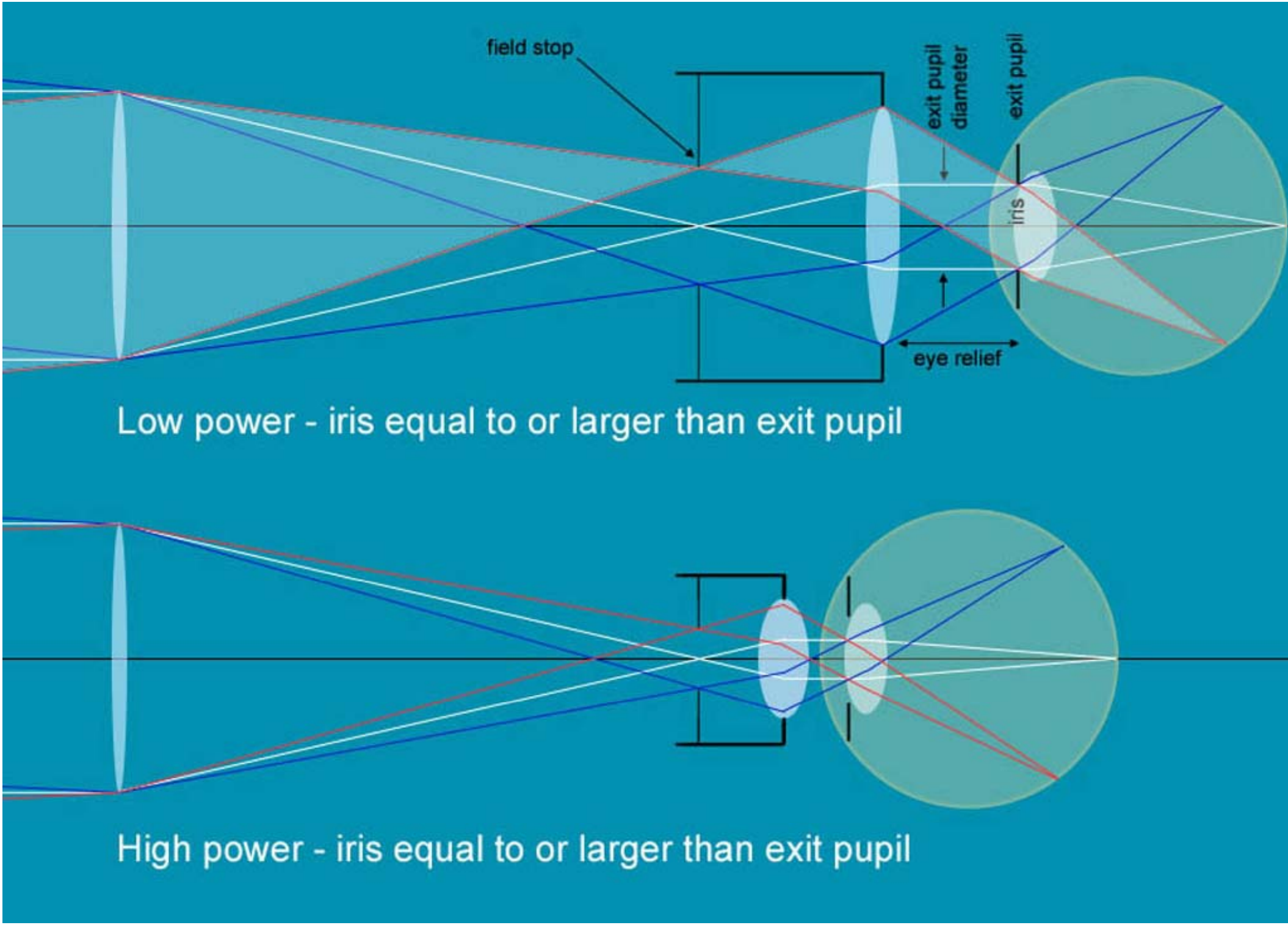
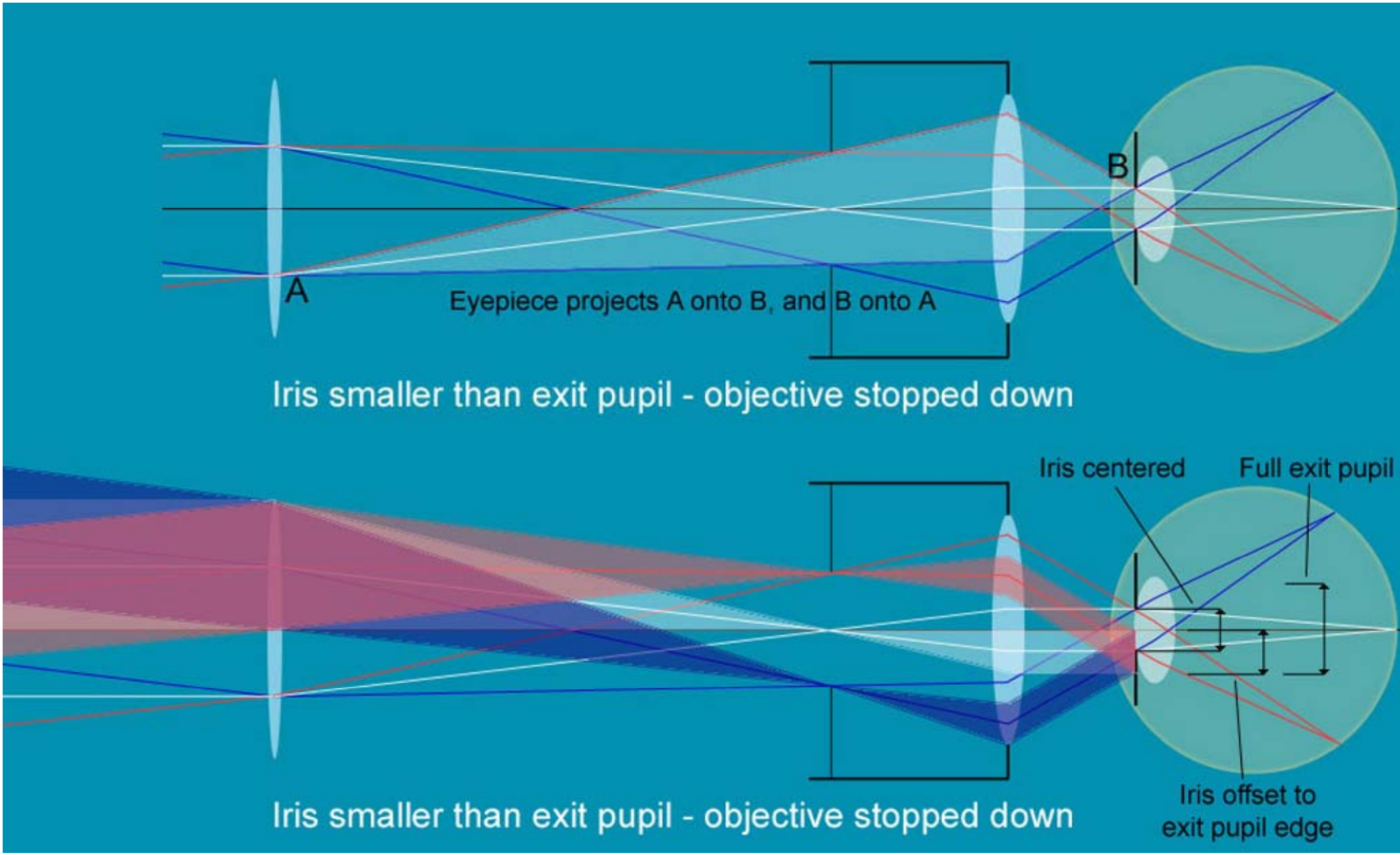
Binoculars for Astronomy

Glenn LeDrew


field stop
exit pupil diameter
exit pupil
iris
eye relief
Low power - iris equal to or larger than exit pupil
High power - iris equal to or larger than exit pupil


A
B
Eyepiece projects A onto B, and B onto A
Iris smaller than exit pupil - objective stopped down
Iris centered
Full exit pupil
Iris offset to
exit pupil edge
Iris smaller than exit pupil - objective stopped down

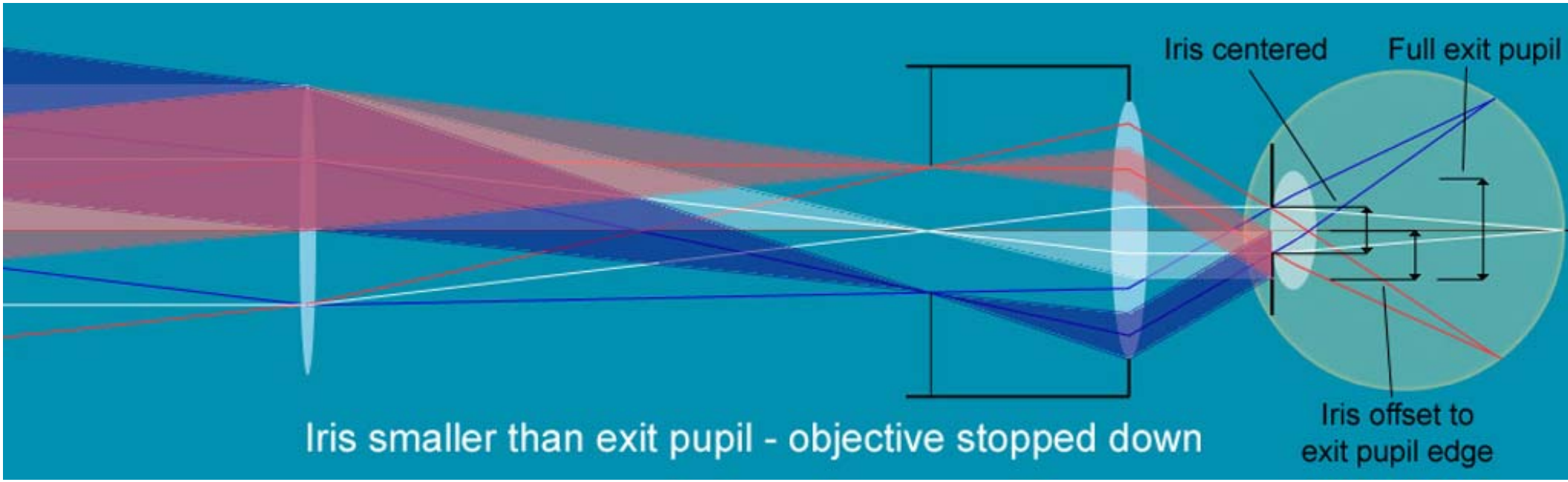
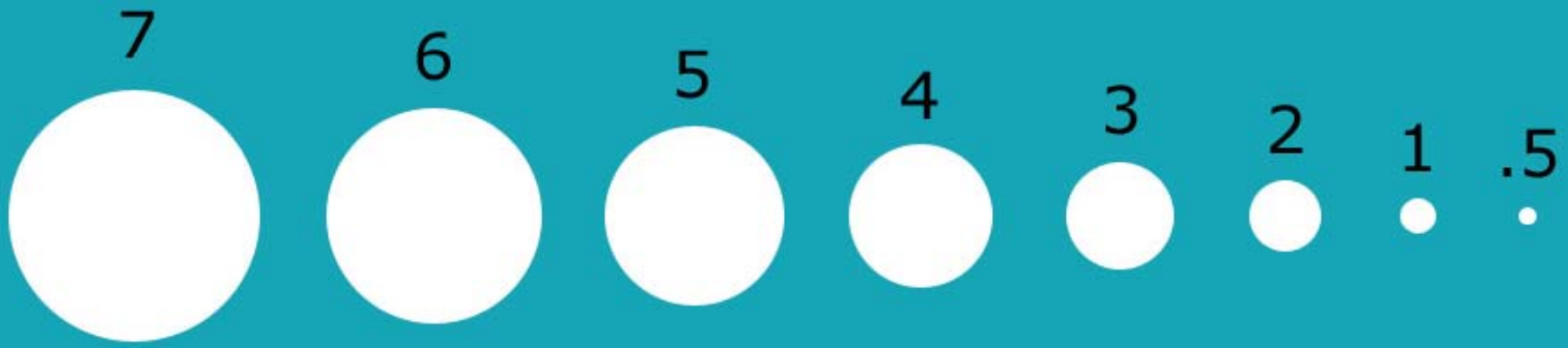

Iris centered
Full exit pupil
Iris smaller than exit pupil - objective stopped down
Iris offset to
exit pupil edge

Image Brightness by Exit Pupil Diameter

(relative to observer's maximum eye pupil)



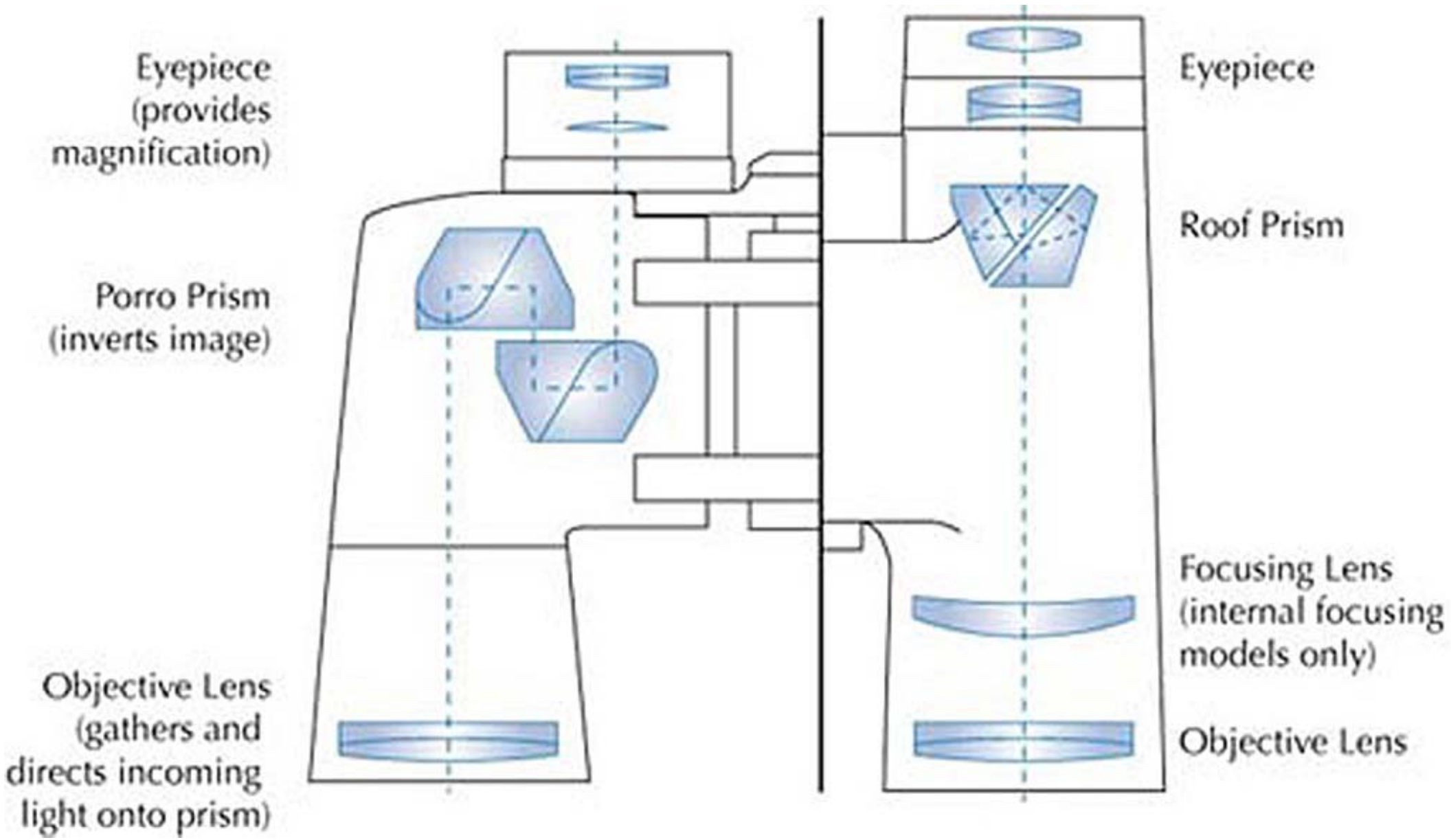
7	6	5	4	3	2	1	.5
100	73	51	33	18	8	2	.5
	100	69	44	25	11	3	.7
		100	64	36	16	4	1

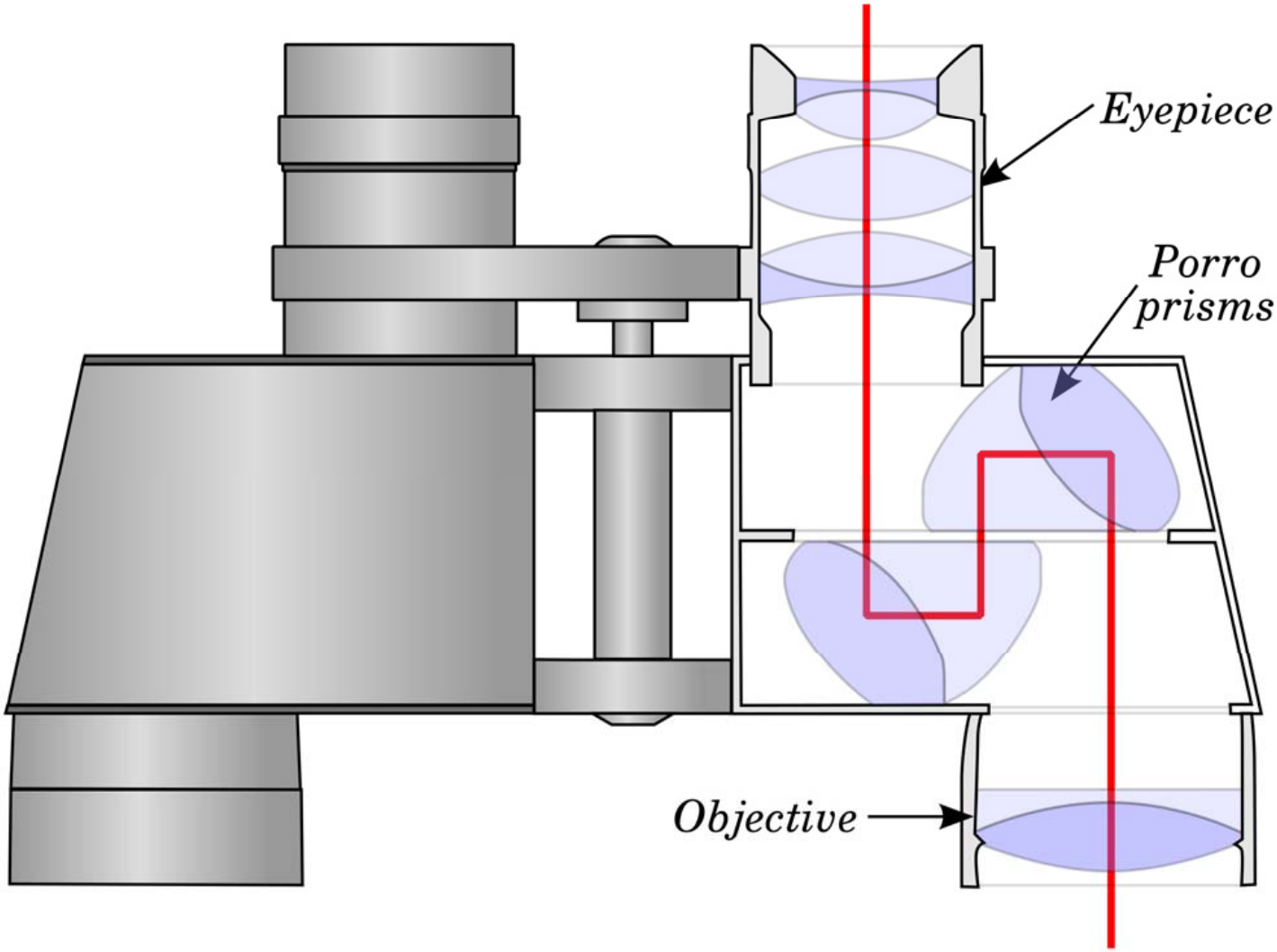
Dimming With Respect to Exit Pupil Diameter

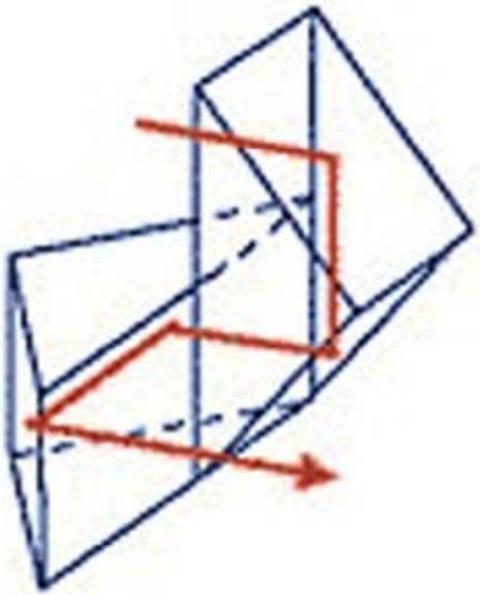
8	7	6	5	4	3	2	1	0.5
0.0	0.3	0.6	1.0	1.5	2.1	3.0	4.5	6.0

7	6	5	4	3	2	1	0.5
0.0	0.3	0.7	1.2	1.8	2.7	4.2	5.7

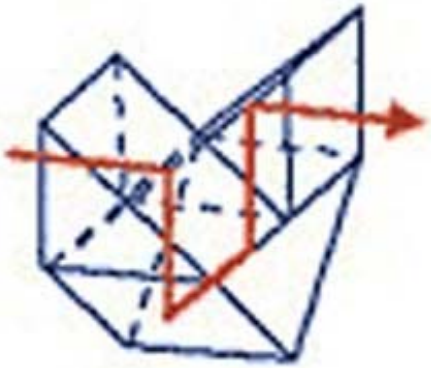
6	5	4	3	2	1	0.5
0.0	0.4	0.9	1.5	2.4	3.9	5.4


Eyepiece
(provides
magnification)
Porro Prism
(inverts image)
Objective Lens
(gathers and
directs incoming
light onto prism)
Eyepiece
Roof Prism
Focusing Lens
(internal focusing
models only)
Objective Lens

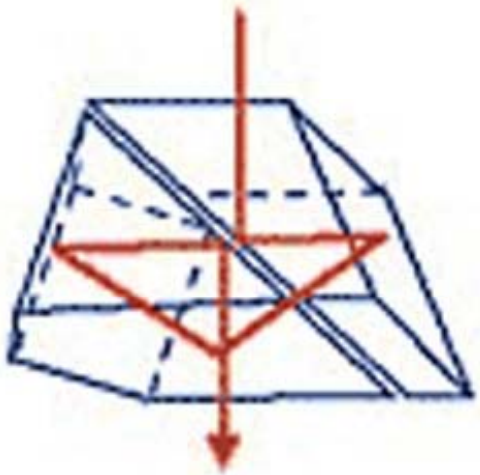

Eyepiece
Porro prisms
Objective



Porro 1

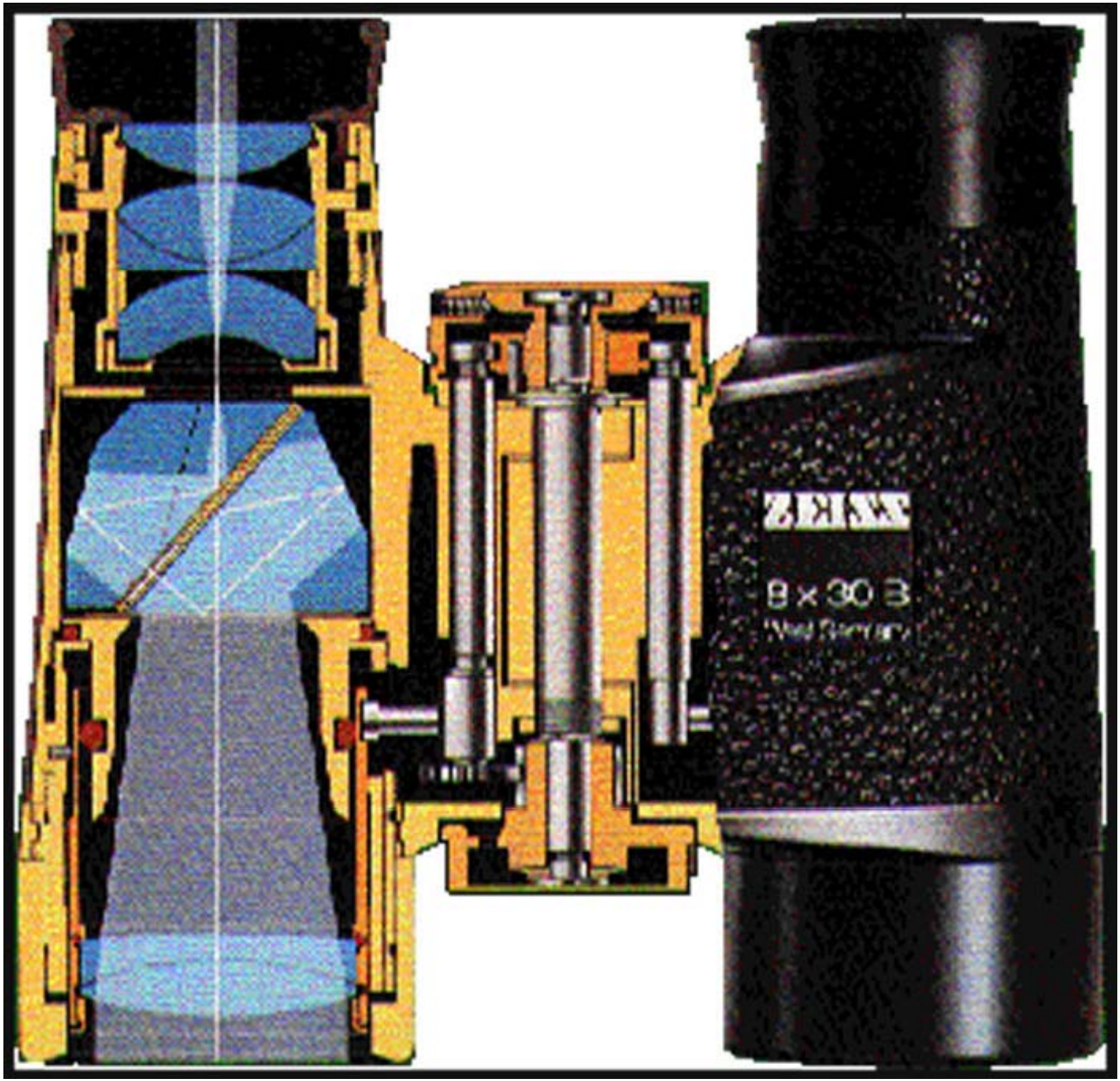


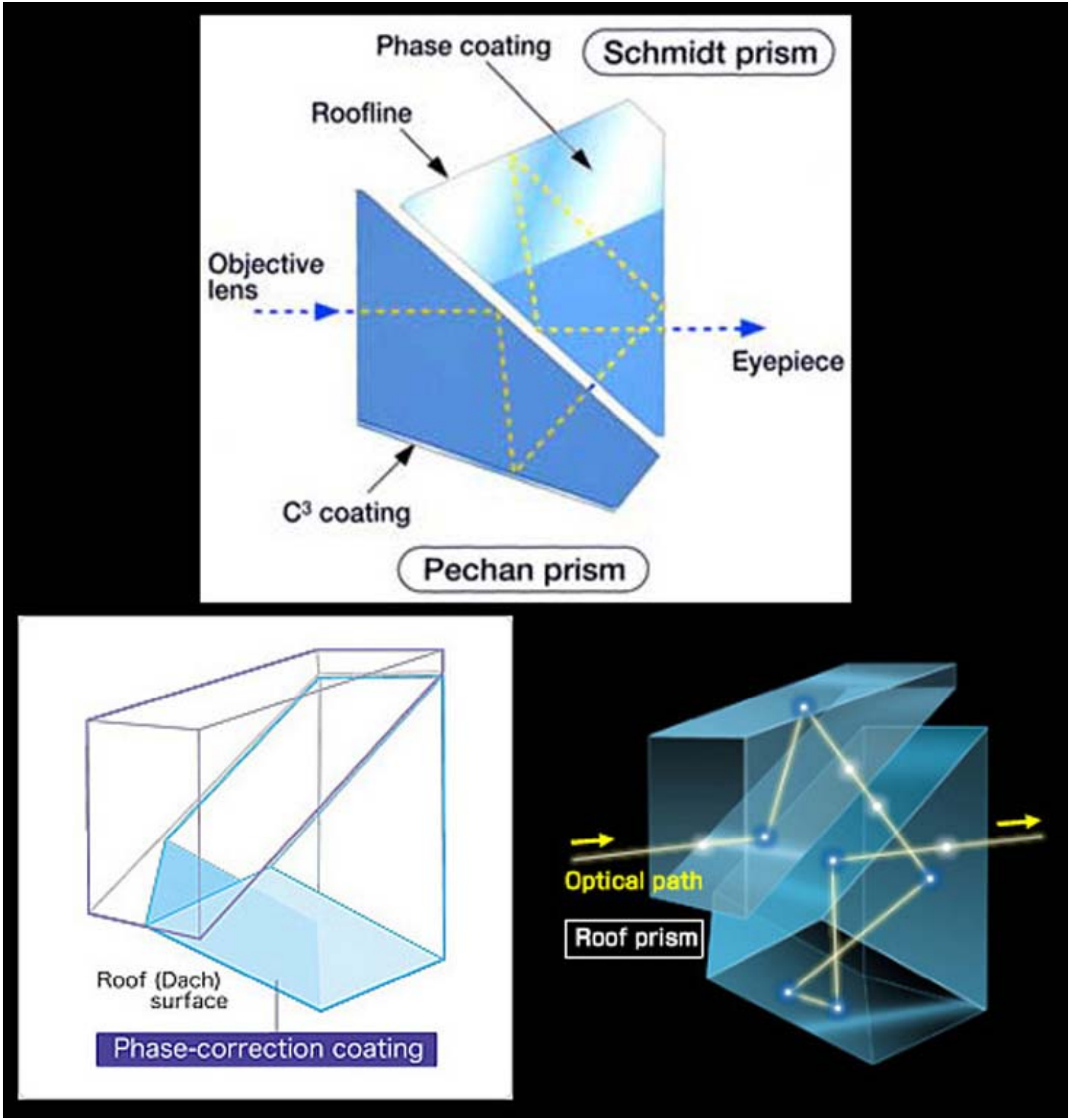
Porro 2

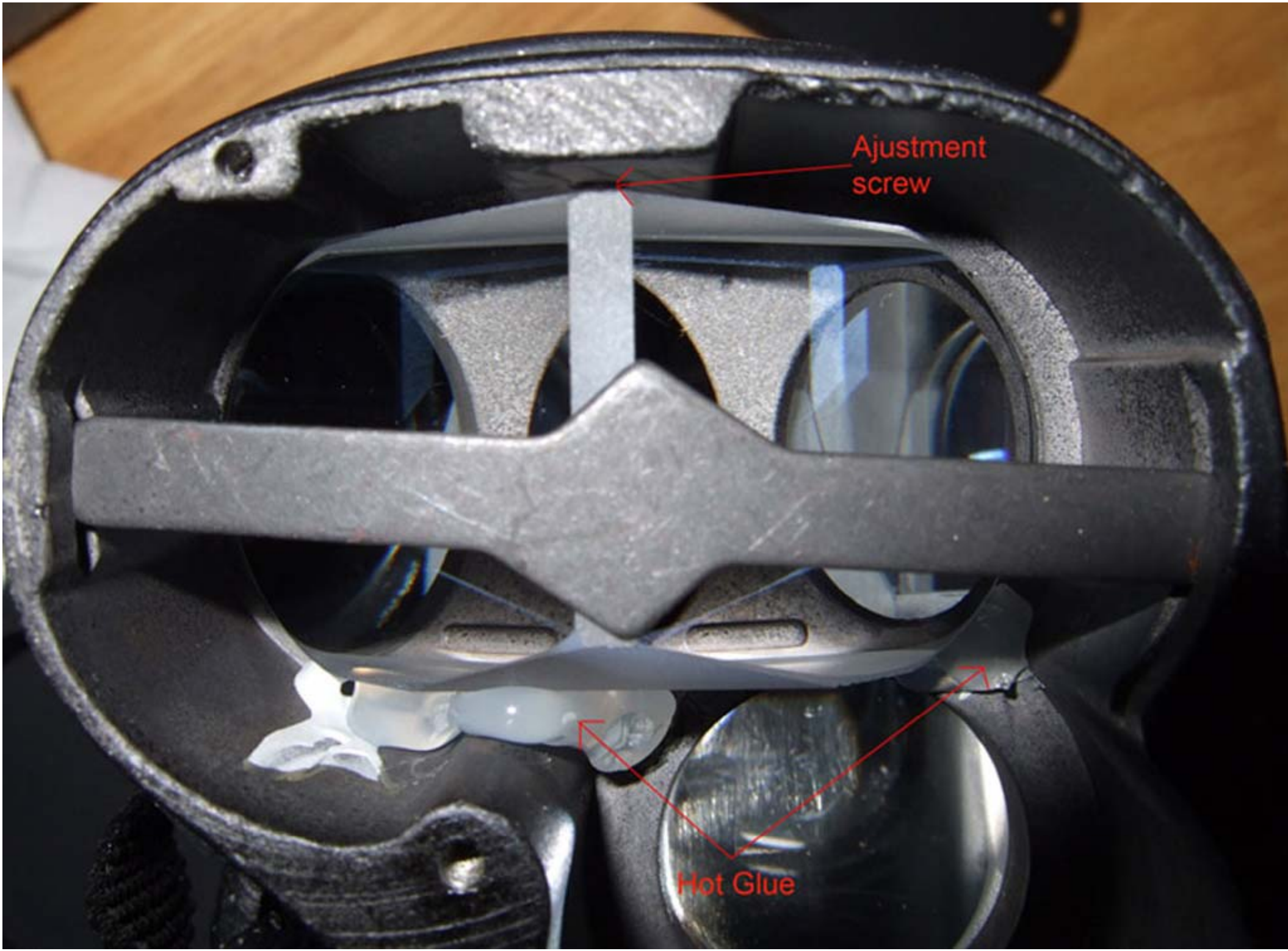


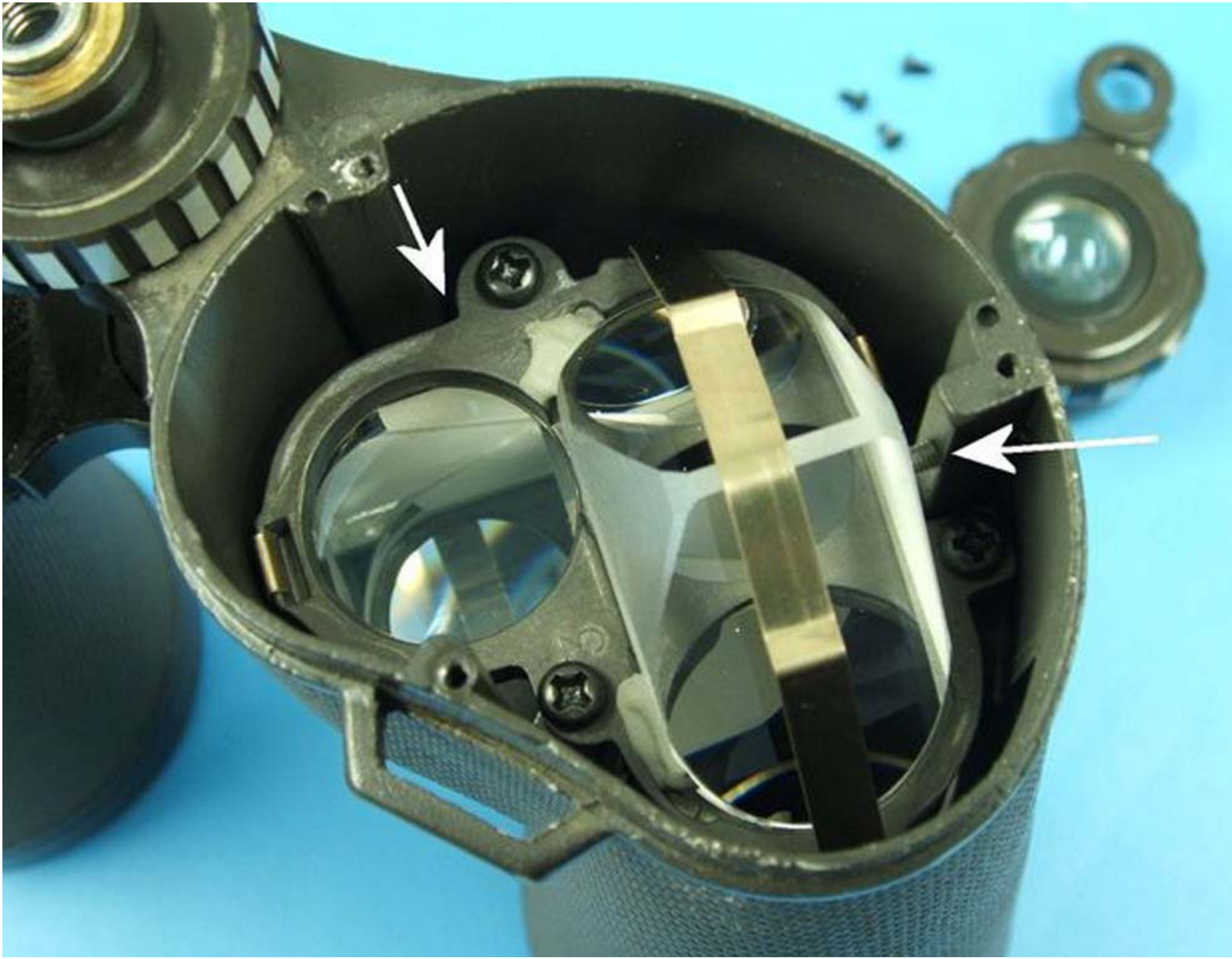
Pechan

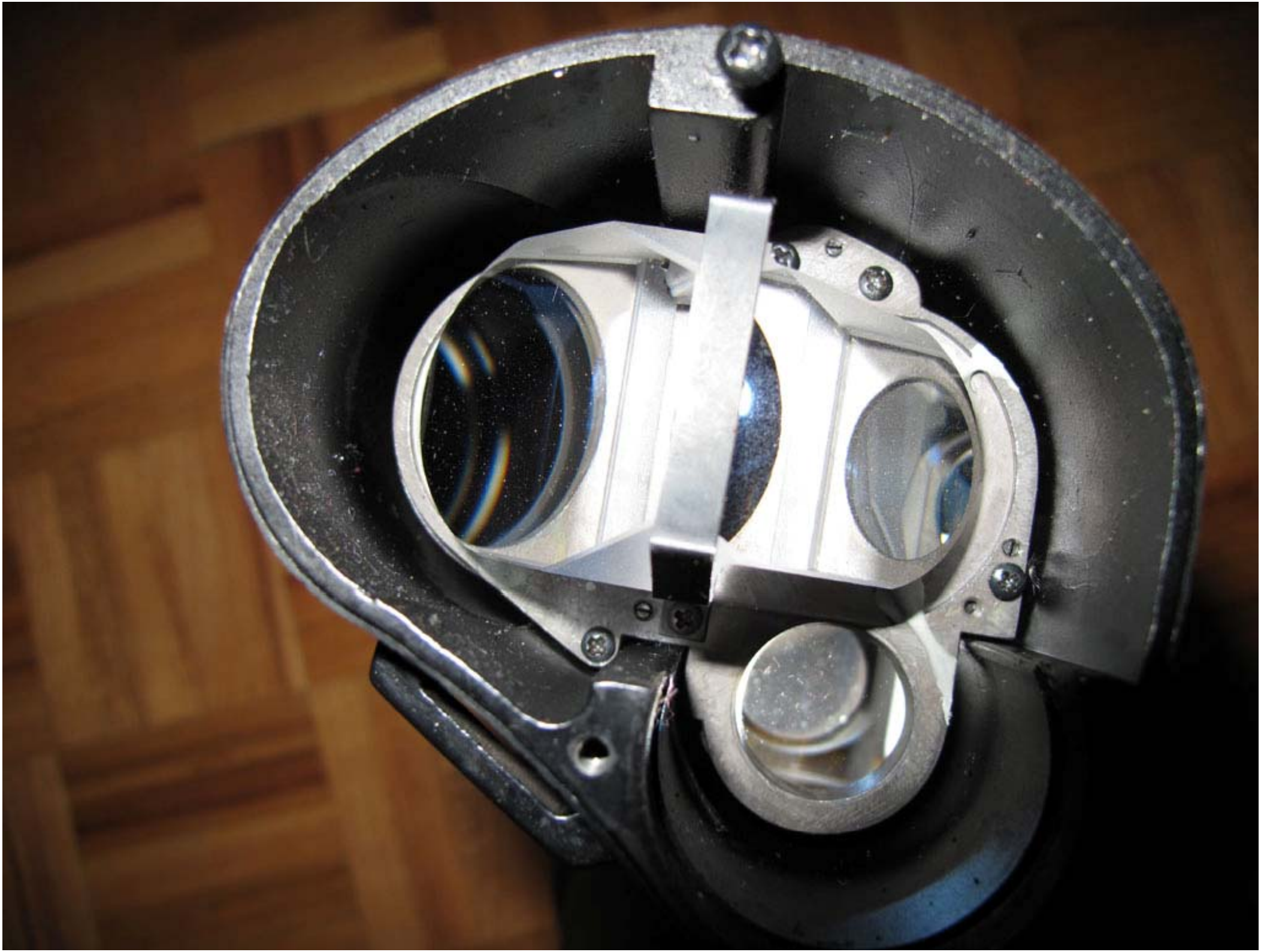
Abbe König

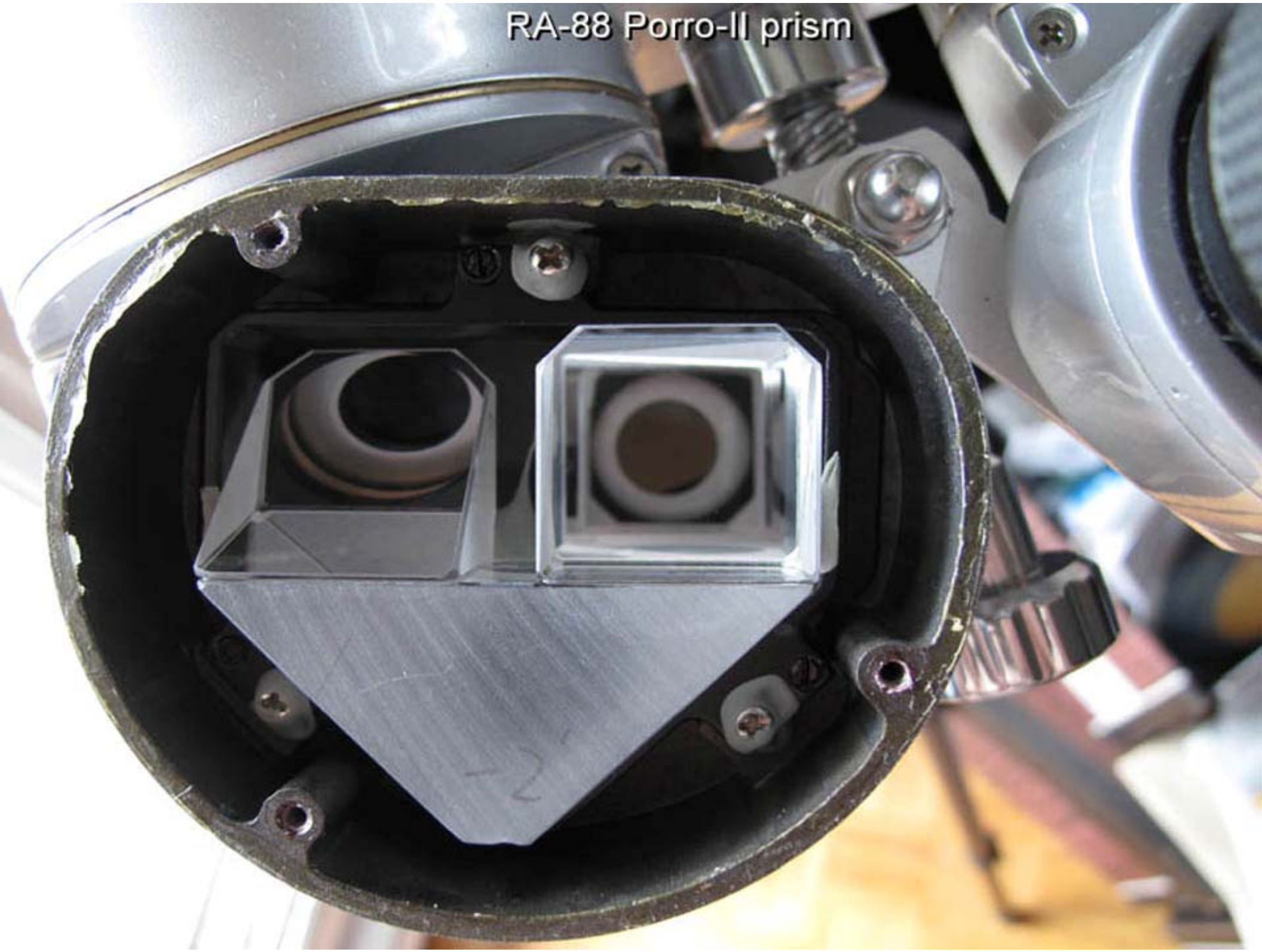

ZEISS
8 x 30 B


Phase coating
Schmidt prism
Roofline
Objective lens
Eyepiece
C³ coating
Pechan prism
Roof (Dach) surface
Phase-correction coating
Optical path
Roof prism

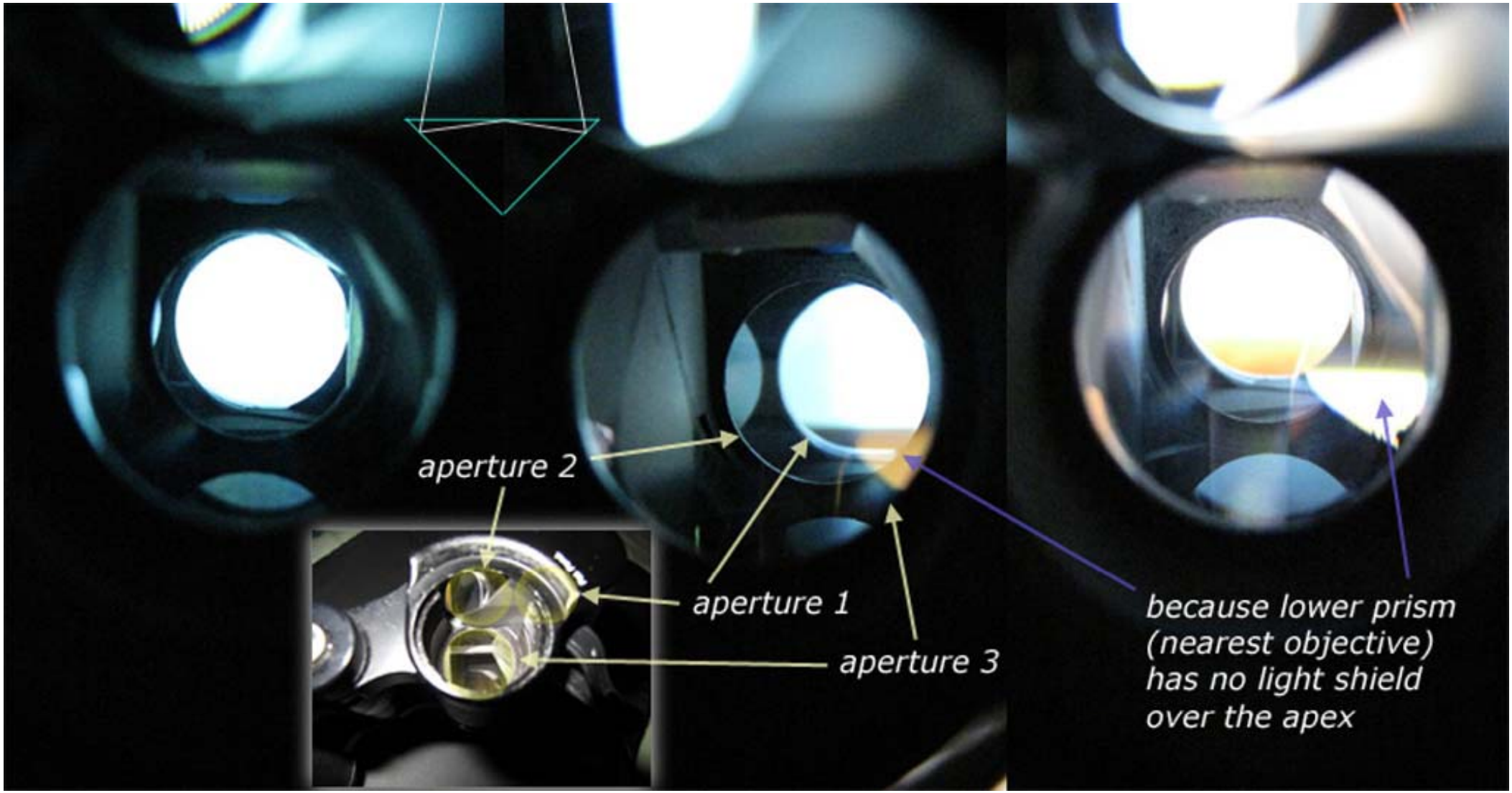

Ajustment
screw
Hot Glue






RA-88 Porro-II prism


50X50


aperture 2
aperture 1
aperture 3
because lower prism
(nearest objective)
has no light shield
over the apex

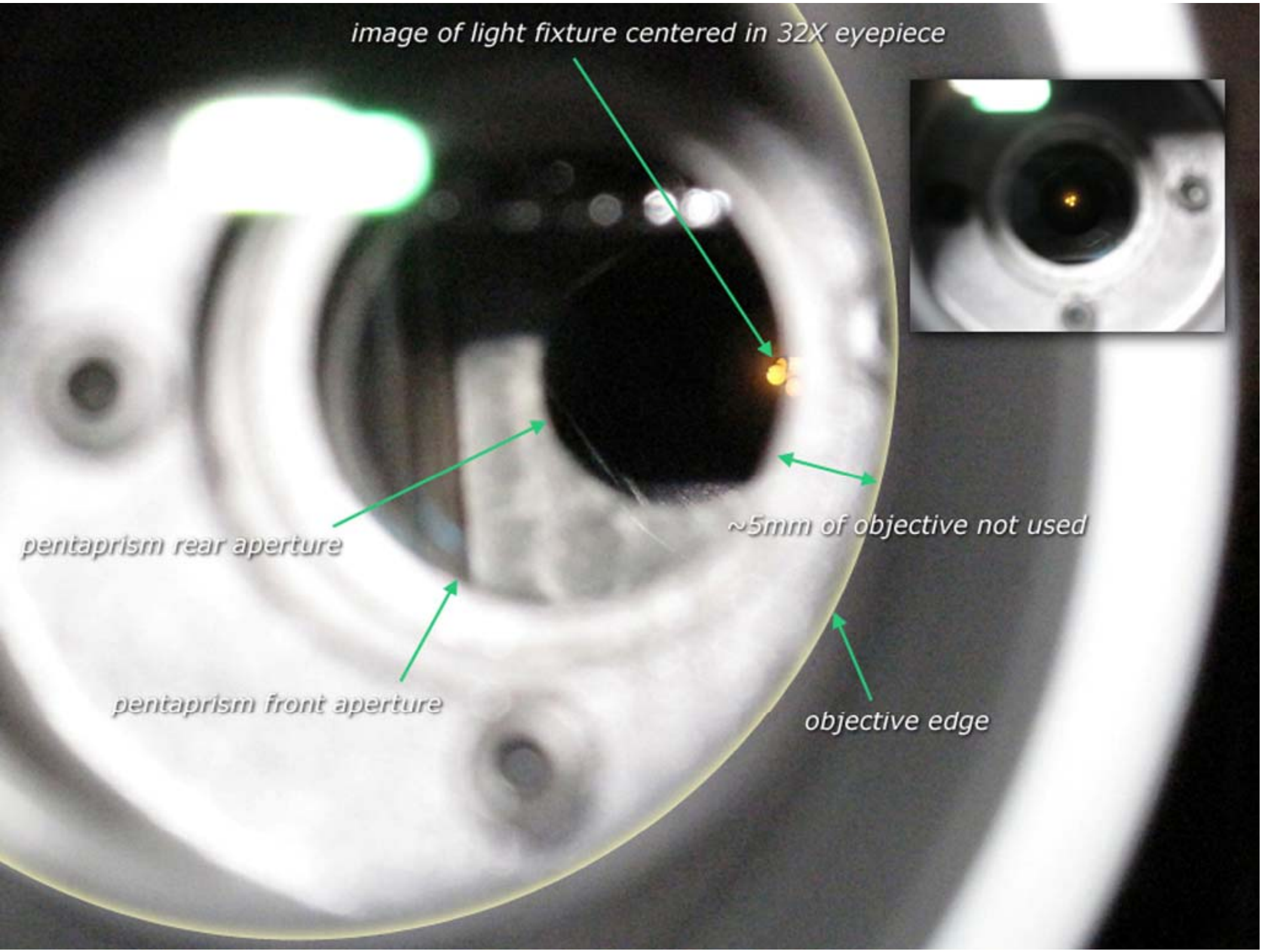
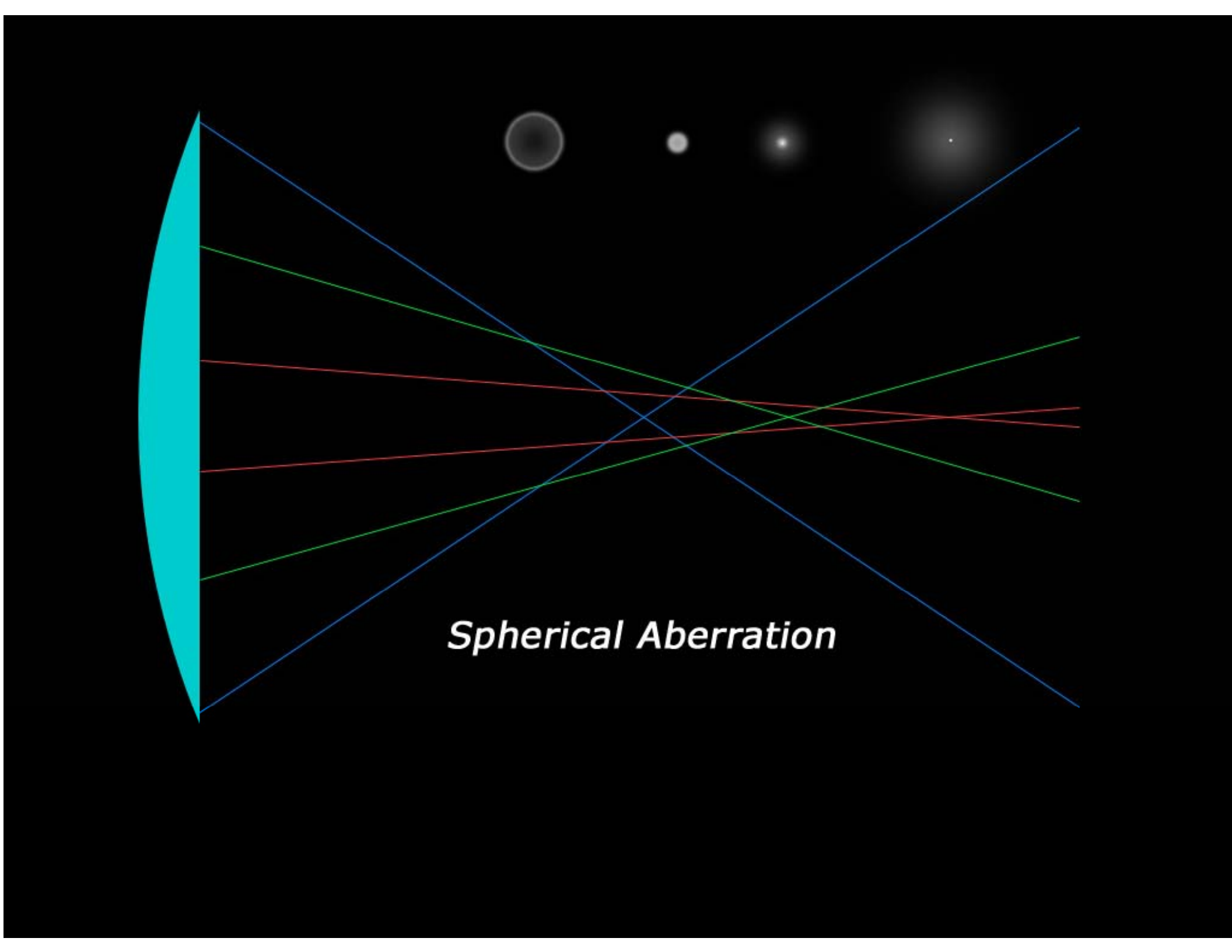
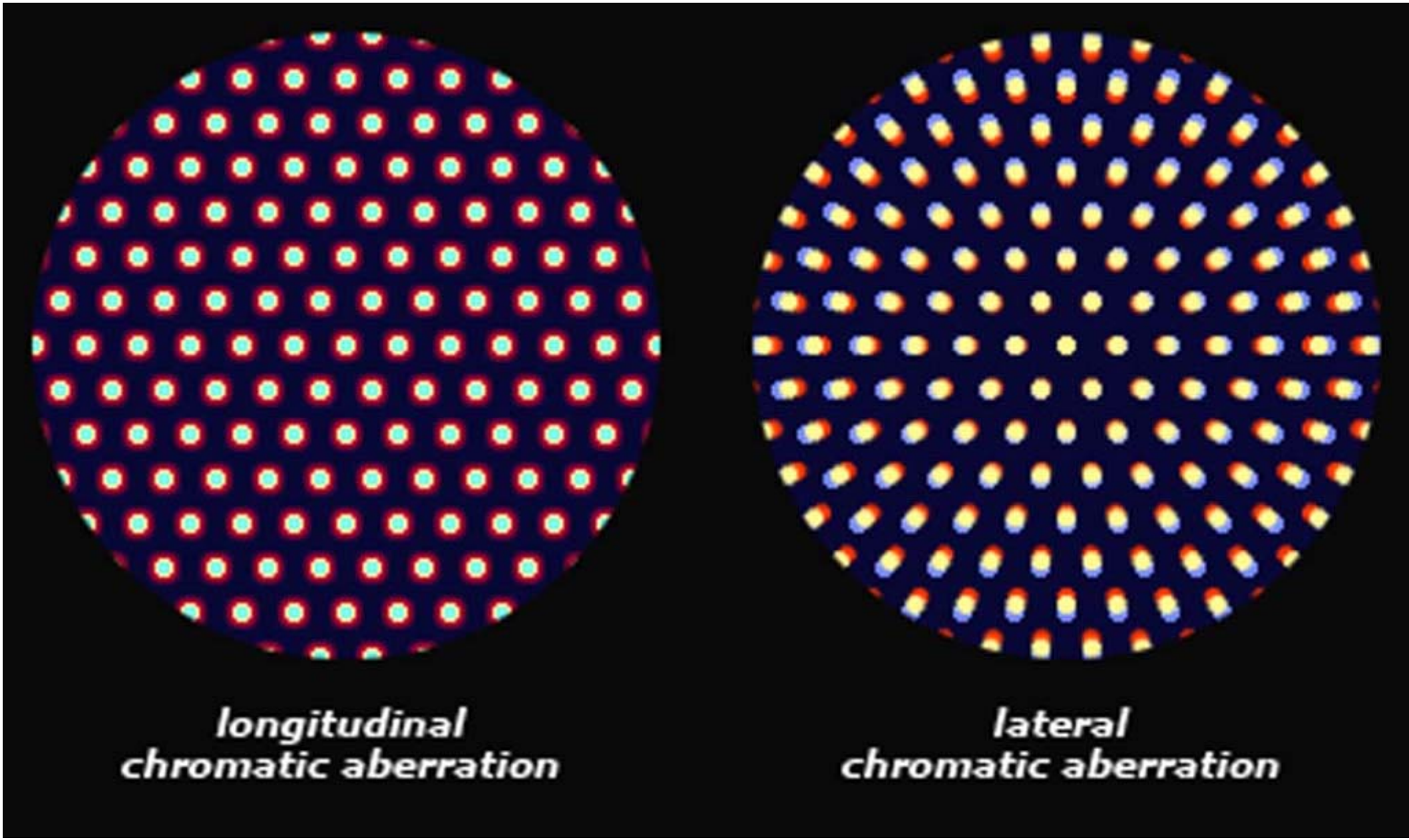
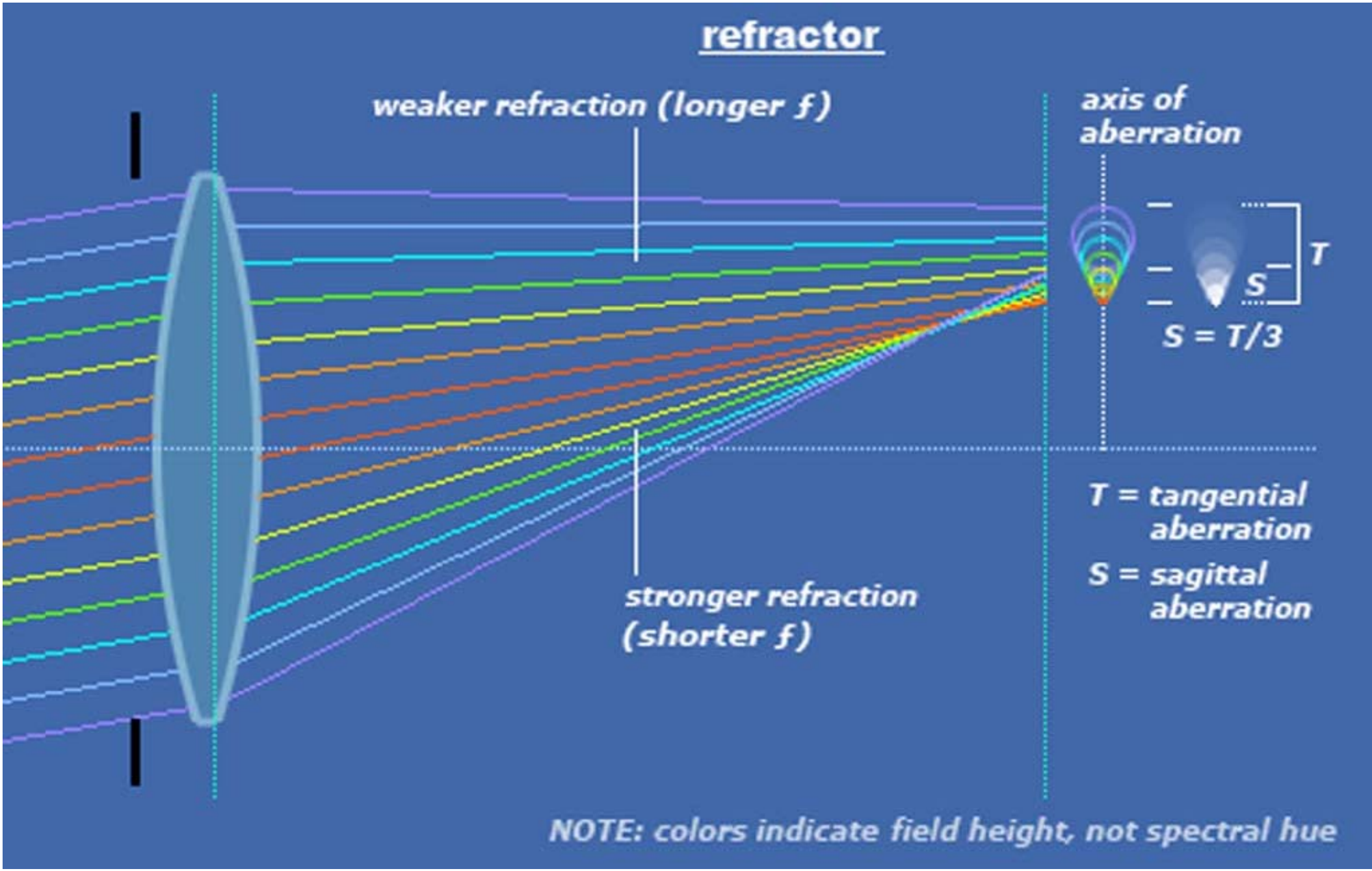


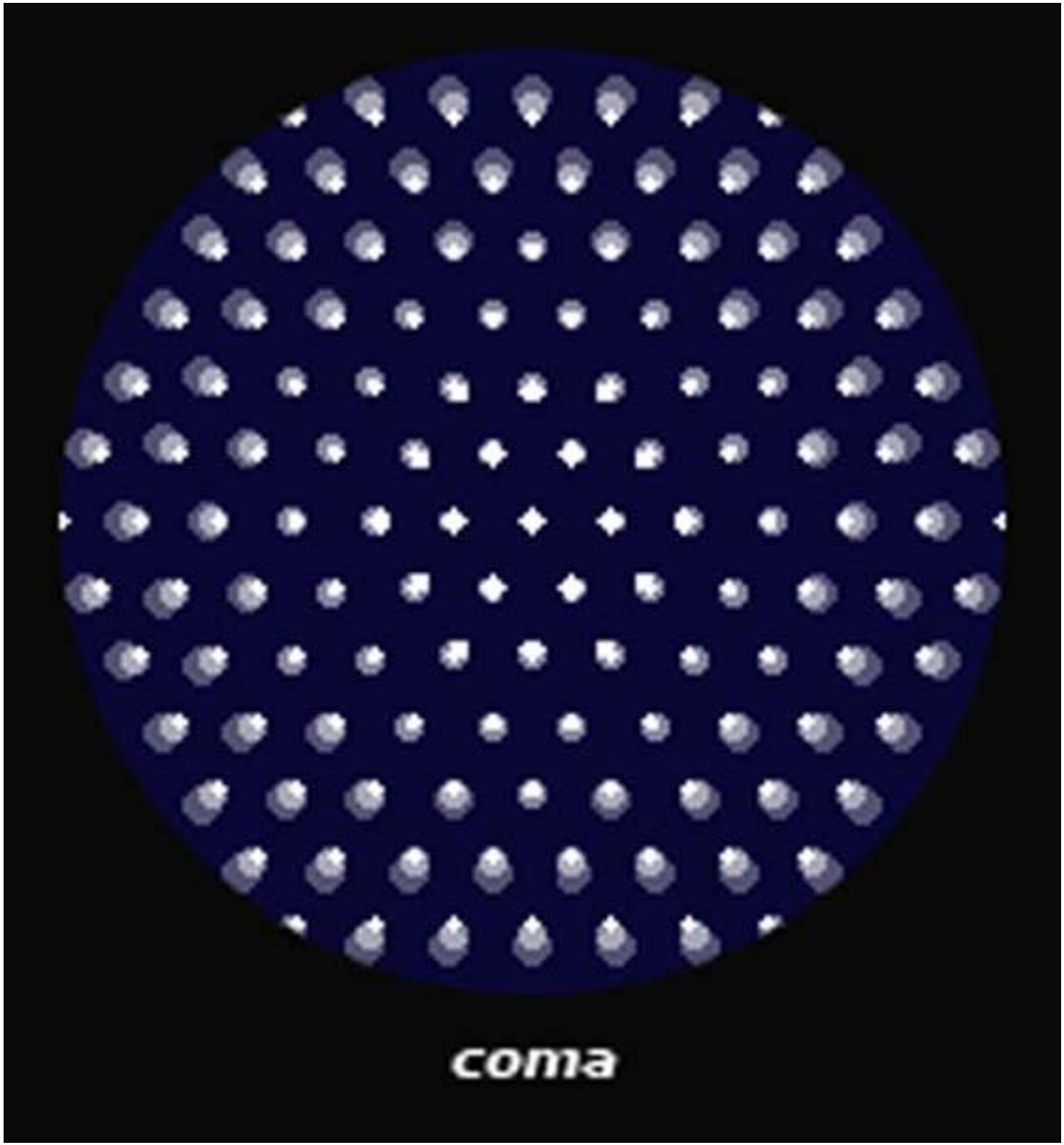
image of light fixture centered in 32X eyepiece
pentaprism rear aperture
~5mm of objective not used
pentaprism front aperture
objective edge

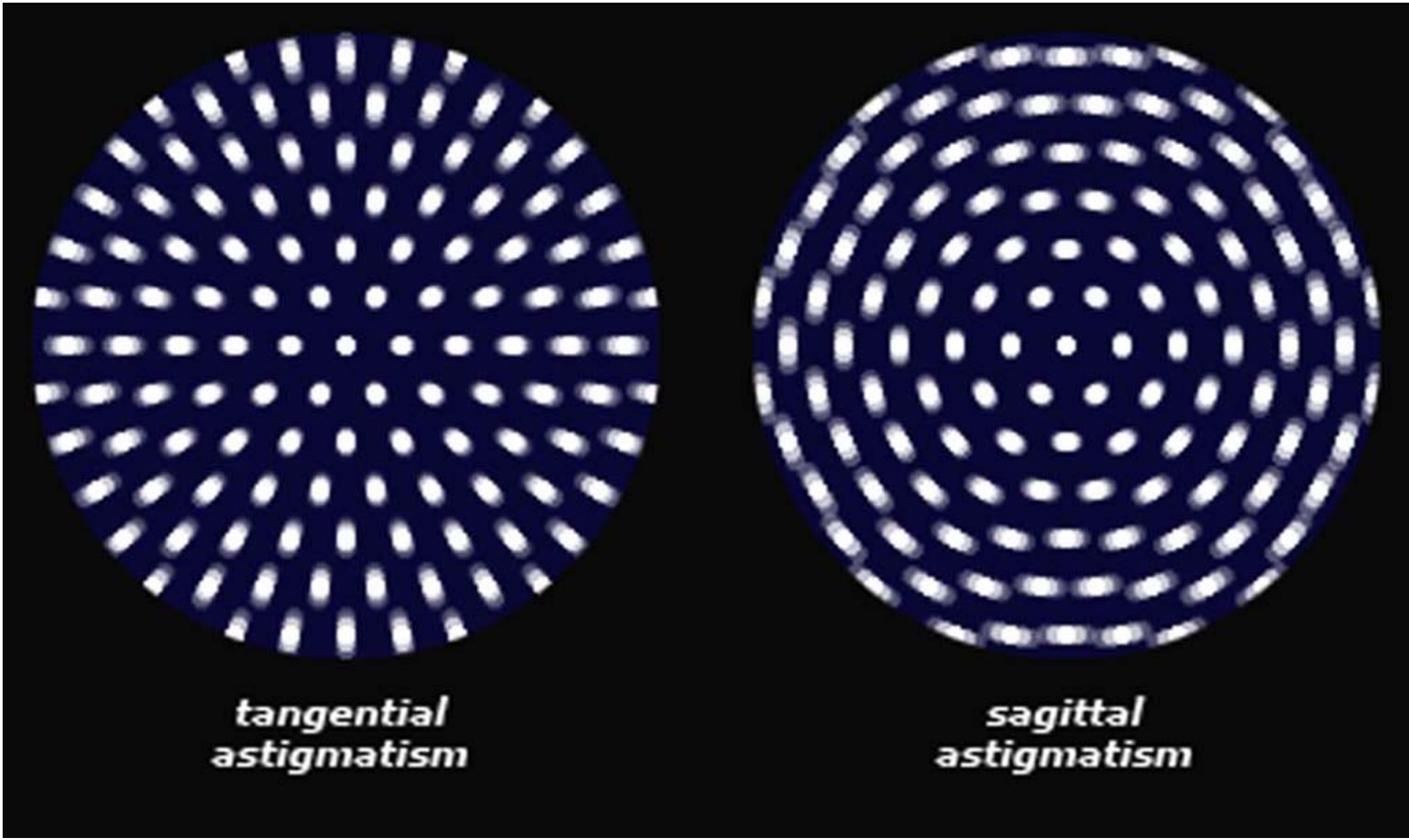

Flashlight Test for Aperture
Single-LED, focused flashlight
33mm circle
7X35
Light source at least 10X eyepiece focal length from eyepiece
Beam Expanded Laser Test for Aperture
6X30 finder
(as beam expander)
Green laser pointer
(into finder eyepiece)
33mm circle
7X35
Spacing between all components NOT critical (can be touching)
6X finder expands GLP's 1mm beam to 6mm, filling 5mm exit pupil


Spherical Aberration

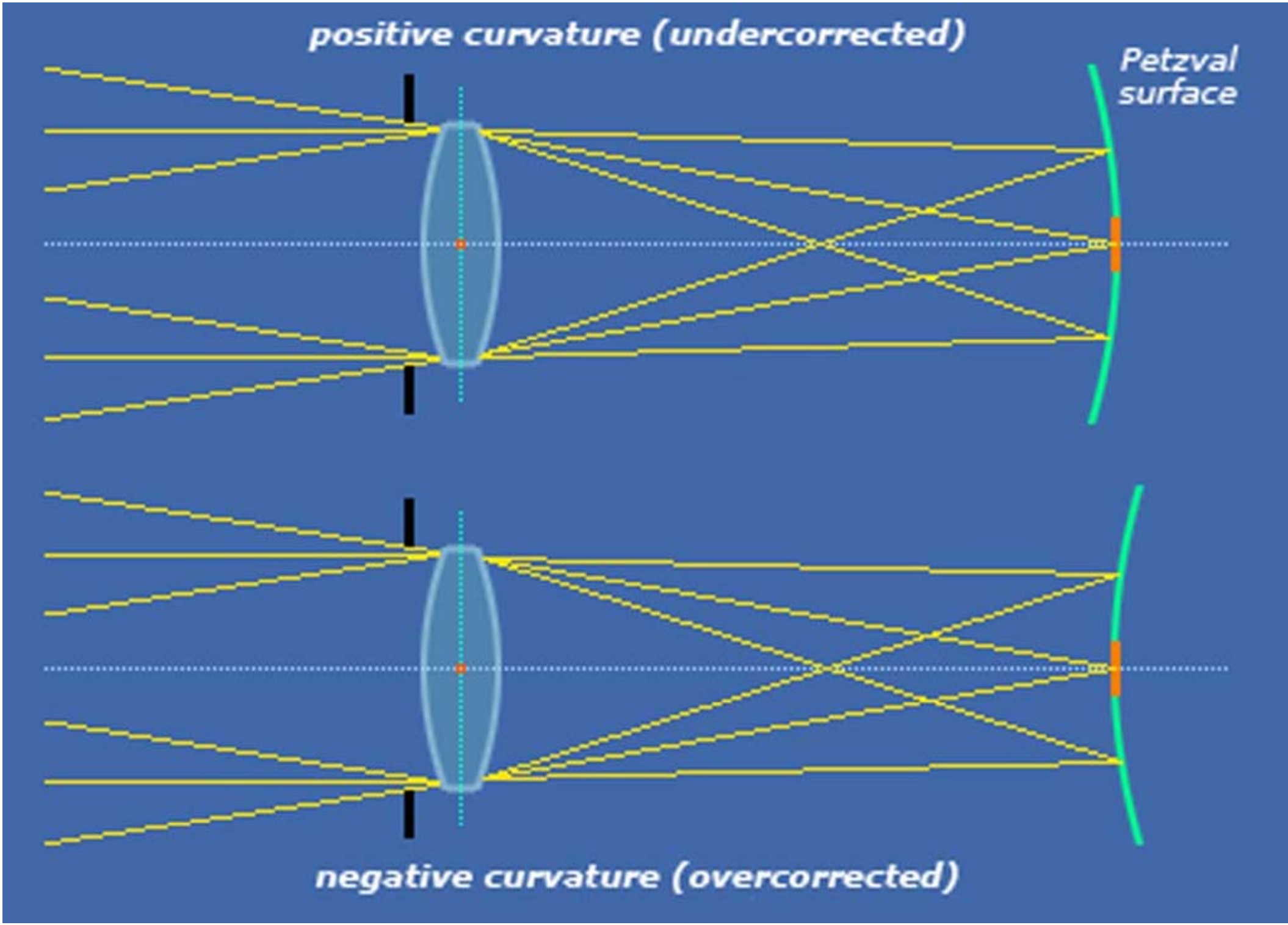

longitudinal
chromatic aberration
lateral
chromatic aberration

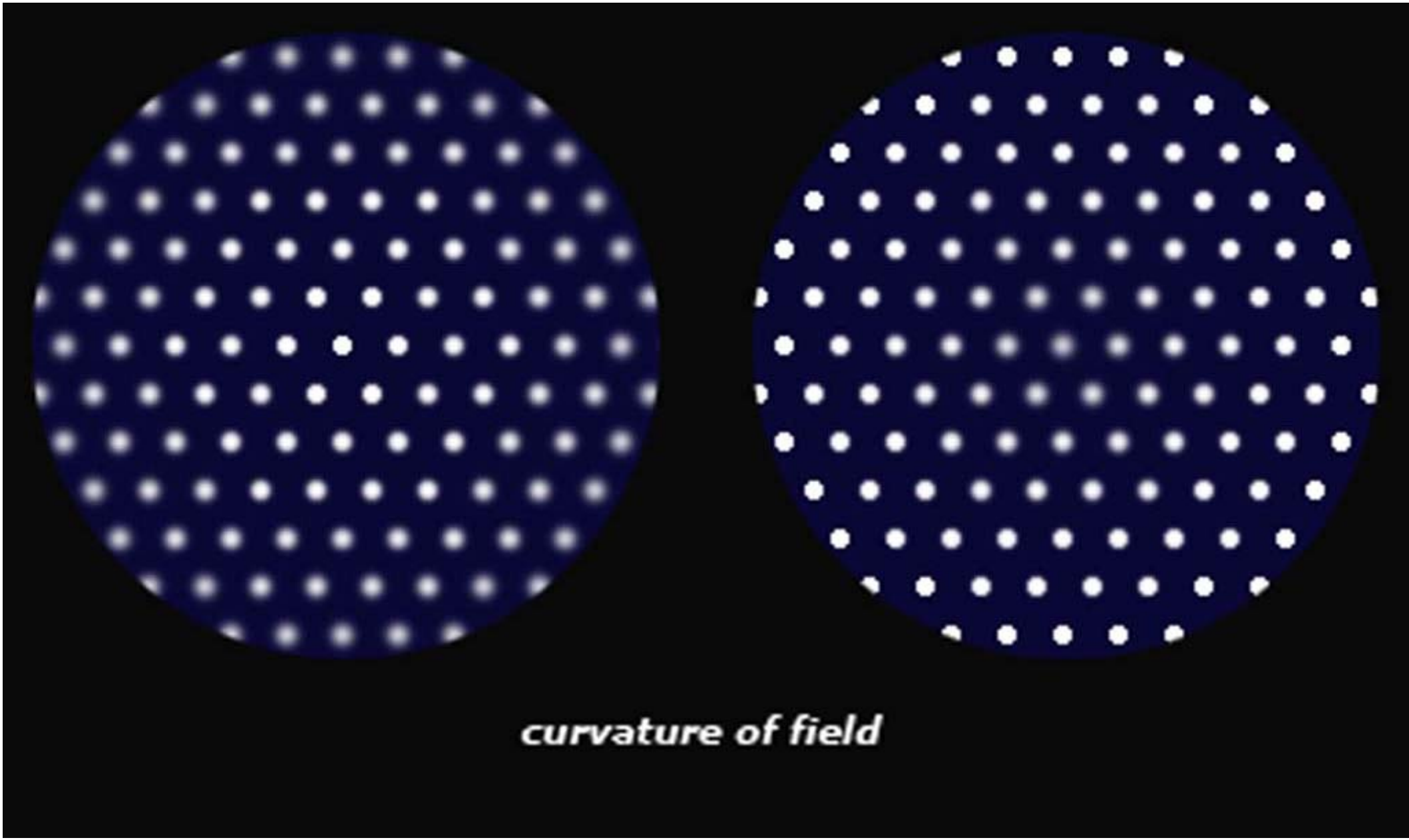

refractor
weaker refraction (longer ƒ)
axis of aberration
T
S
S = T/3
T = tangential aberration
S = sagittal aberration
stronger refraction (shorter ƒ)
NOTE: colors indicate field height, not spectral hue

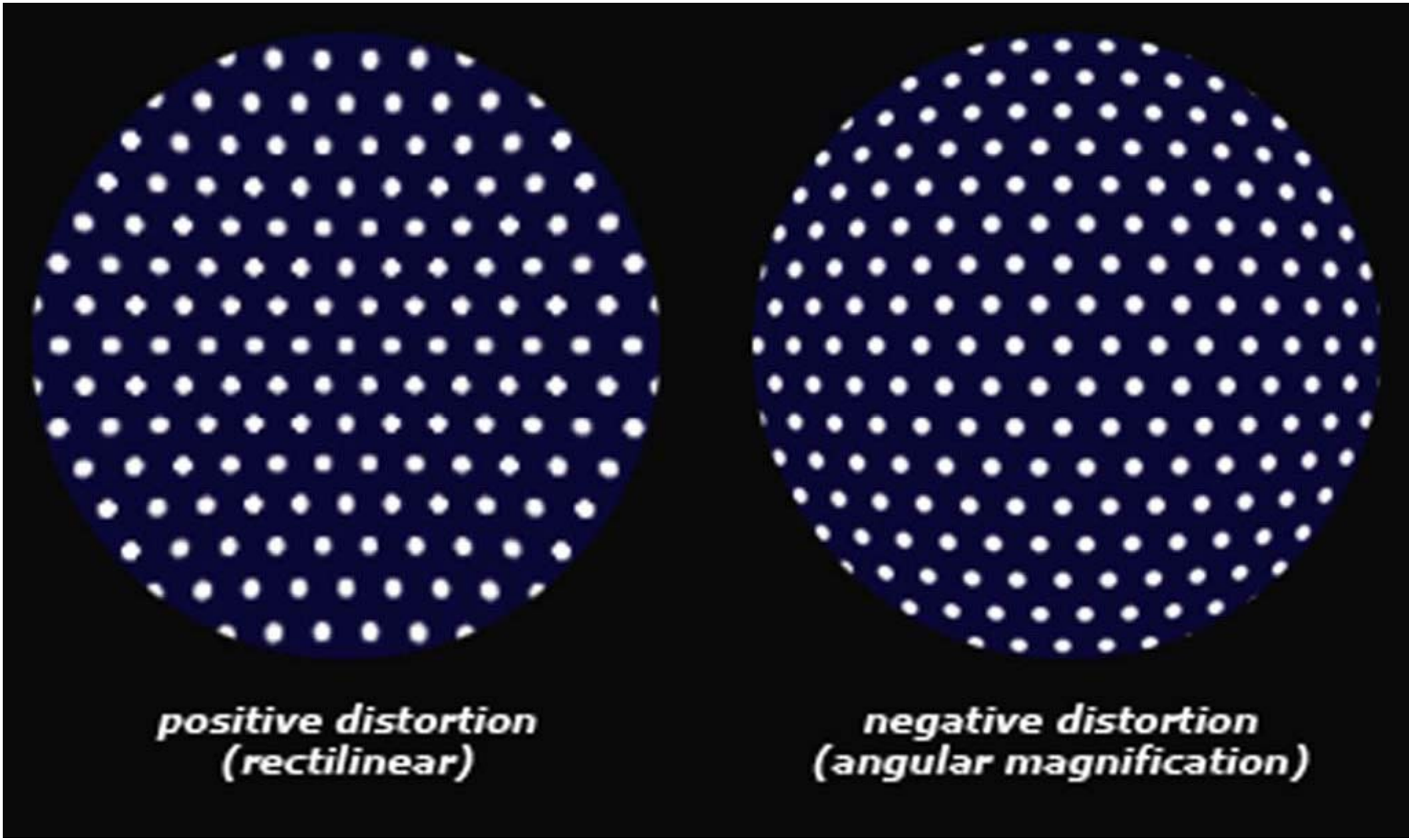

coma

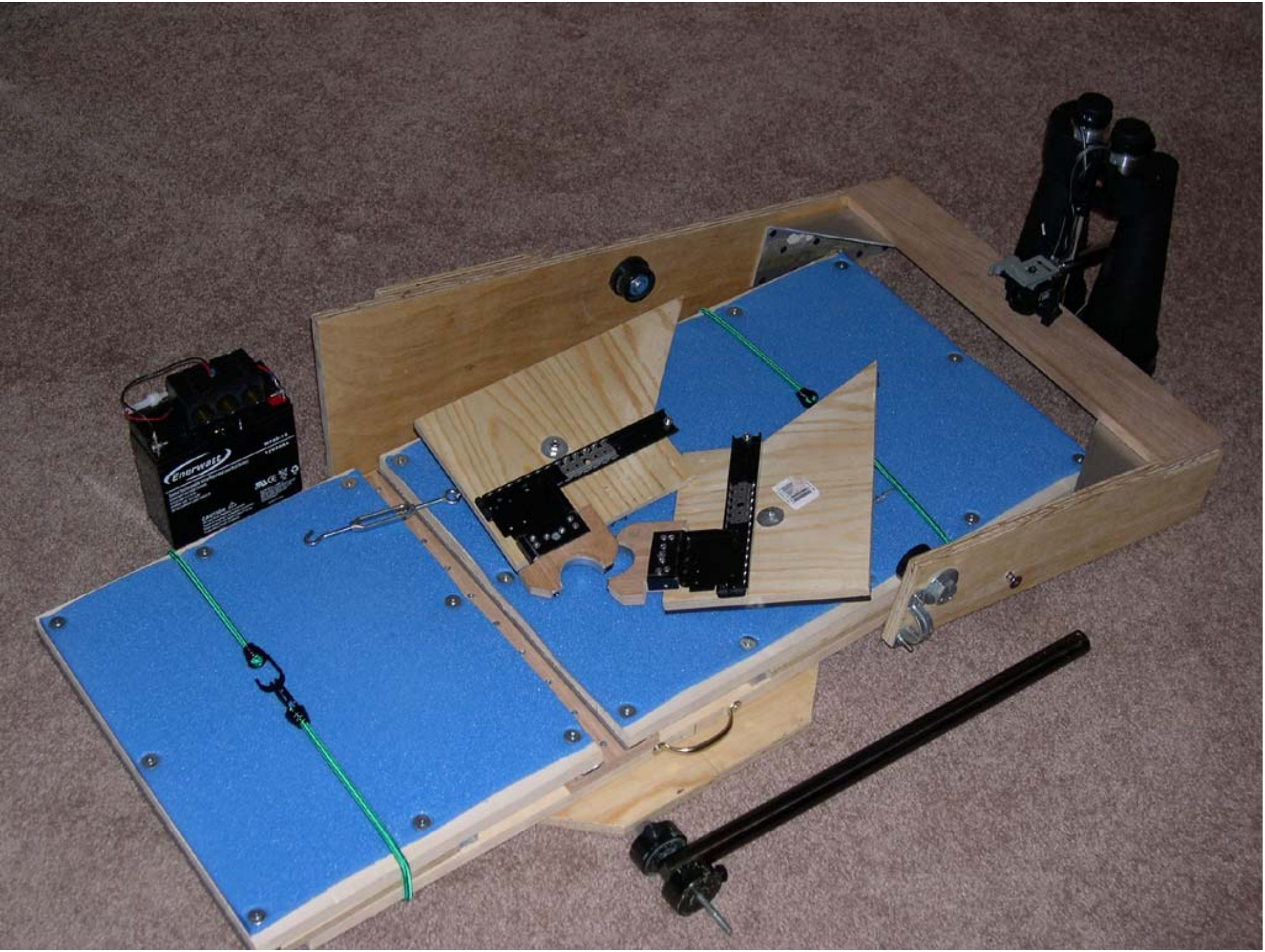

tangential
astigmatism
sagittal
astigmatism

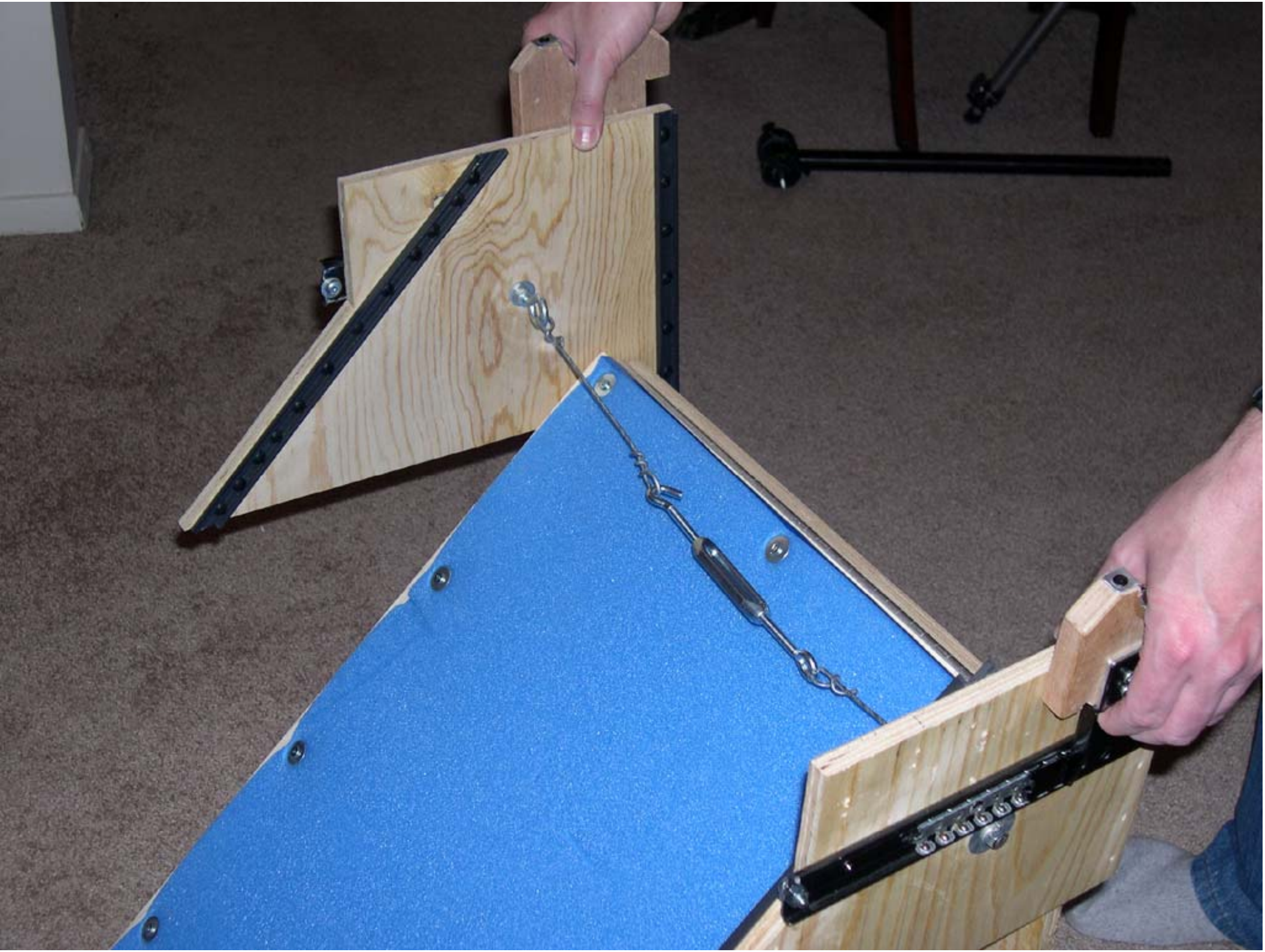

pure coma
coma + astigmatism
pure astigmatism

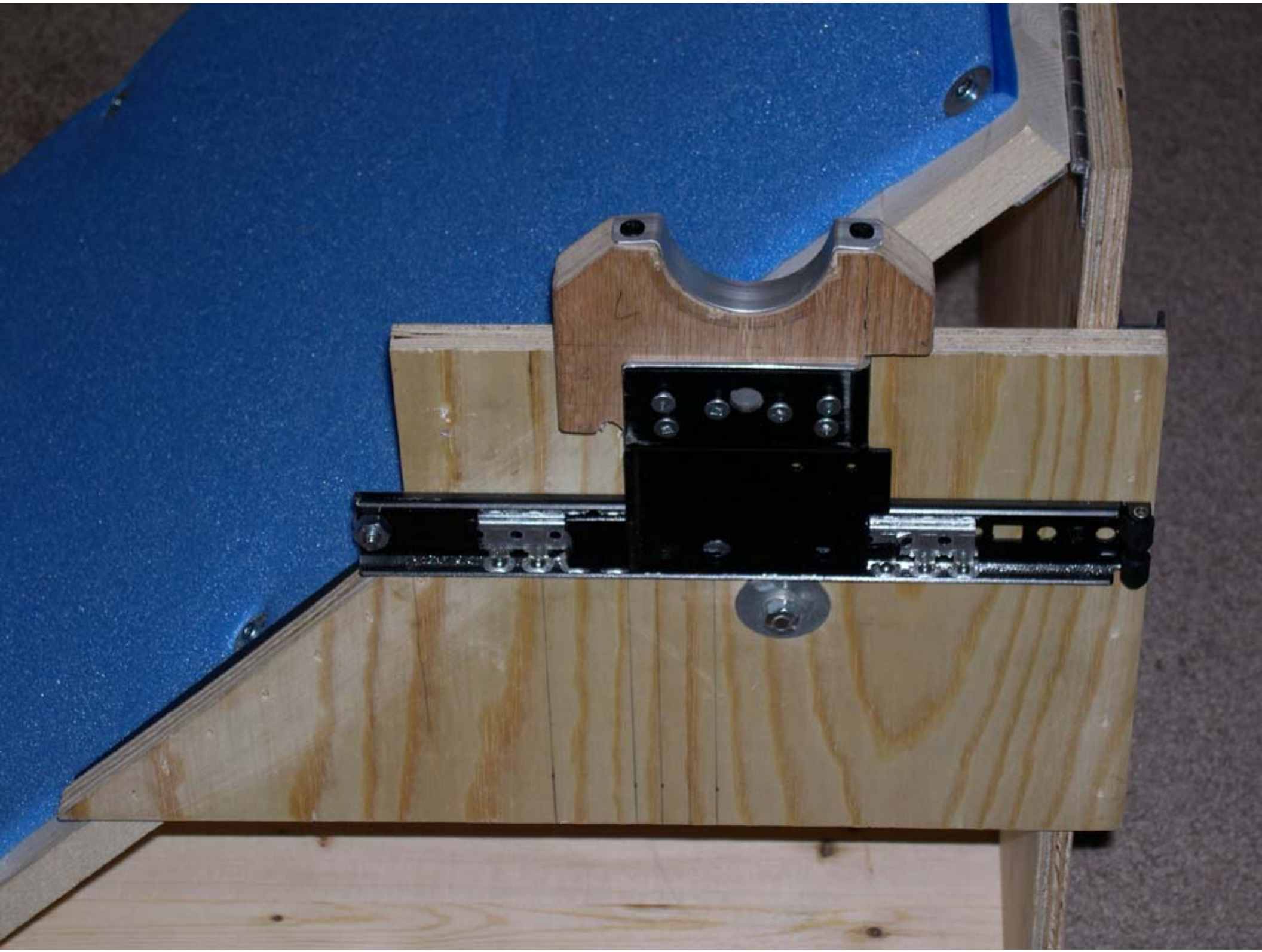

positive curvature (undercorrected)
Petzval surface
negative curvature (overcorrected)


curvature of field


positive distortion
(rectilinear)
negative distortion
(angular magnification)


ENERGIZER

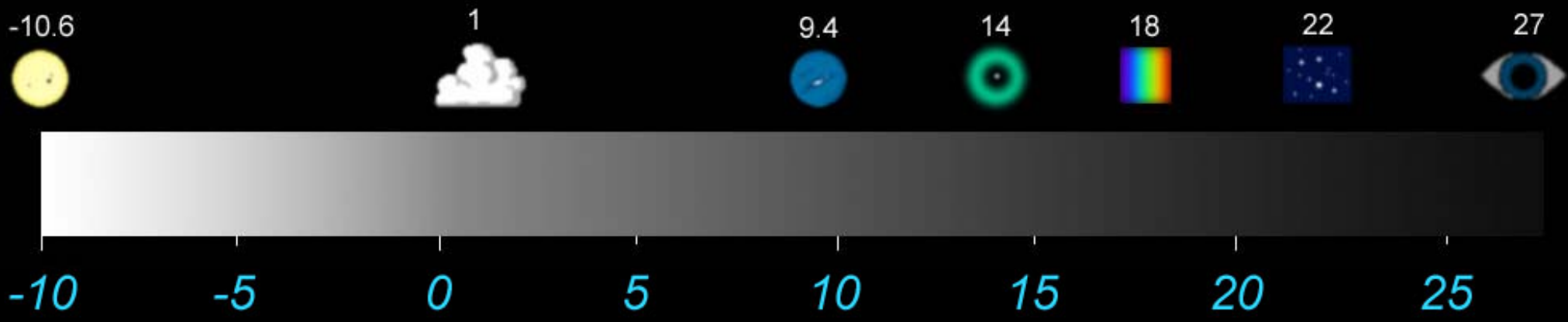


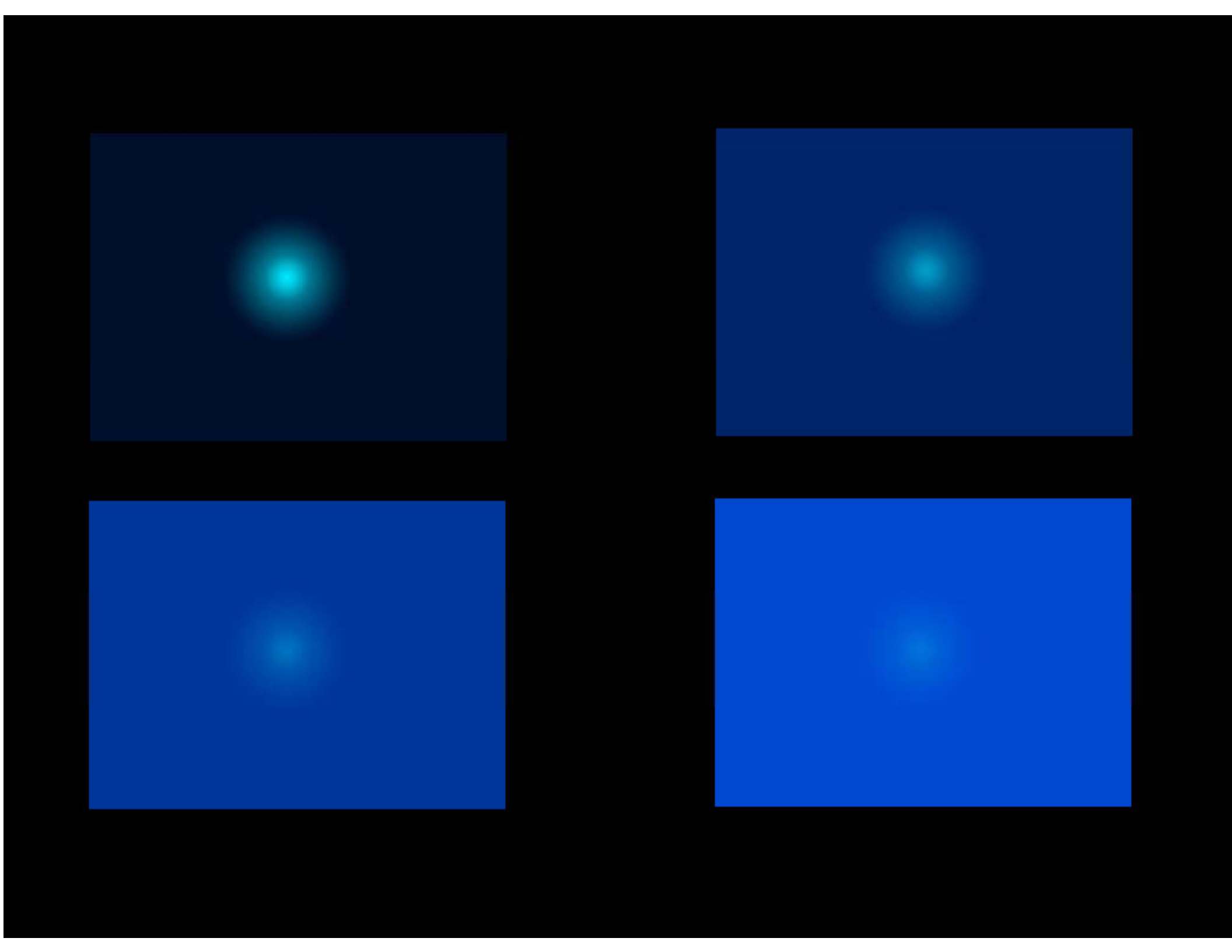


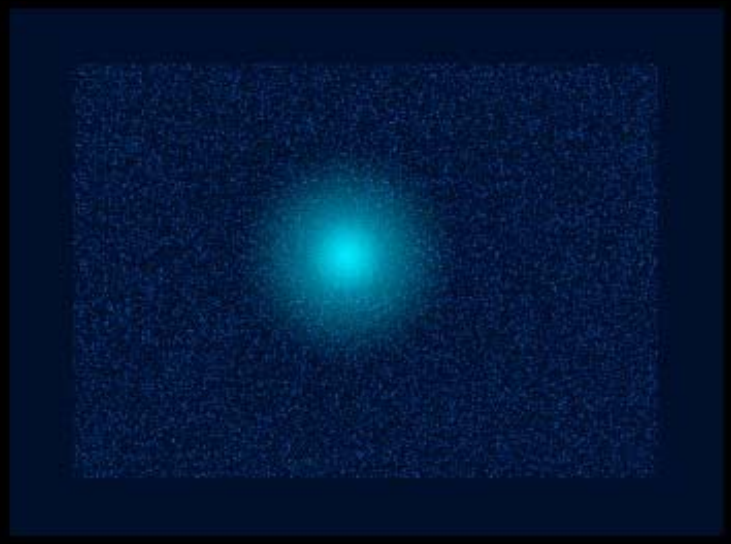
Which nebula is easier to see?

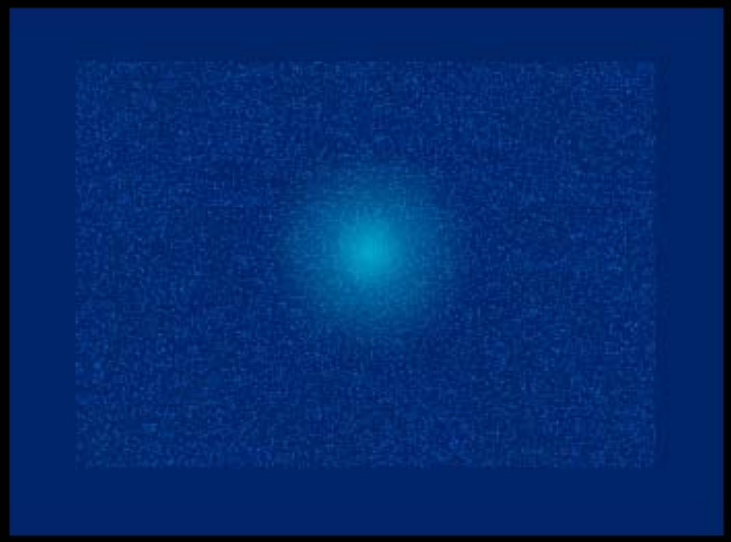
int. mag. = 3.5
SB = 23m / sq. arcsec

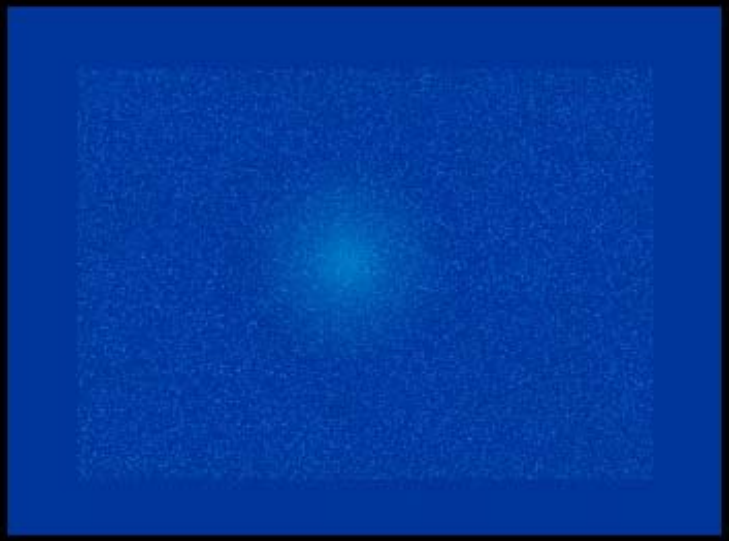
int. mag. = 7.4
SB = 20m / sq. arcsec

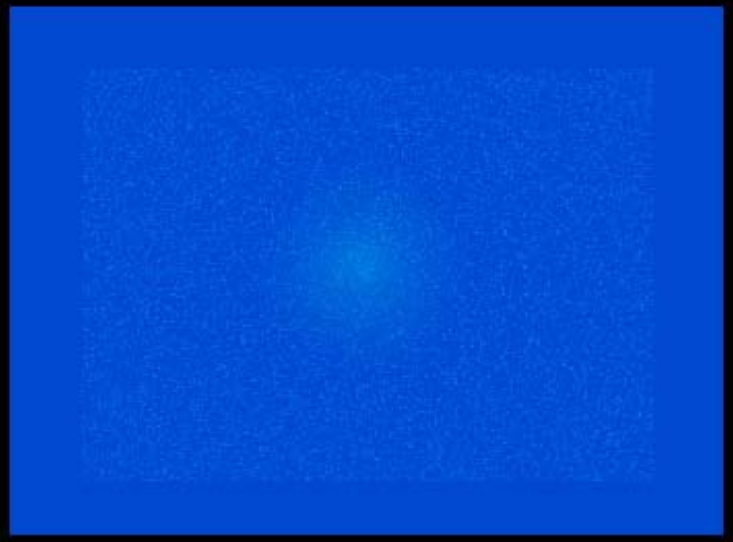

-10.6
1
9.4
14
18
22
27
-10
-5
0
5
10
15
20
25







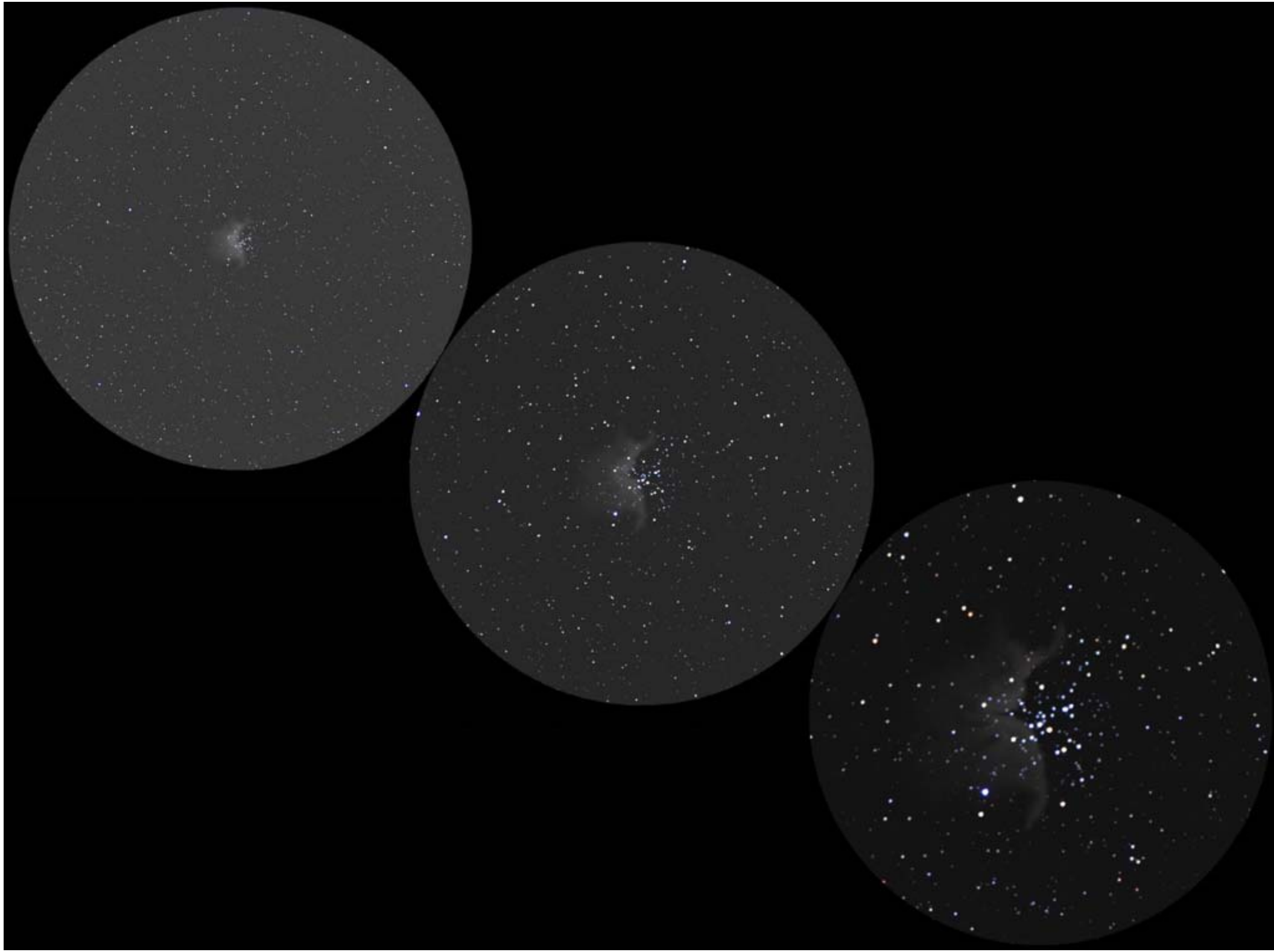




Object - Sky

4	3	2	1	0	-1	-2	-3	-4	-5
0.02_m	0.06_m	0.16_m	0.37_m	0.75_m	1.36_m	2.16_m	3.06_m	4_m	5_m
1.025	1.06	1.16	1.4	2	3.5	7.3	16.9	40.8	101

(Object + Sky) : Sky



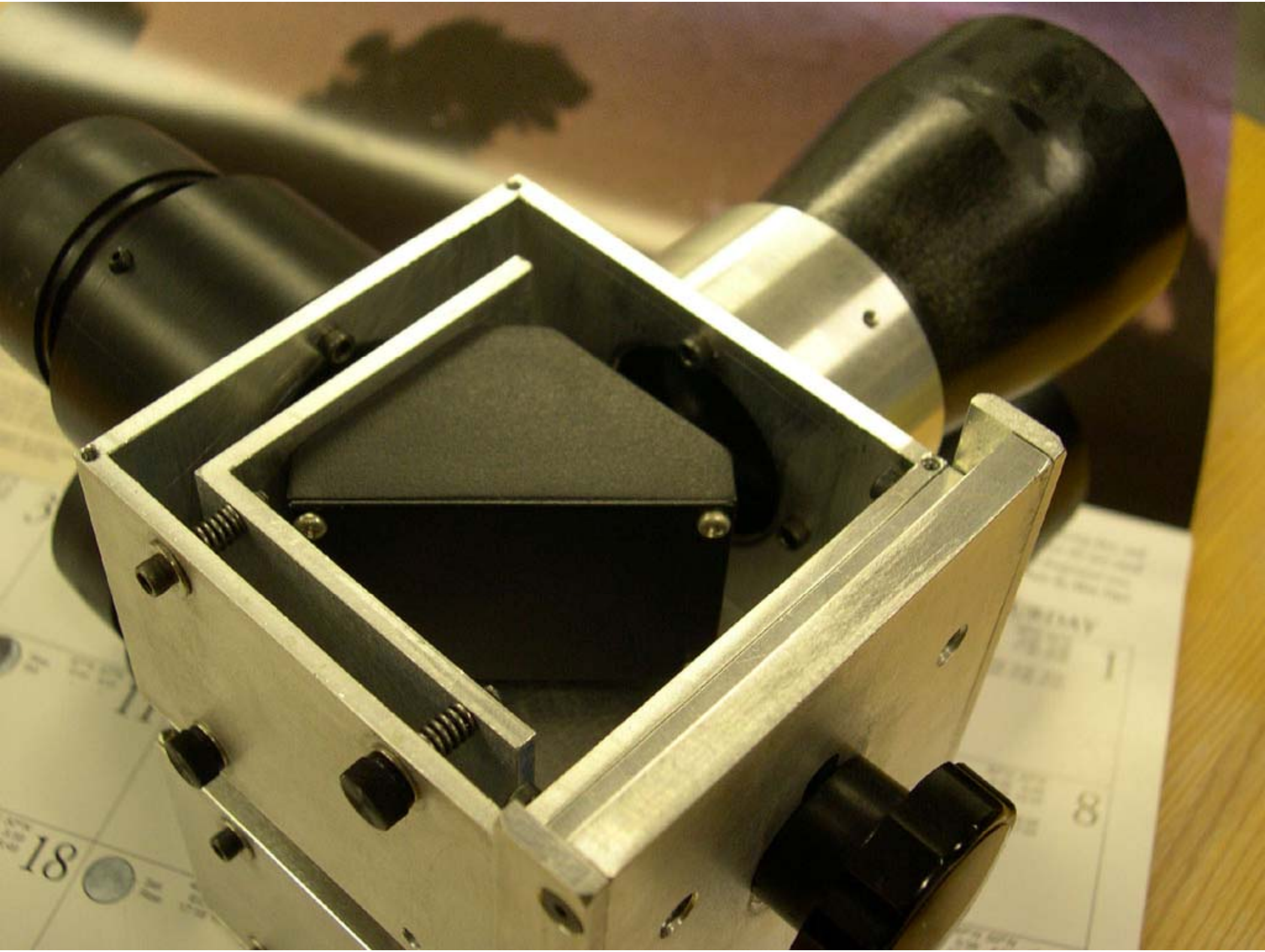
MARCH

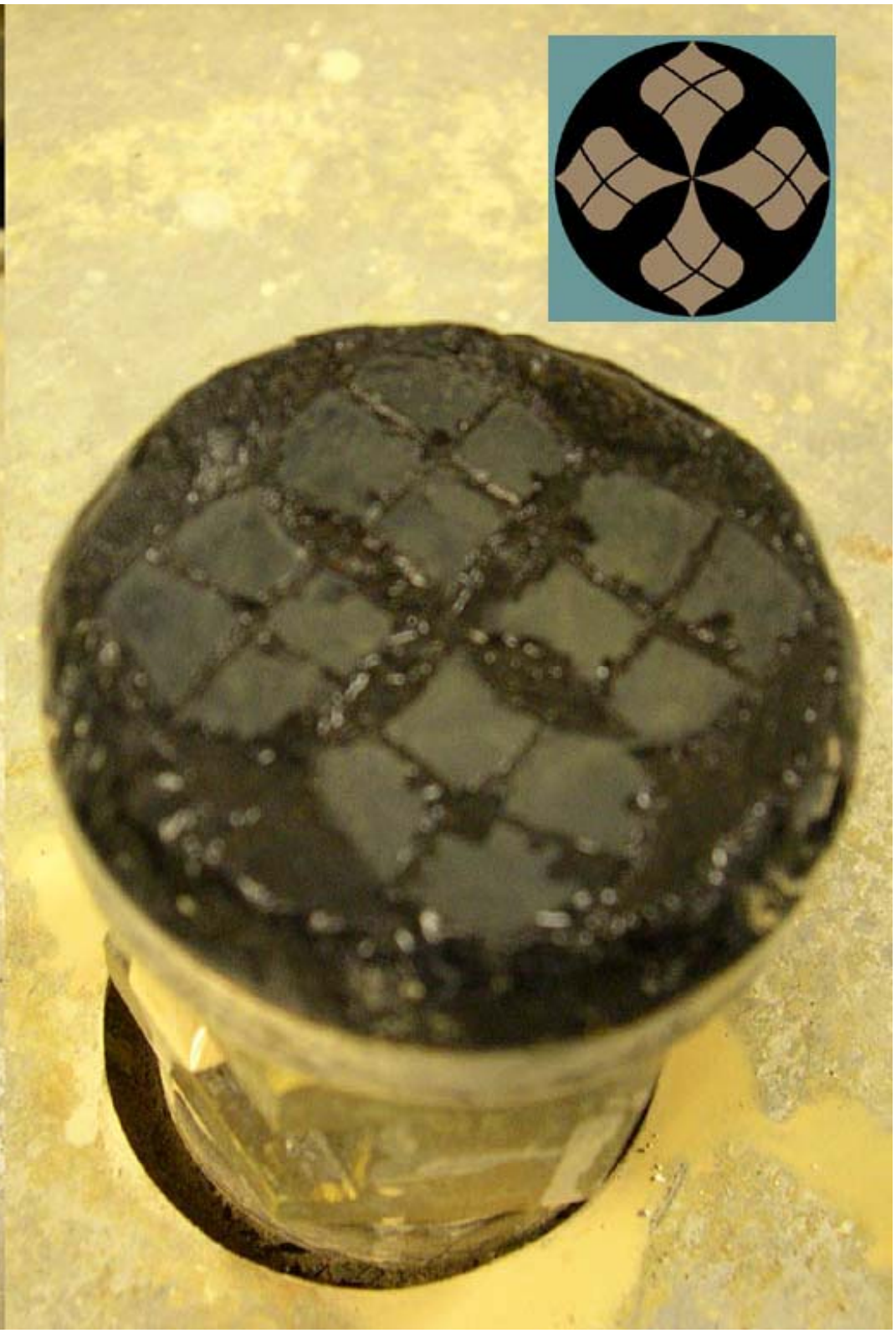
Backbone of the ... The glories of the ... glowing clouds of interstellar gas. Almost unnoticed under the grandeur of our home galaxy are the two small satellite galaxies, the Large and Small Magellanic Clouds, playing hide-and-seek among the foreground trees.

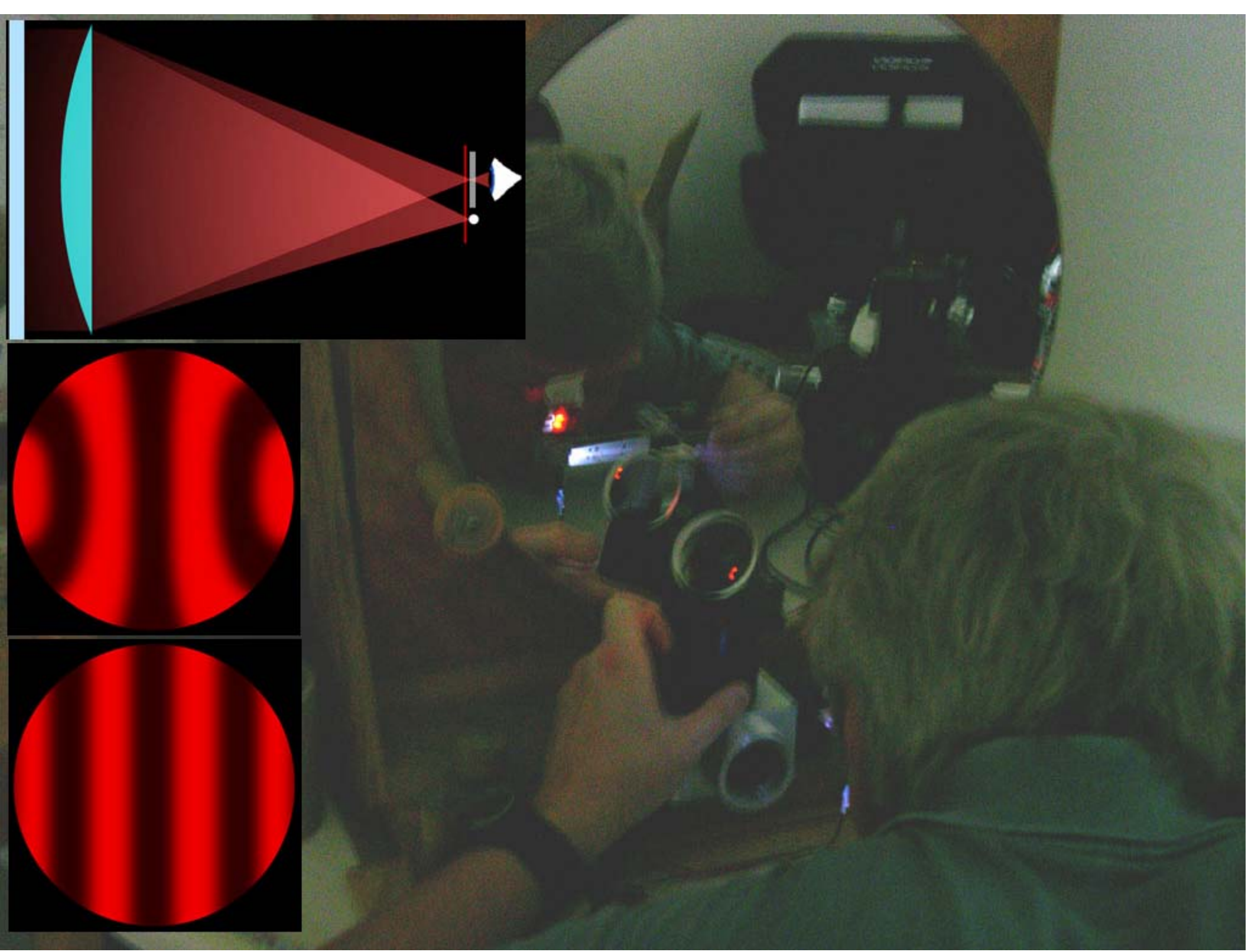
Photo by Alan Dyer


MARCH
SUNDAY
MONDAY
TUESDAY

TUESDAY
WEDNESDAY
THURSDAY

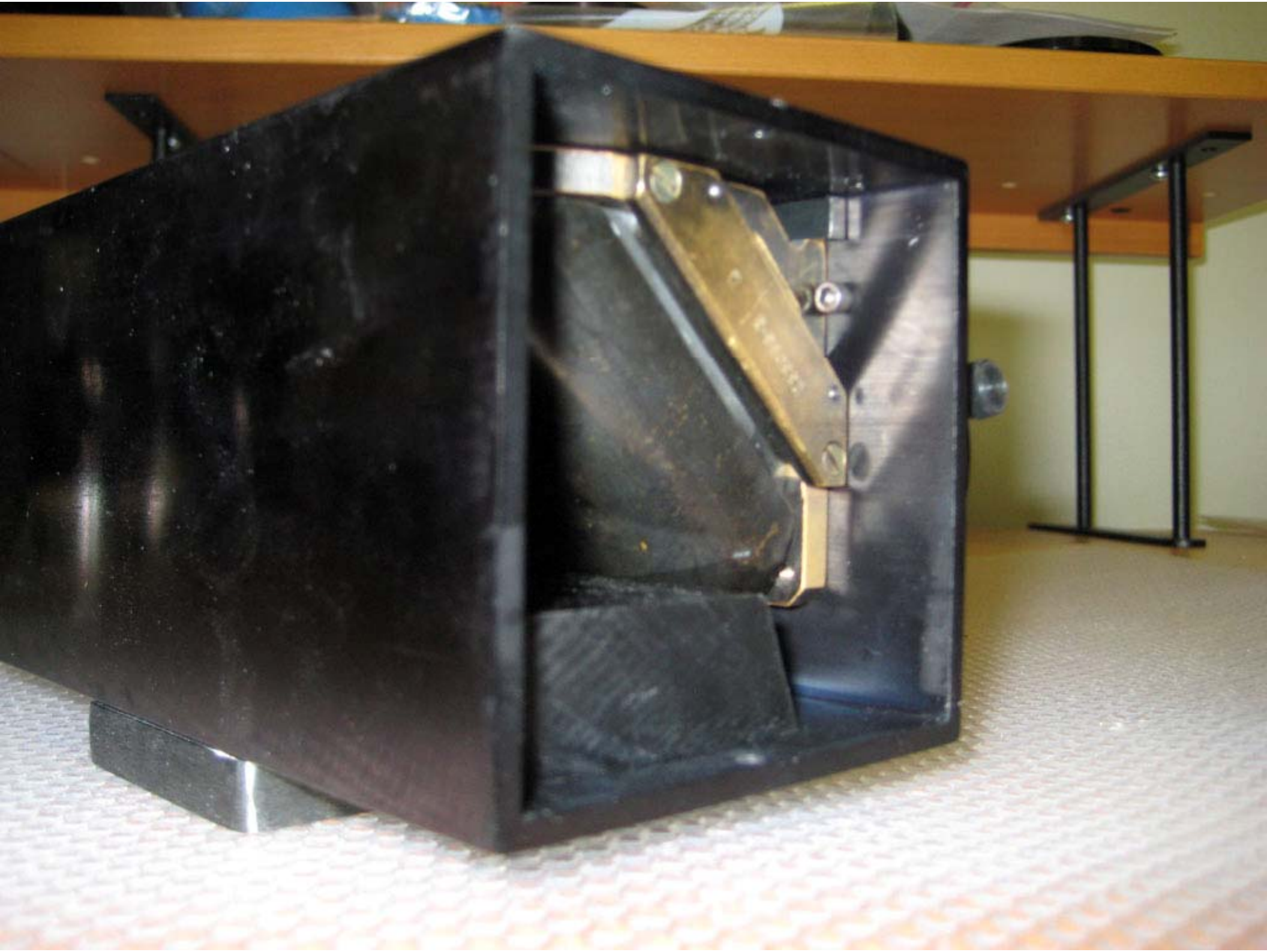







Tele Vue®
Tele Vue®


Vue® 13mm Ethos™ 100°




UW80° F30mm