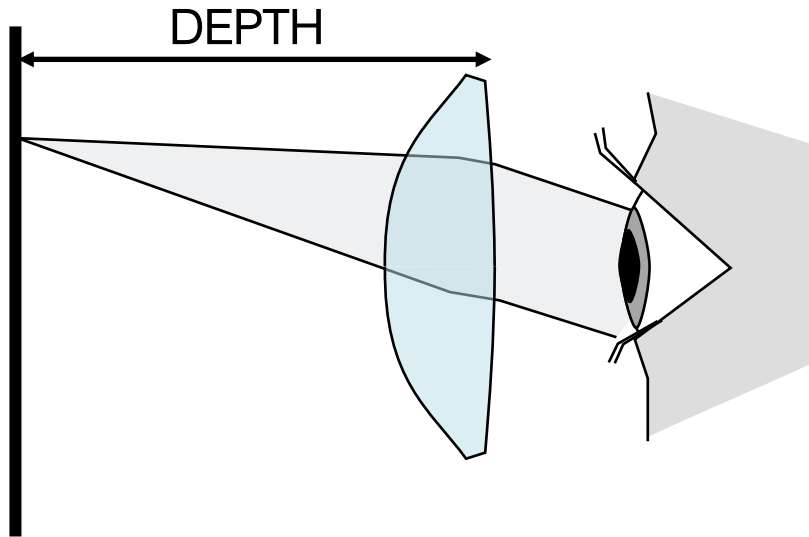
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N CHANNELS

THE BASIC DESIGN

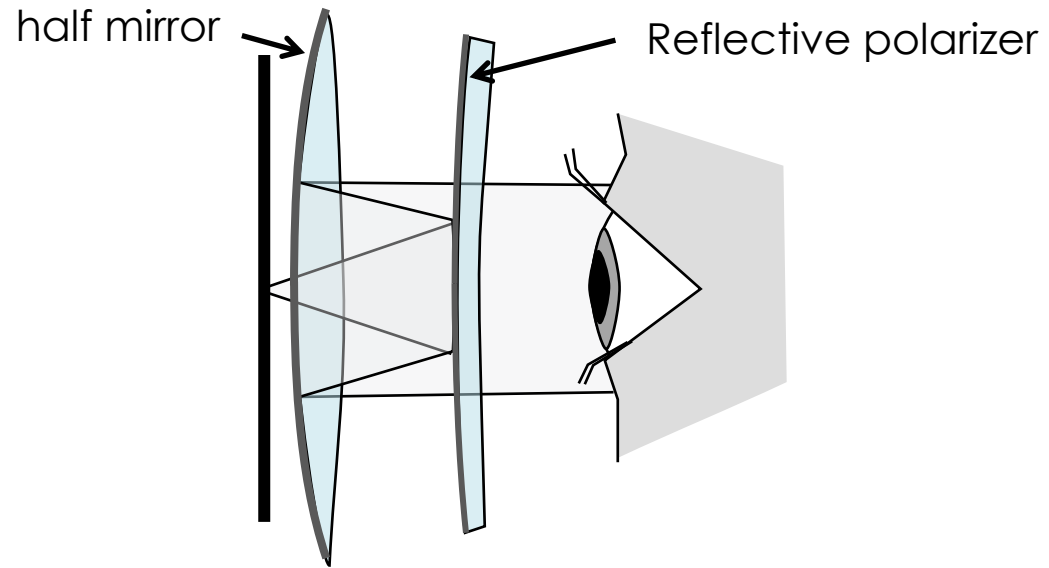


*Assuming a 1.8k x 1.8k display per eye

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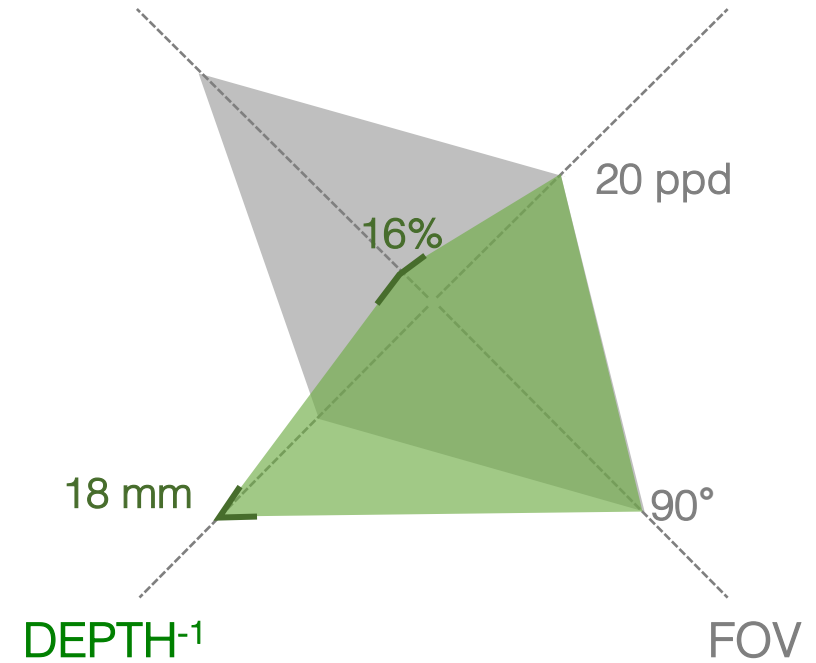


PANCAKE



EFFICIENCY

RESOLUTION



COMMERCIAL PANCAKE PRODUCTS

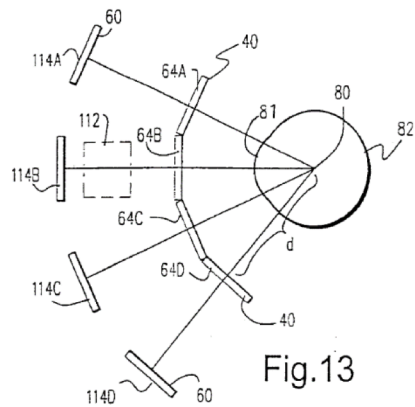


90° / 1,600x1,600 pixels per eye

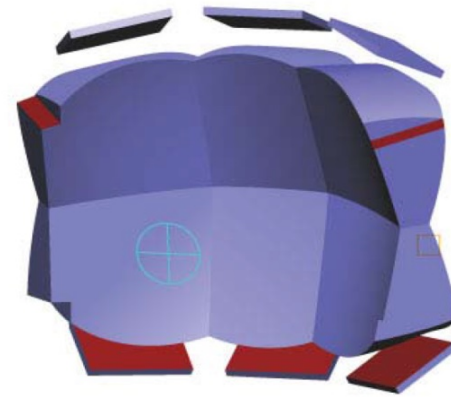


95° / 1,600x1,600 pixels per eye

MULTICHANNEL OPTICS



US 6,529,331 by Massof et al.



D. Cheng, et al. Opt. Lett. 2011

NATURE INSPIRED



Photo courtesy of Thomas Shahan

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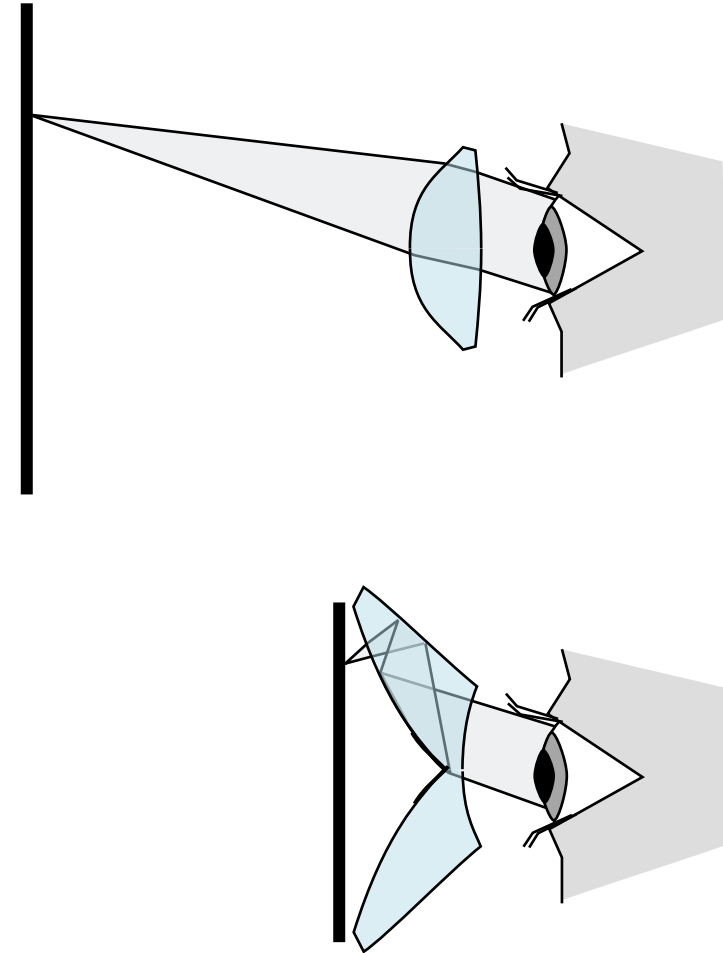
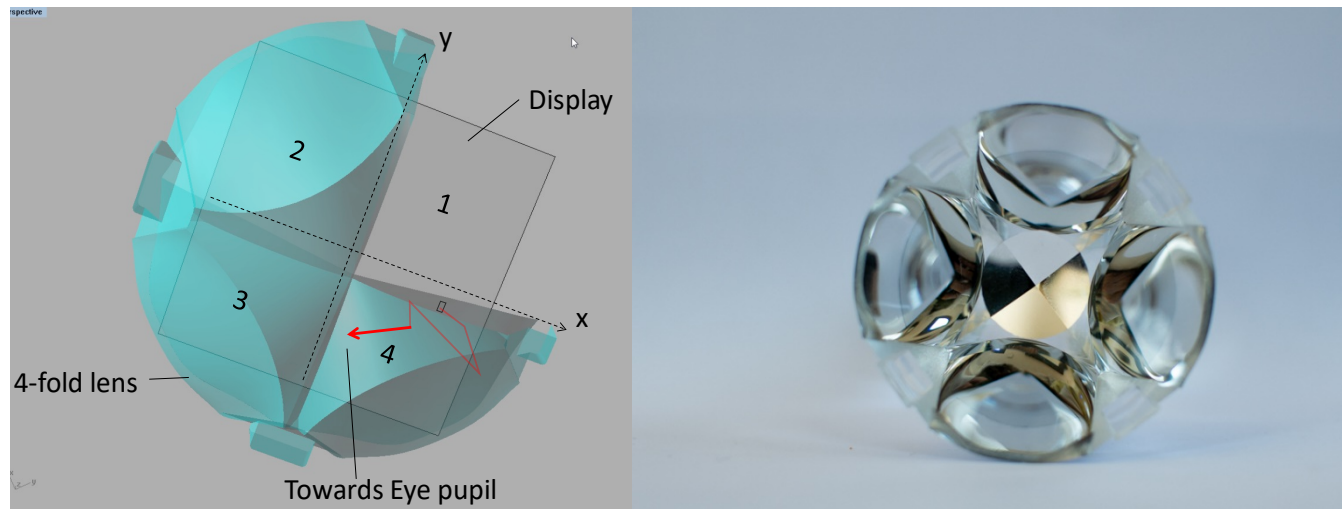
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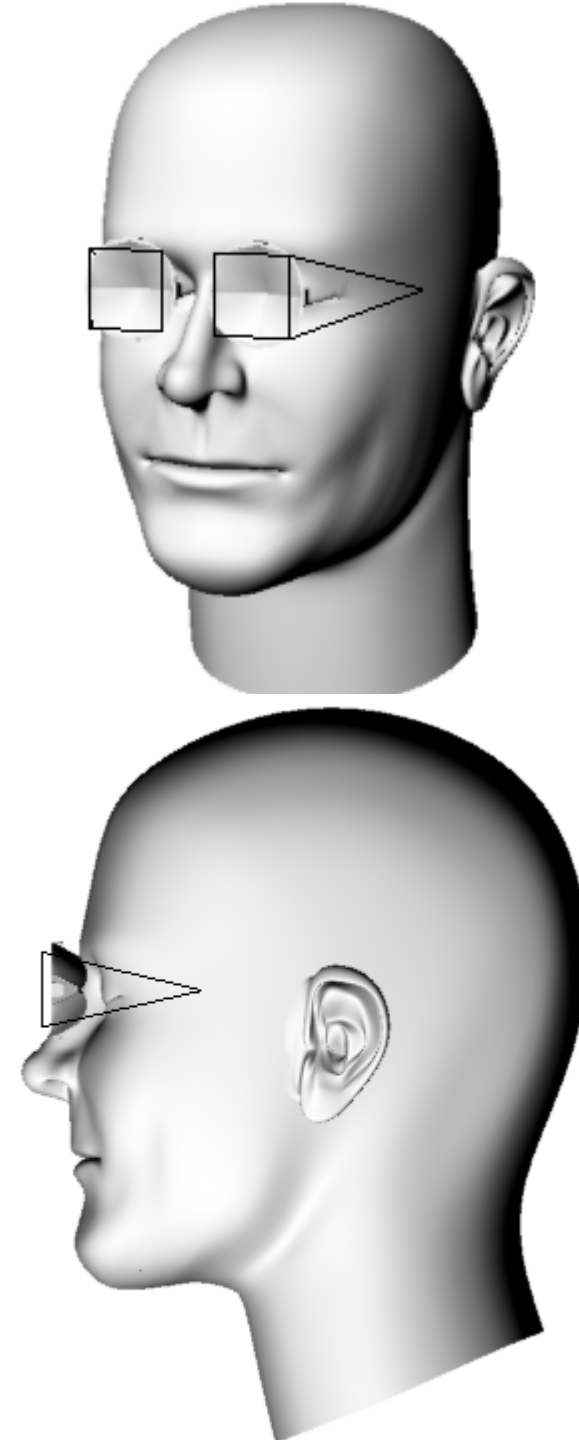
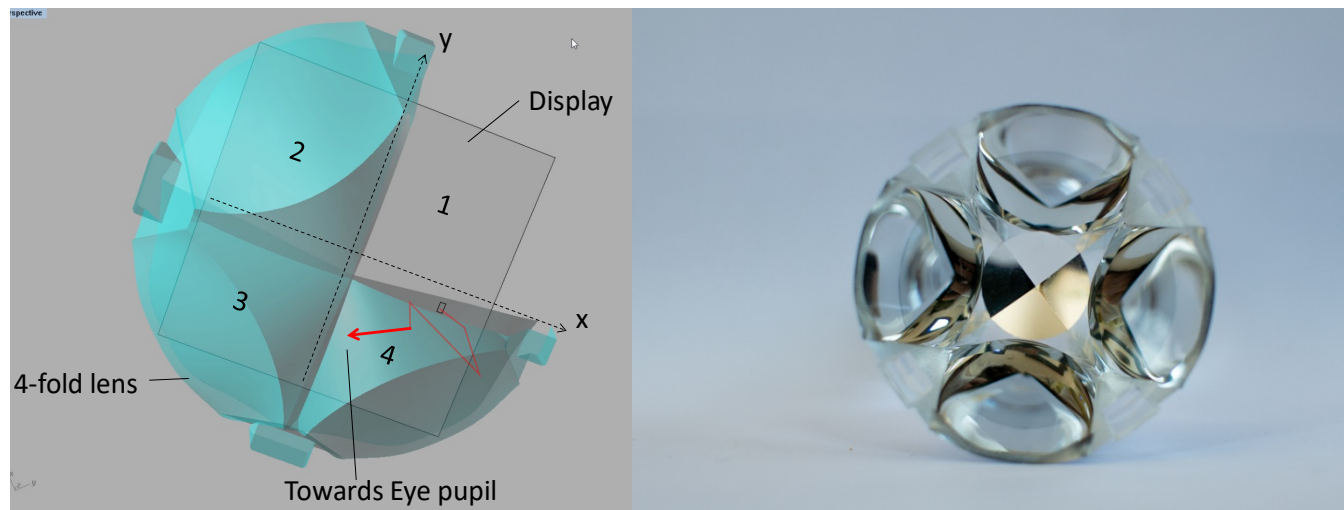
4-CHANNELS

ThinEyes® CLOVER

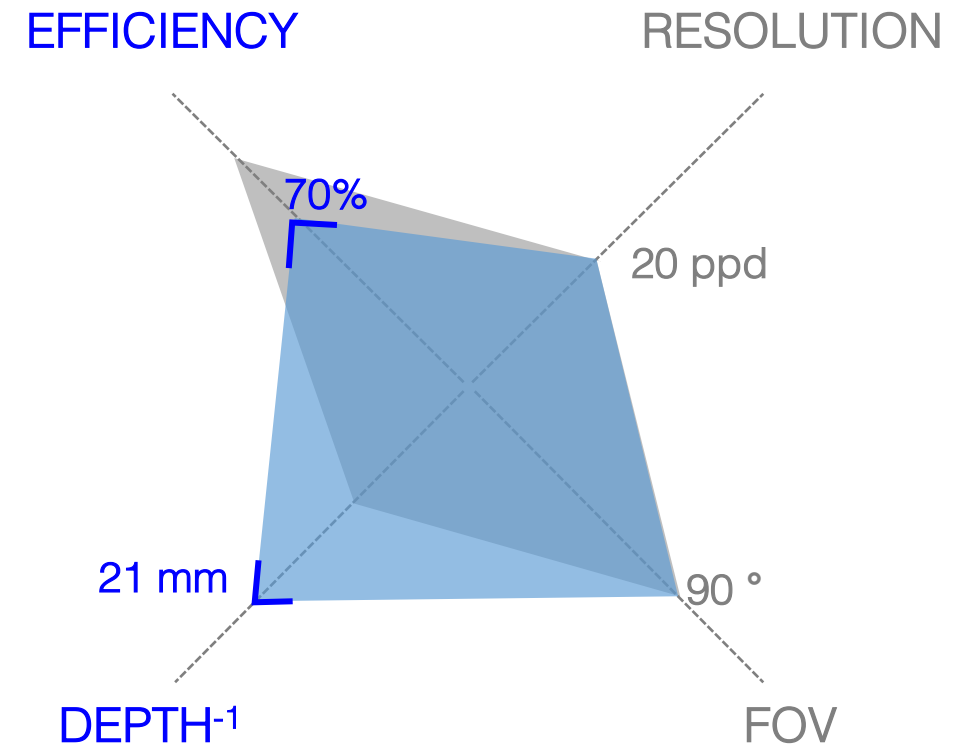


4-CHANNELS

ThinEyes® CLOVER

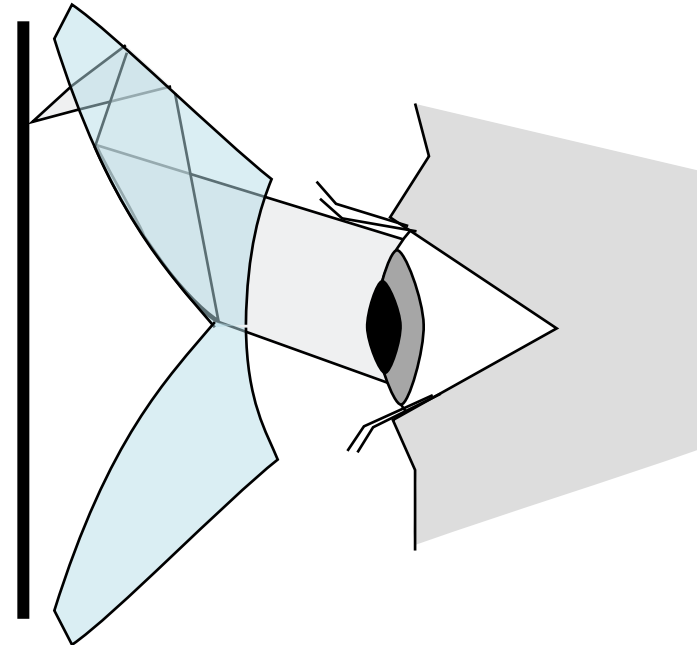


ThinEyes® CLOVER





ThinEyes® CLOVER



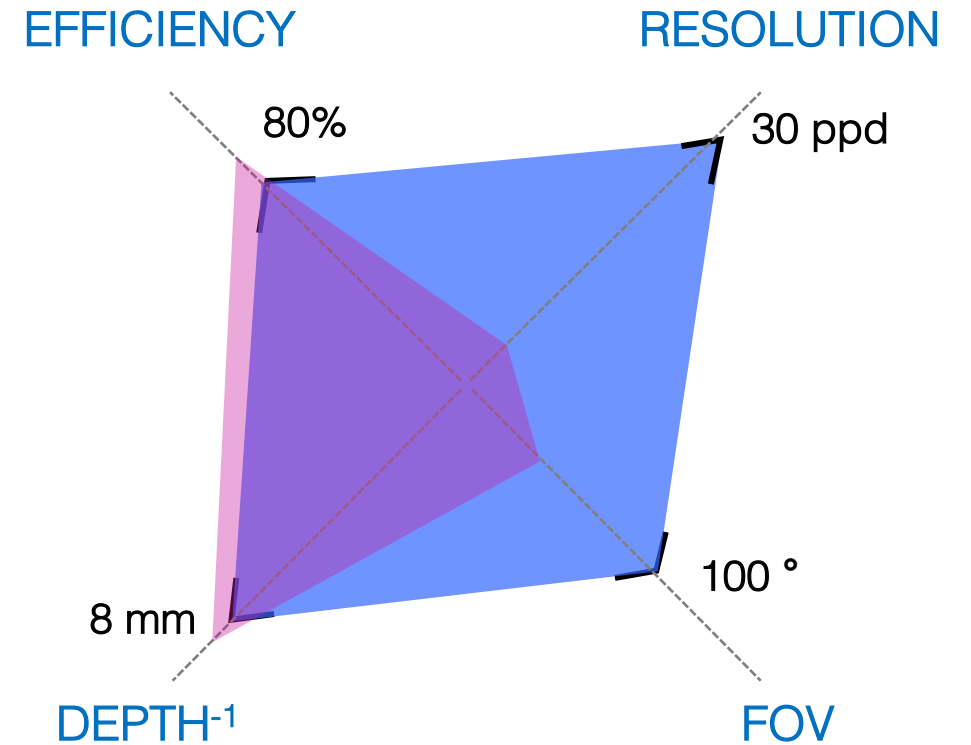
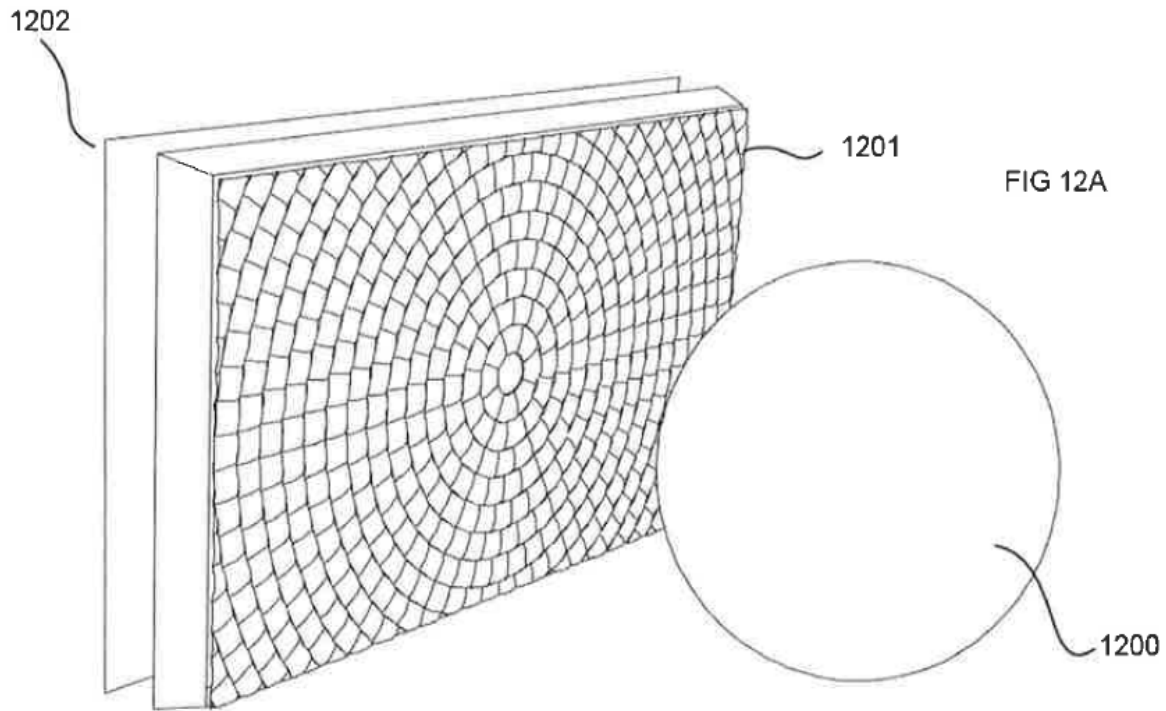
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ThinEyes® TRENZA

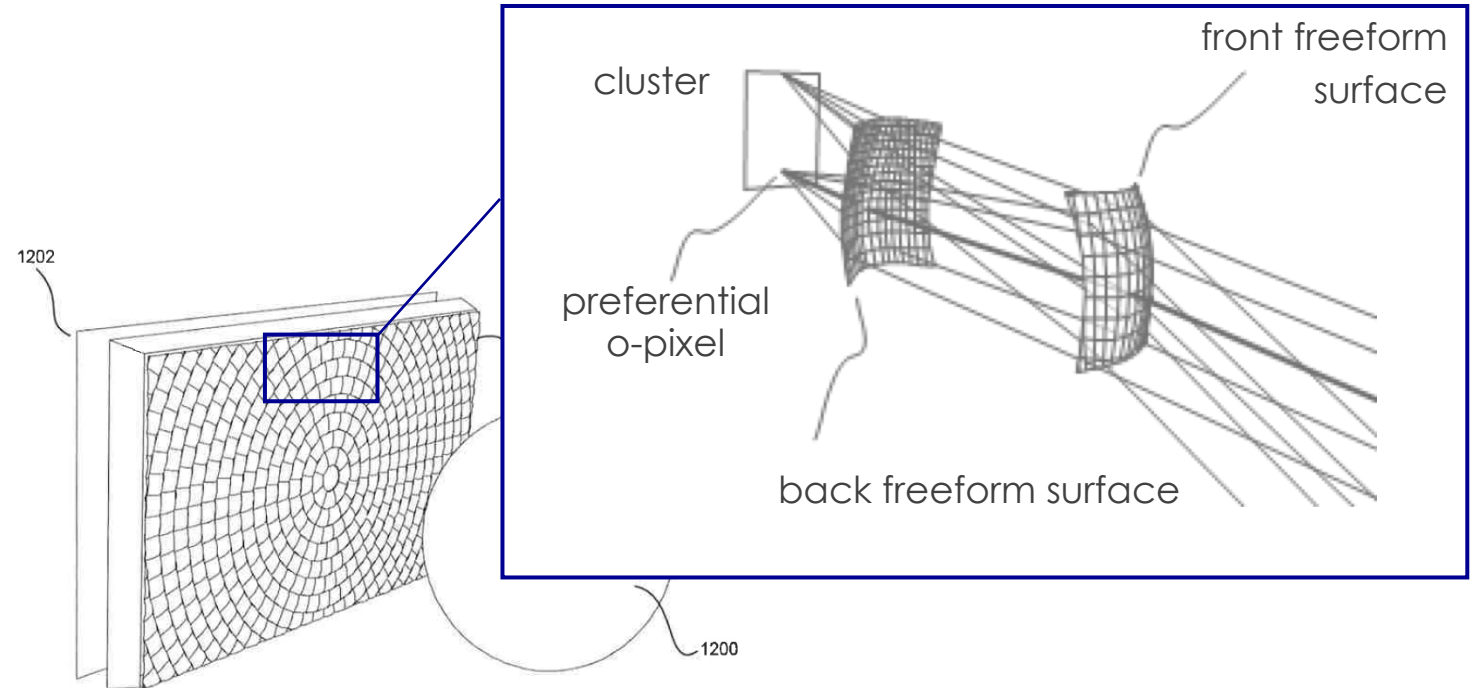


4k x 4k display per eye

ThinEyes® TRENZA

KEY ELEMENTS

FREEFORMS

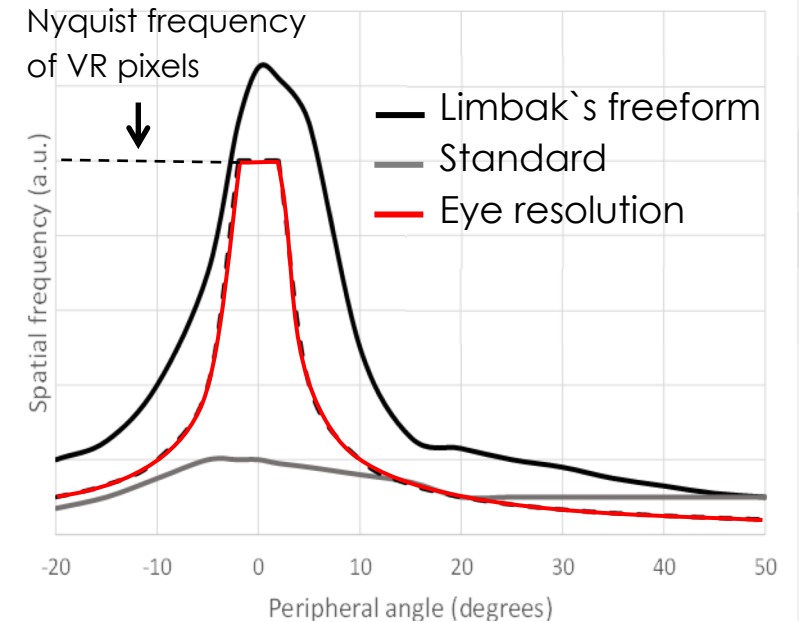
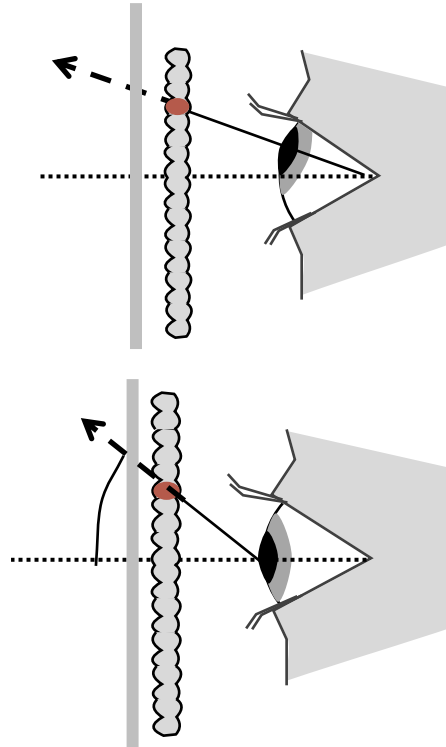


ThinEyes® TRENZA

KEY ELEMENTS

FREEFORMS

PASSIVE FOVEAL SUPER-RESOLUTION



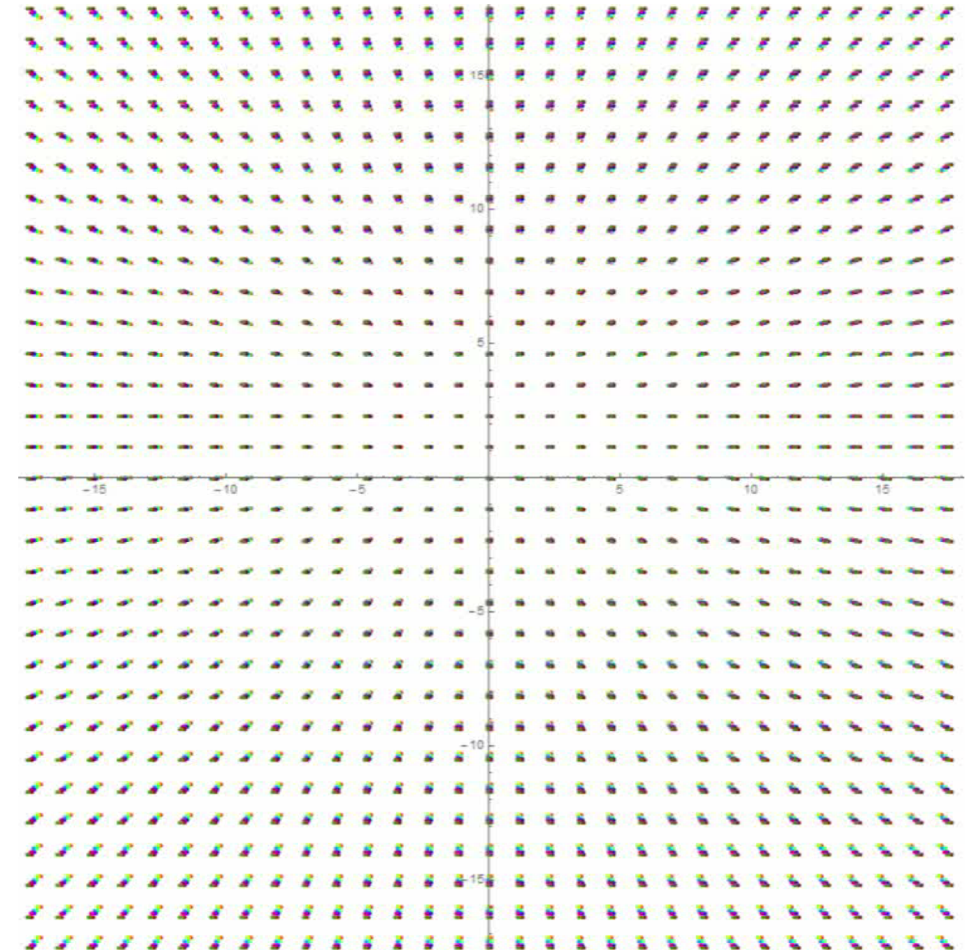
ThinEyes® TRENZA

KEY ELEMENTS

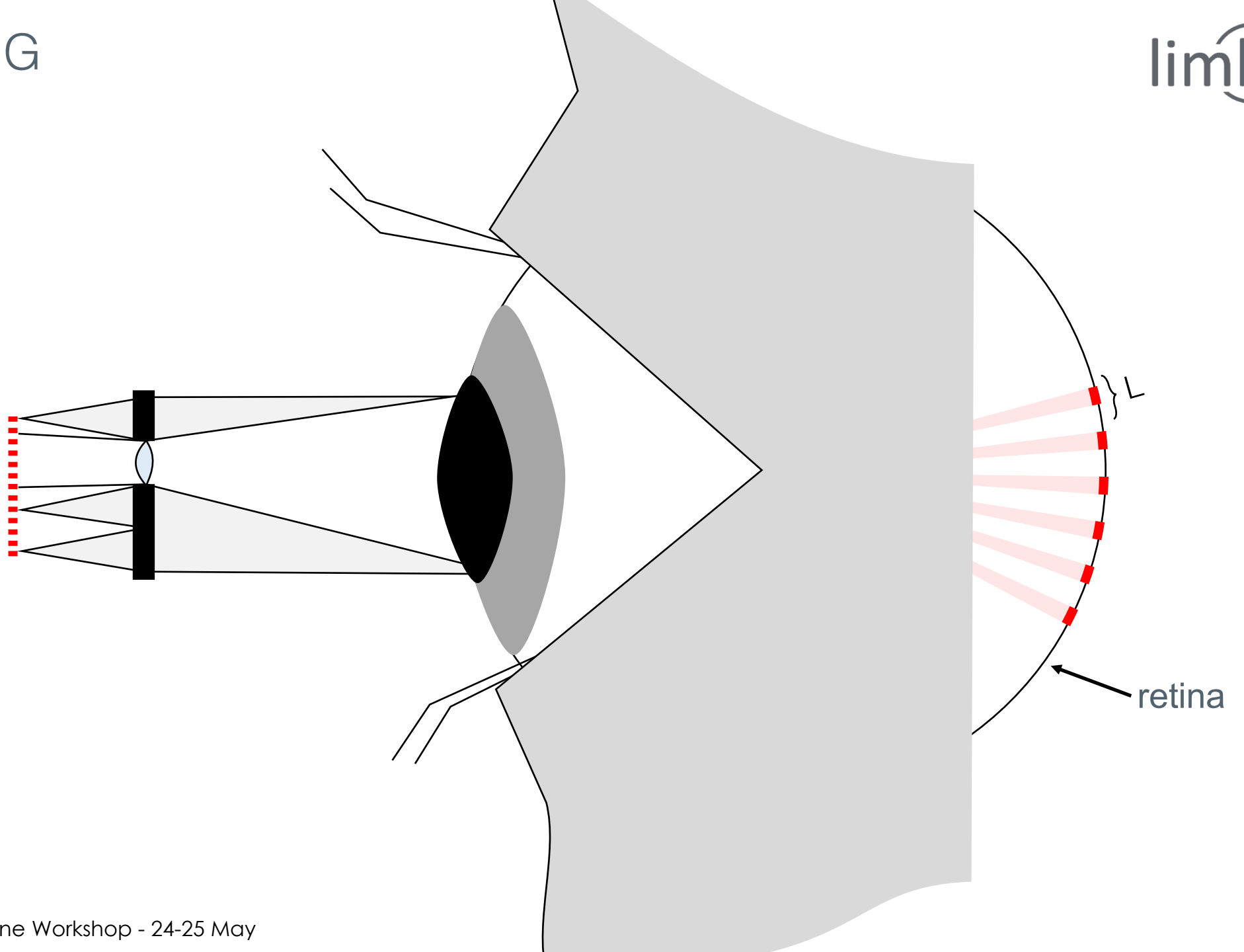
FREEFORMS

PASSIVE FOVEAL SUPER-RESOLUTION

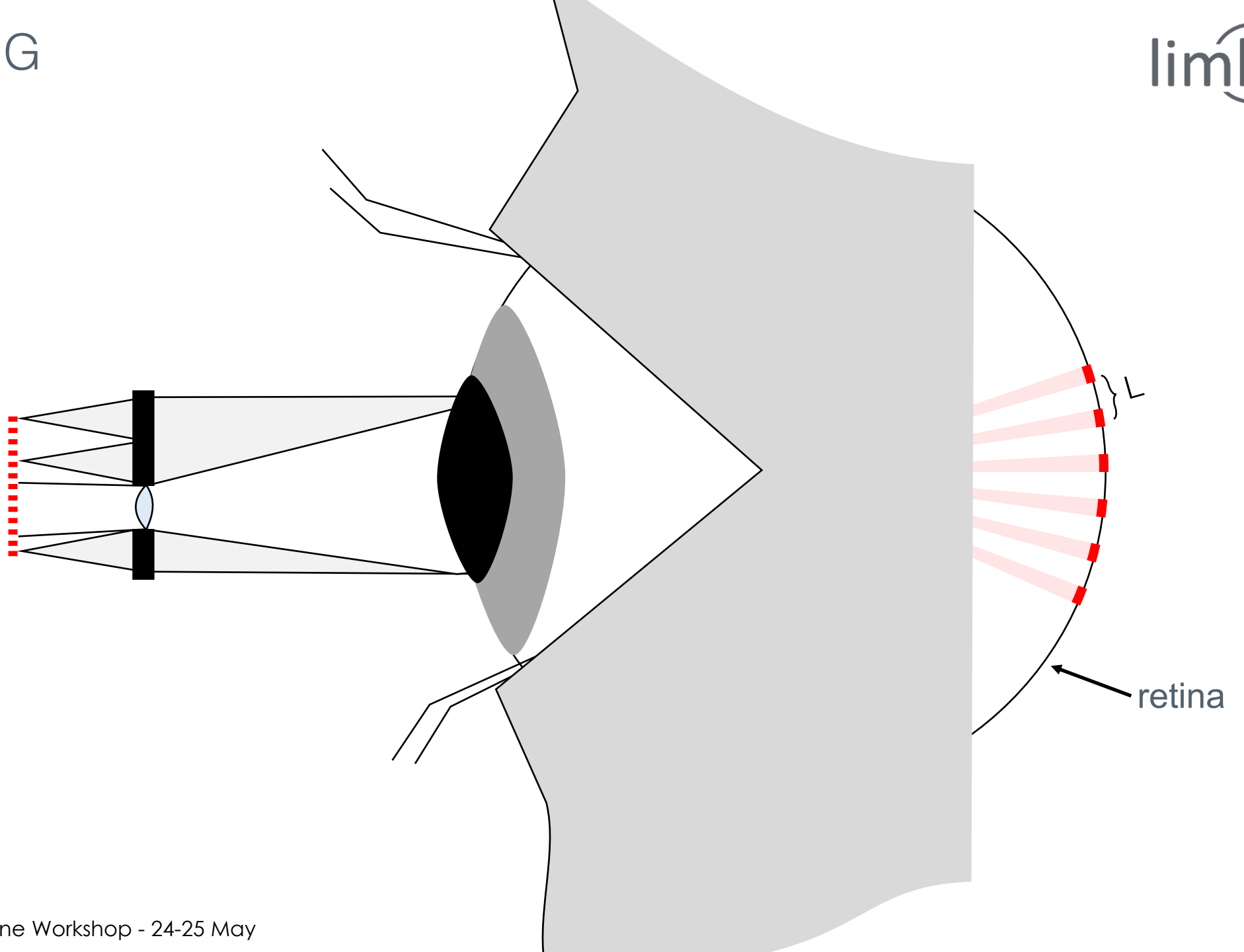
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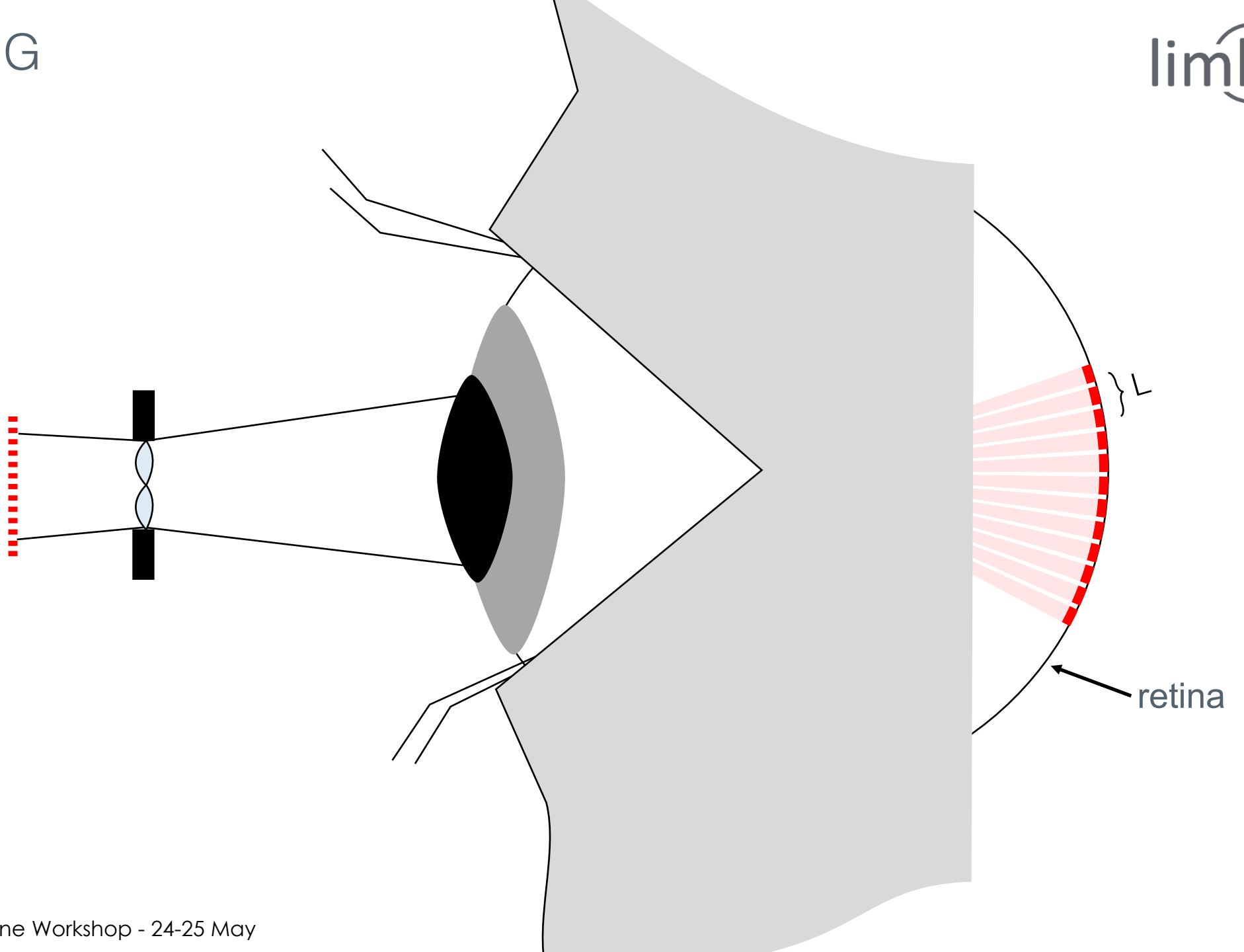
INTERLACING



INTERLACING



INTERLACING



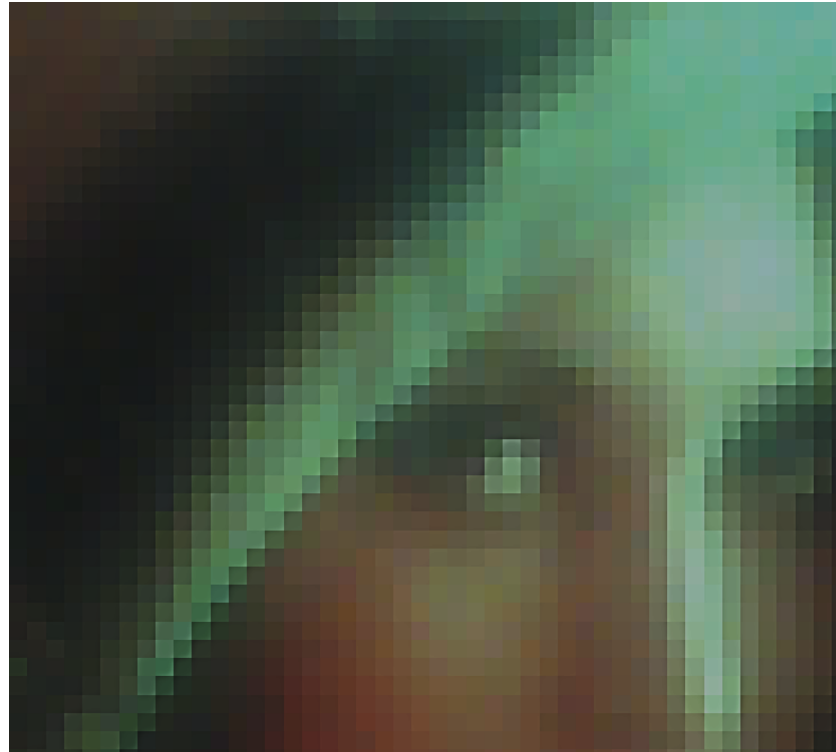
ThinEyes® TRENZA

2019 proof of concept

~~FREEFORMS~~

~~PASSIVE FOVEAL SUPER-RESOLUTION~~

INTERLACING



Benchmark: 5 ppd



2019 POC: 17.5 ppd

* Off-the-shelf MLA, Limited eyebox

ThinEyes® TRENZA

Phabulops

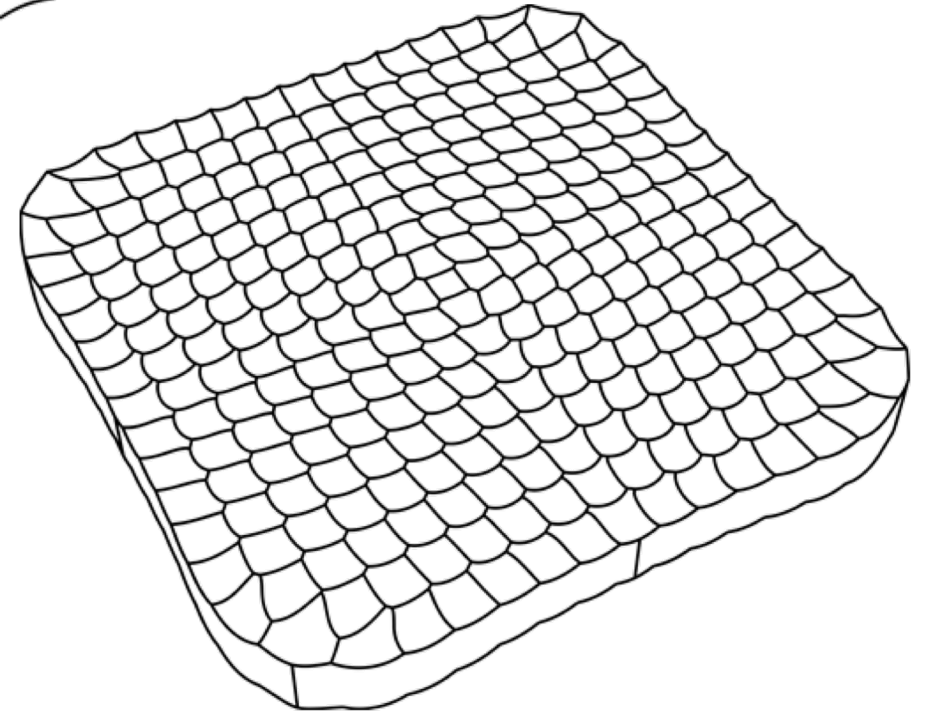
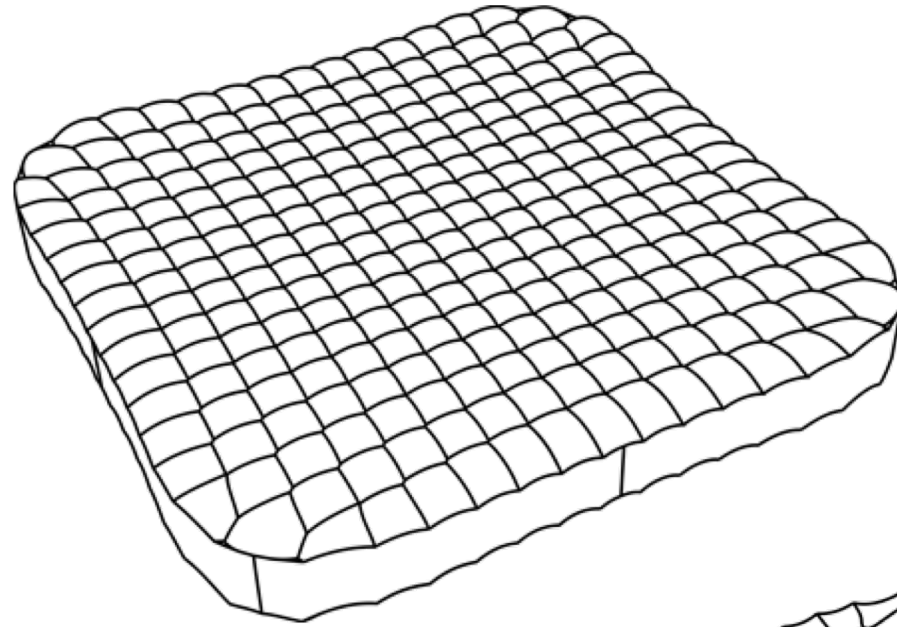


PHOTONICS²¹

PHOTONICS PUBLIC PRIVATE PARTNERSHIP

Resolution = 26 ppd

FOV = 80 deg



ThinEyes® TRENZA

Wielandts
upmt

SÜSS+MicroOptics

Phabulous

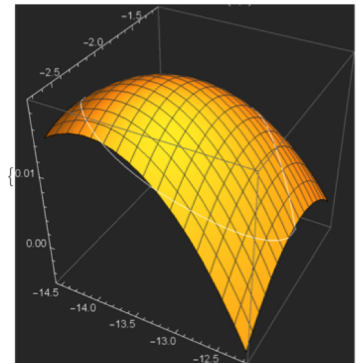
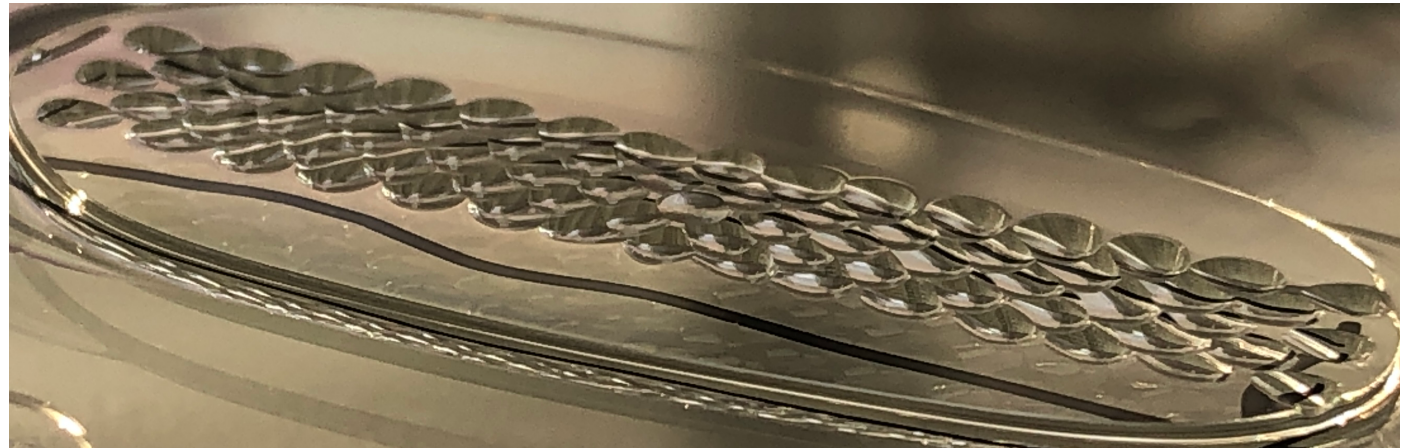


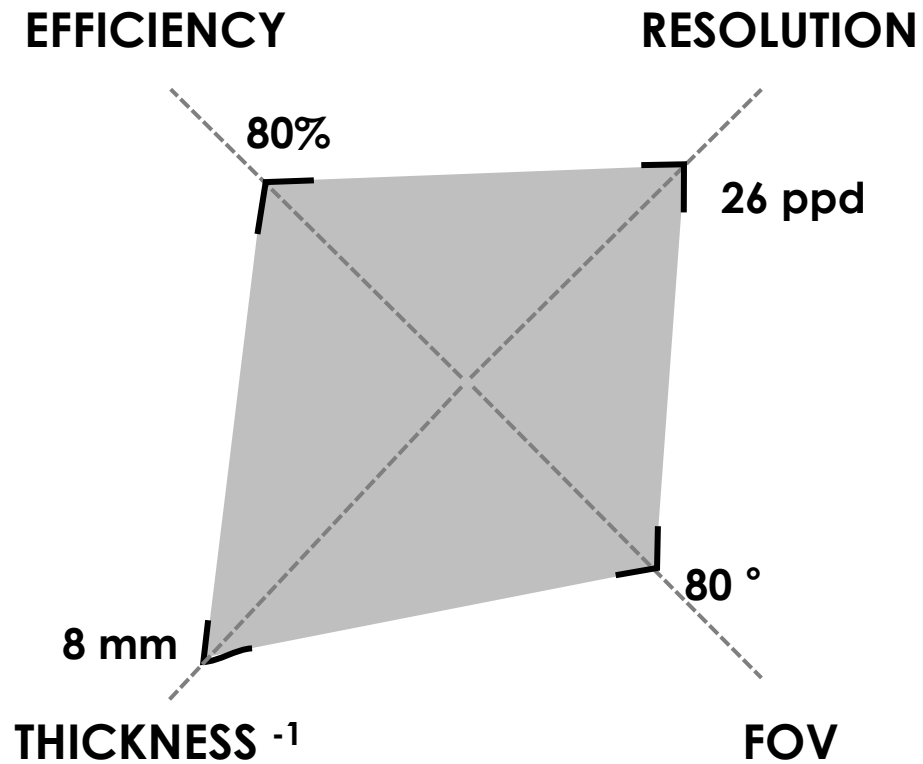
PHOTONICS PUBLIC PRIVATE PARTNERSHIP

PHOTONICS²¹

Resolution = 26 ppd

FOV = 80 deg





TRENZA 2023 demo

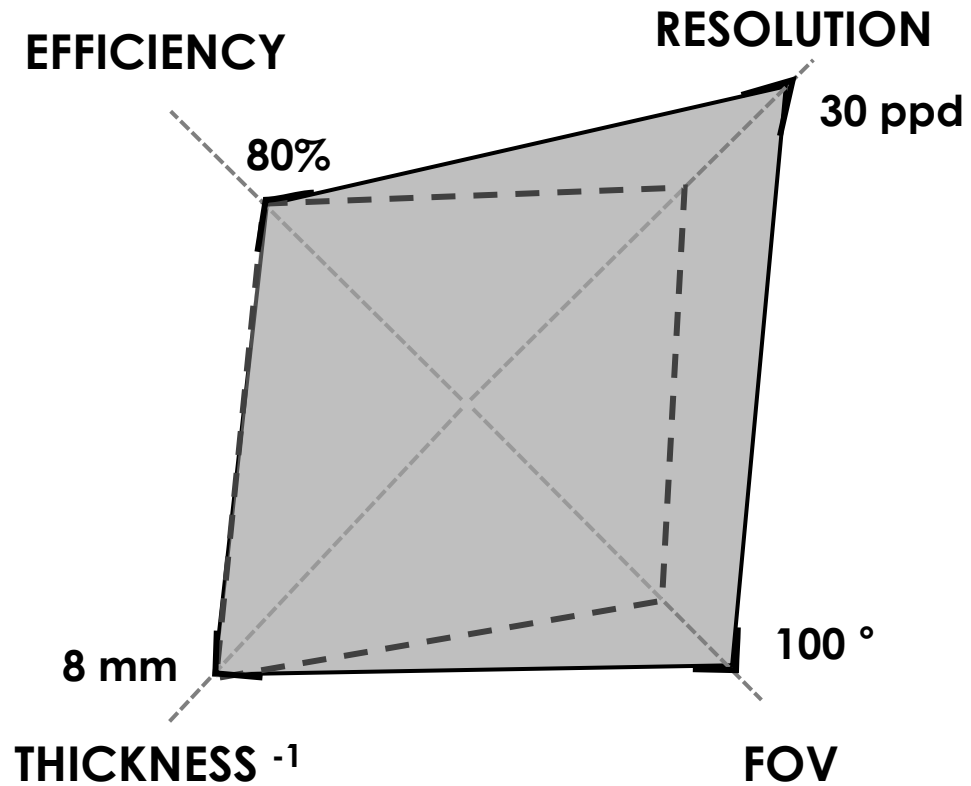
Phabulous

CUSTOM OPTICS

1.65" DISPLAY

EYE TRACKING

Assuming 3.2k x 3.2k display per eye



TRENZA 2023 demo

Phabulous

CUSTOM OPTICS

1.65" DISPLAY

EYE TRACKING

TRENZA 2024

CUSTOM OPTICS

CUSTOM DISPLAY

EYE TRACKING

MYOPIA

ThinEyes® TRENZA



2019 prototype: 17.5 ppd



TRENZA product > 30 ppd

- MULTICHANNEL OPTICS ARE ENABLING HIGH EFFICIENCY IN A REDUCED SPACE
- CHOOSING THE BEST MULTICHANNEL SOLUTION DEPENDS ON THE SPECIFICATIONS REQUIRED (DISPLAY, FOV, ETC)
- FREEFORM SURFACES ARE NECESSARY FOR BEST IMAGE QUALITY
- THEIR MANUFACTURING TECHNOLOGY IS ALREADY AVAILABLE
- COORDINATED DISPLAY AND OPTICS DESIGNS WILL MAXIMIZE PERFORMANCE

The devices and system architectures of LIMBAK presented in this paper are protected under US and International patents and patents pending WO2015077718A1, WO2016118640A1, WO2016118643A1, WO2016118647A1, WO2016118648A1, WO2016160099A2, WO2018237263, WO 2019147946A1 and WO2019210254 by LIMBAK 4PI SL, Spain, and Tesseland dba LIMBAK, 91101 CA, USA.

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