# Overview and working principle of OSIRIS-T

Francesco Versaci

1° CSO distributor meeting

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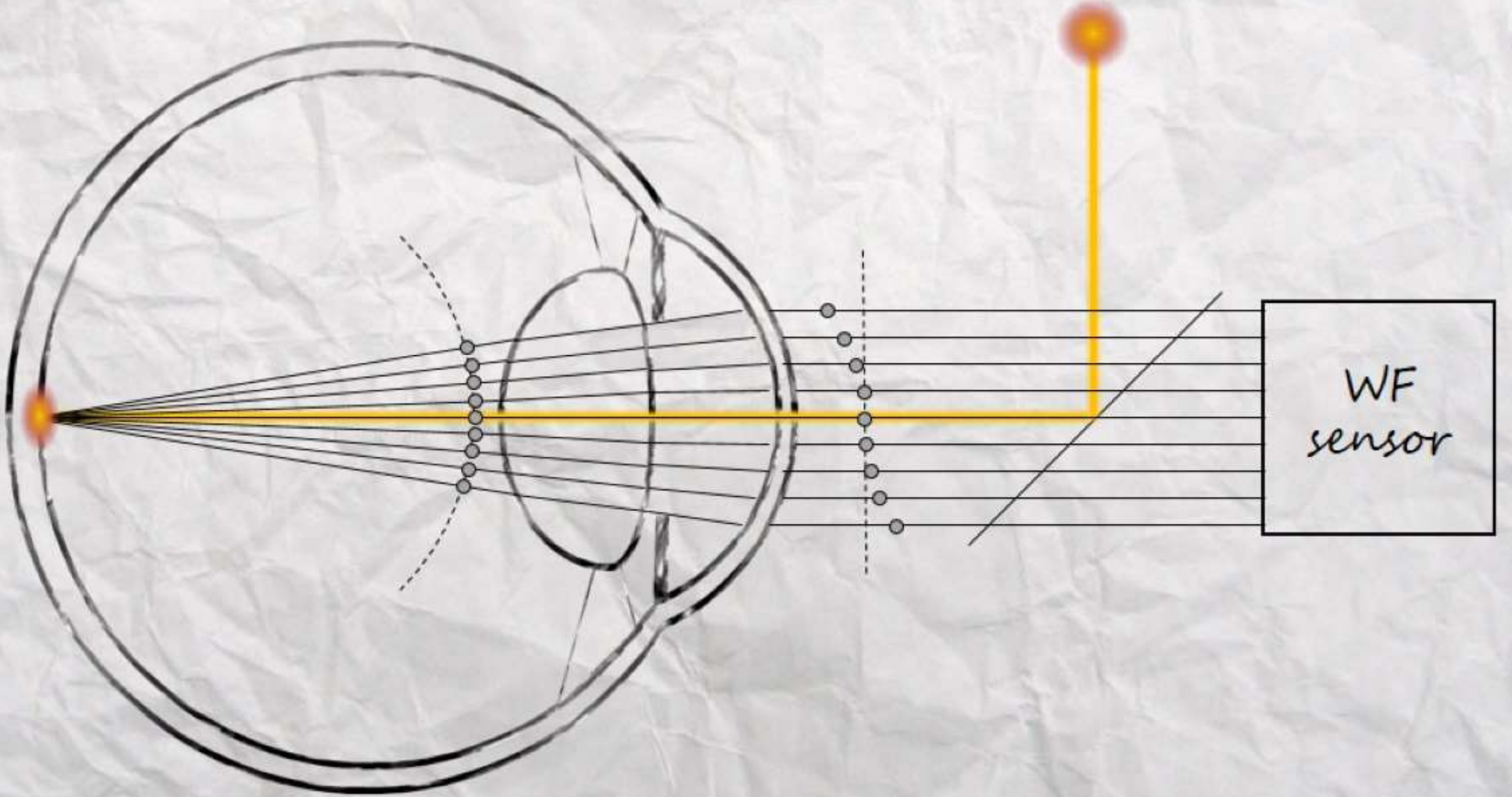
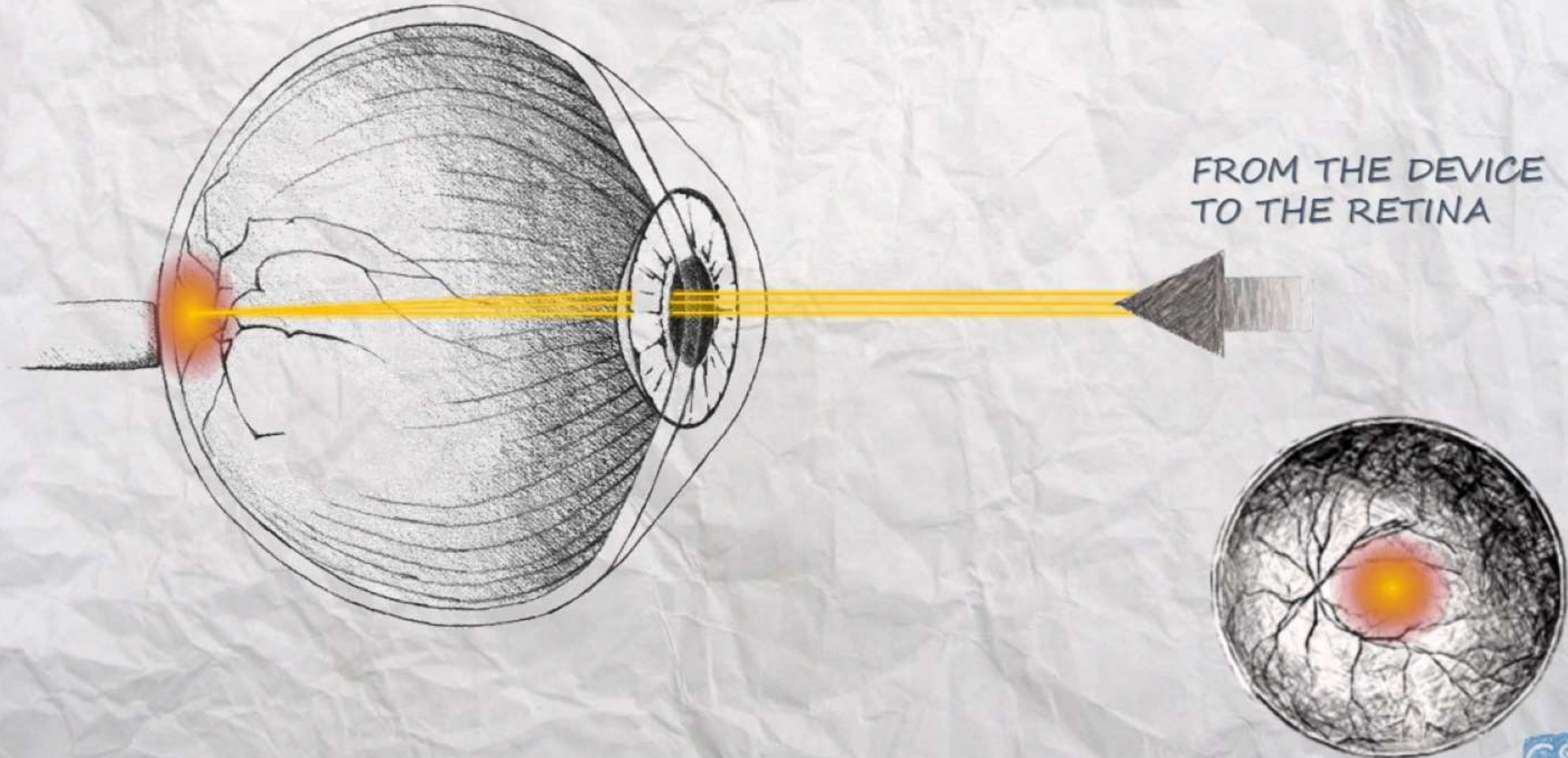
# Working principle

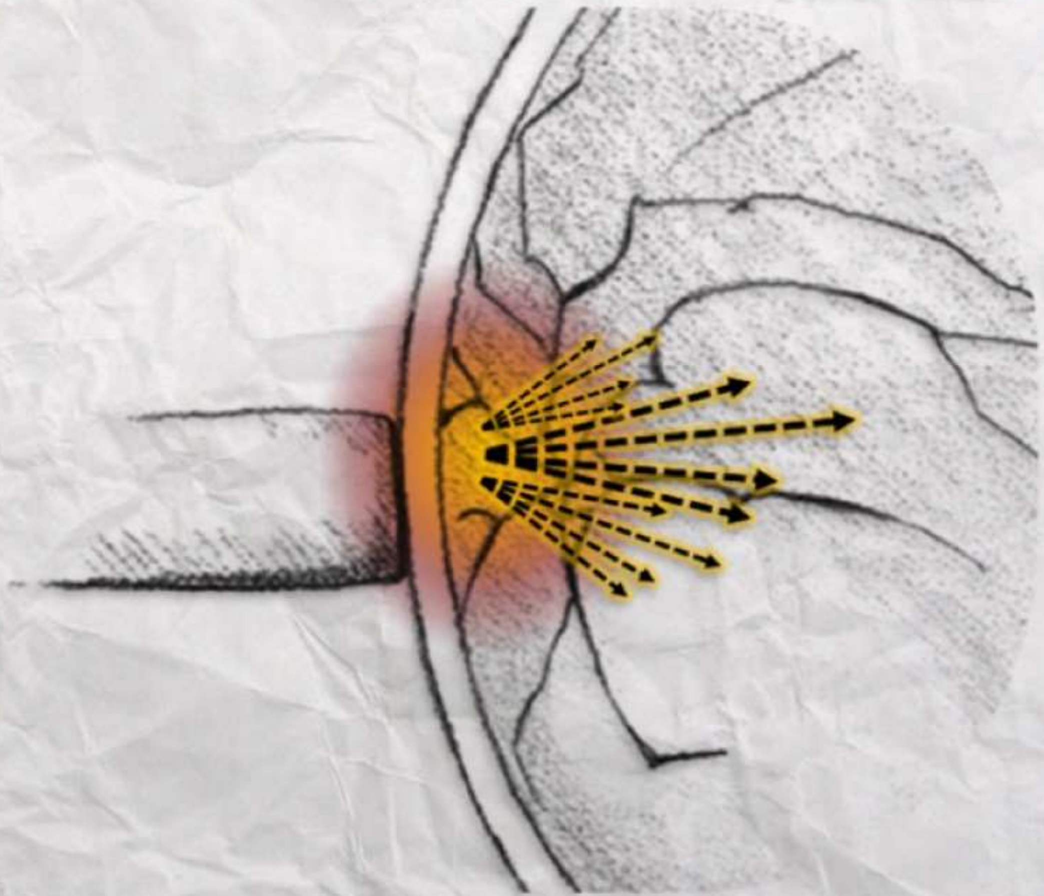
# Basic scheme of an Aberrometer



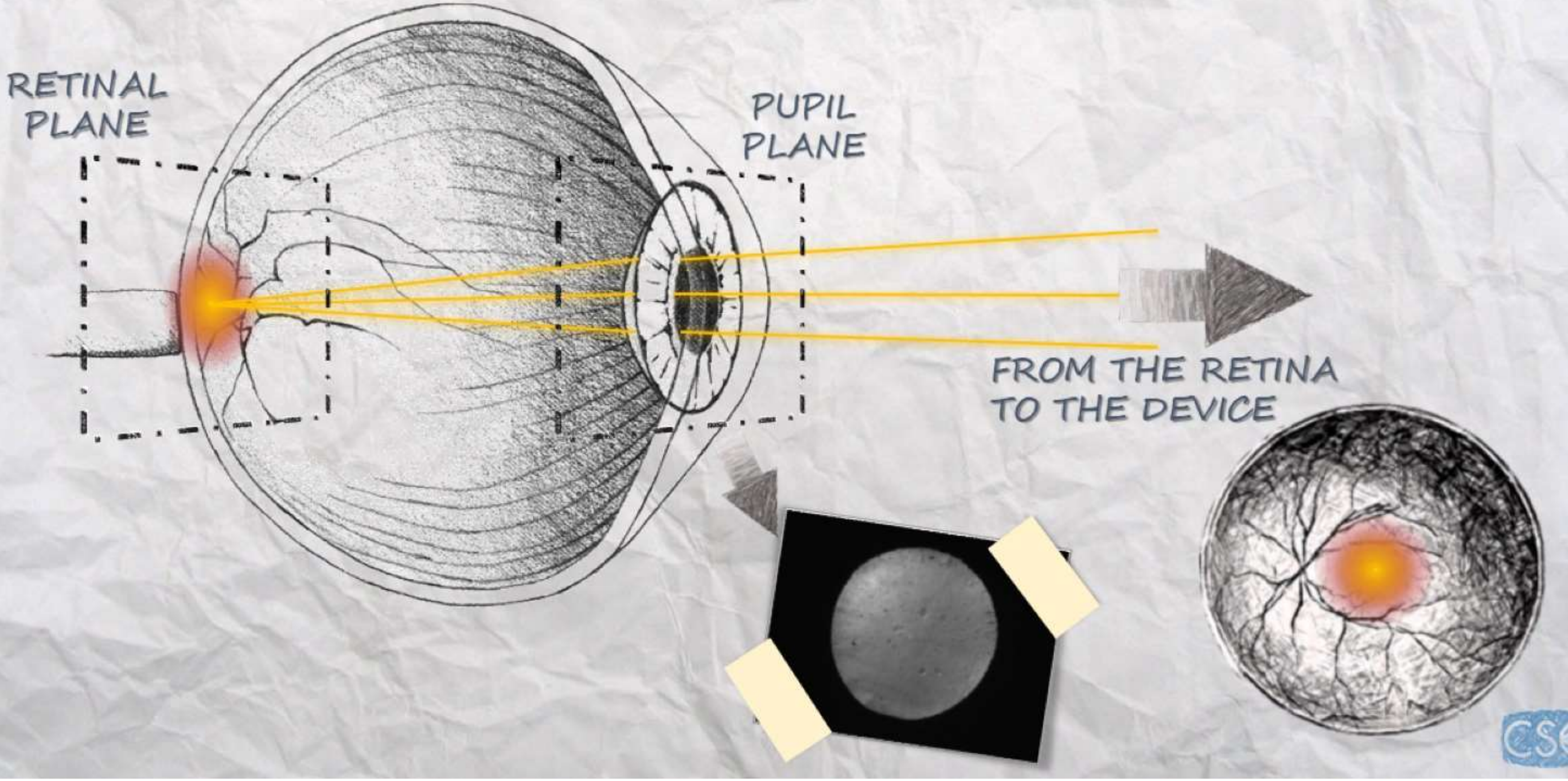
# LIGHTING SYSTEM



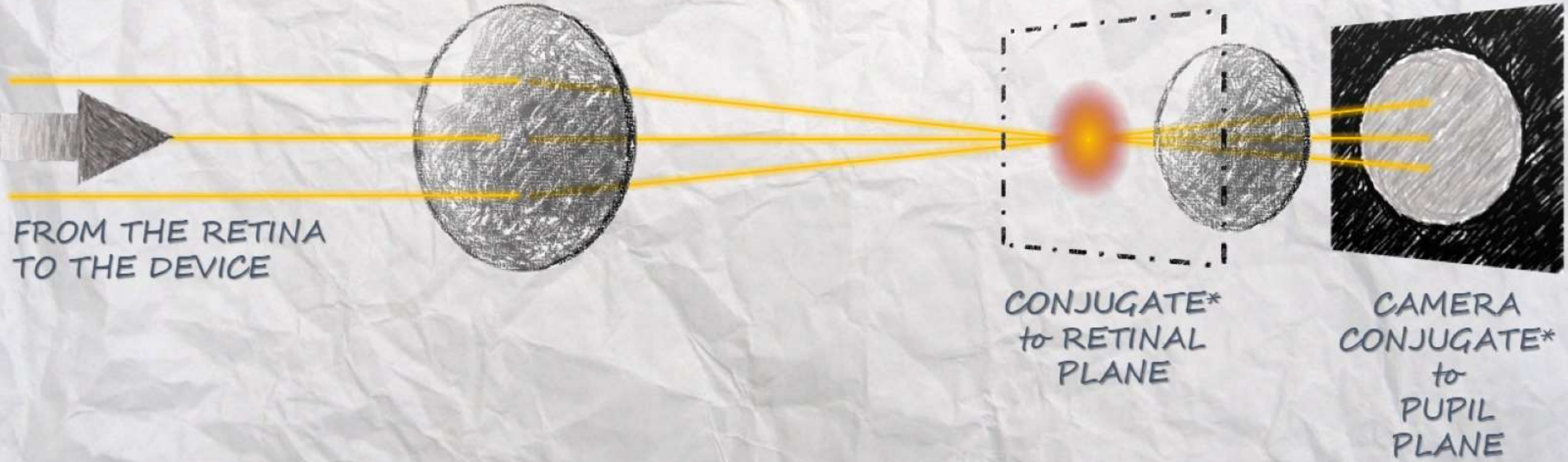
# Scattering back to the Device



# REFLECTION BACK TO THE DEVICE

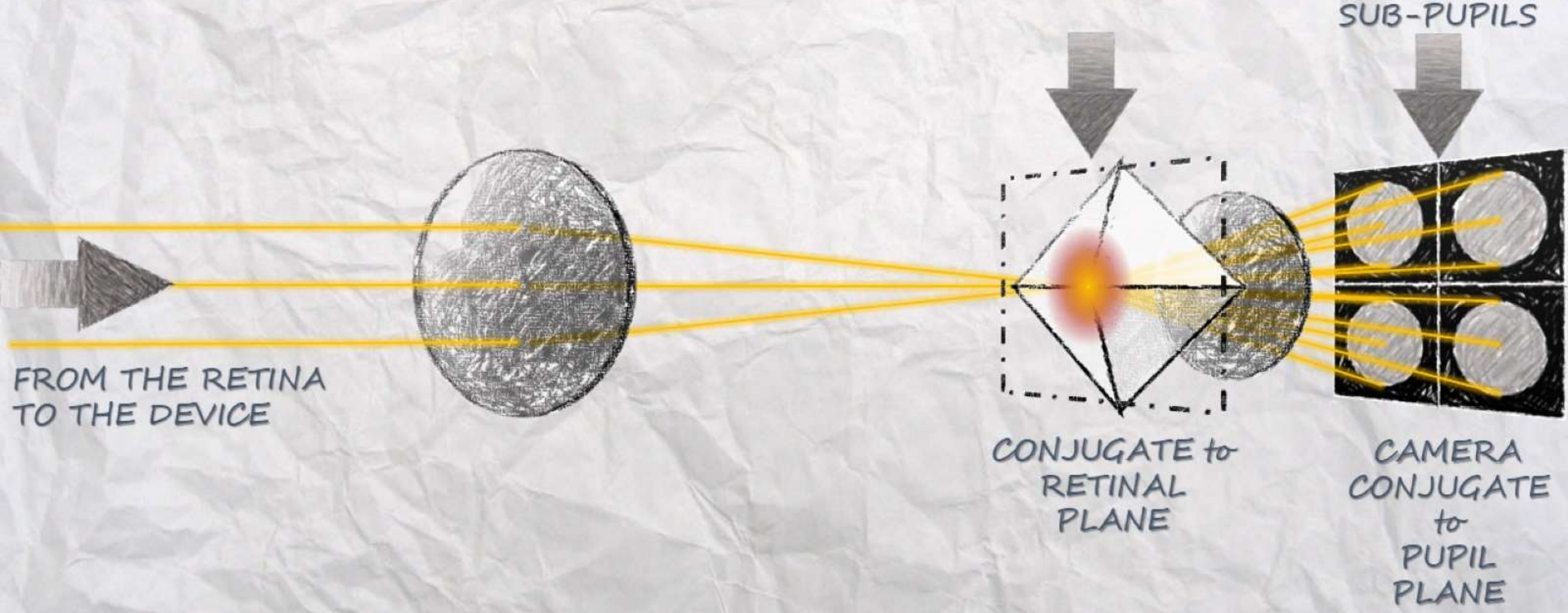


# INTO OSIRIS-T...



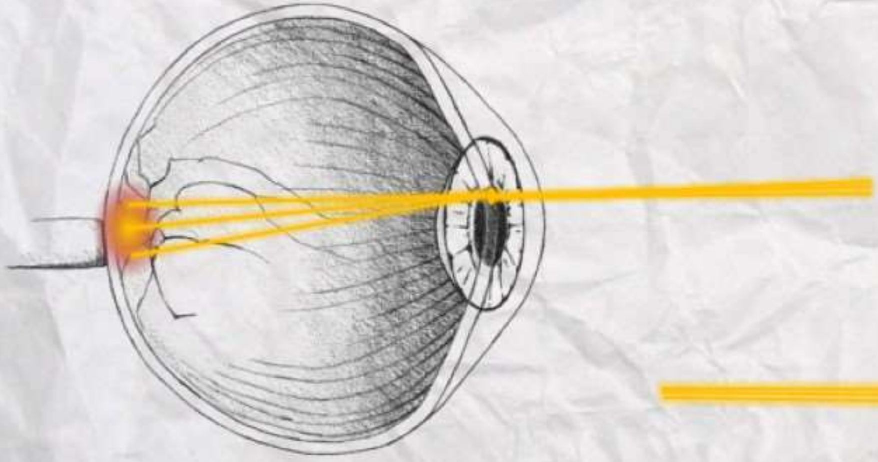

*IN OPTICS, A CONJUGATE FOCAL PLANE OF A GIVEN PLANE P, IS THE PLANE P` SUCH THAT POINTS ON P ARE IMAGED ON P`.

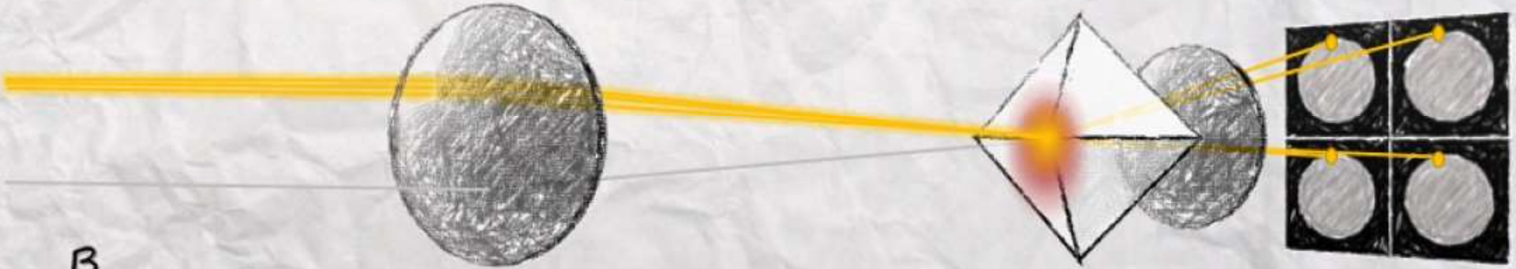
# Into OSIRIS-T...

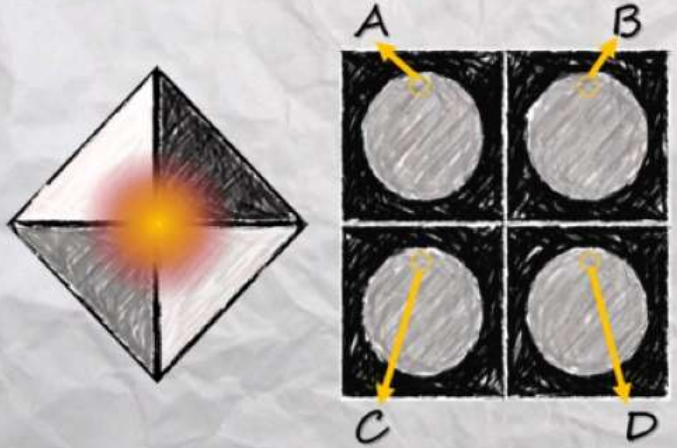



1996-Roberto Ragazzoni

# EMMETROPIC RAY (SLOPE = 0):
## Y-AXIS

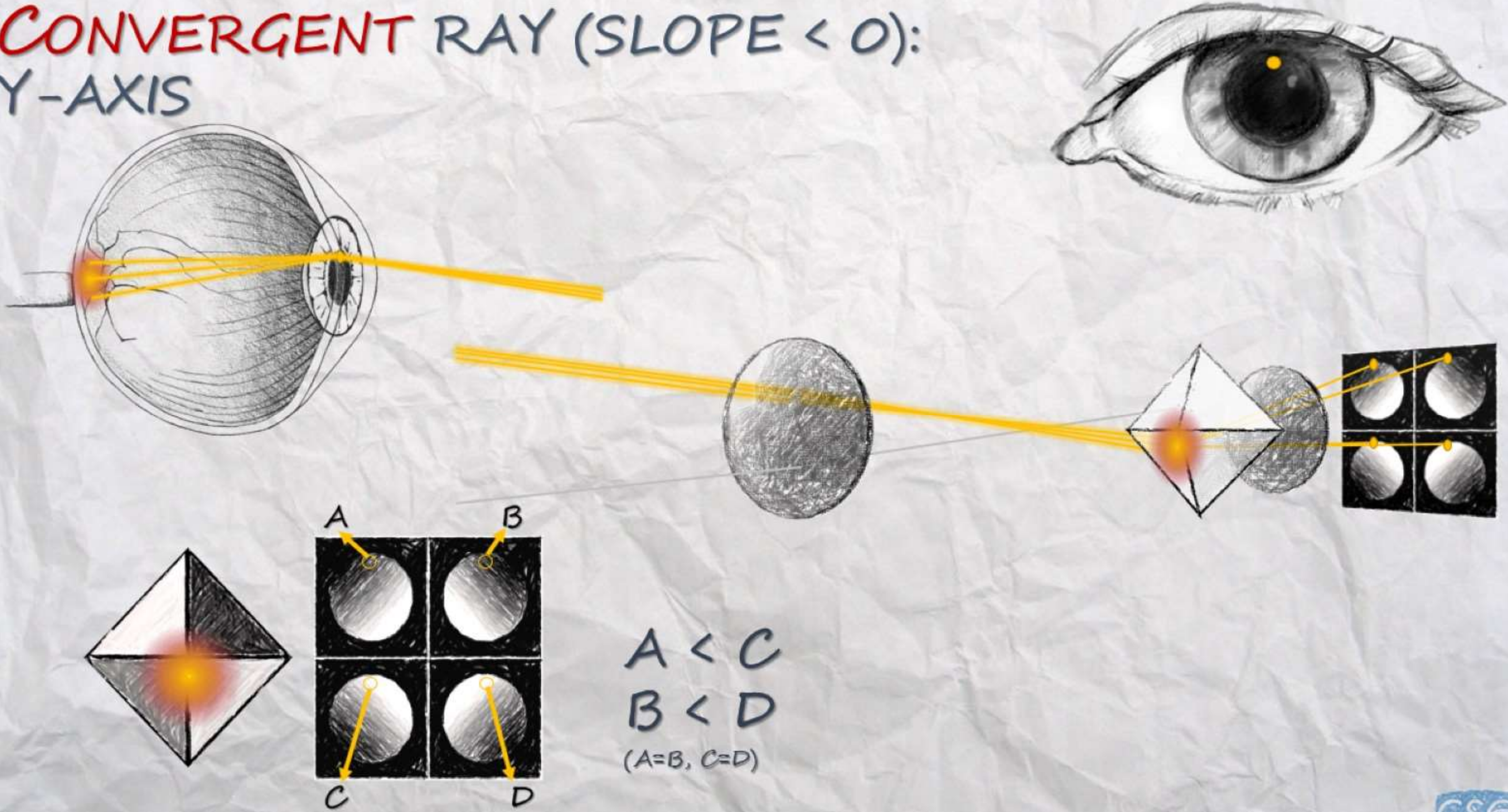




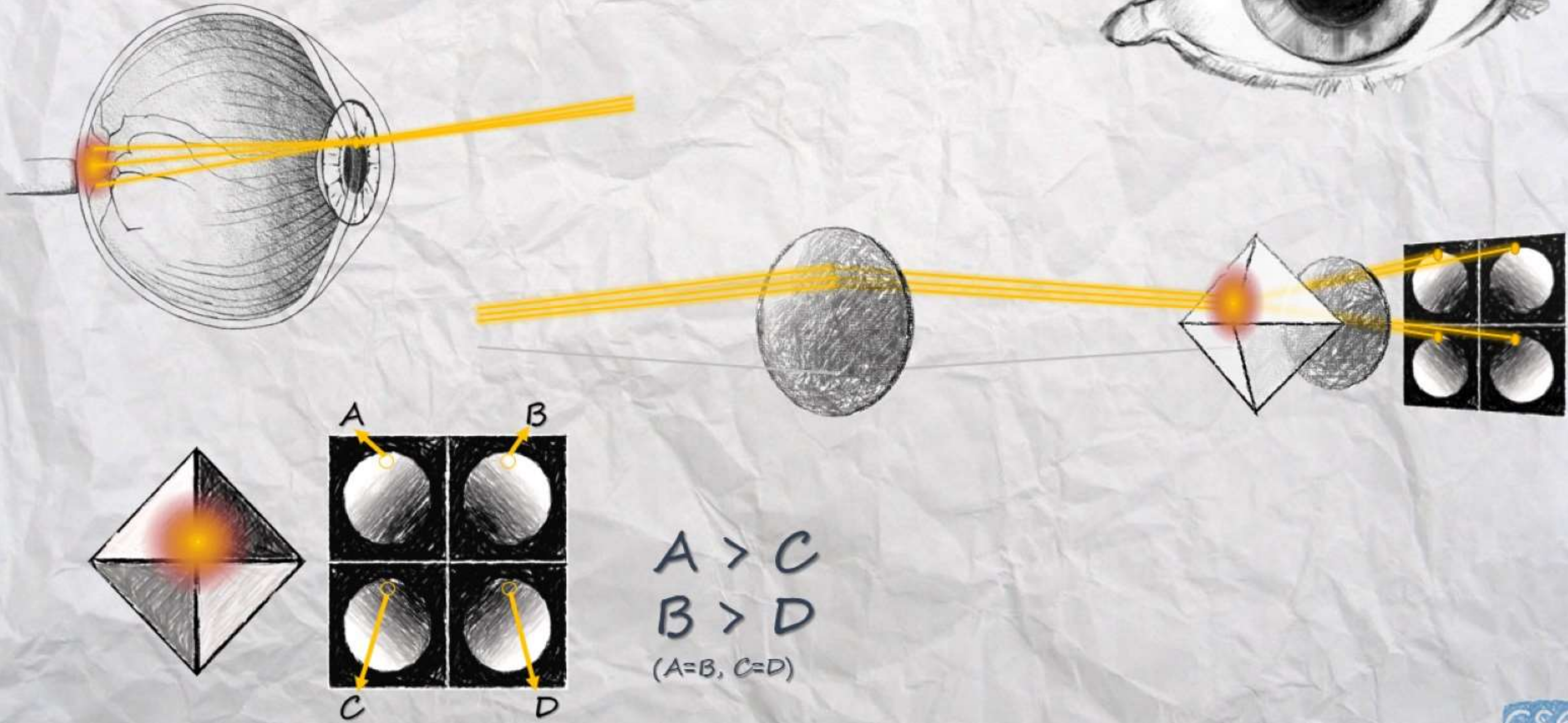



A = B = C = D

# CONVERGENT RAY (SLOPE < 0):
## Y-AXIS

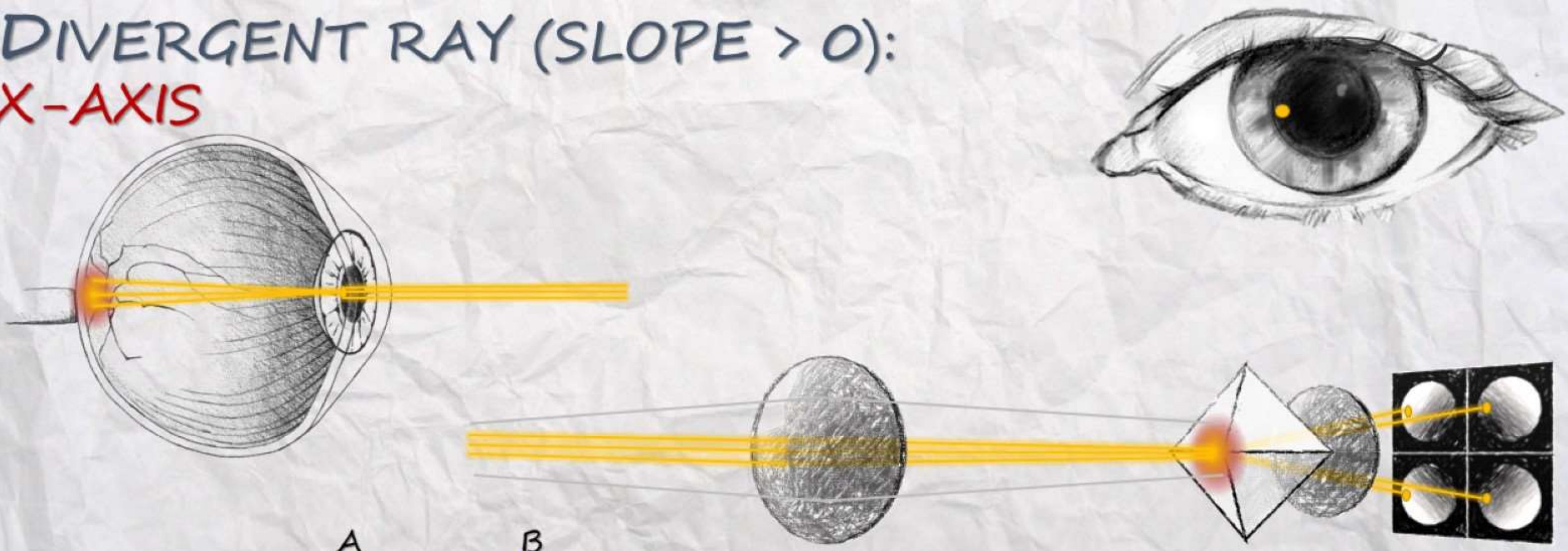


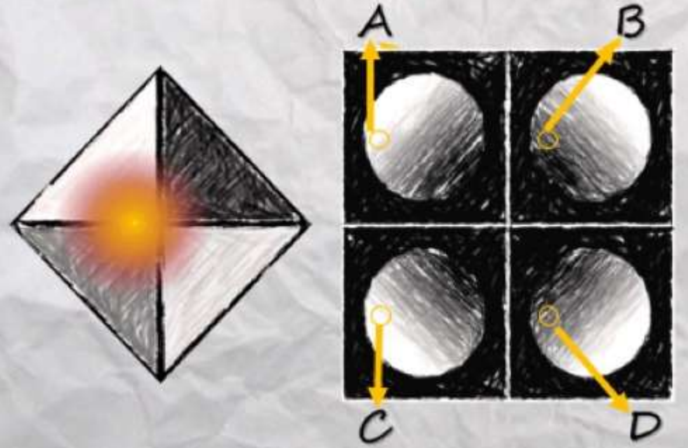
# DIVERGENT RAY (SLOPE > 0):
## Y-AXIS




A > C
B > D
(A=B, C=D)

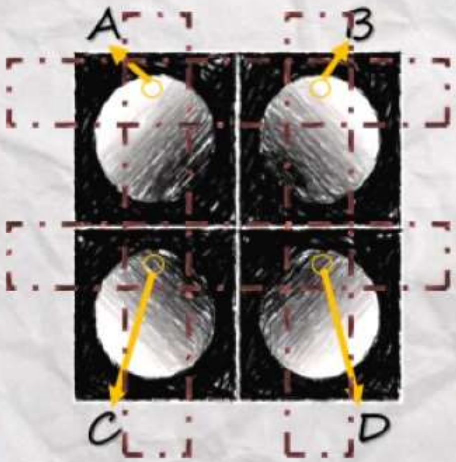
# DIVERGENT RAY (SLOPE > 0):
## X-AXIS






A > B
C > D
(A=C, B=D)

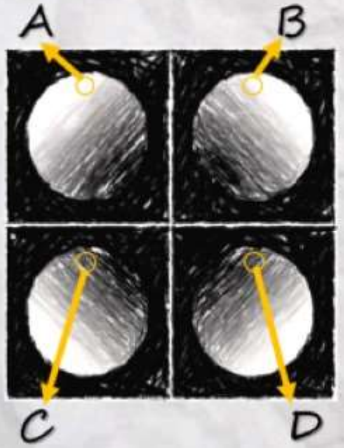
# RELATIONSHIP SLOPE-LIGTH INTENSITY




$$\frac{\partial WF}{\partial y} \propto \frac{A+B-C-D}{A+B+C+D}$$

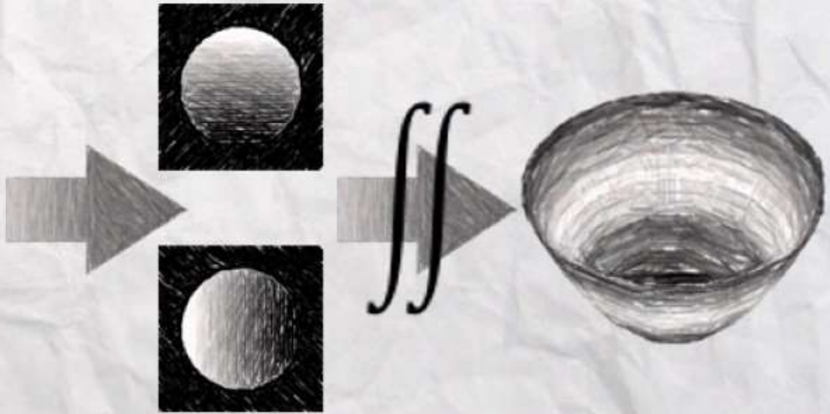
$$\frac{\partial WF}{\partial x} \propto \frac{A+C-B-D}{A+B+C+D}$$

# Wave-Front Error




$$\frac{\partial WF}{\partial y} \propto \frac{A+B-C-D}{A+B+C+D}$$

$$\frac{\partial WF}{\partial x} \propto \frac{A+C-B-D}{A+B+C+D}$$



# Refractive Error (Vergence Error)

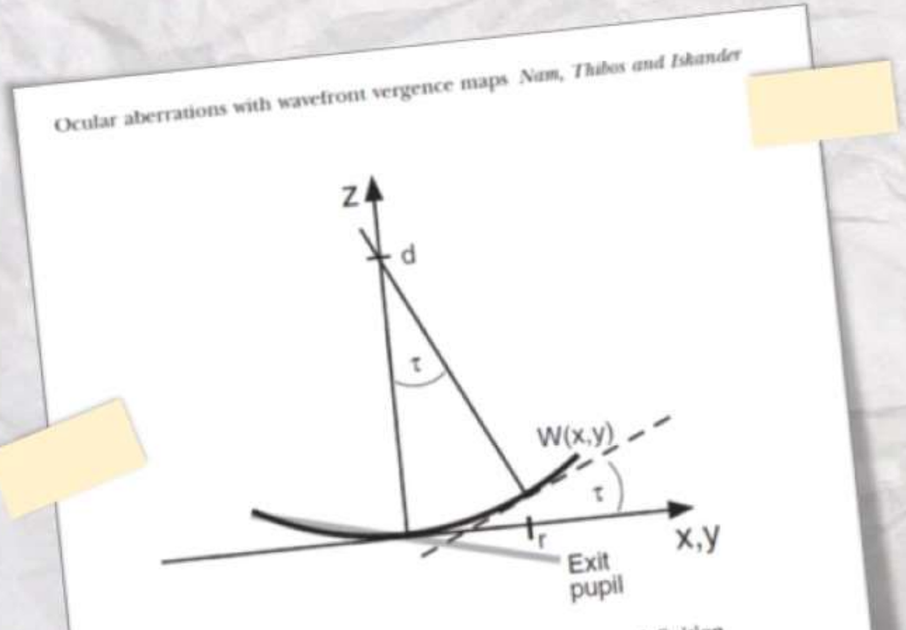
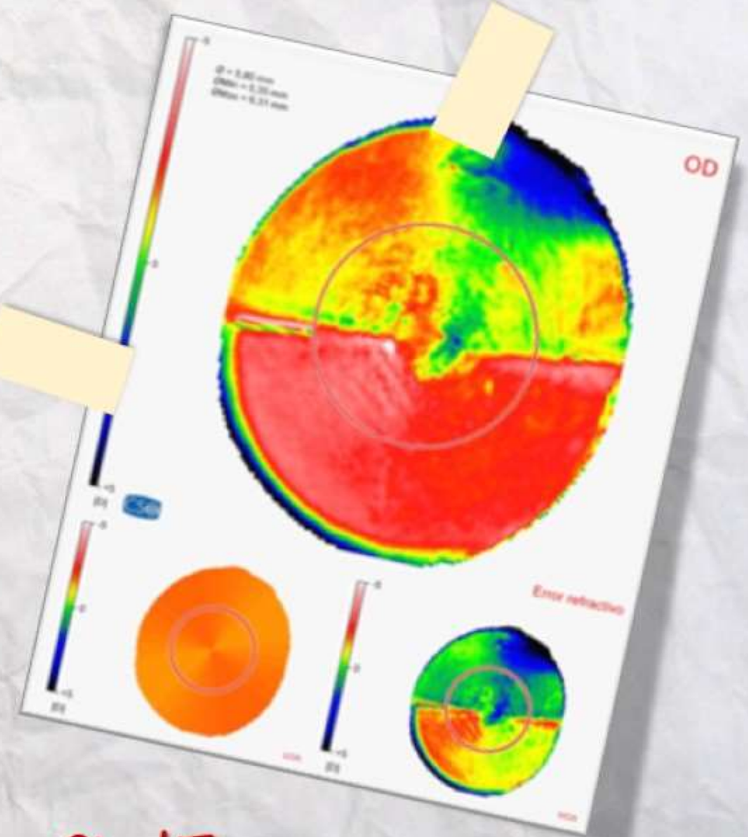


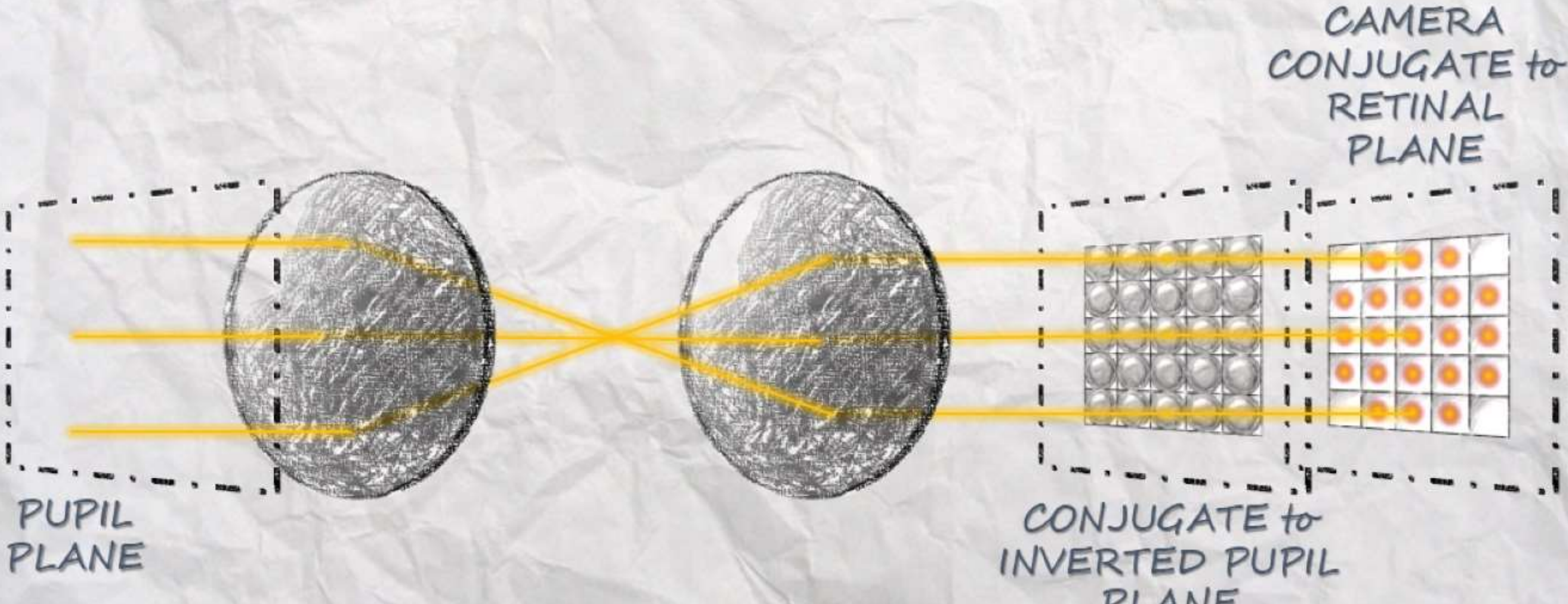

Figure 1. Geometry of the wavefront vergence definition. The z axis indicates the direction of the chief ray, which is not necessarily perpendicular to the exit pupil.



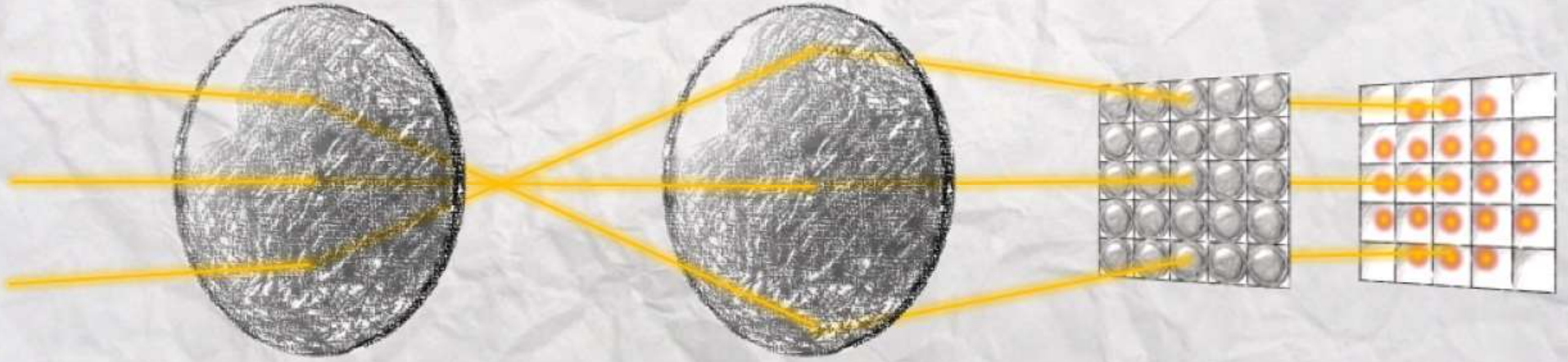

$$V(\rho,\theta) = \frac{1}{\rho}\frac{\partial WF}{\partial \rho} = \frac{1}{\rho}\left(\frac{\partial WF}{\partial x}\cos(\theta) + \frac{\partial WF}{\partial y}\sin(\theta)\right)$$

# Comparison to Hartmann-Shack

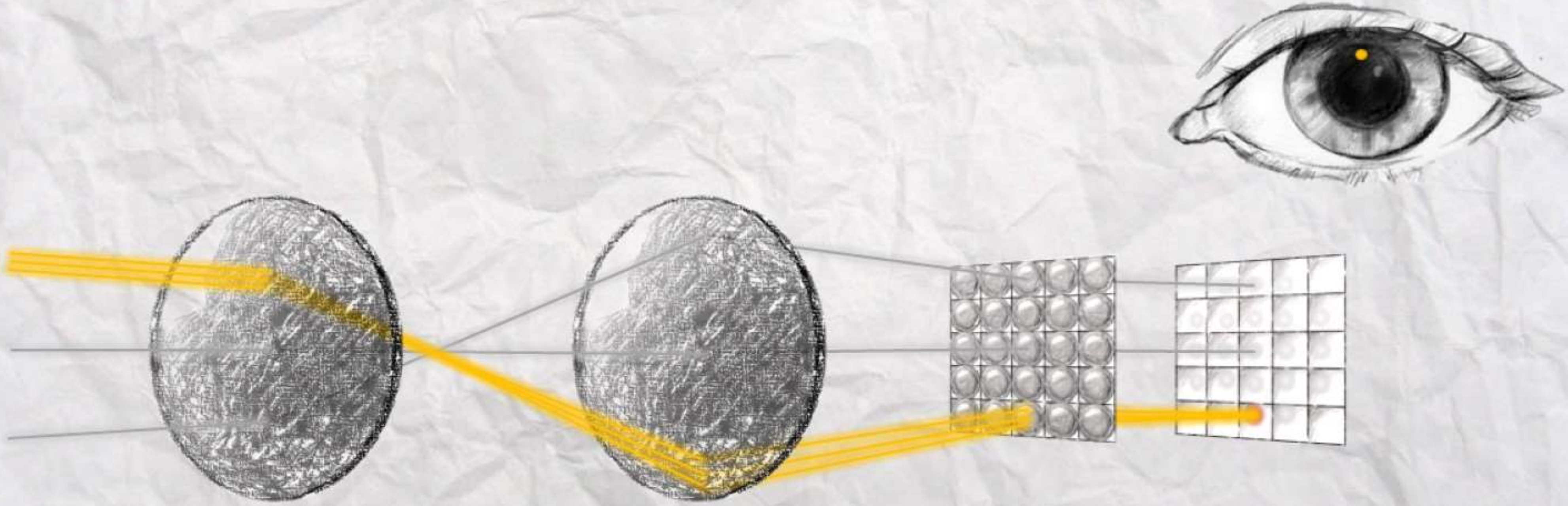
# HARTMANN-SHACK

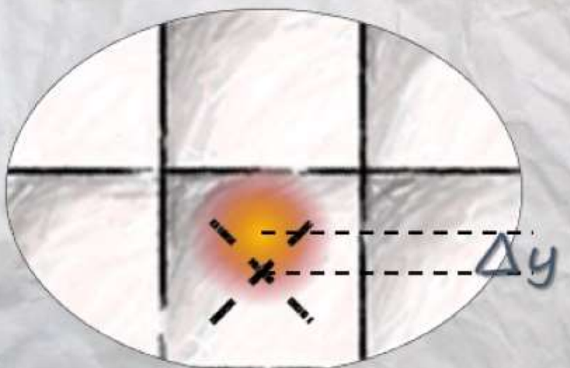


# HARTMANN-SHACK: CONVERGENT WF



# Hartmann-Shack: convergent ray

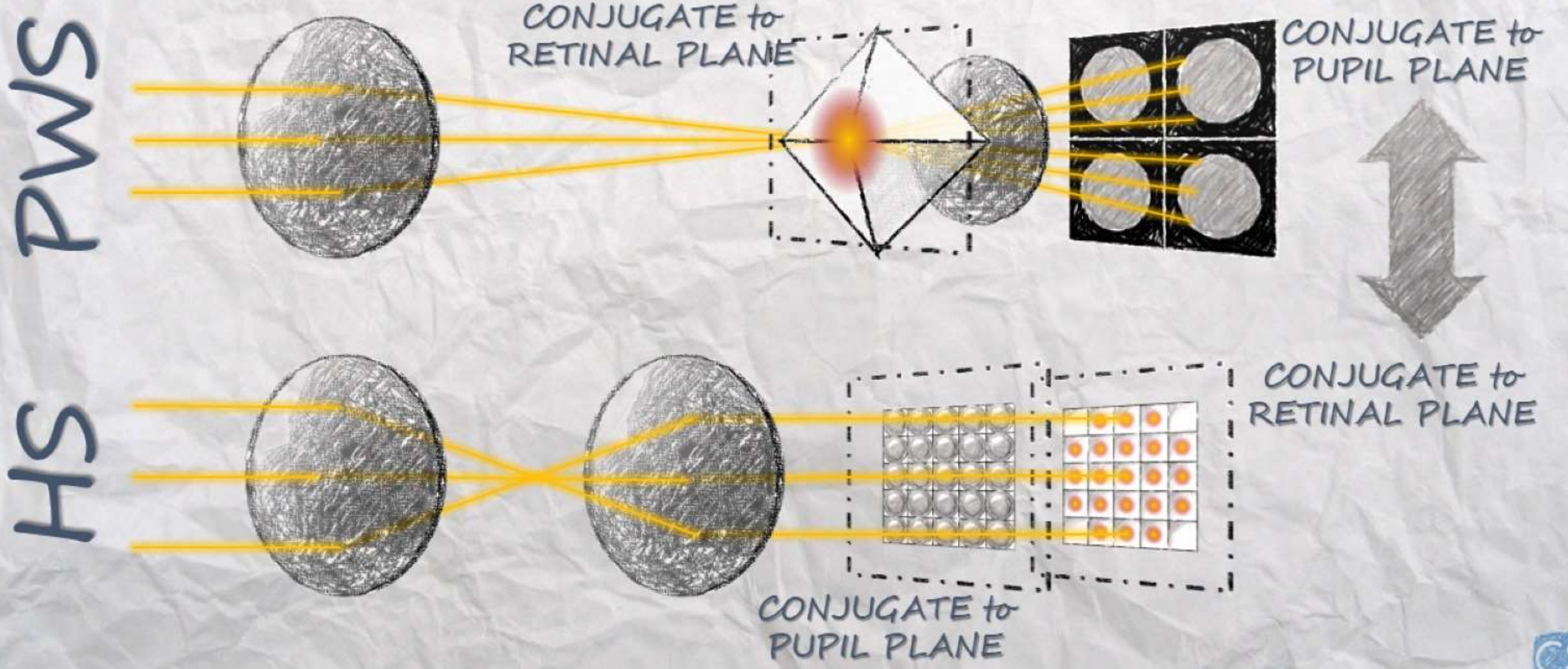





$$\frac{\partial WF}{\partial x} \propto \Delta x$$

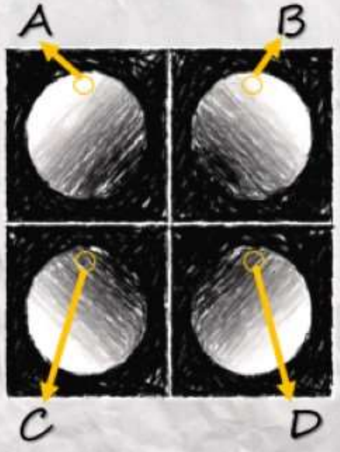
$$\frac{\partial WF}{\partial y} \propto \Delta y$$

# COMPARISON: OPTICAL SETUP



# Comparison: Working Principle

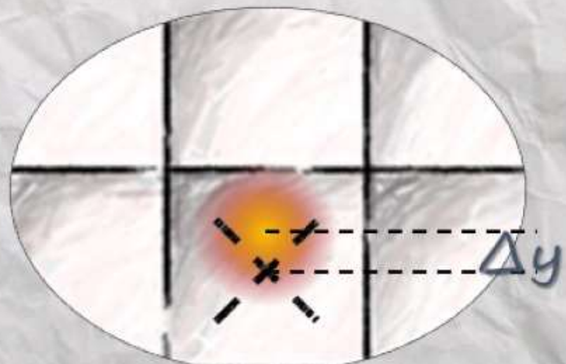
PWS




$$\frac{\partial WF}{\partial x} \propto \frac{A+C-B-D}{A+B+C+D}$$

$$\frac{\partial WF}{\partial y} \propto \frac{A+B-C-D}{A+B+C+D}$$

HS




$$\frac{\partial WF}{\partial x} \propto \Delta x$$

$$\frac{\partial WF}{\partial y} \propto \Delta y$$

# COMPARISON: RESOLUTION

PWS

N = # POINTS ON A SUB-PUPIL

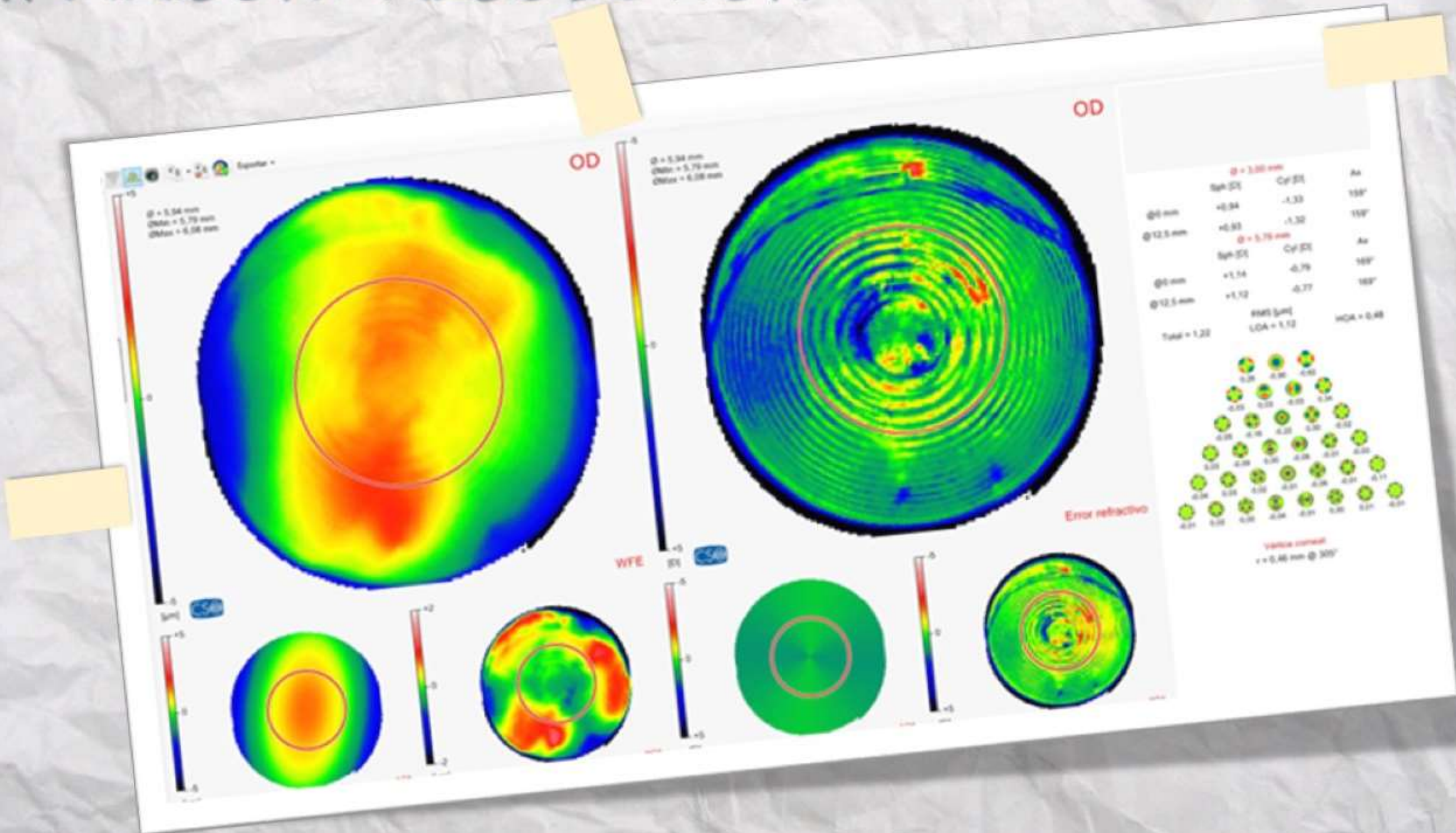
- 45.000 SAMPLES (Ø = 9.0 mm)
- SPATIAL RESOLUTION: 41 μm

HS

N = # LENSES ON THE LENSLET

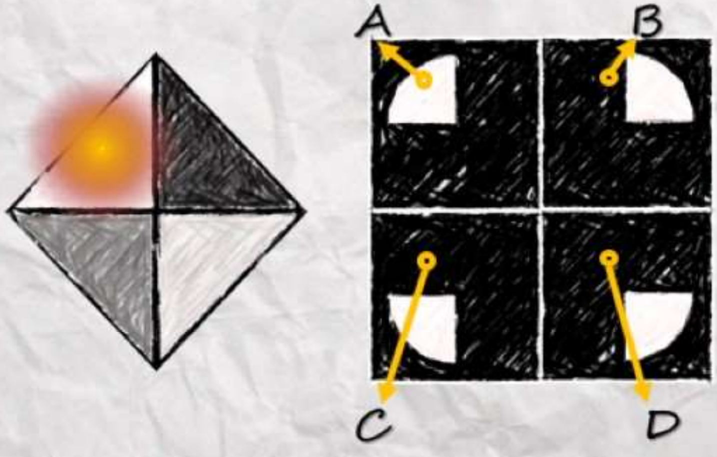
- 1.000-2.000 SAMPLES (Ø = 9.0 mm)
- SPATIAL RESOLUTION: 250-125 μm

# Comparison: resolution



# COMPARISON: SATURATION & DINAMIC RANGE

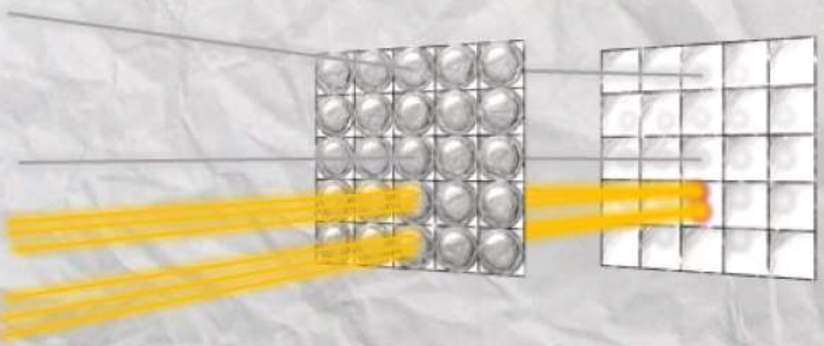
PWS




B=C=D=0

$$\frac{\partial WF}{\partial y} \propto \frac{A+B-C-D}{A+B+C+D} = 1$$

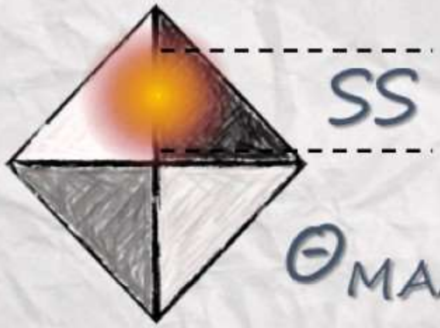
HS



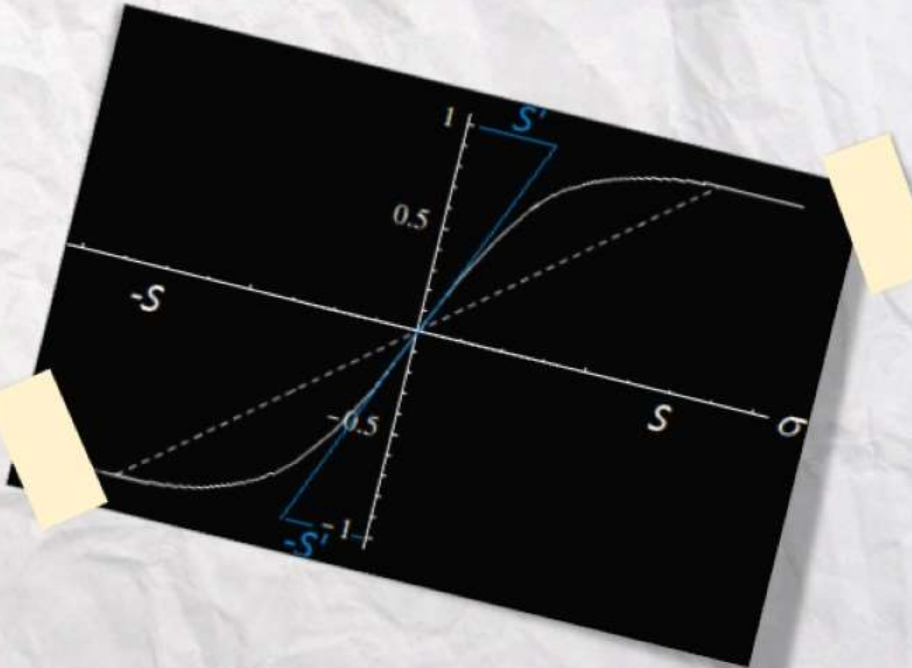
$$\frac{\partial WF}{\partial y} \propto \Delta y = ?$$

# COMPARISON: SATURATION & DINAMIC RANGE

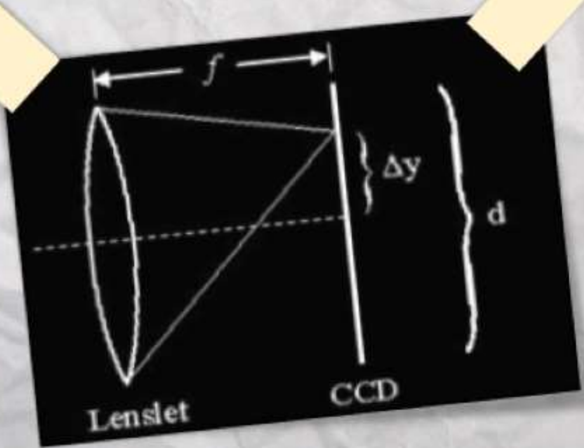
PWS




$\Theta_{MAX} \propto SS$




HS




$\Theta_{MAX} \propto \Delta y / f = d/2f$

# Comparison: Processing

PWS

## DIRECT INTEGRATION METHOD

- 30 Fps (REAL TIME WF IMAGING)
- FITTING «OPTIONAL»

HS

## MODAL (ZERNIKE FITTING)

- WF IMAGING «OFF LINE»
- FITTING MANDATORY

# PROCESSING (REAL TIME ACCOMMODATION MEASUREMENT)