



Aberrometria corneale: gli errori ottico funzionali nascosti

Andrea Russo, MD, PhD, P-CEO,
FWCRS



gruppo
refrattivo
italiano



Why pupil size matters in modern MF/EDOF IOLs

- Impact on **DoF, halos, contrast**.
- **Spherical aberration scales with pupil radius⁴.**

→ Premium IOLs are generally more sensitive to pupil behaviour

...but in different ways:

- Diffractive: pupil impacts quality (halos/contrast), not the basic power split.
- Refractive: pupil impacts function (near vs distance distribution) more than halos.

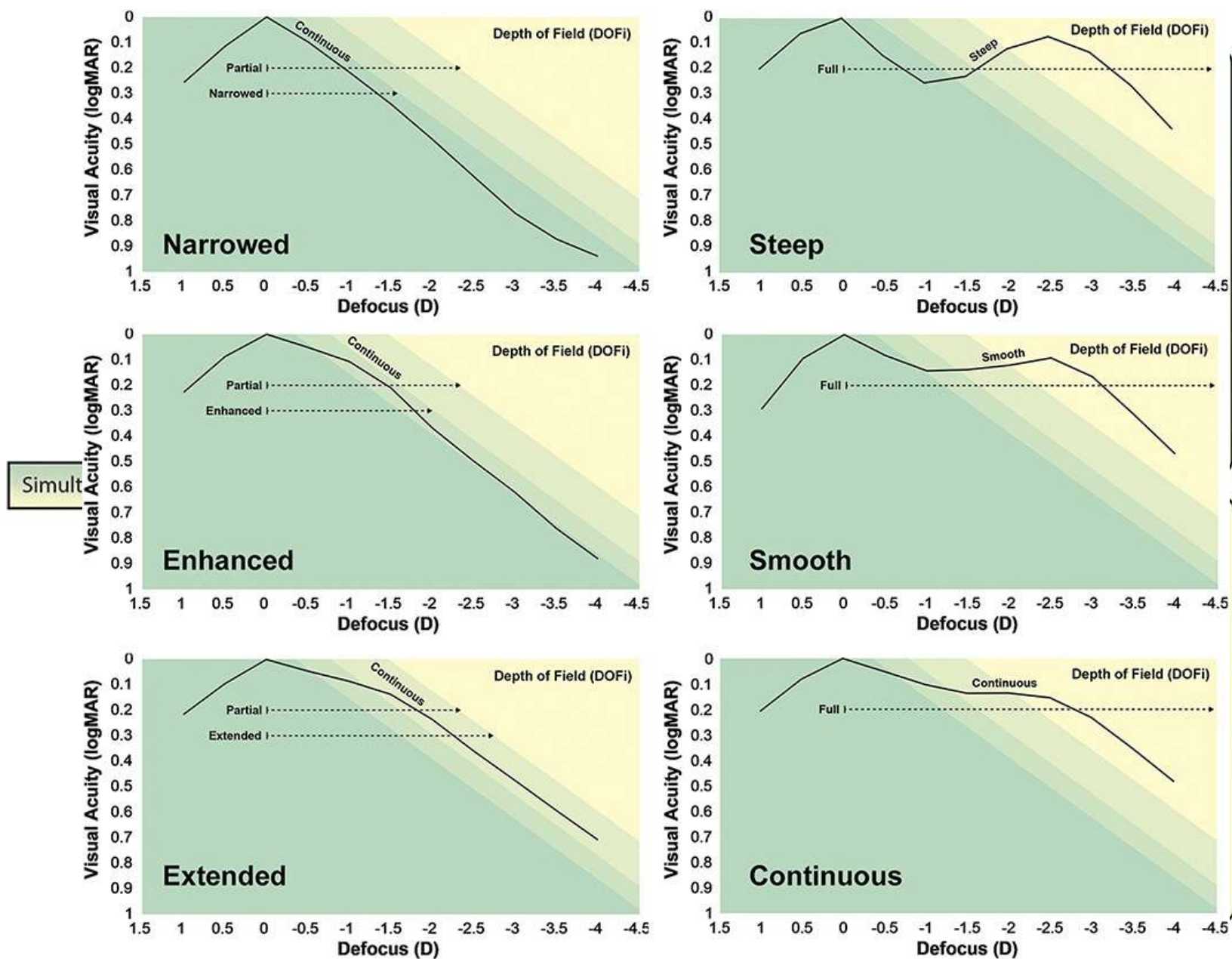
TABLE A
Literature Review

Author, Year	No. of Eyes	MIOL Model (Type)	Specific Centration Method(s)	Conclusions on Angle κ	Negative Impact of Angle κ
Wallerstein et al, 2023 (current study)	26,430	FineVision & PanOptix (trifocal)	In the capsular bag	No predictive clinical impact on postoperative MIOL visual outcomes, refractive accuracy, nor subjective patient satisfaction.	No
Koç & Kaya, 2023	50	PanOptix (trifocal)	In the capsular bag	Overall satisfaction, spectacle need, and photic phenomena did not differ statistically between patients with apparent chord mu less than and greater than 0.4 mm. Photic phenomena do not occur or do not significantly impact daily activities when angle κ is less than 0.6mm.	No
Saad et al, 2023	548	FineVision (trifocal)	Pupil center	A large angle κ is not a significant risk factor for poor visual acuity. Not a suitable clinical predictor of outcomes after MIOL implantation followed by LASIK touch-up.	No
Cervantes-Coste et al, 2022	56	Liberty 677MY (trifocal)	In the capsular bag	Not an optimal predictive factor for future visual outcomes. No correlation was shown with visual acuities or HOA postop.	No
Sandoval et al, 2022	56	PanOptix (trifocal)	Corneal vertex	No apparent effect on refractive, visual acuity or subjective clinical outcomes.	No
Luo et al, 2021	152	Symfony (EDOF)	In the capsular bag	Need for careful patient assessment prior to implantation of this IOL. Depth of focus narrowed for those with an excessively large angle κ .	Yes
Garzón et al, 2020	63	FineVision (trifocal)	Pupil center	Magnitude of angle κ did not influence visual and refractive outcomes. May be due to MIOL design. Complaints of halos were found in those with small angle κ .	No
Liu et al, 2020	80	SBL-3 (bifocal)	Angle κ customized centration vs controls	Angle kappa-customized centration did not have significant differences in near and distant visual acuity, contrast sensitivity, MTF, SR and patient satisfaction, compared to a control group without customized centration.	No
Fu et al, 2019	57	Symfony (EDOF)	In the capsular bag	Influenced the objective visual quality after IOL implantation. 1 eye with an angle κ greater than 0.5mm reported moderate halos postop.	Yes
Velasco-Barona et al, 2019	43	839MP & PanOptix (trifocal)	In the capsular bag	Had no significant effect on visual acuity when using the two TFIOLs. No significant correlations were found with HOAs and internal aberrations.	No
Qi et al, 2018	89	839MP (trifocal)	In the capsular bag	Impacted incidence of photic phenomenon, with increase greater than 0.4mm. No effect on far, intermediate and near vision. Decreased visual quality in patients with angle κ greater than 0.5mm.	Yes

Optical Platforms Overview

- **Refractive MF**
- **Aspheric EDOF**
- **Diffraction MF**

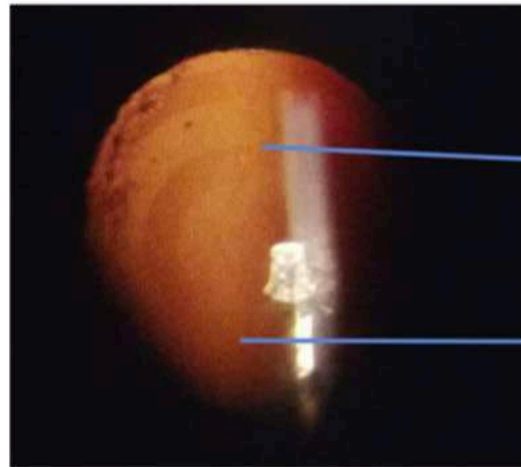
→ Different sensitivity to HOAs, pupil size and centration



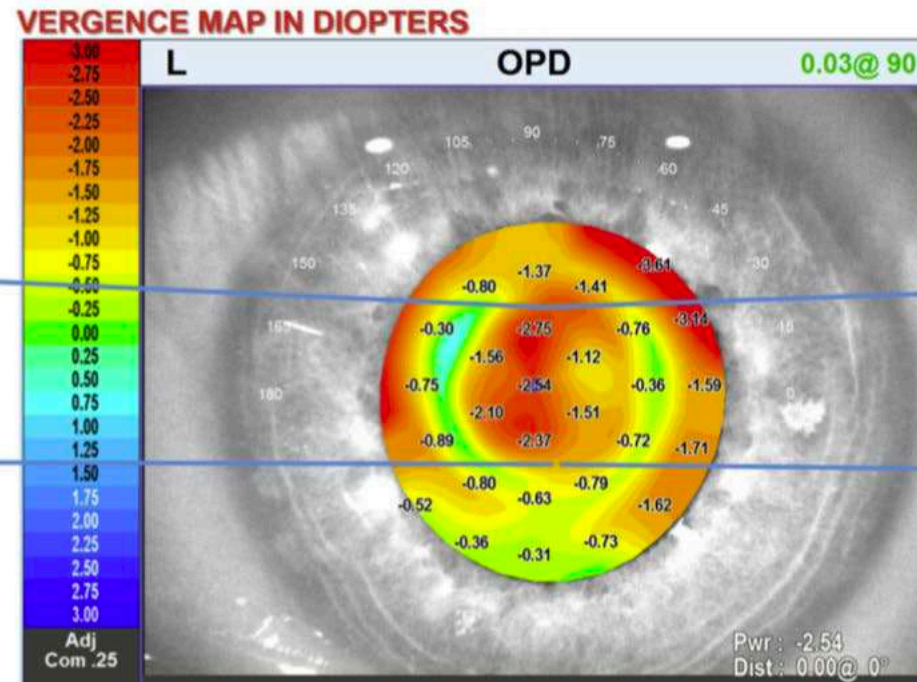
Refractive Multifocals

- **Pupil-dependent**
- **Zone-based optics**
- **Sensitive to decentration**

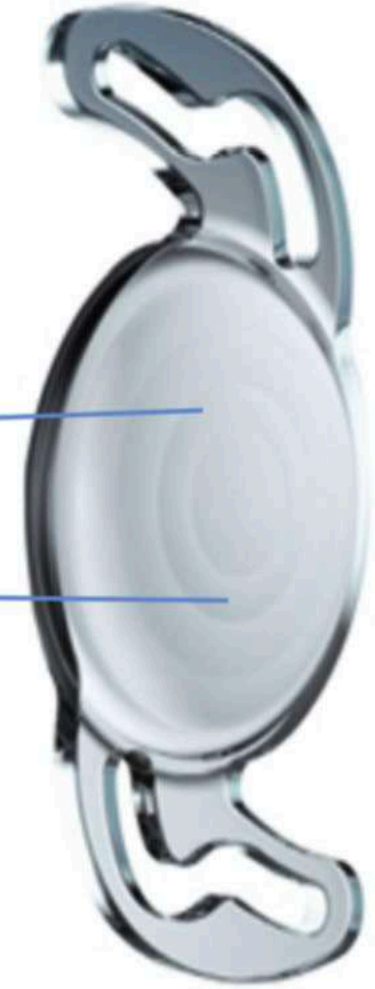
Refractive Lenses



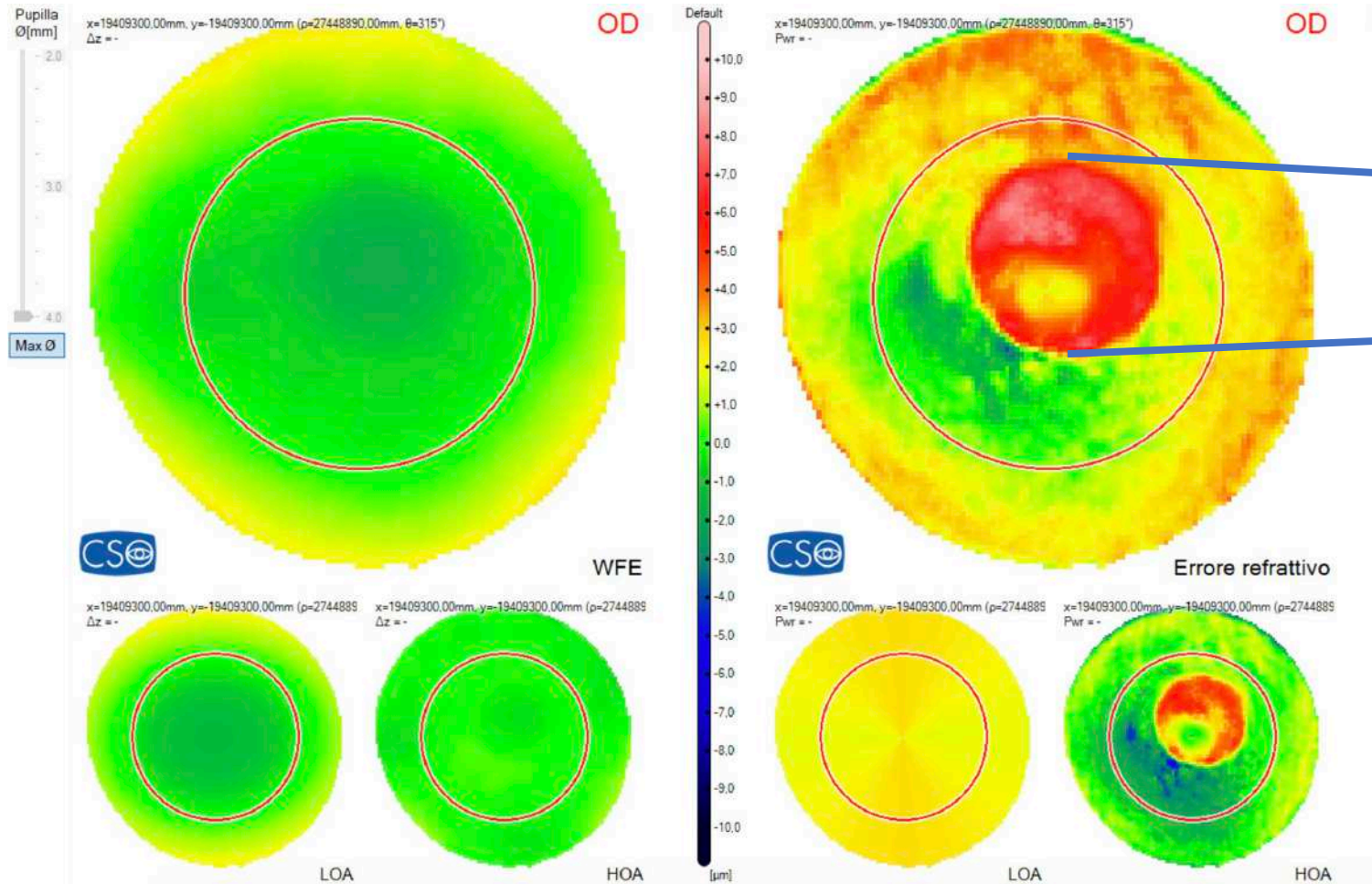
Slit lamp photograph



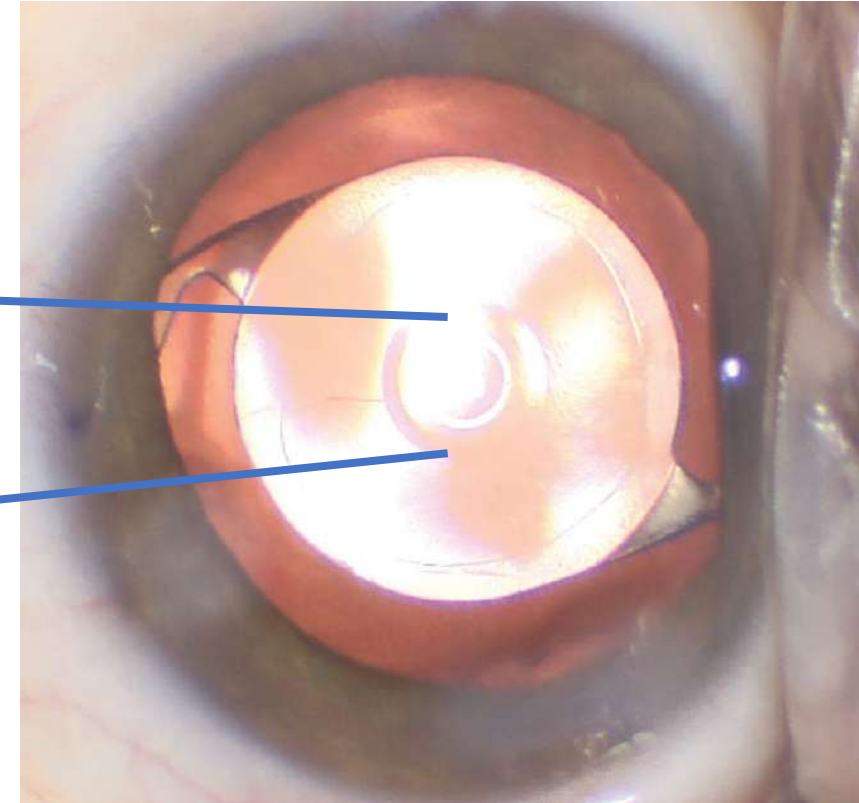
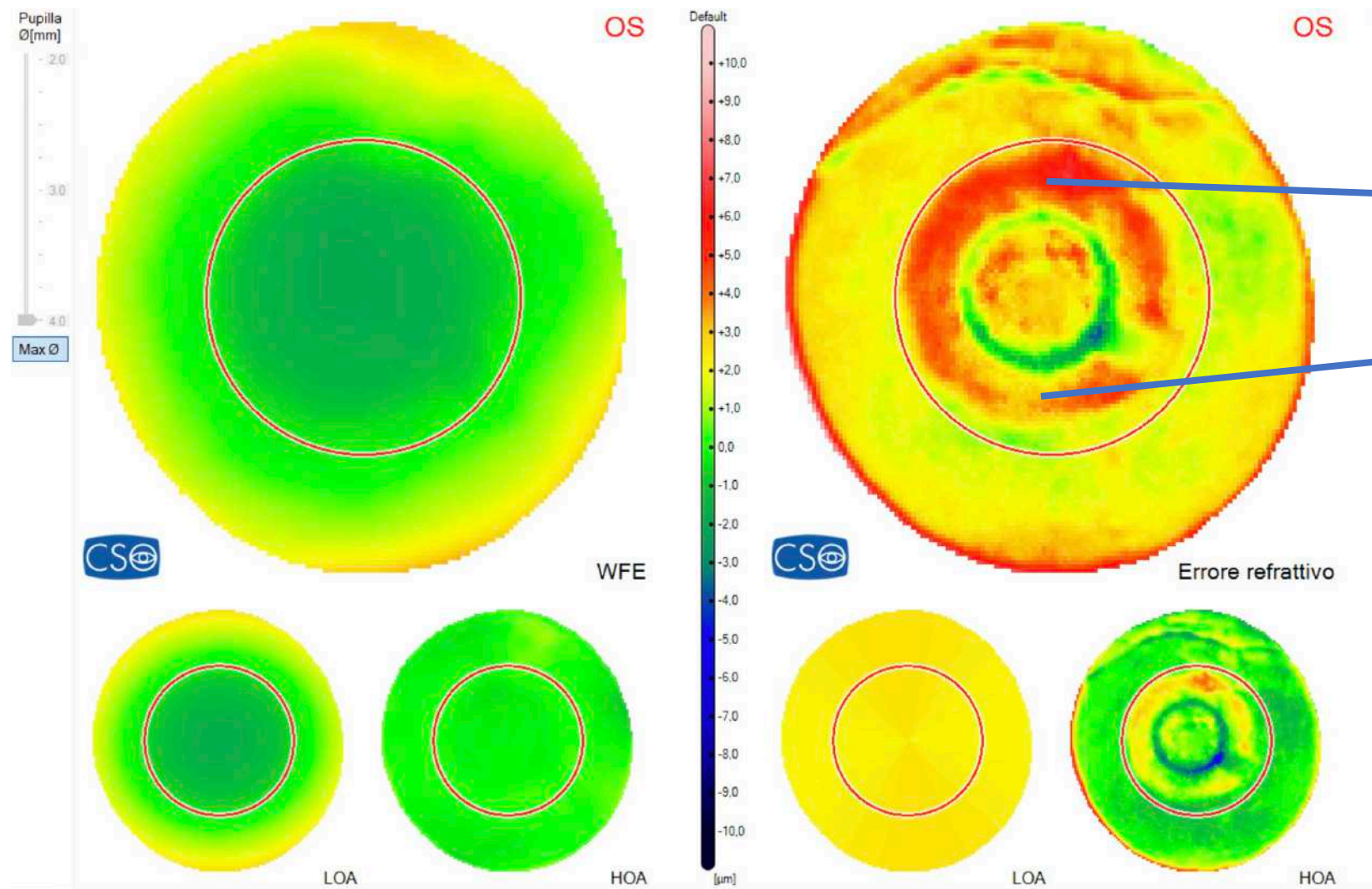
Automated Skiascopy

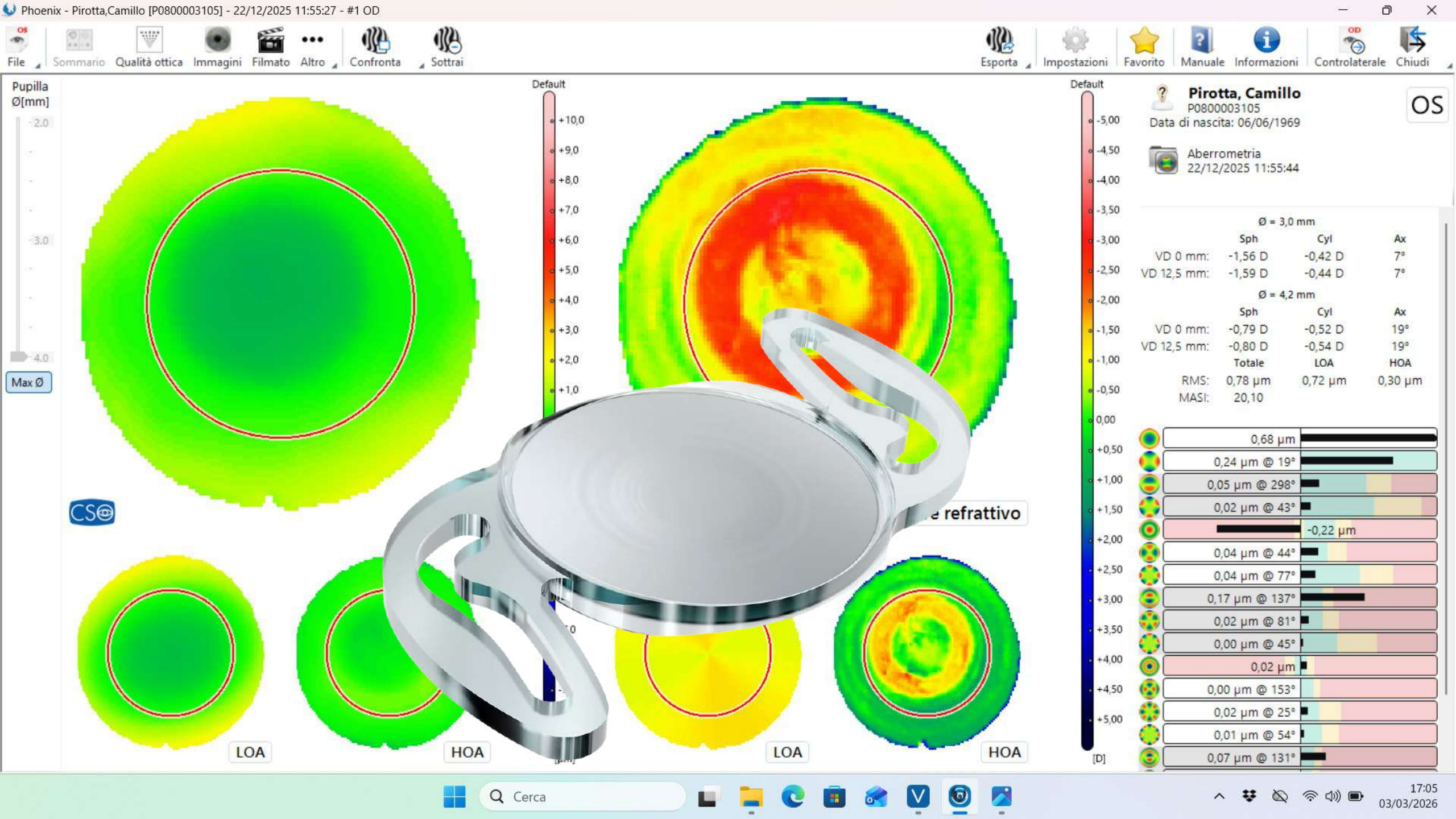


Refractive Lenses

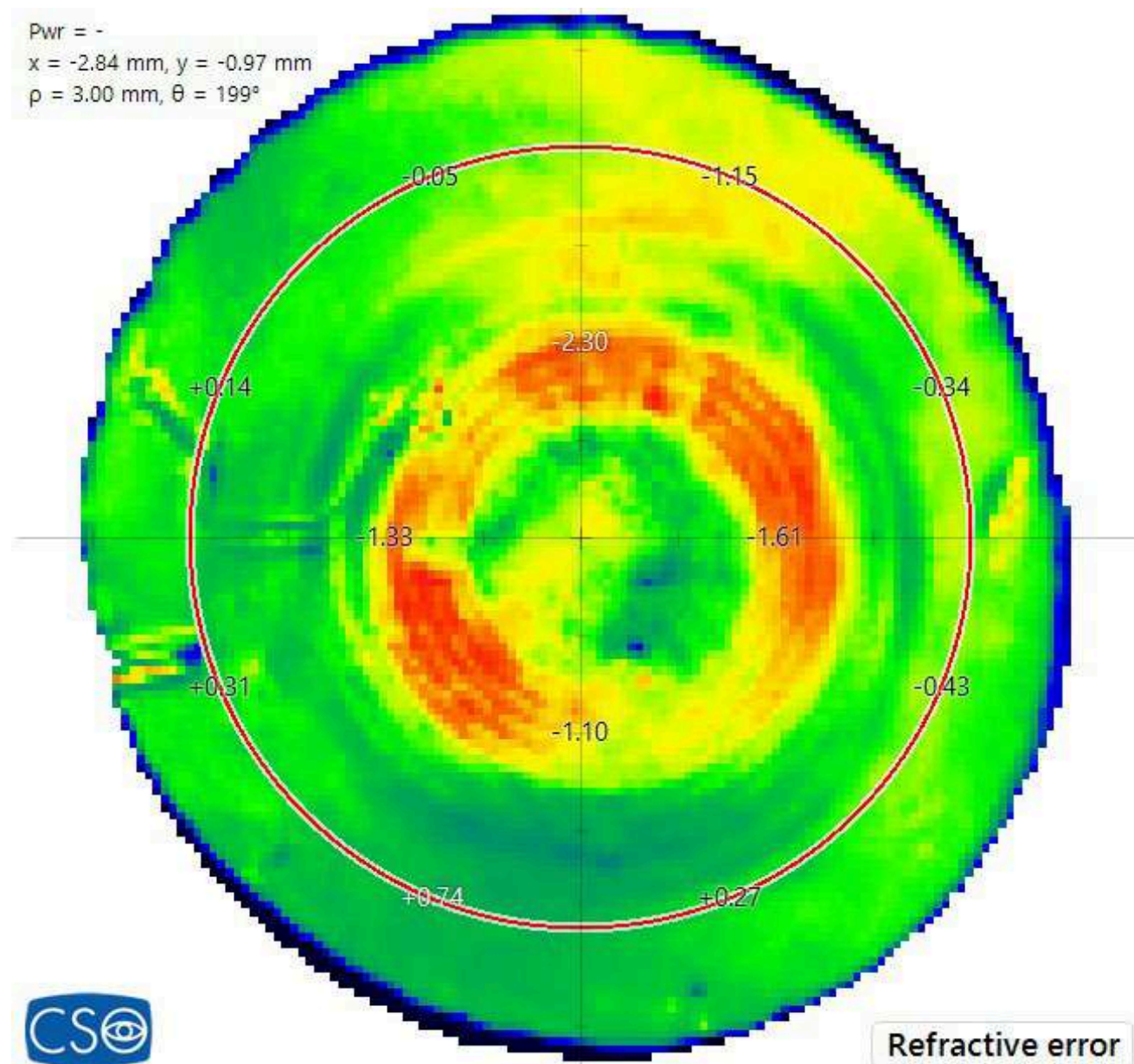


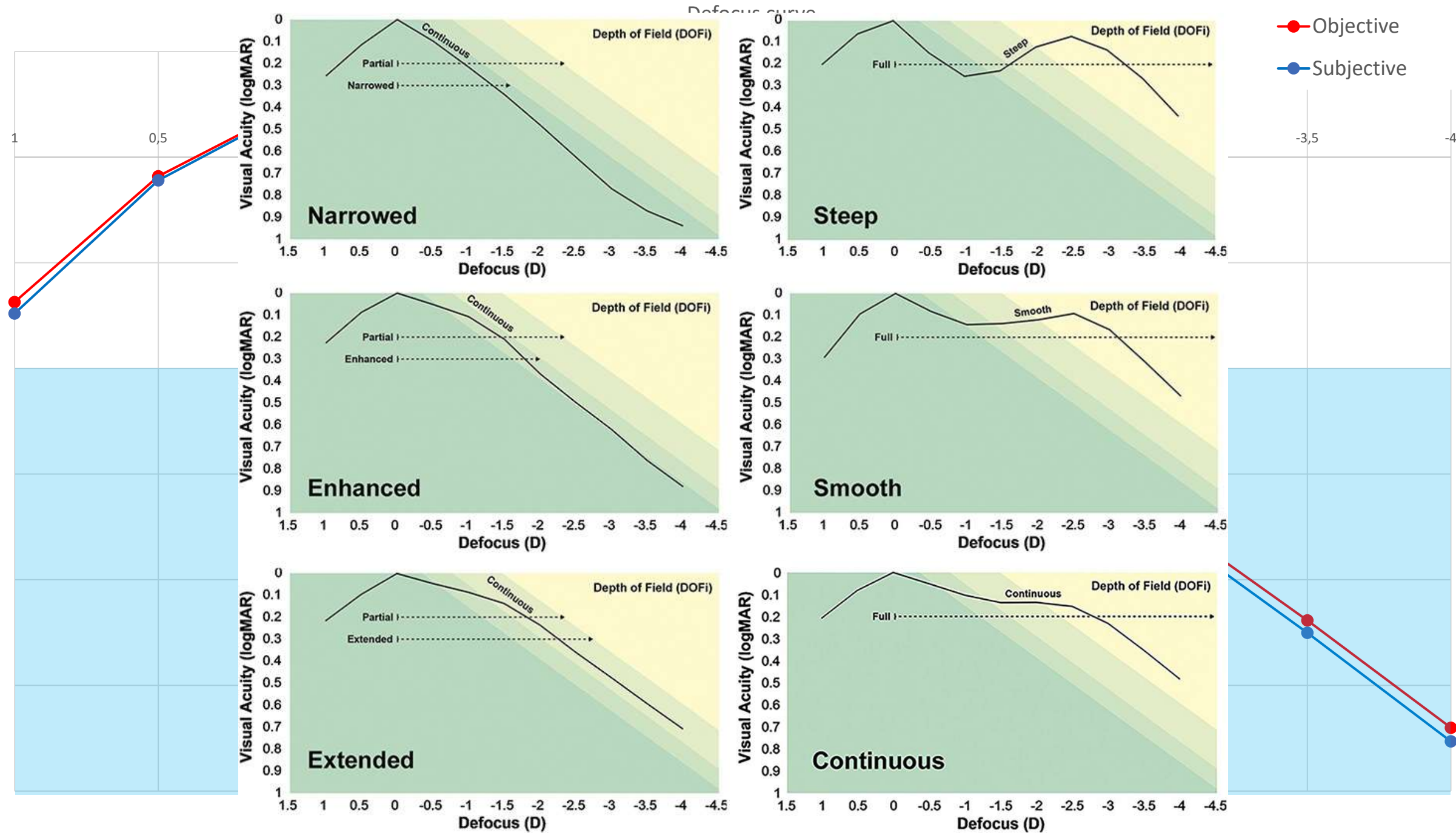
Refractive Lenses





Pwr = -
x = -2.84 mm, y = -0.97 mm
 $\rho = 3.00$ mm, $\theta = 199^\circ$





Pupilla Ø[mm]

z = -

x = 2,80 mm, y = 1,88 mm

p = 3,37 mm, $\theta = 34^\circ$

Default

+10,0

+9,0

+8,0

+7,0

+6,0

Pirotta, Camillo

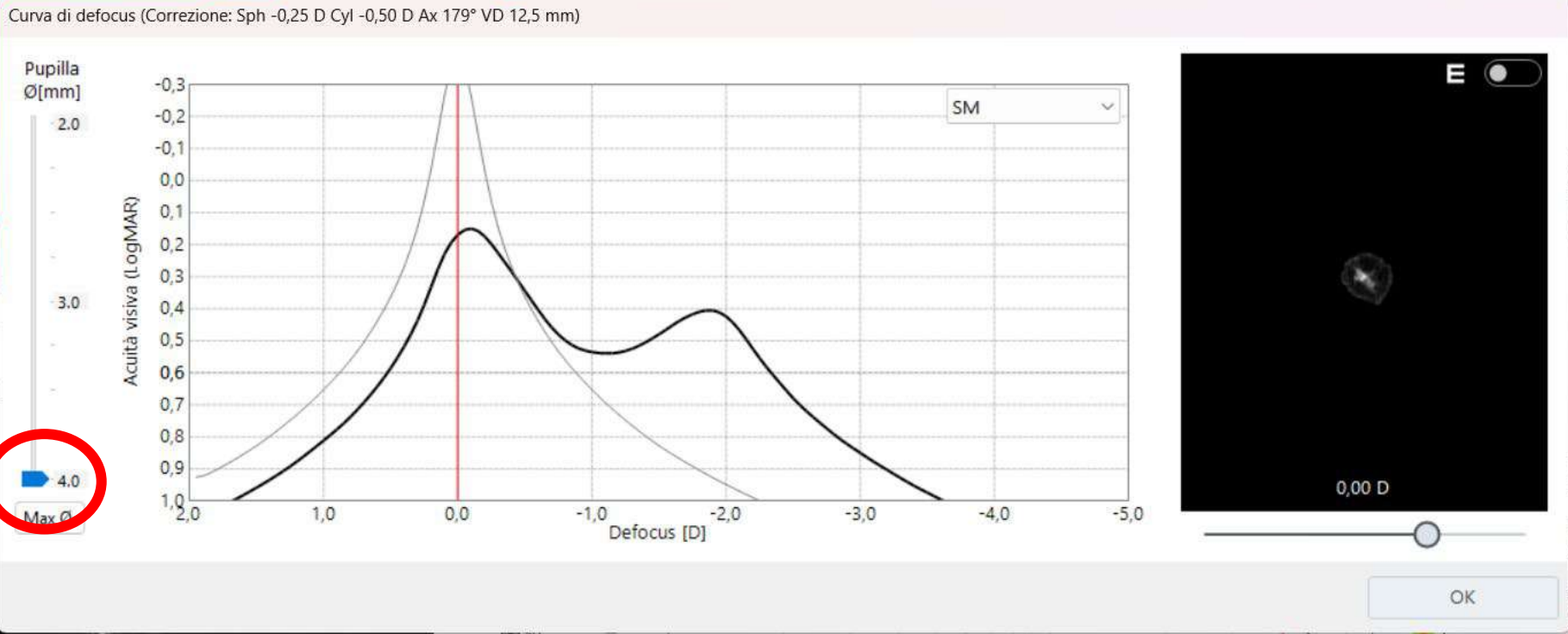
P0800003105

Data di nascita: 06/06/1969

Aberrometria

22/12/2025 11:55:44

OS



CS@

15'

4.0

Max Q

PSF

Rapporto di Strehl = 0,2799

Cyl -0,50 D

Ax 179°

UDVA

Applica

-0,58 μm
μm @ 51°
μm @ 311°
μm @ 34°
-0,18 μm
0,04 μm @ 44°
0,04 μm @ 76°
0,09 μm @ 139°
0,00 μm @ 84°
0,01 μm @ 61°

Curva di defocus

Pupilla Ø[mm]

z = -

x = 2,80 mm, y = 1,88 mm

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Pirotta, Camillo

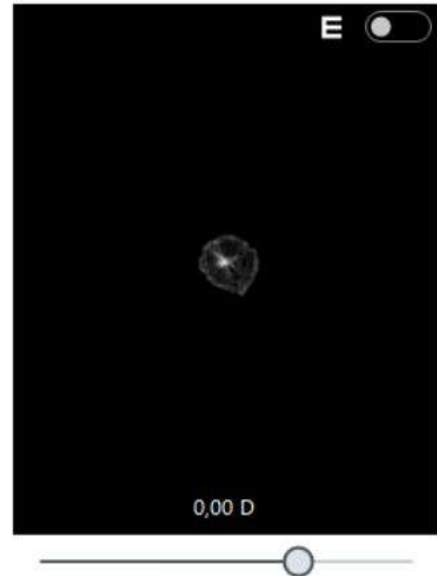
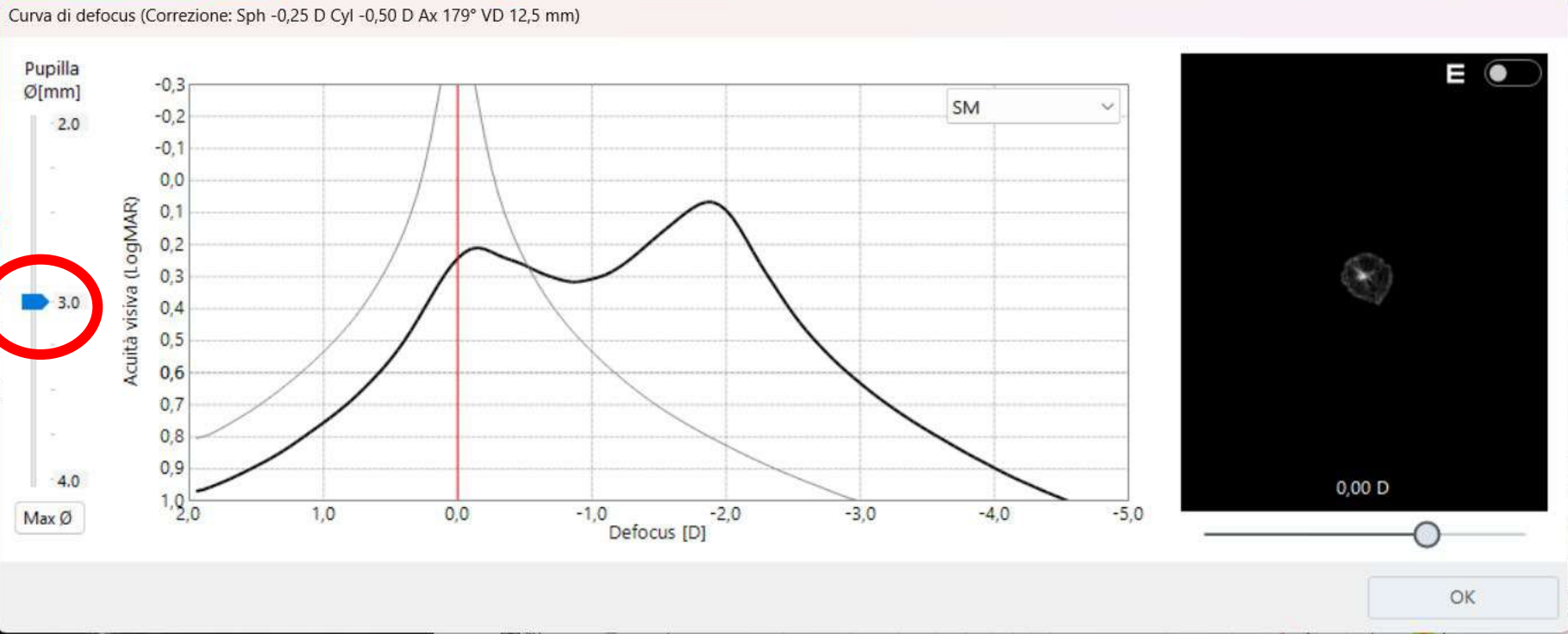
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Curva di defocus



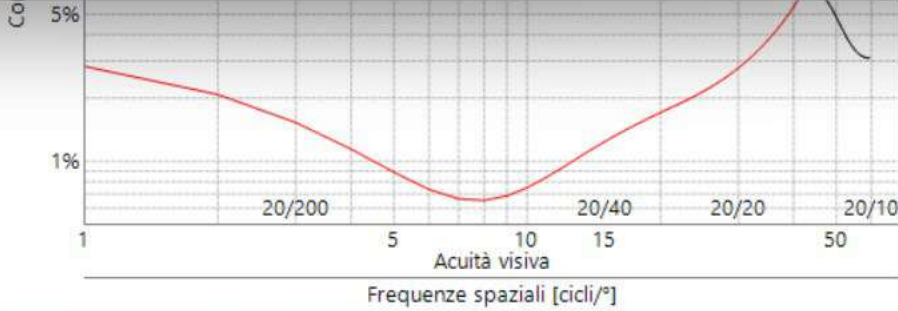
15'

PSF

Rapporto di Strehl = 0,2799

0

[%]



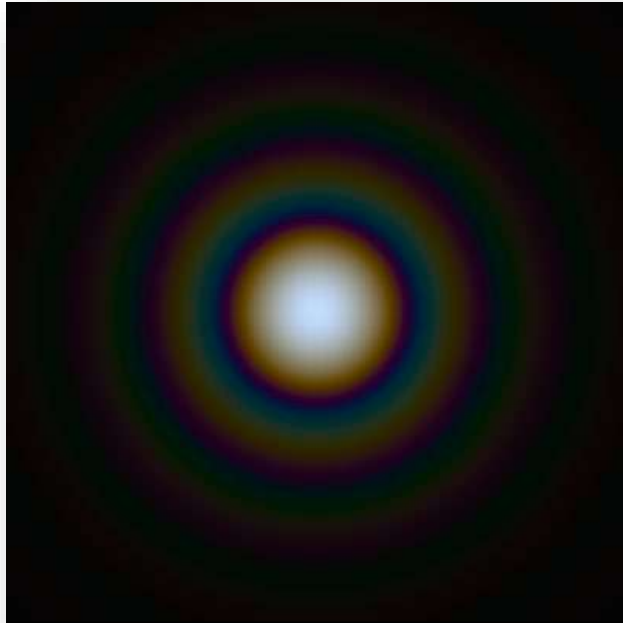
Cerca



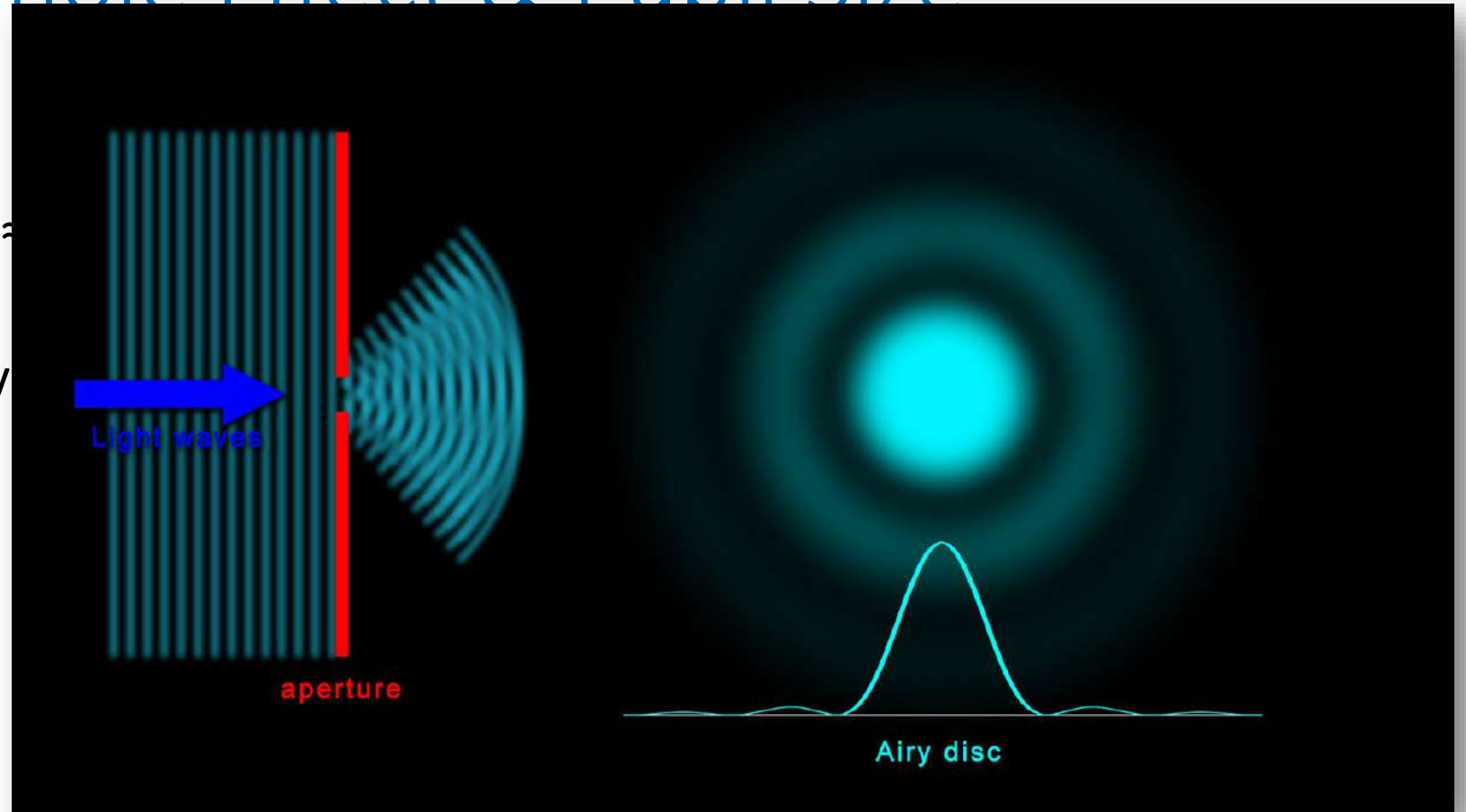
EDOF Lenses

- True EDOF: pinhole, aspheric continuous.
 - Induce negative/positive SA
 - **Smooth vergence slope** → DOF
 - Small pupils reduce EDOF effect → **Diffraction limited**
- Pseudo-EDOF: diffractive multifocal behaving as EDOF.

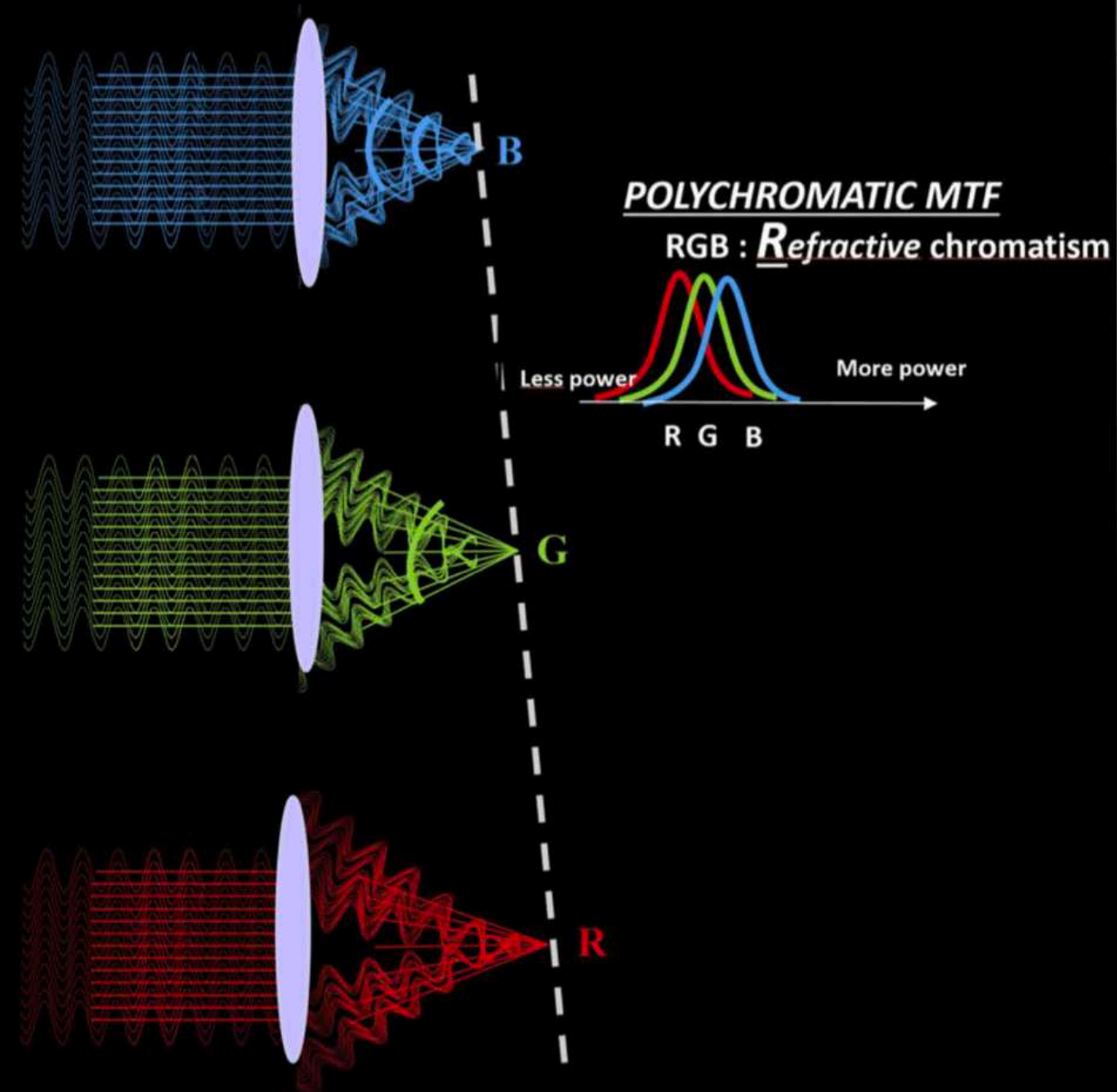
Pinhole Effect & Pupil Size



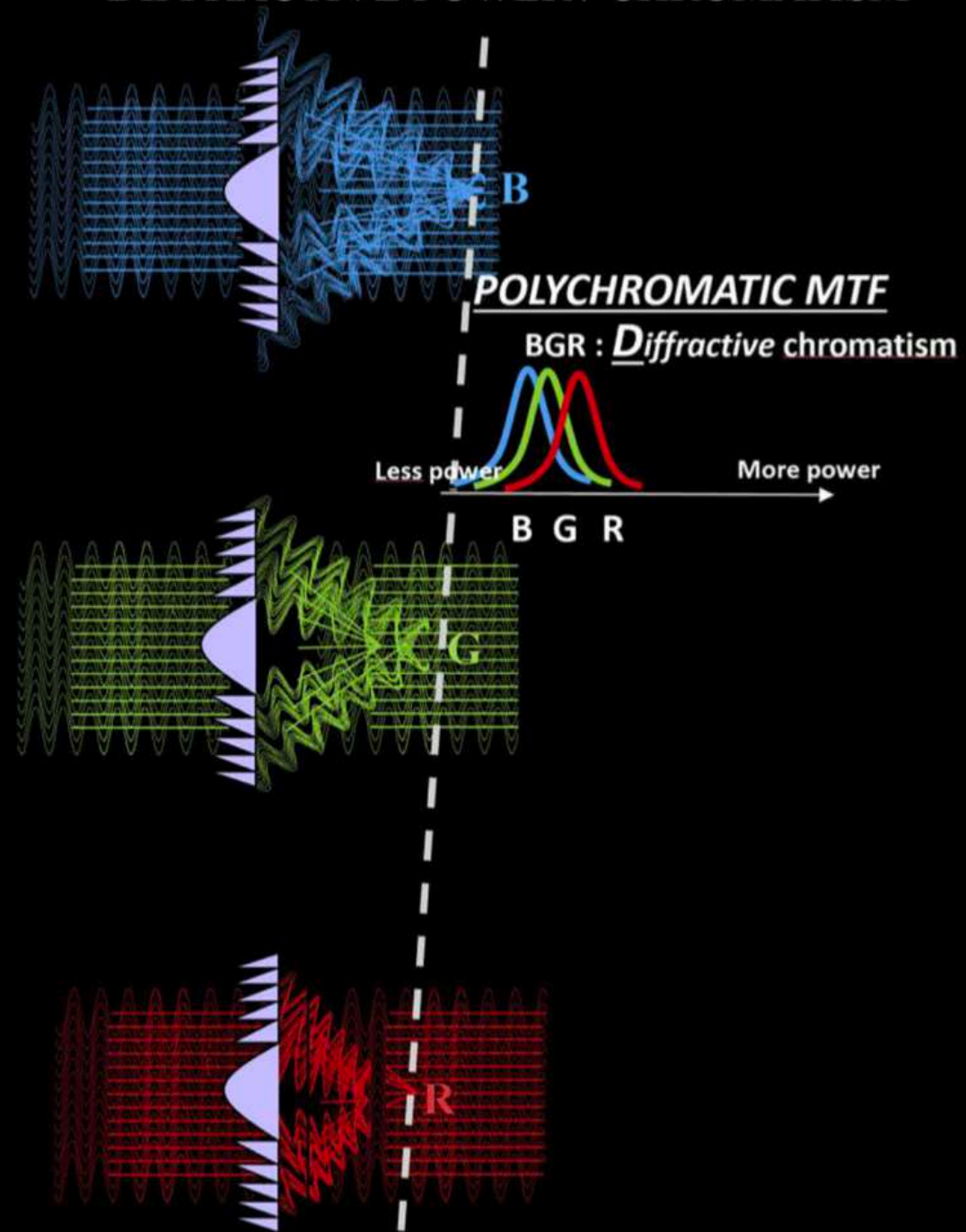
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REFRACTIVE POWER / CHROMATISM



DIFFRACTIVE POWER / CHROMATISM



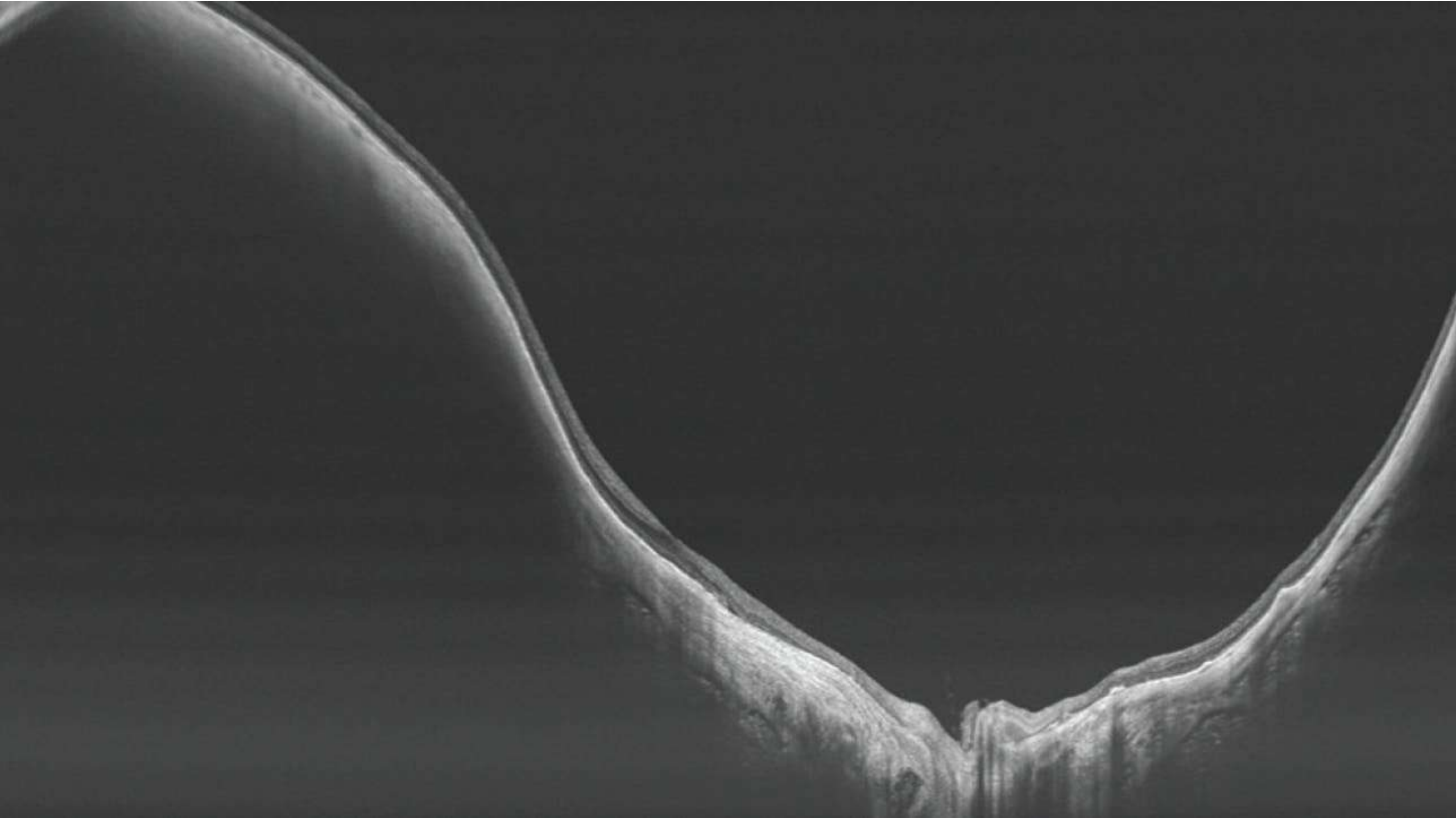
Optical Bench Data: DOF & MTF

- MTF curves: EDOF = merged peaks.
- Trifocals = 3 peaks.
- Pupil dilation reveals multifocality.

A small pupil “hides” the multifocal design, and a large pupil “reveals” it.

This is especially visible in optical bench measurements, where:

- at 2–3 mm → MTF curves show smoother, merged peaks
- at 4–5 mm → discrete, well-separated near/intermediate/far peaks re-emerge
- halos increase because more diffractive orders enter the optical path





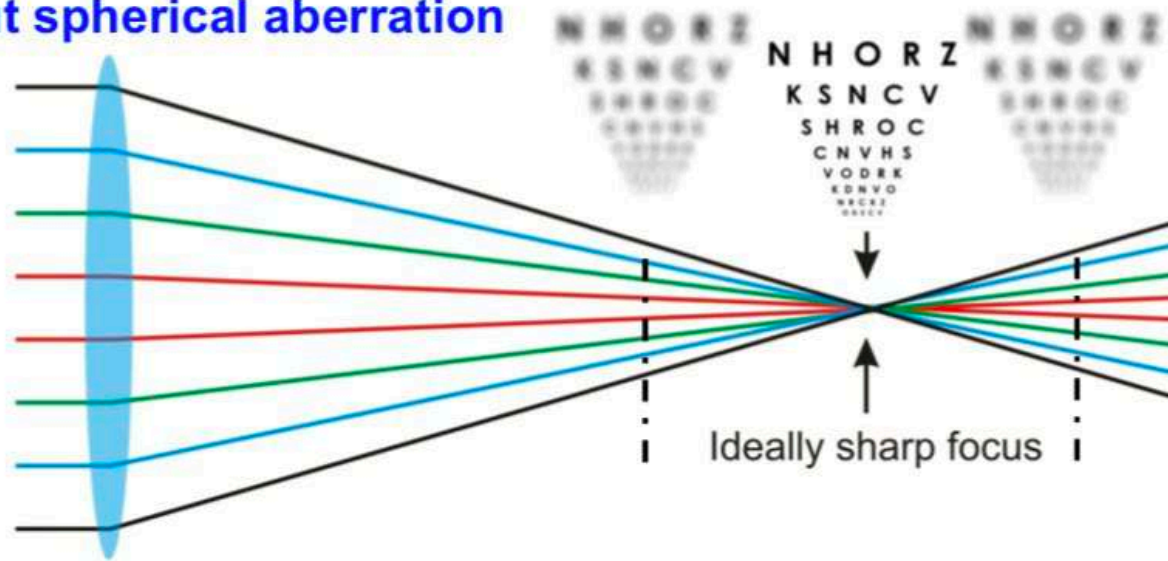
Expanding depth of focus by modifying



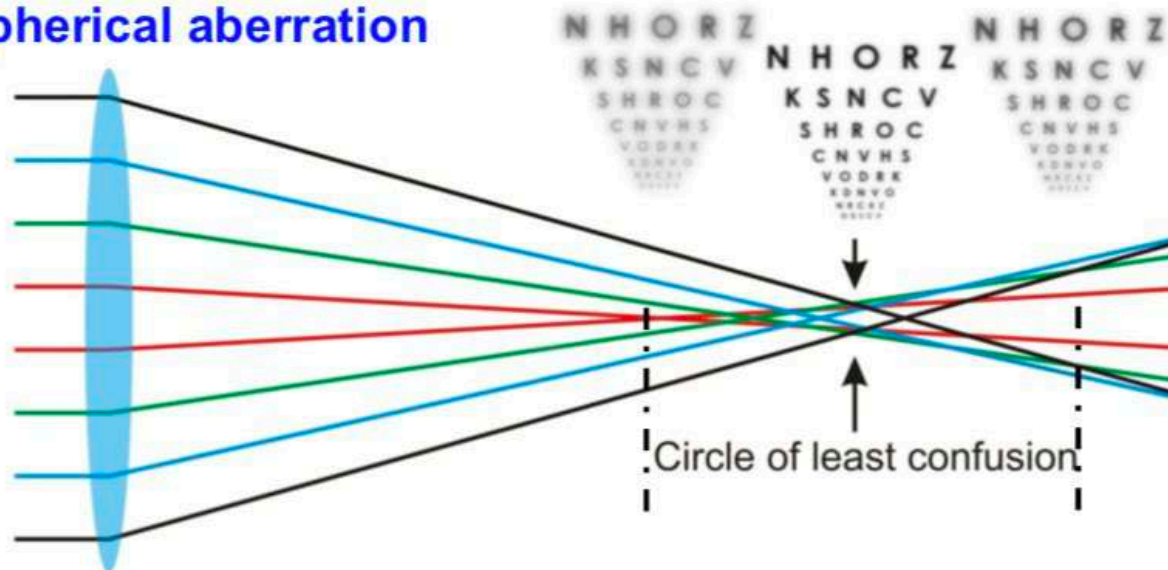
optics technology significantly shifted and expanded the subject's overall depth of focus, simulating coma or trefoil did not produce such effects.

Influence of Spherical Aberration on Depth of Field

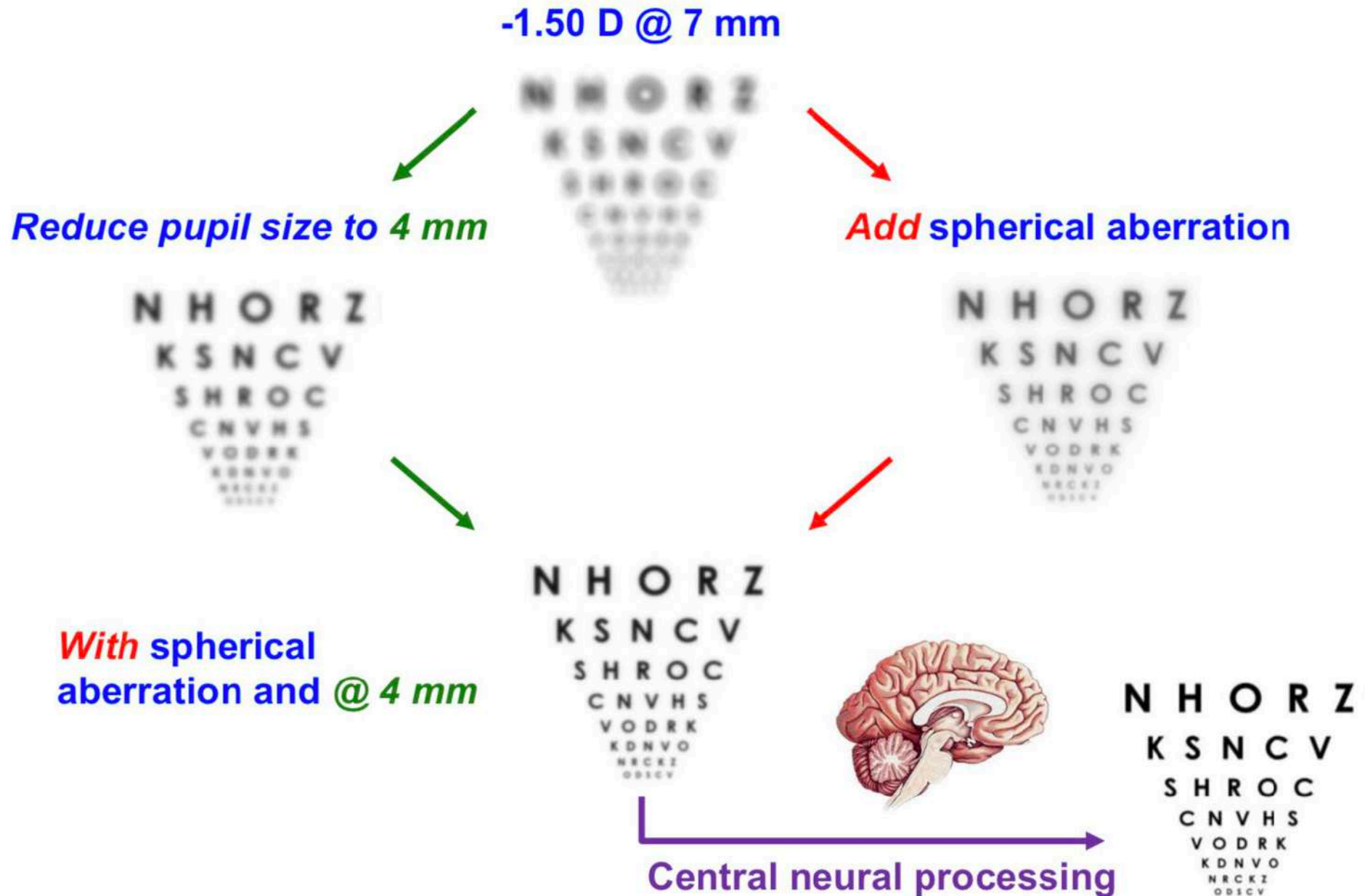
without spherical aberration

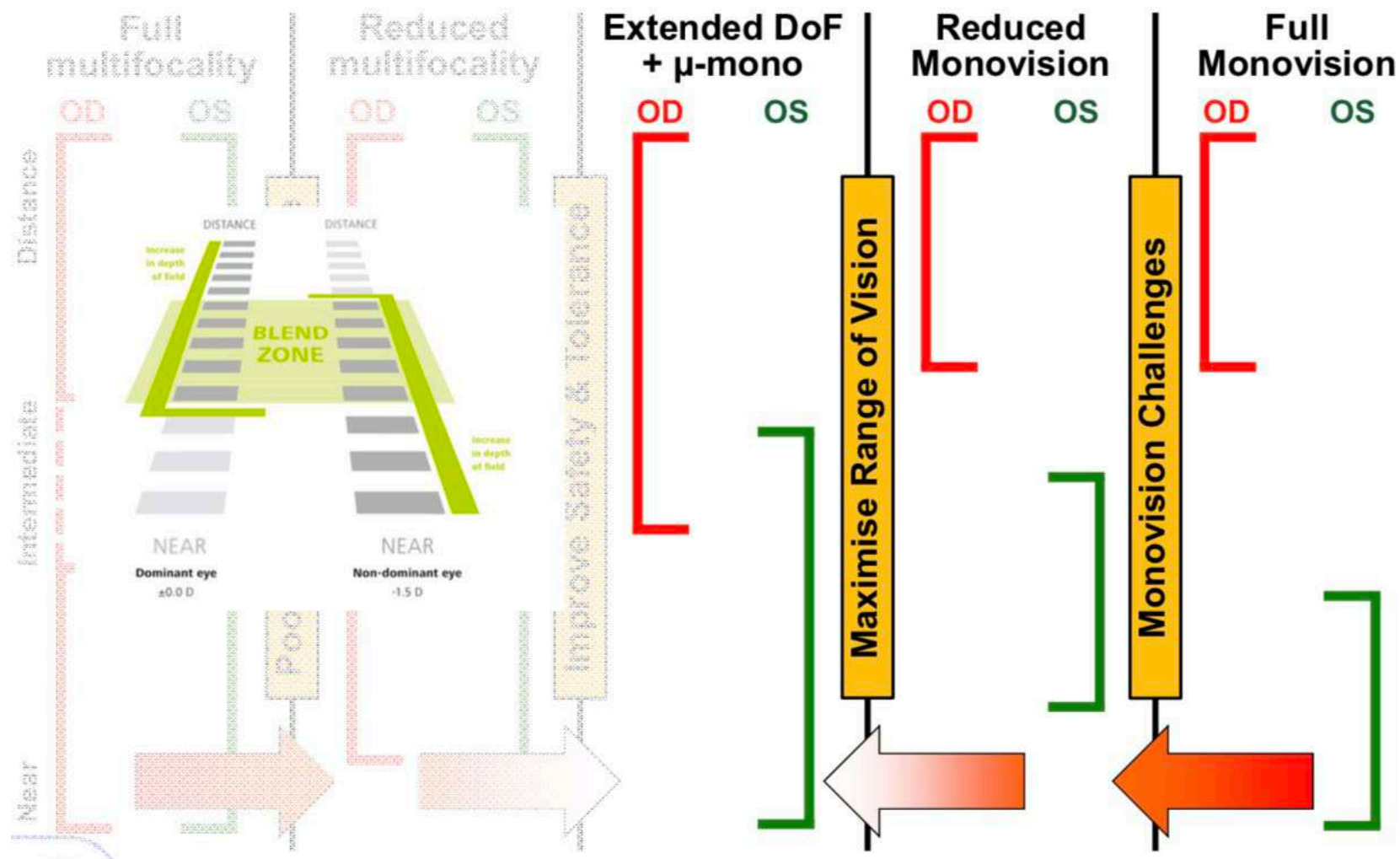


with spherical aberration



Simulation for -1.50 D defocus





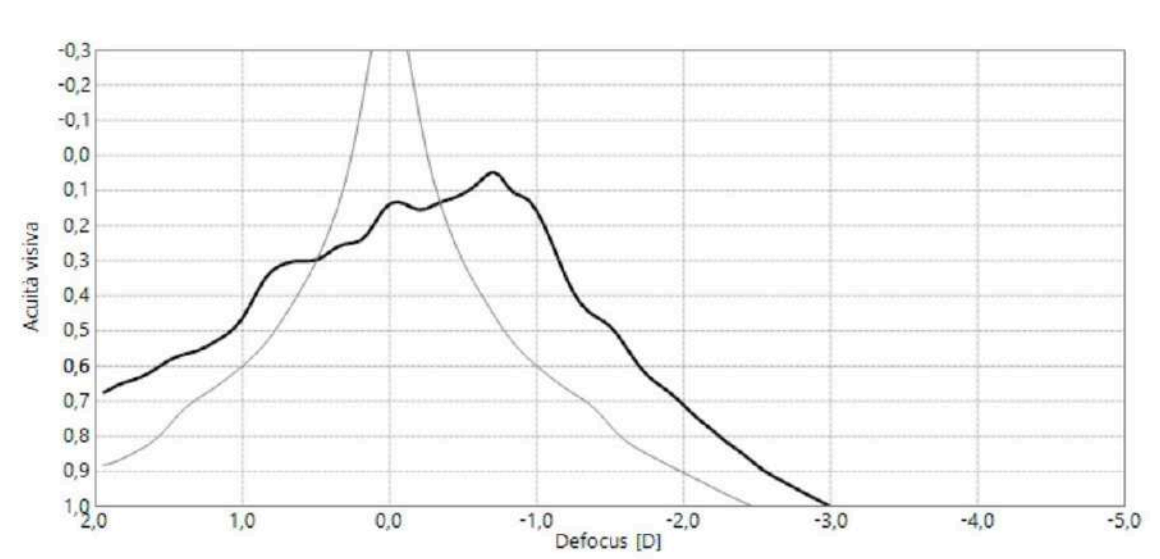
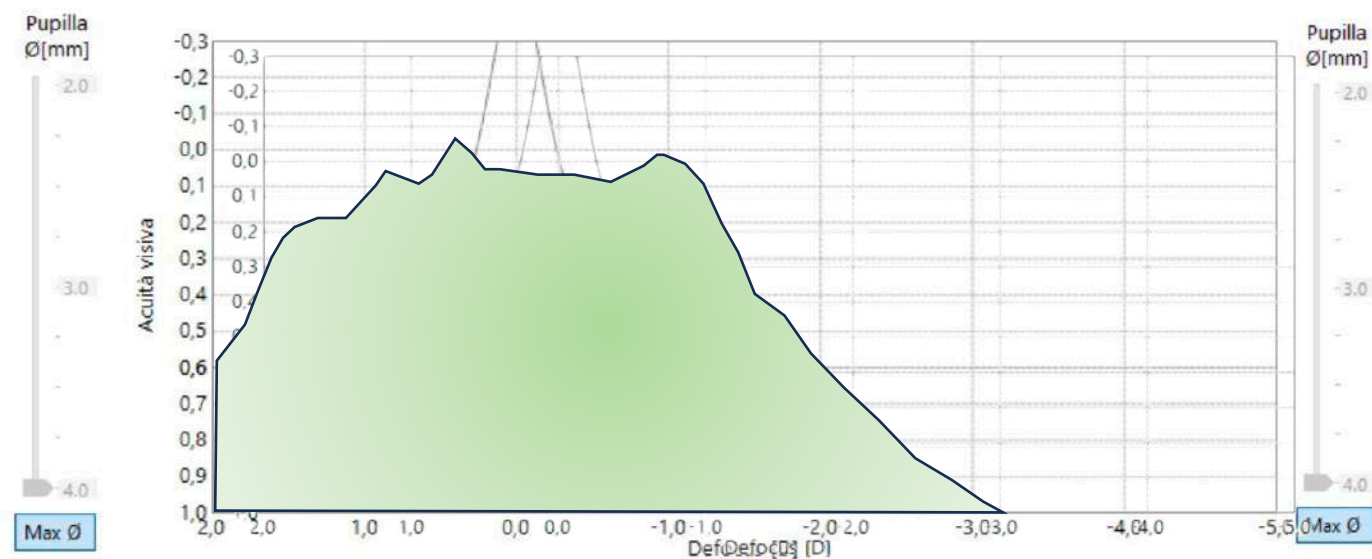
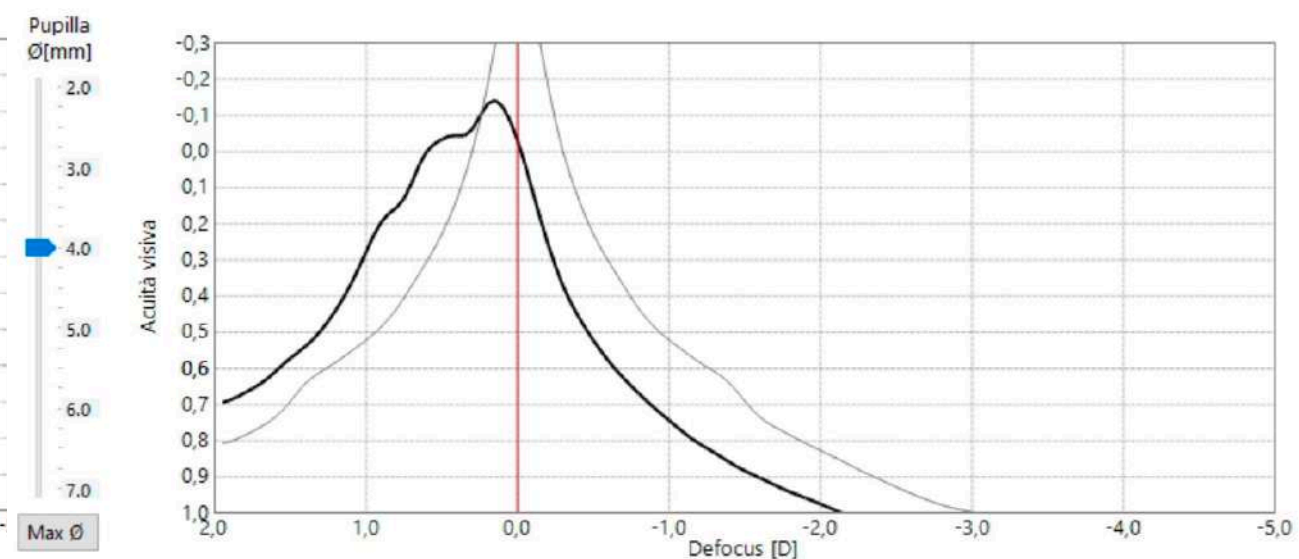
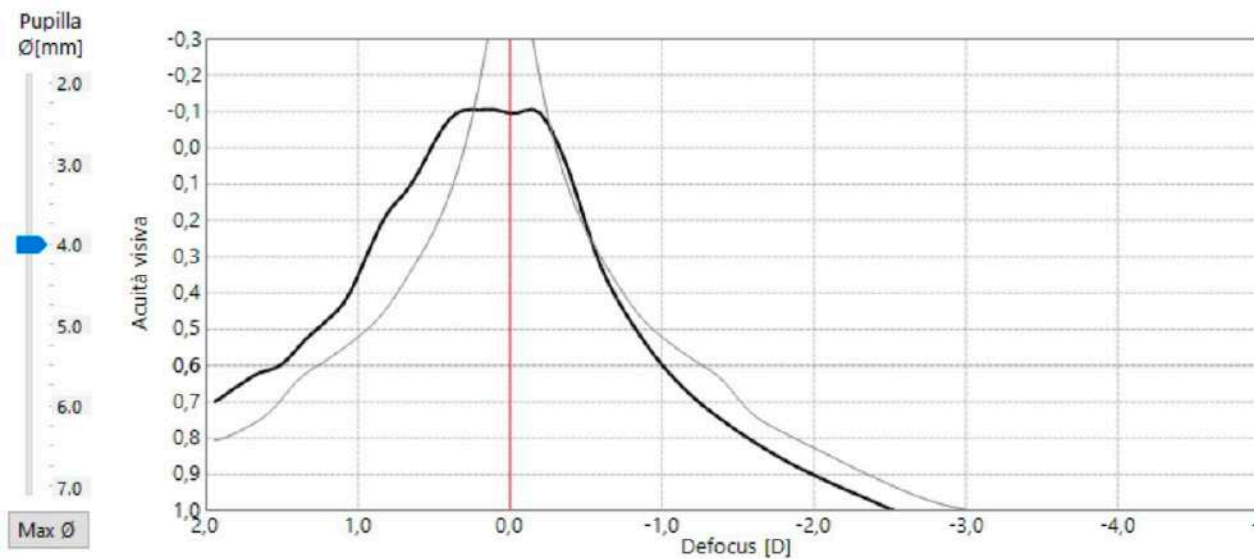
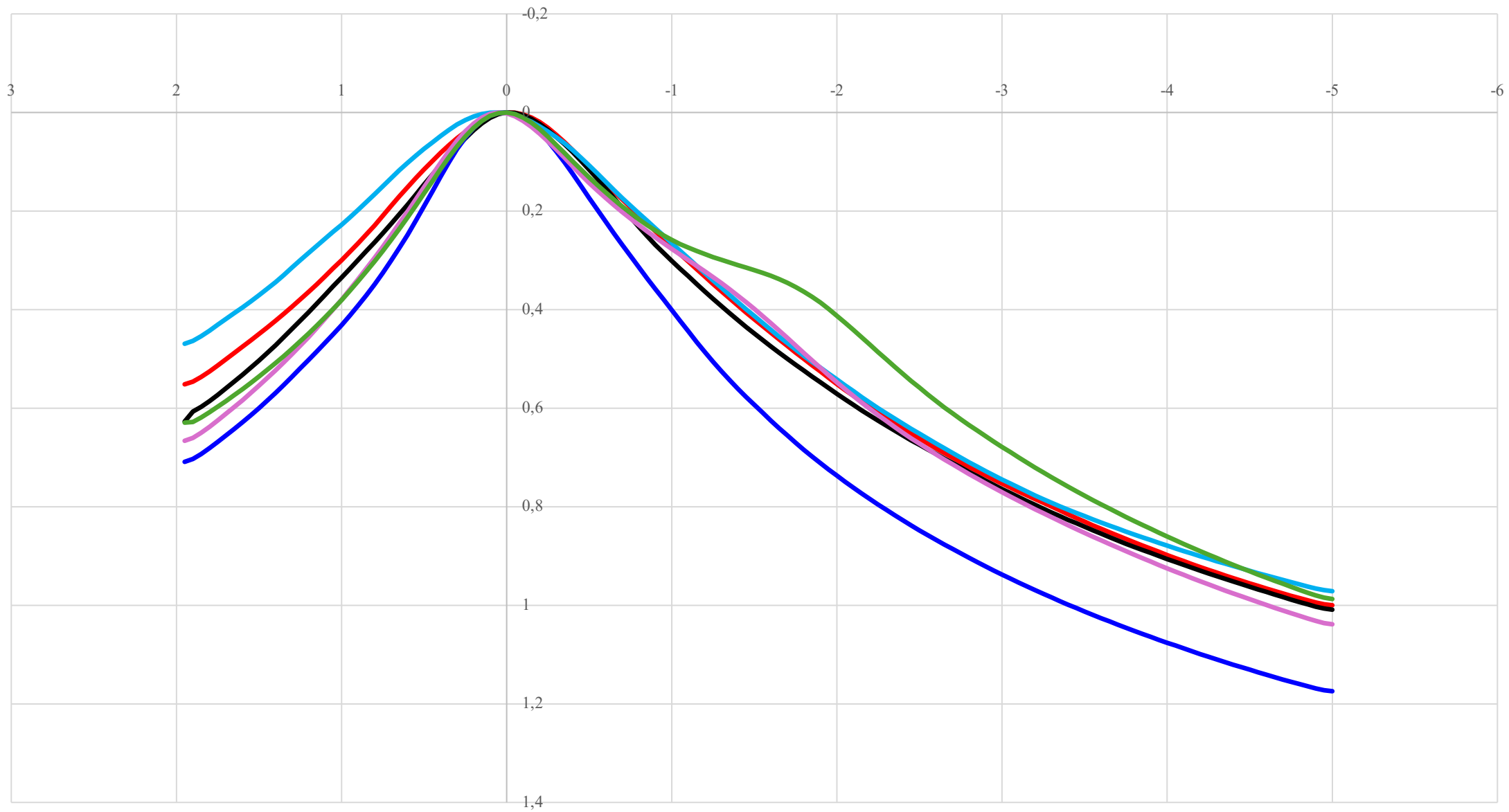
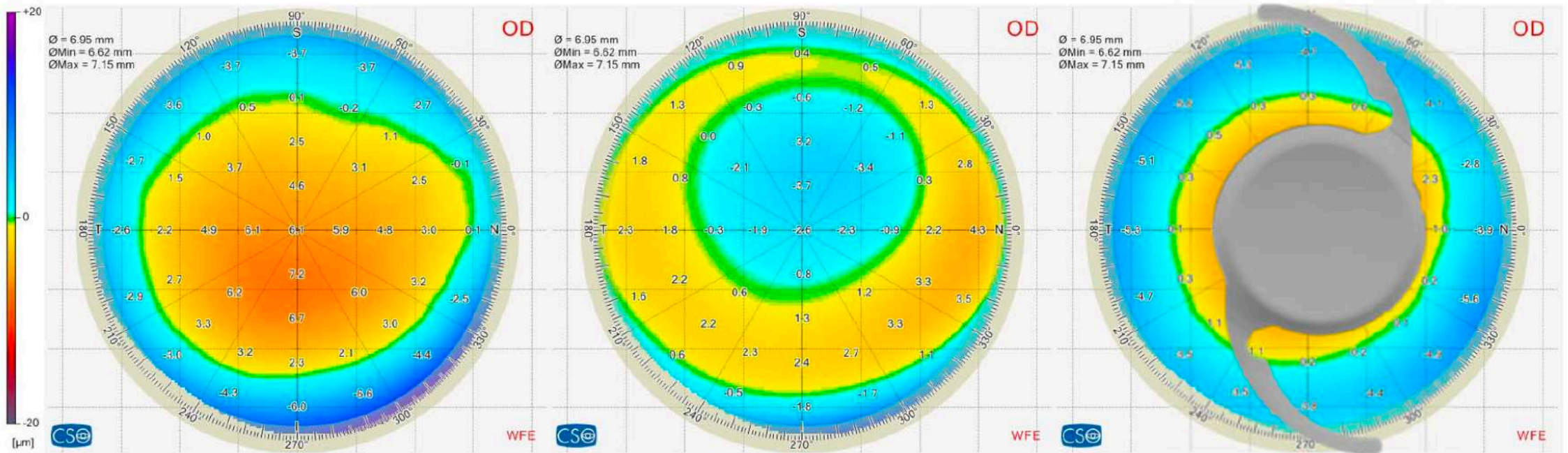


GRAFICO COMPLESSIVO TRASLATO





$\varnothing = 6.62 \text{ mm}$				$\varnothing = 6.63 \text{ mm}$				$\varnothing = 6.63 \text{ mm}$			
Sph [D]	Cyl [D]	Ax		Cyl [D]	Ax			Cyl [D]	Ax		
@0 mm	-1.96	-0.82	10°	@0 mm	-0.81	178°		@0 mm	-0.37	46°	
@12.5 mm	-2.01	-0.87	10°	@12.5 mm	-0.80	178°		@12.5 mm	-0.40	46°	
Total = 4.05	0.50	HOA = 1.23	=	Total = 2.09	0.30	HOA = 1.75	+	Total = 4.58	+0.20	HOA = 0.85	
3.75 μm	0.91 μm @ 10°			0.90 μm @ 178°				0.42 μm @ 46°			
0.99 μm @ 84°	0.41 μm @ 1°			1.21 μm @ 91°	0.34 μm @ 107°			0.24 μm @ 291°	0.30 μm @ 19°		
0.49 μm	0.20 μm @ 23°	0.18 μm @ 4°		0.30 μm	0.34 μm @ 22°	0.12 μm @ 79°		-0.31 μm	0.15 μm @ 111°	0.17 μm @ 14°	
0.10 μm @ 241°	0.07 μm @ 30°	0.11 μm @ 12°		0.16 μm @ 191°	0.10 μm @ 20°	0.03 μm @ 45°		0.12 μm @ 333°	0.05 μm @ 66°	0.15 μm @ 11°	
0.00 μm	0.02 μm @ 95°	0.06 μm @ 3°	0.03 μm @ 10°	0.30 μm	0.05 μm @ 160°	0.04 μm @ 44°	0.05 μm @ 50°	-0.31 μm	0.07 μm @ 77°	0.11 μm @ 1°	0.04 μm @ 22°
0.06 μm @ 268°	0.07 μm @ 83°	0.10 μm @ 39°	0.07 μm @ 11°	0.09 μm @ 231°	0.03 μm @ 48°	0.00 μm @ 72°	0.01 μm @ 42°	0.07 μm @ 13°	0.10 μm @ 84°	0.10 μm @ 38°	0.07 μm @ 12°



