



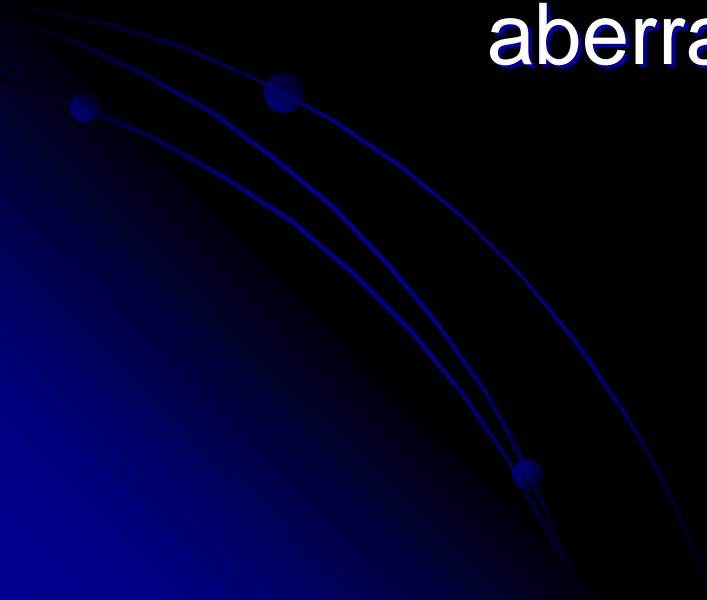
To See or Not To See: Visual Acuity With and Without Adaptive Optics

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Experiment

- How Does Visual Acuity change with aberrations and pupil size?

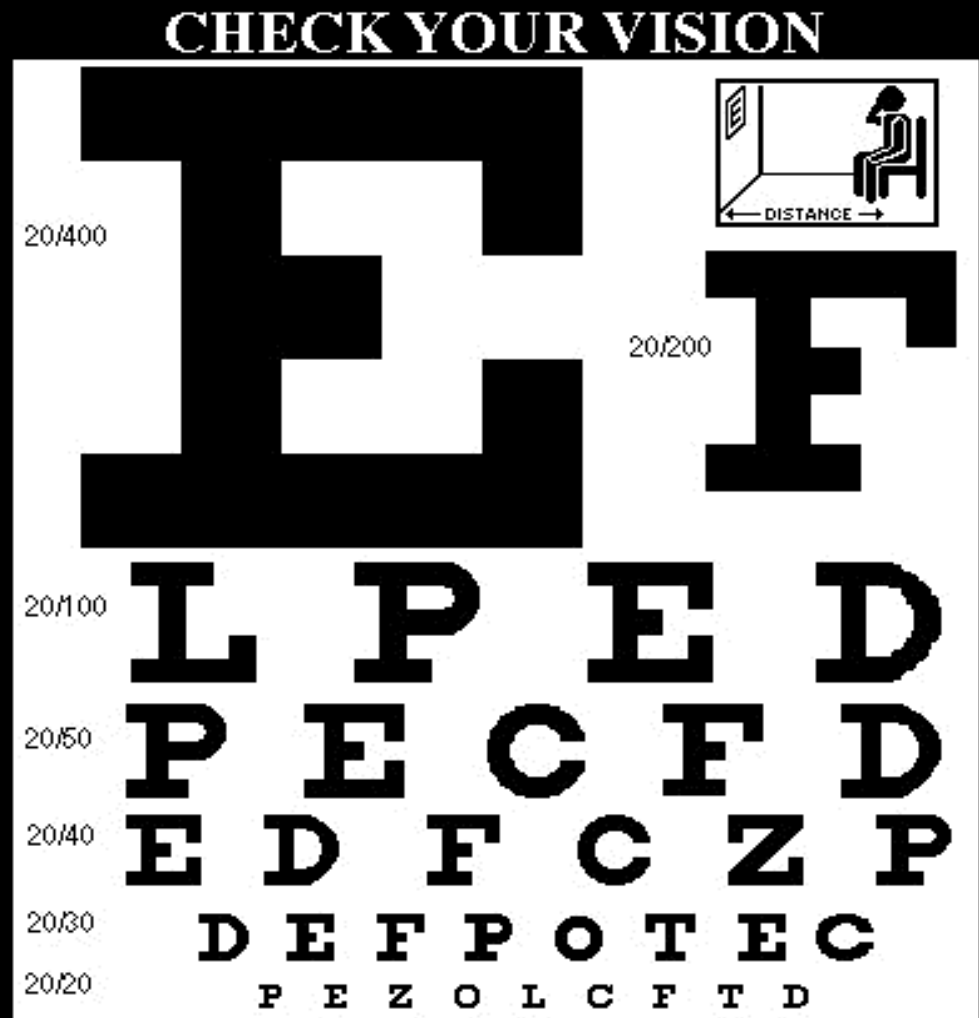




Visual Acuity

❖ Definition: The ability to resolve fine detail (usually determined by a Snellen chart).

➤ Limited by aberrations & pupil size





AOSLO

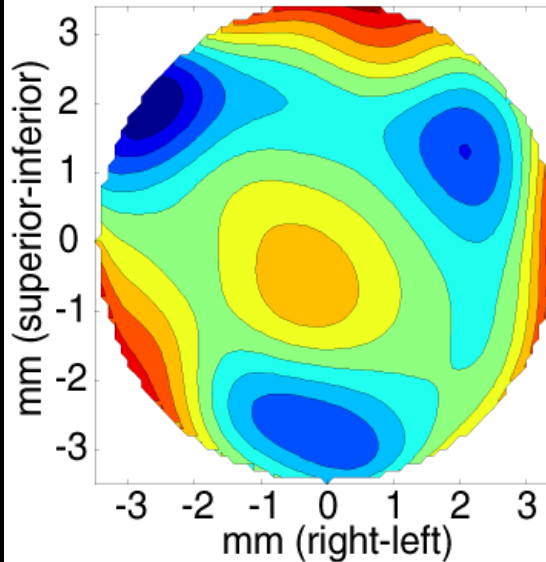
- Stands For: Adaptive Optics Scanning Laser Ophthalmoscope
- Major components:
 - Adaptive Optics system
 - Scanning Laser Ophthalmoscope



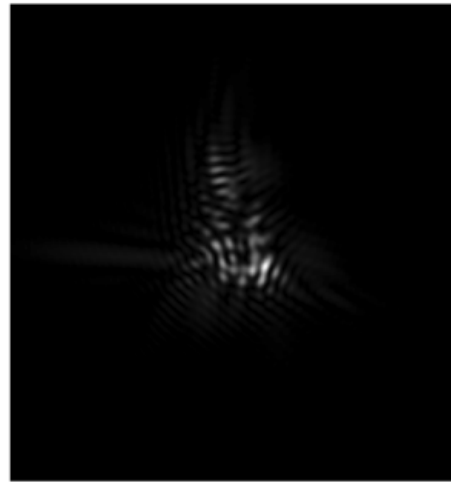
Adaptive Optics

AO OFF

Wave Aberration



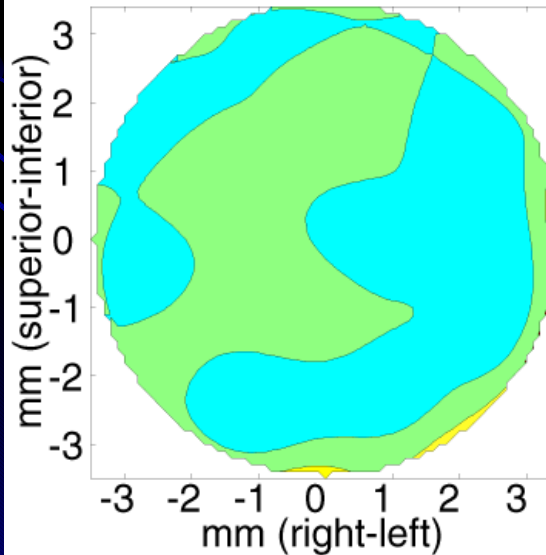
Point Spread Function



Adaptive Optics:
corrects
aberrations that
cause blur in the
retinal image

AO ON

Wave Aberration



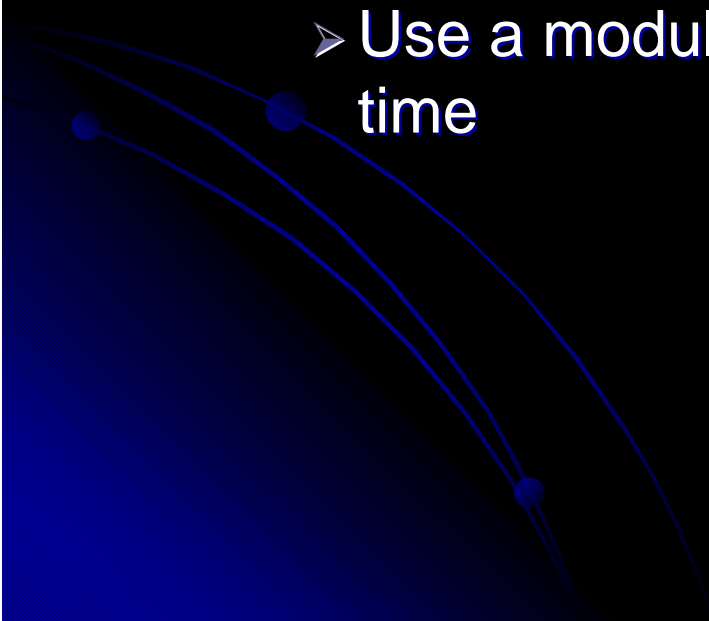
Point Spread Function





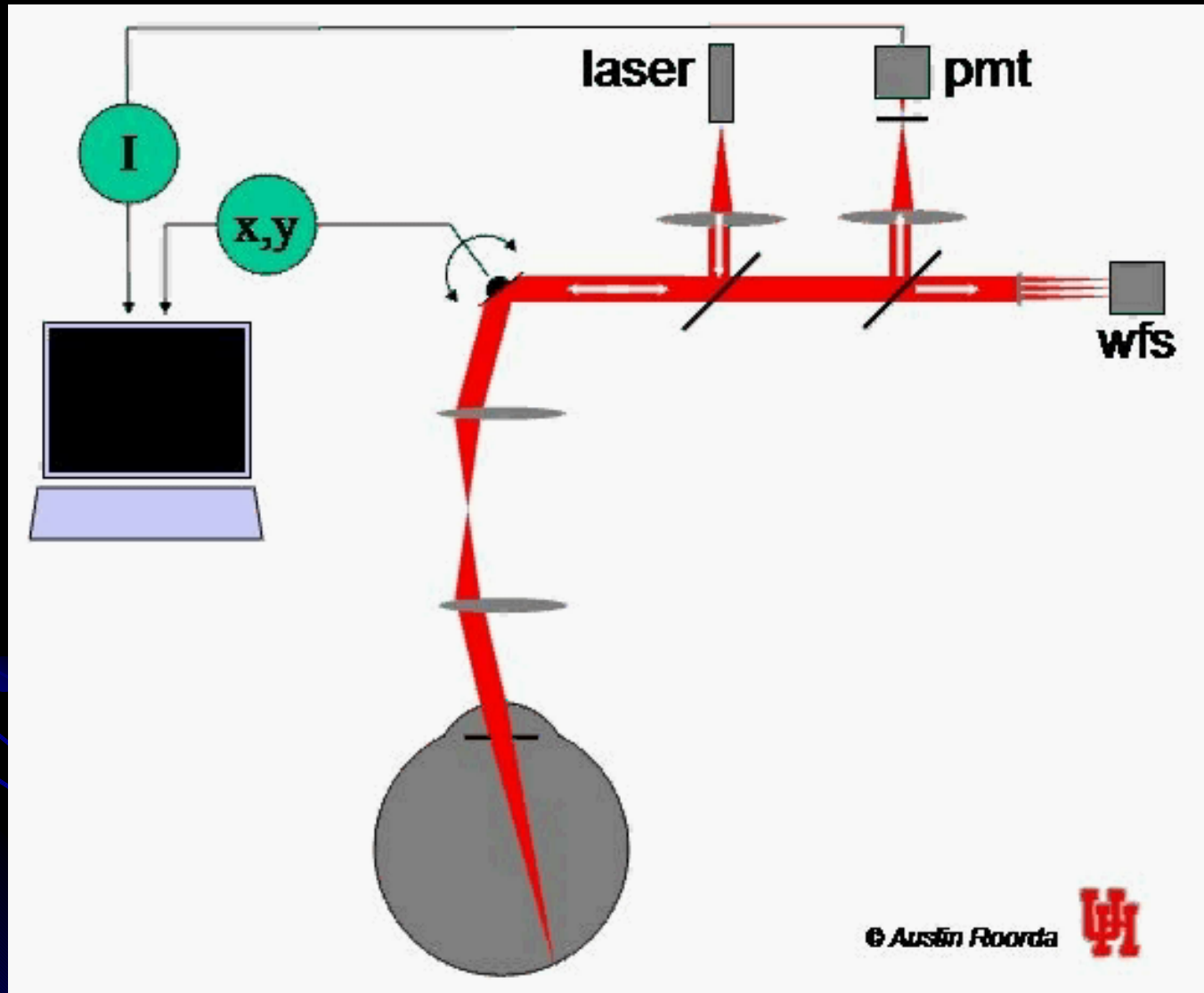
Scanning Laser Ophthalmoscope

- SLO: an efficient method of imaging and presenting stimuli
 - Use a modulated laser to construct an image over time





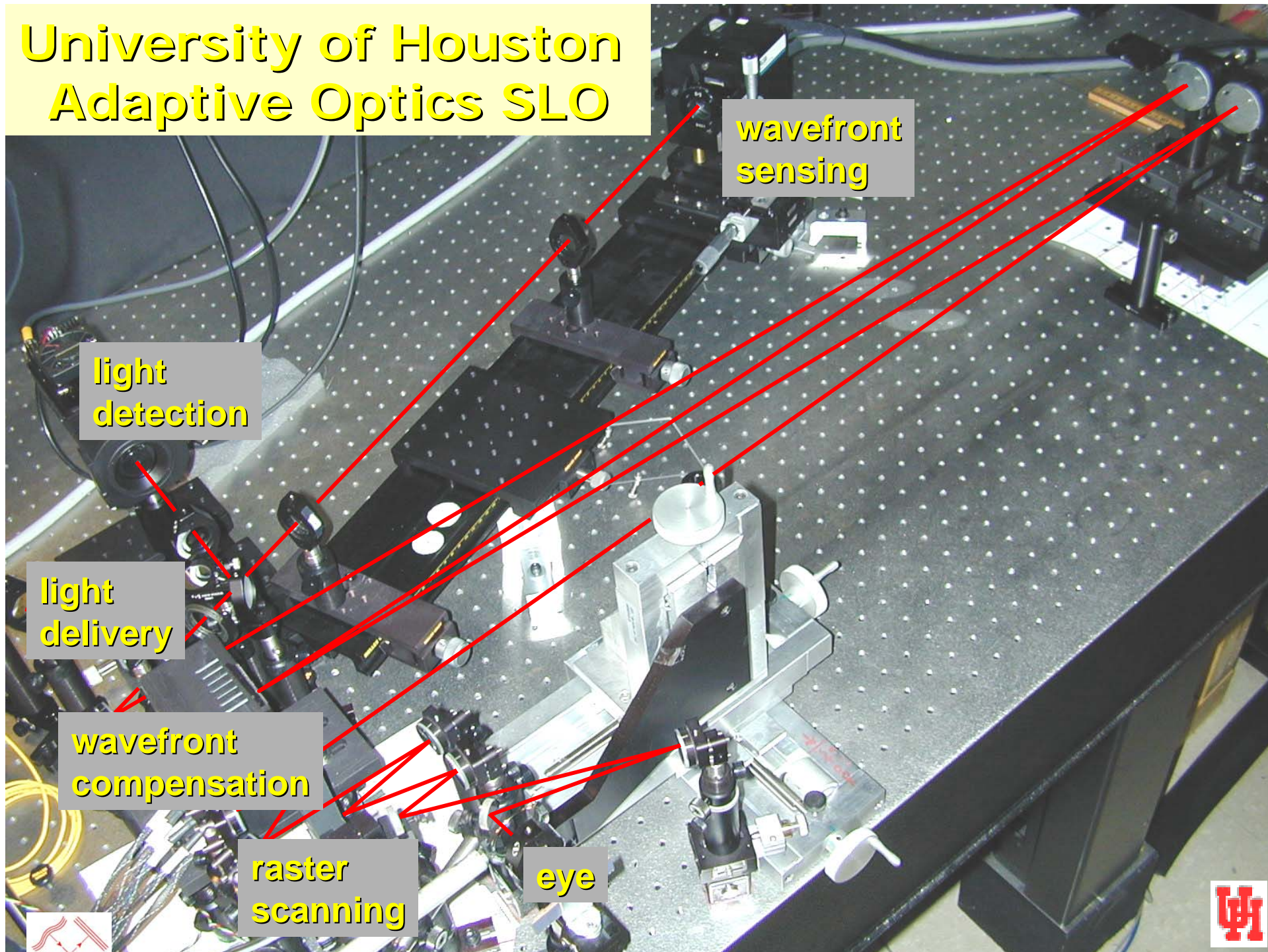
How an SLO Works



© Austin Roorda



University of Houston Adaptive Optics SLO



wavefront
sensing

light
detection

light
delivery

wavefront
compensation

raster
scanning

eye





Visual Acuity Measurements

- SLO forms an Raster image of an E directly on retina
- Four Alternative Forced-Choice Tumbling E or “illiterate E test”



- Find the smallest size E that can be properly identified

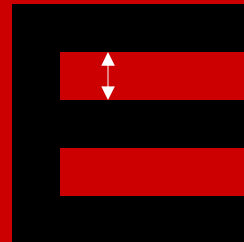


Raster Scan

- The scanning mirrors use the laser beam to form raster which is 512 pixels by 480 lines

20/20 image

1
2
3
4
5



1 minute of arc

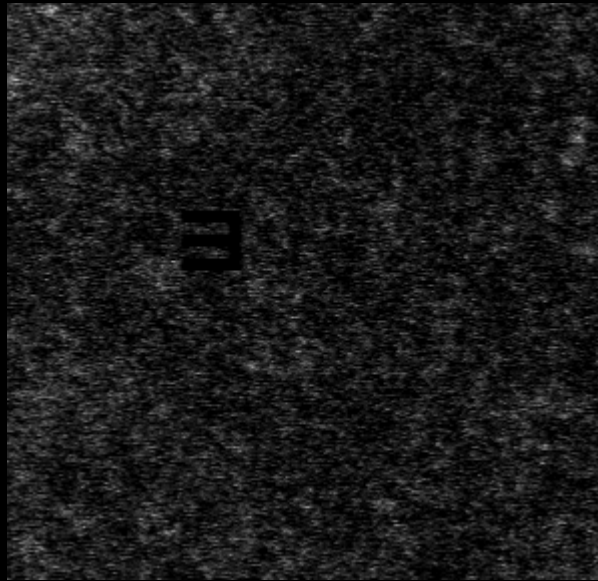


Conditions

- 1) 6mm pupil uncorrected – expect large PSF & wave aberration
- 2) 6mm pupil corrected with AO – expect a compact PSF & near perfectly flat wave
- 3) 3mm pupil corrected with AO – expect larger PSF (less compact than condition two) & near perfectly flat wave

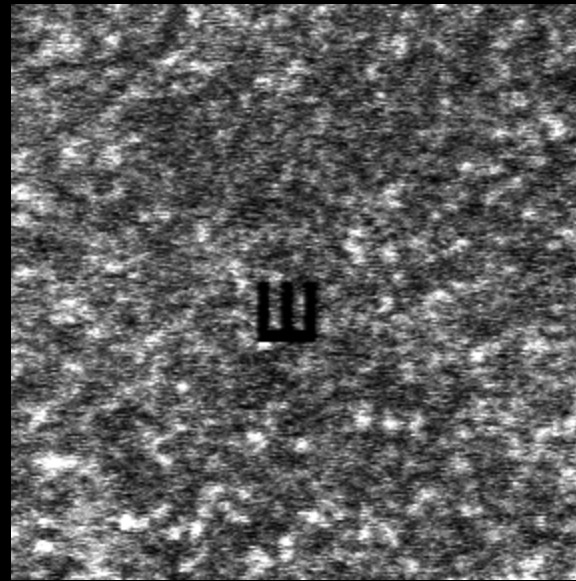


Conditions



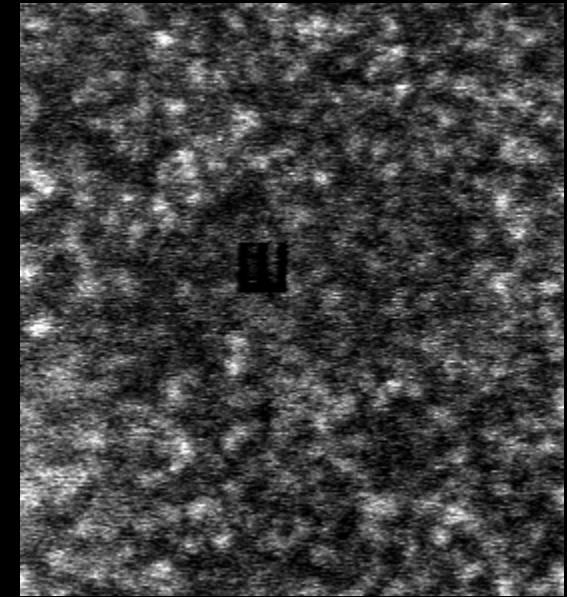
Condition 1

- 6mm pupil
- Uncorrected



Condition 2

- 6mm pupil
- AO corrected



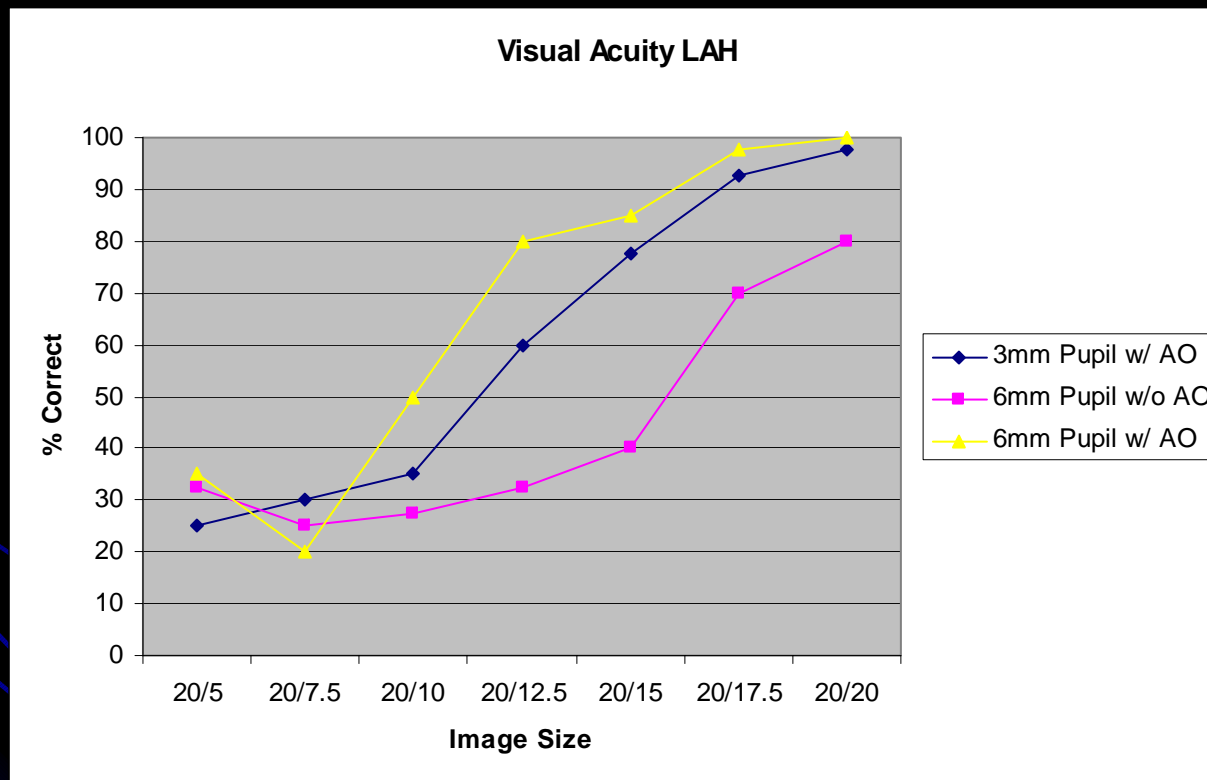
Condition 3

- 3 mm pupil
- AO Corrected

- An E is presented and the subject is asked to make a choice of the orientation



Visual Acuity Plot



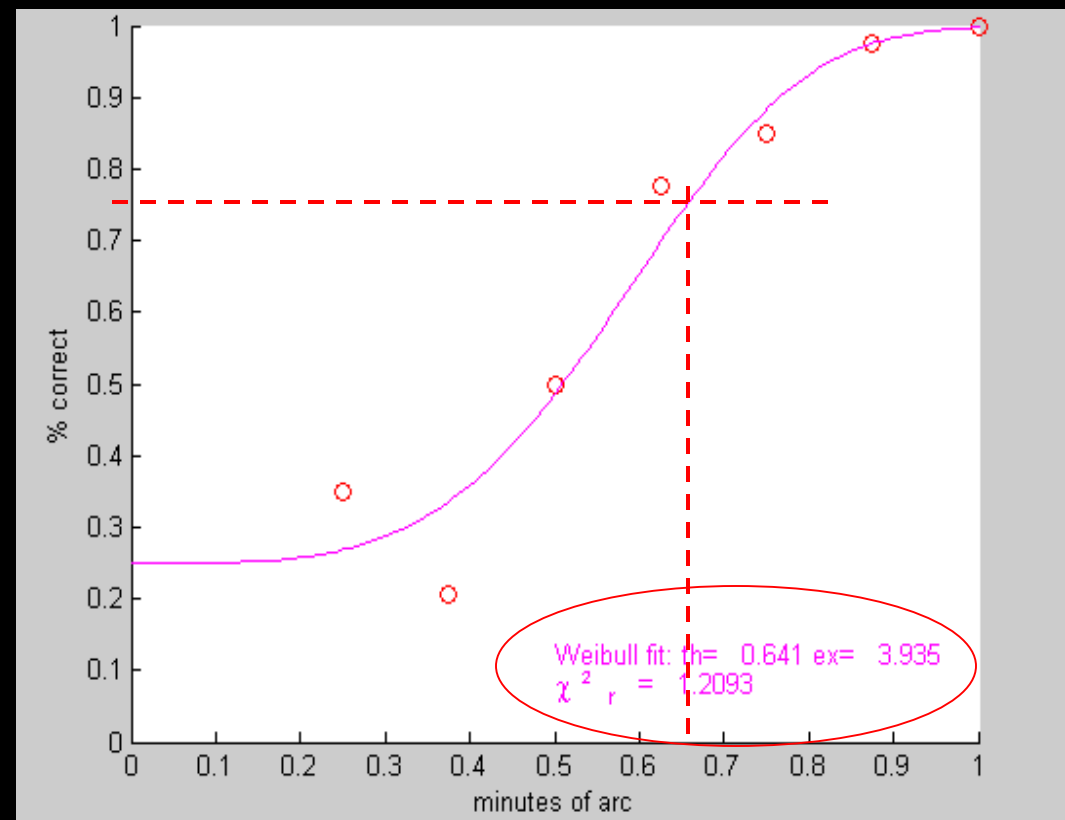


Psychometric Function Fit

VA= Threshold *20

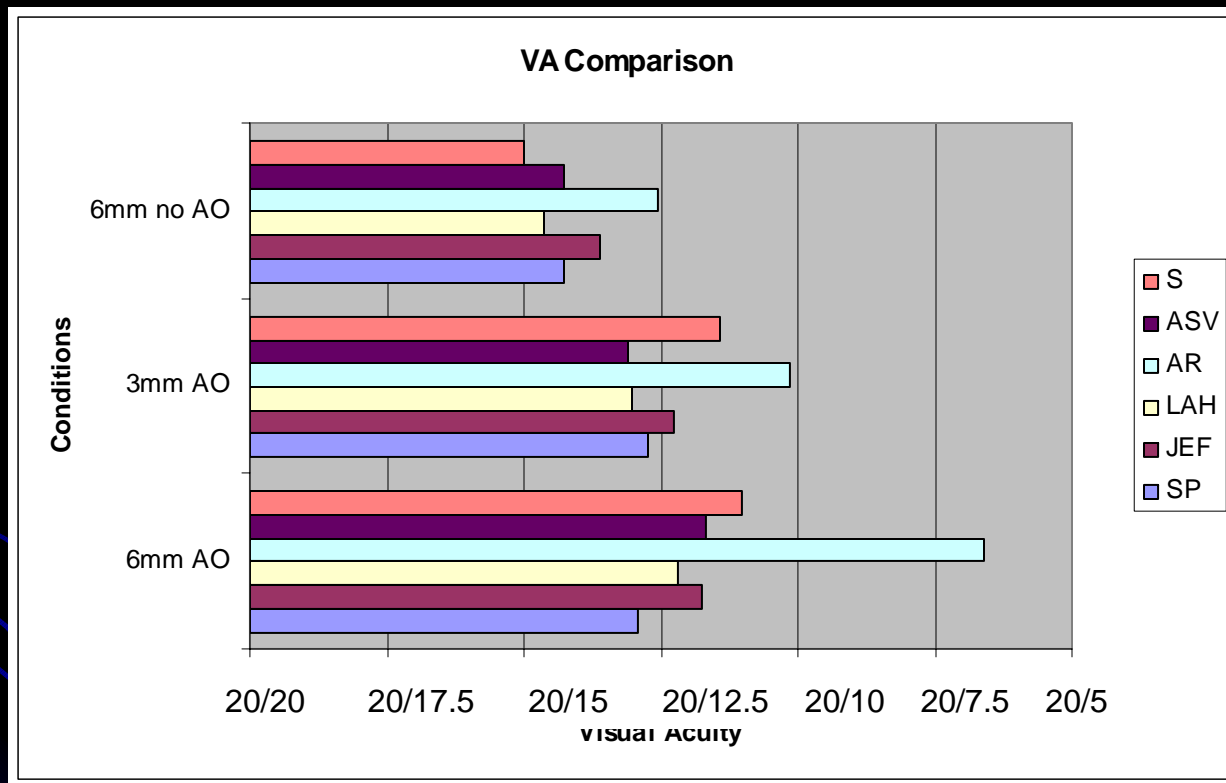
➤ VA= .641* 20 = 12.82

➤ VA=20/12.82



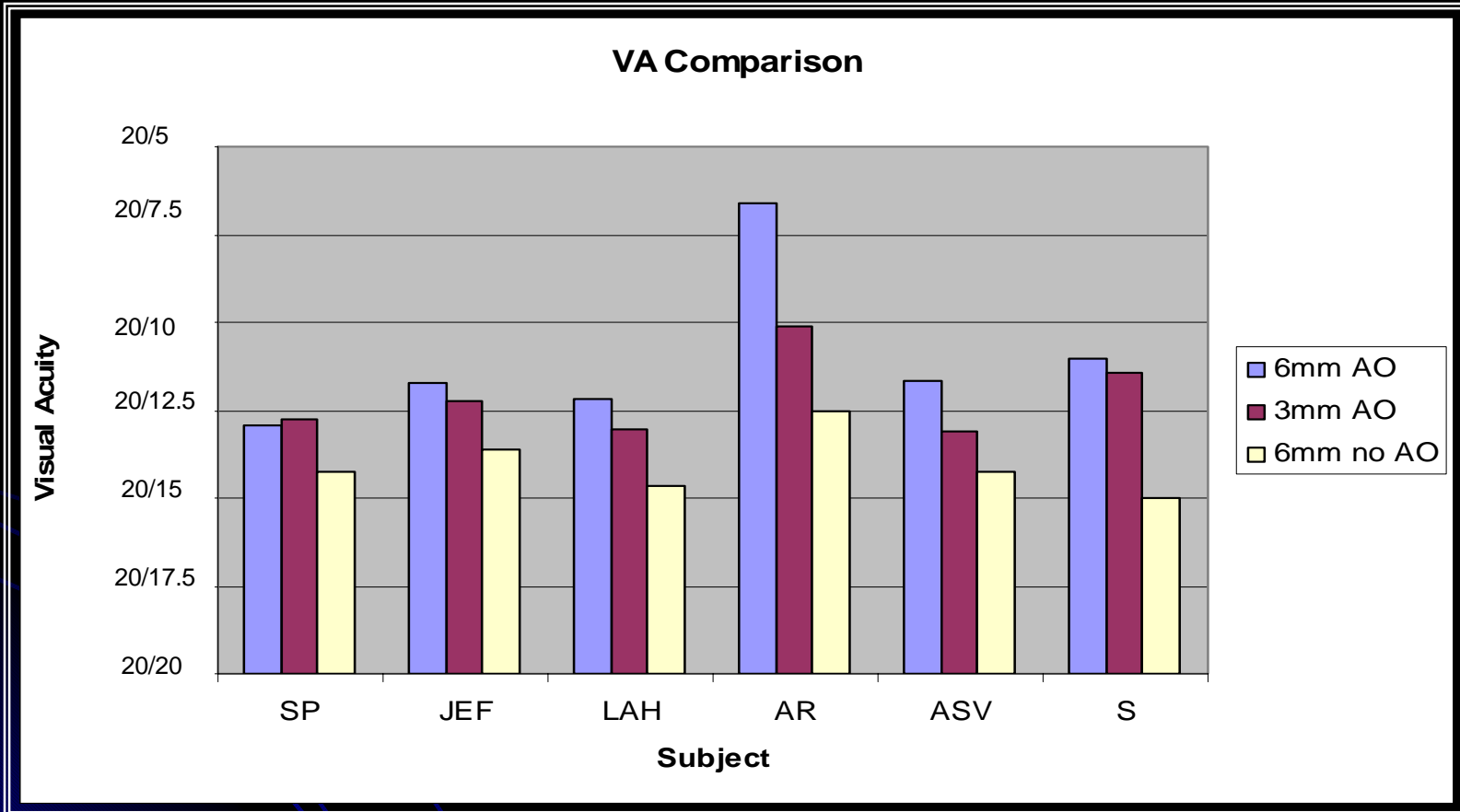


Results





Results





Final analysis

- AO can help improve visual acuity, but is limited by:
 - Sampling limits (photoreceptor density)
 - Neural limitations



References & Acknowledgements

- <http://www.mdsupport.org/library/acuity.html>
- <http://webvision.med.utah.edu/KallSpatial.html>
- <http://www.bcs.rochester.edu/people/williams/yon.2002.pdf>
- Austin Roorda
- Siddharth Poonja
- This project was supported by a Research Experiences for Undergraduates (REU) supplement to the national Science Foundation and Technology Center for Adaptive optics, managed by the University of California at Santa Cruz under a cooperative agreement No. AST-9876783

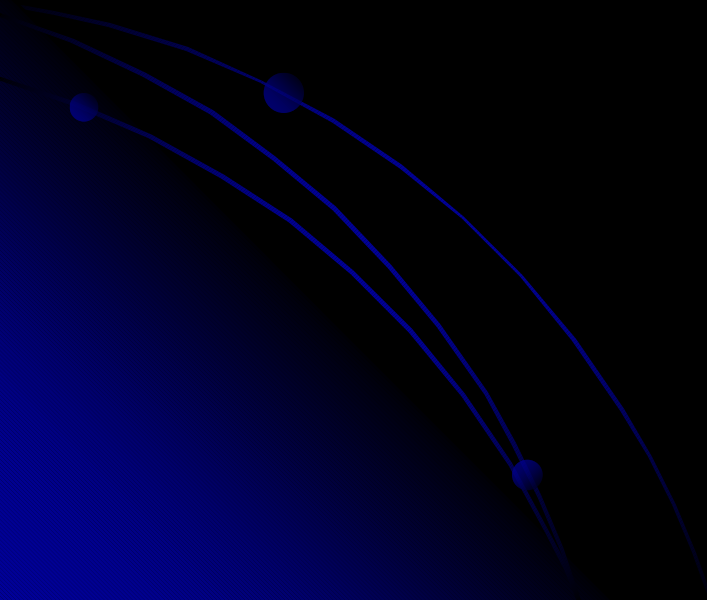


Austin Roorda Lab





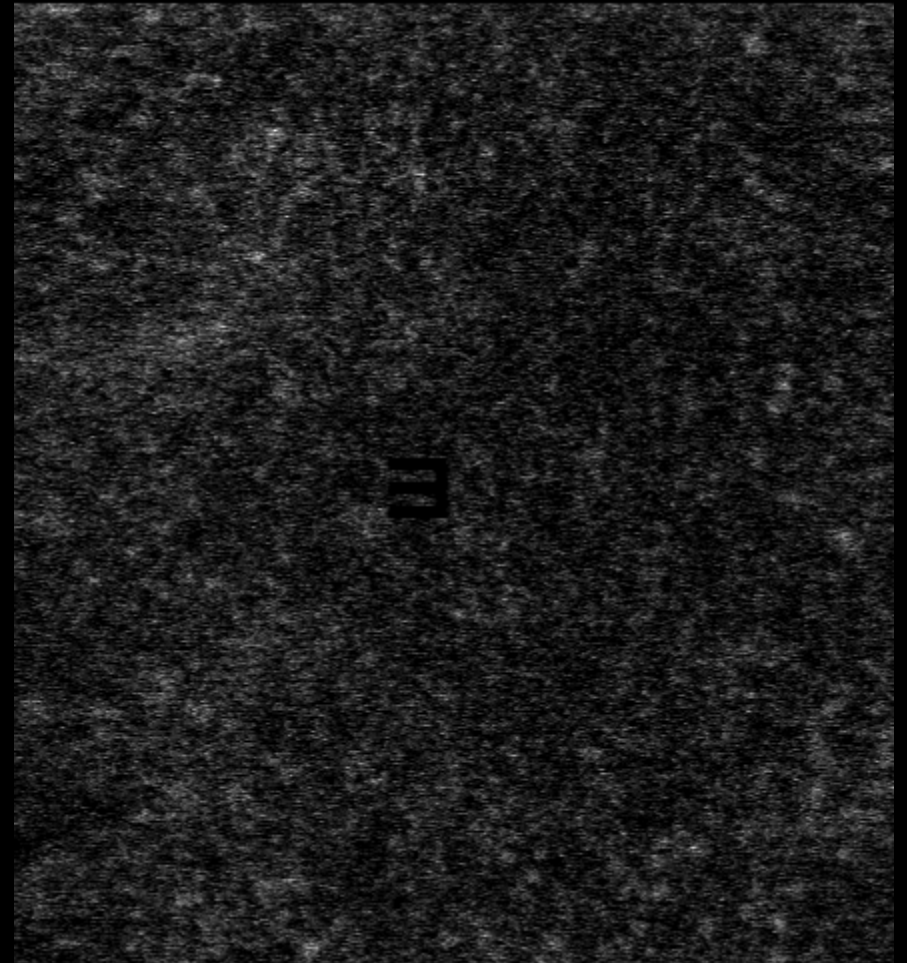
Thank You





Condition 1

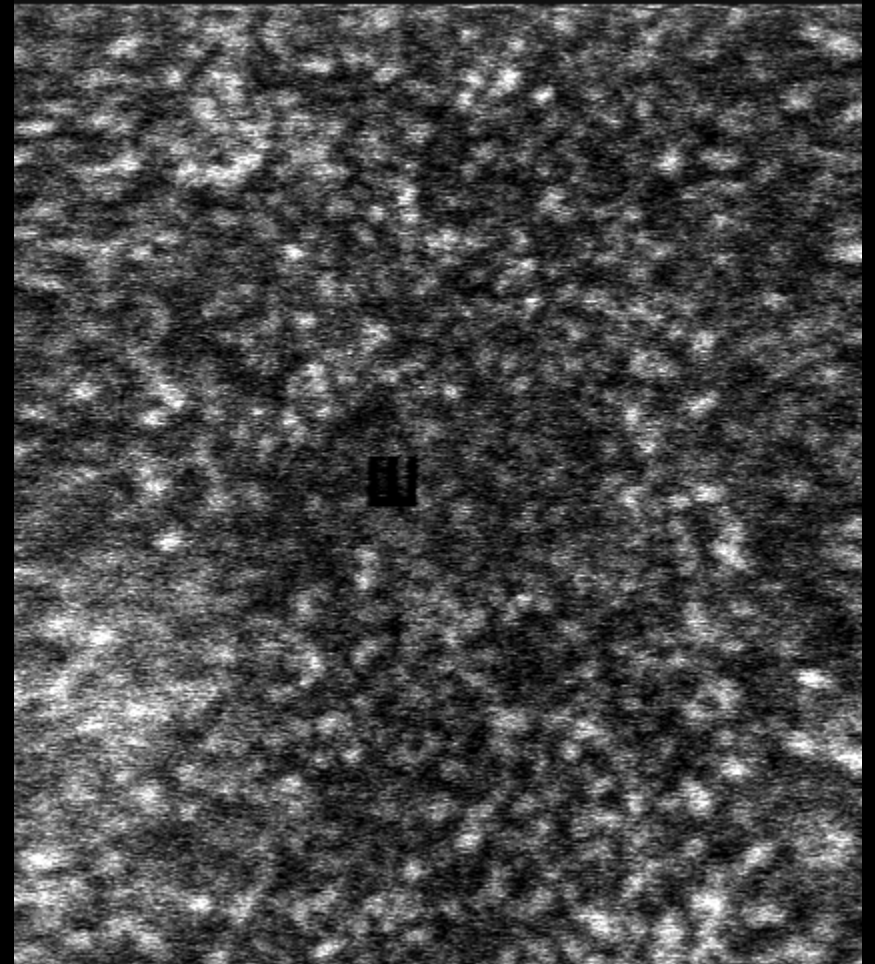
- Subject LAH, 6 mm pupil without AO
- An E is presented and the subject is asked to make a choice or orientation





Condition 3

- Subject LAH, 3 mm pupil with AO
- An E is presented and the subject is asked to make a choice or orientation





Condition 2

- Subject LAH, 6 mm pupil with AO
- An E is presented and the subject is asked to make a choice of the orientation

