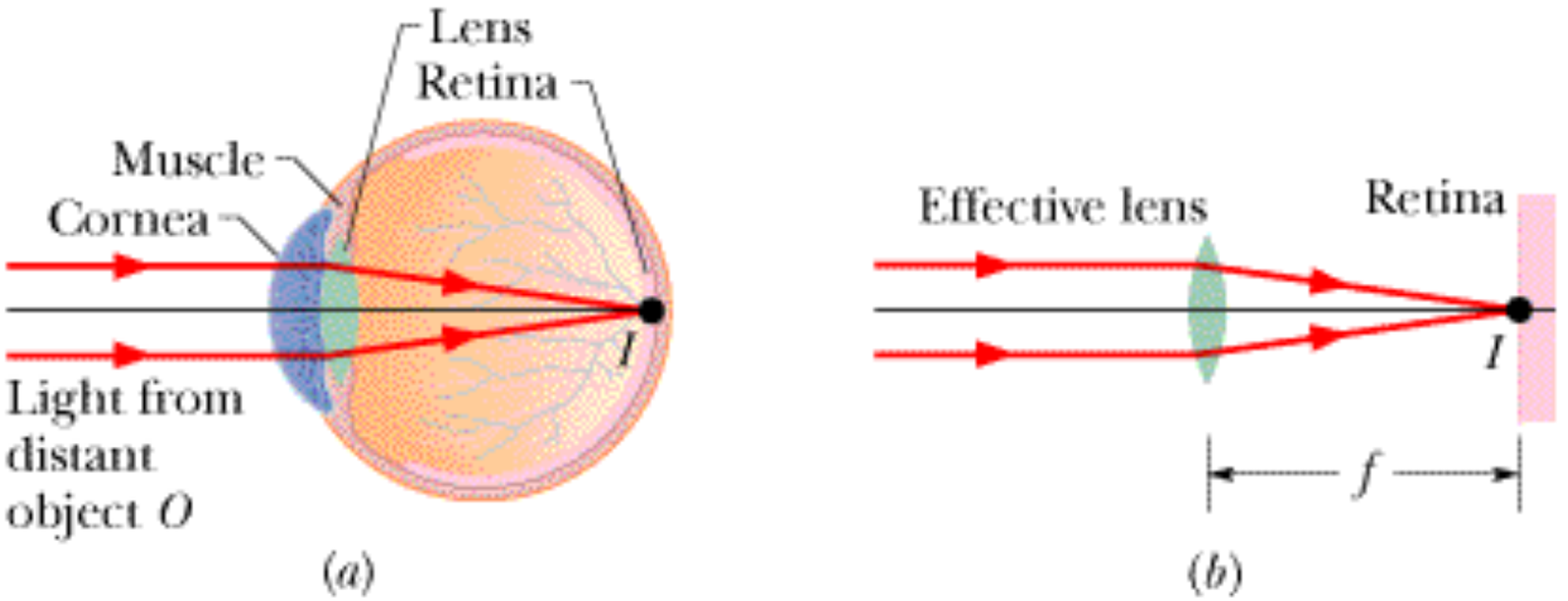
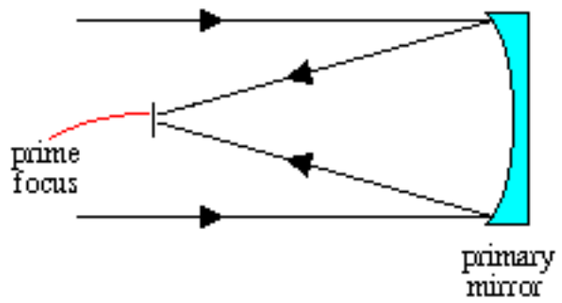
ASTR 555

Feb 20 2018

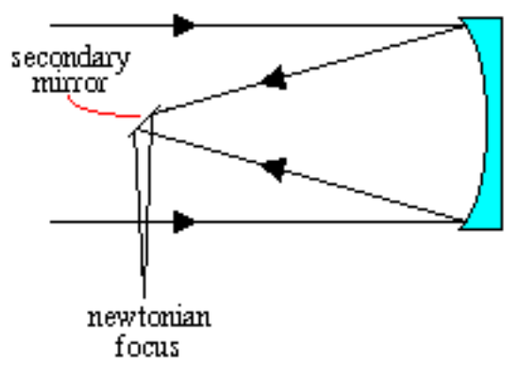

Lens
Retina
Muscle
Cornea
I
Light from
distant
object O
(a)
Effective lens
Retina
I
f
(b)

Reflecting Telescopes

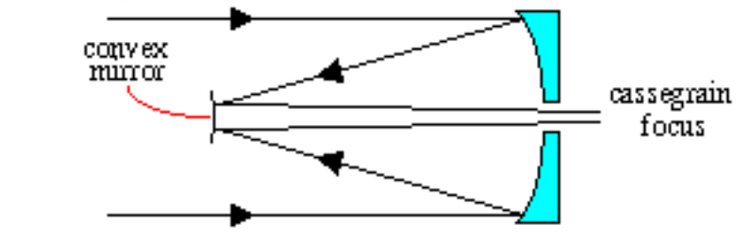
Prime



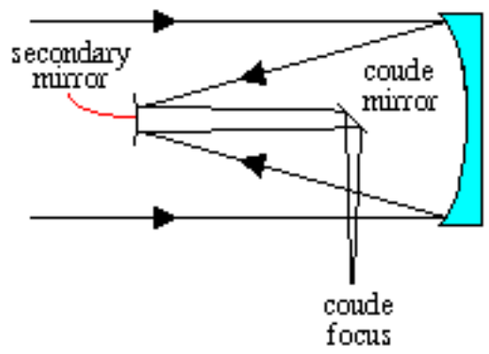
Newtonian

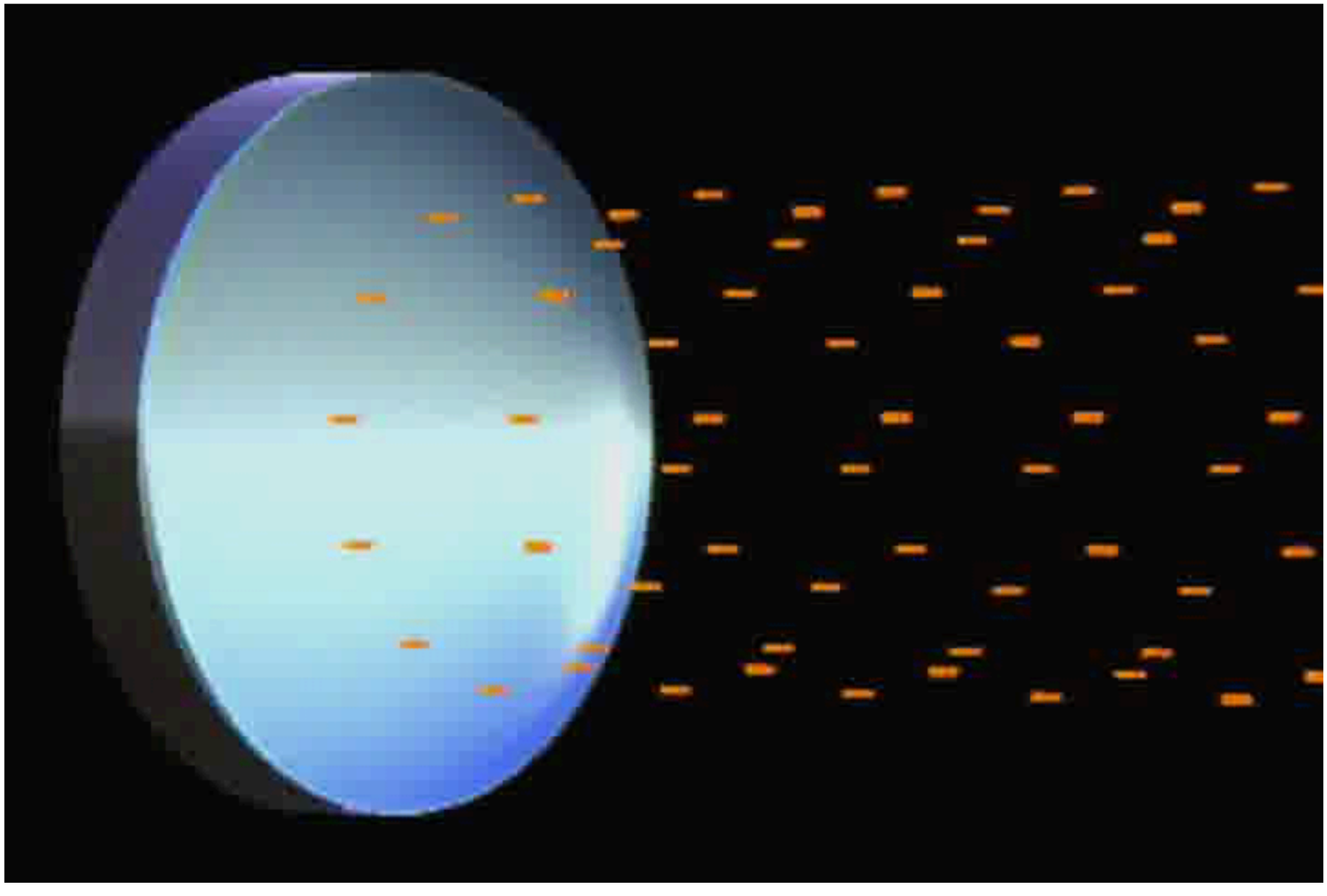


Cassegrain

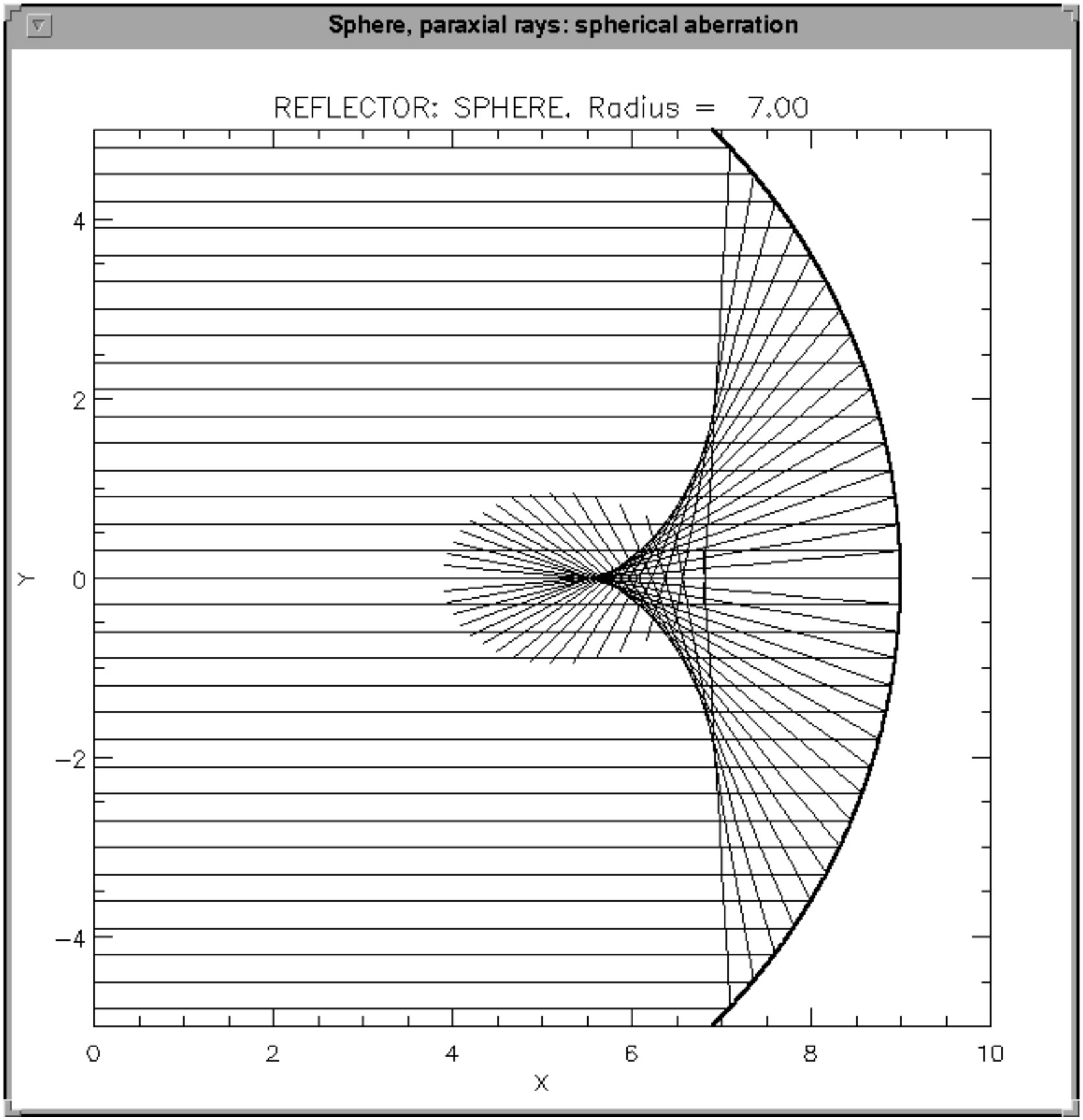


Coude

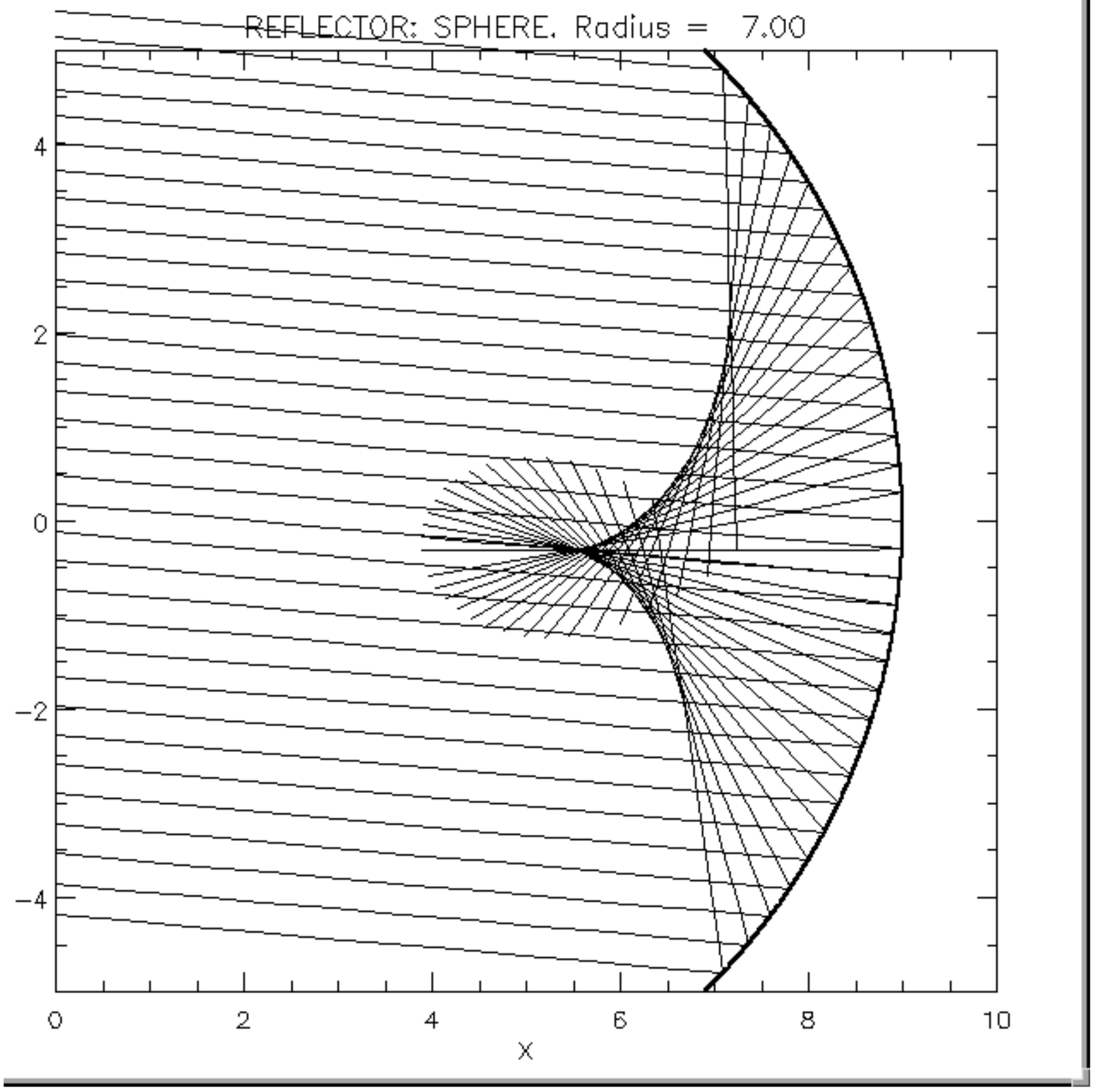


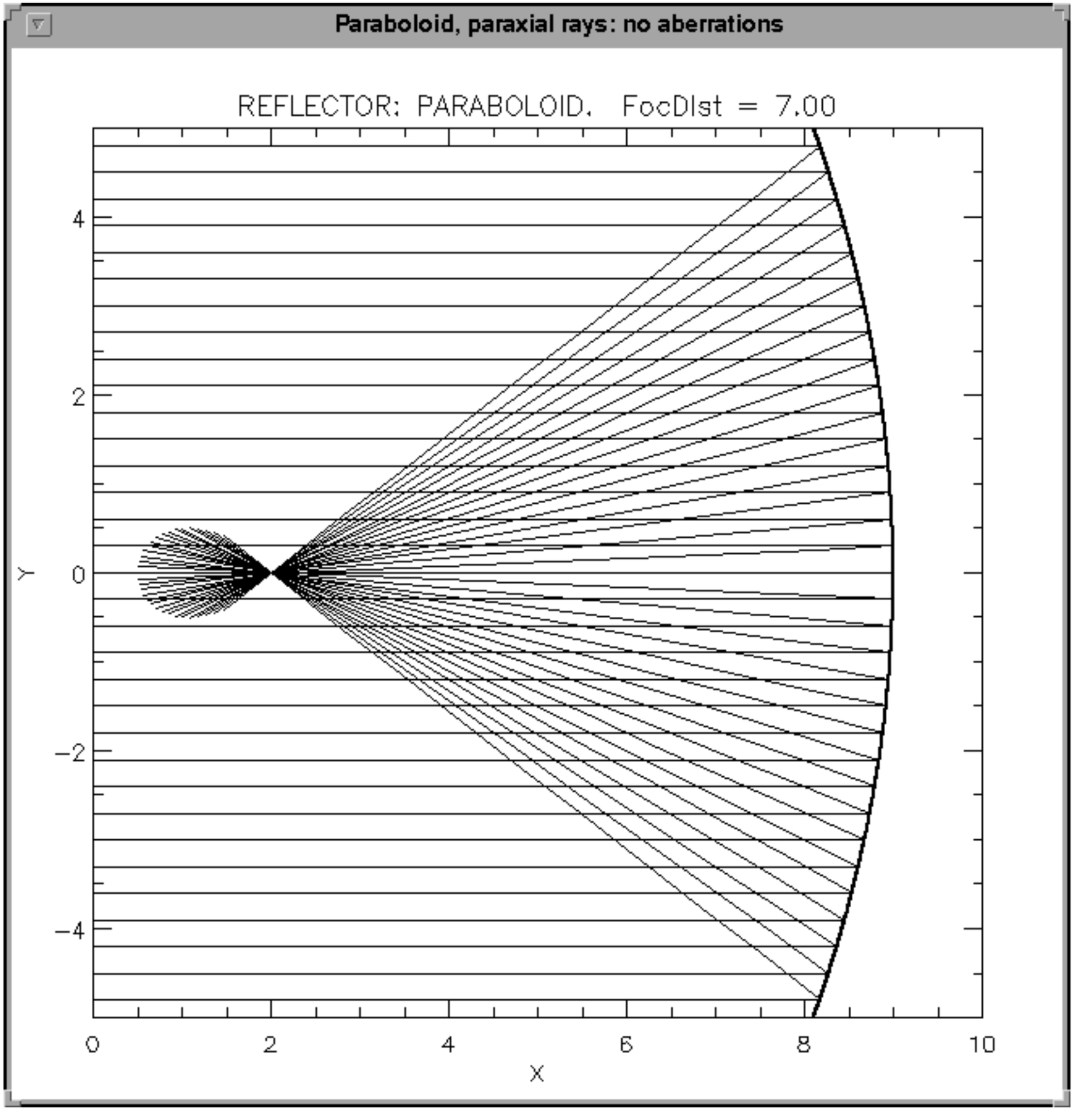


Sphere, paraxial rays: spherical aberration

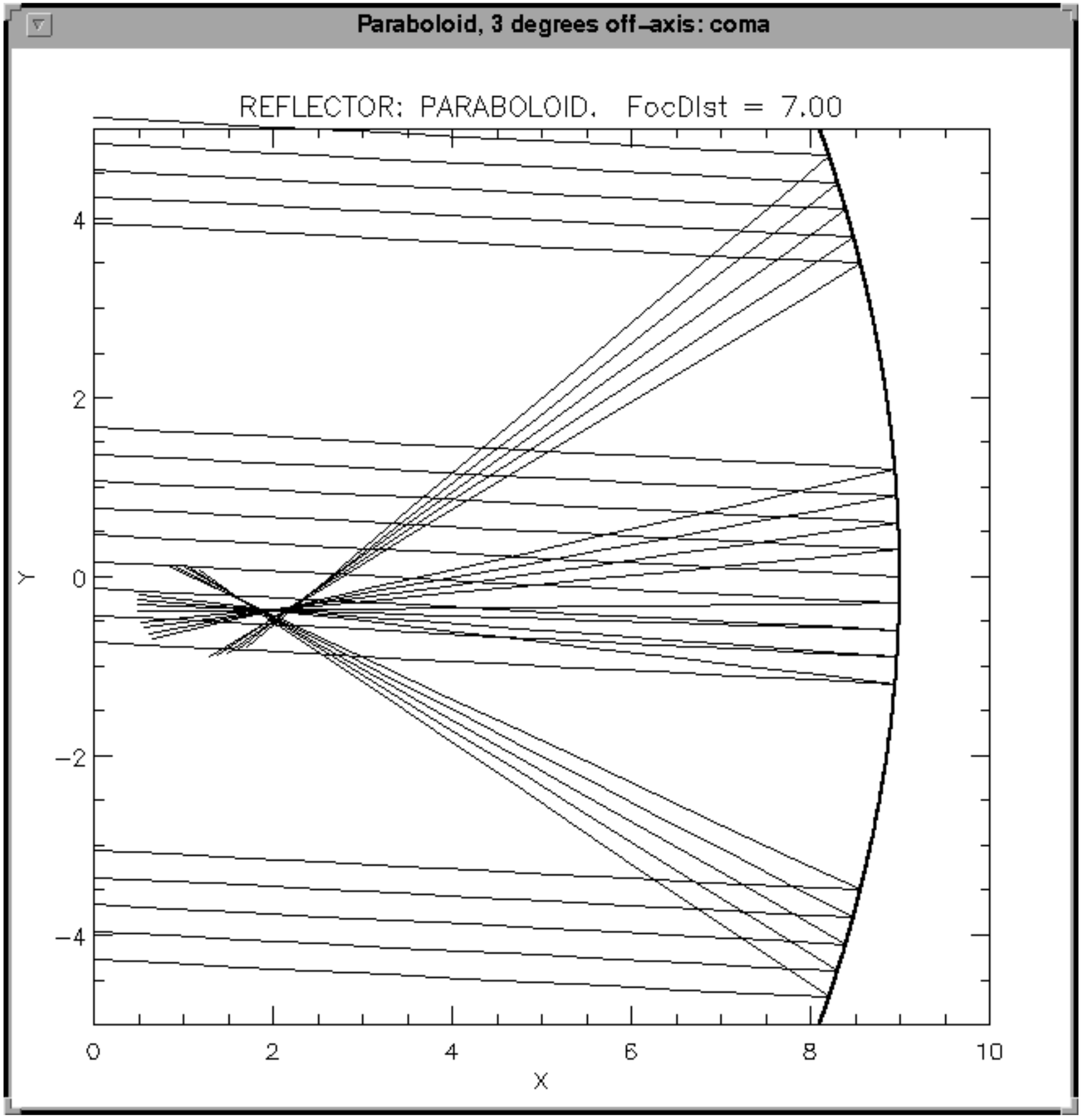


Sphere, 5 degrees off–axis: spherical aberration

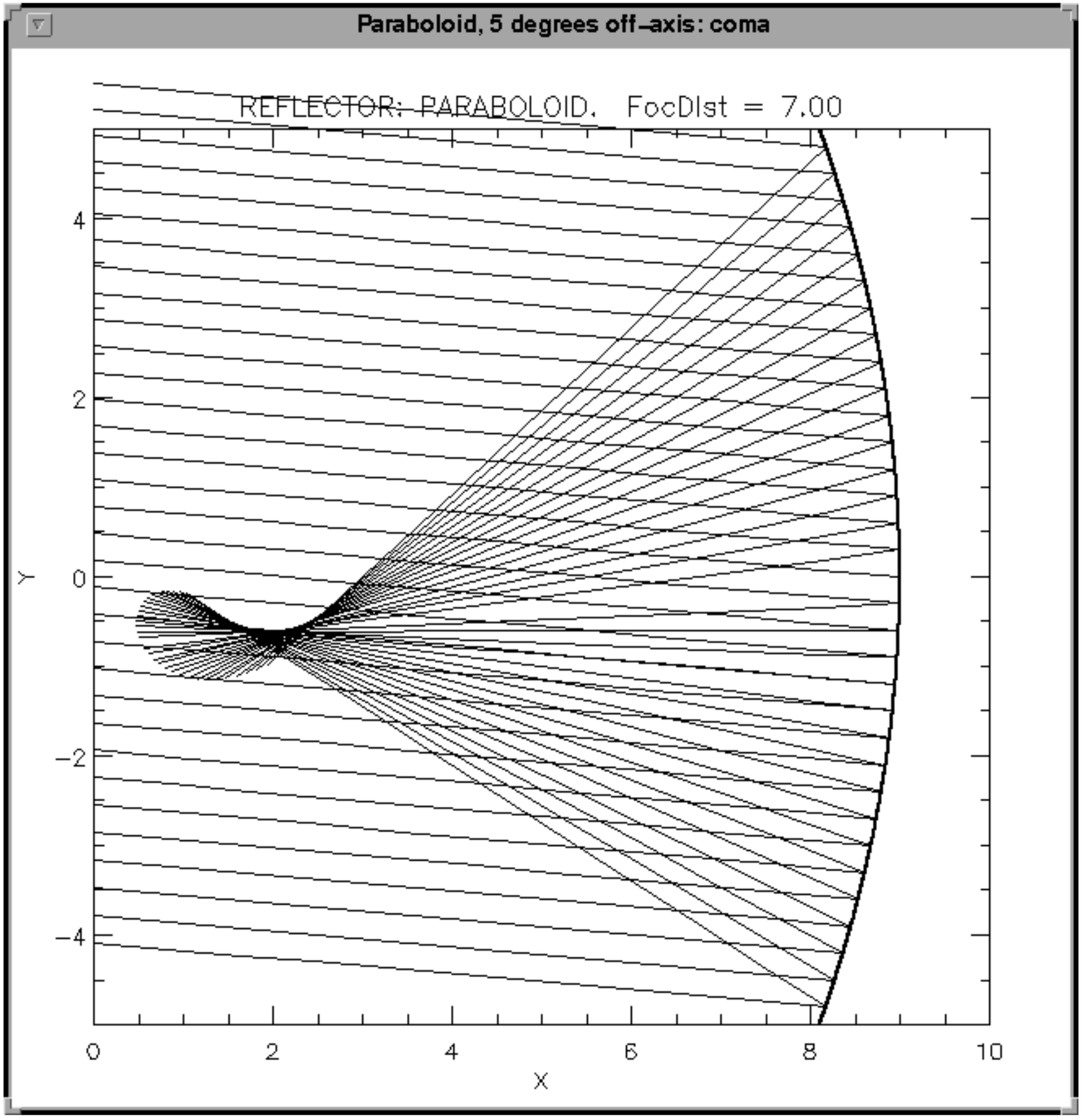



Paraboloid, paraxial rays: no aberrations
REFLECTOR: PARABOLOID. FocDist = 7.00
4
2
0
−2
−4
Y
0
2
4
6
8
10
X

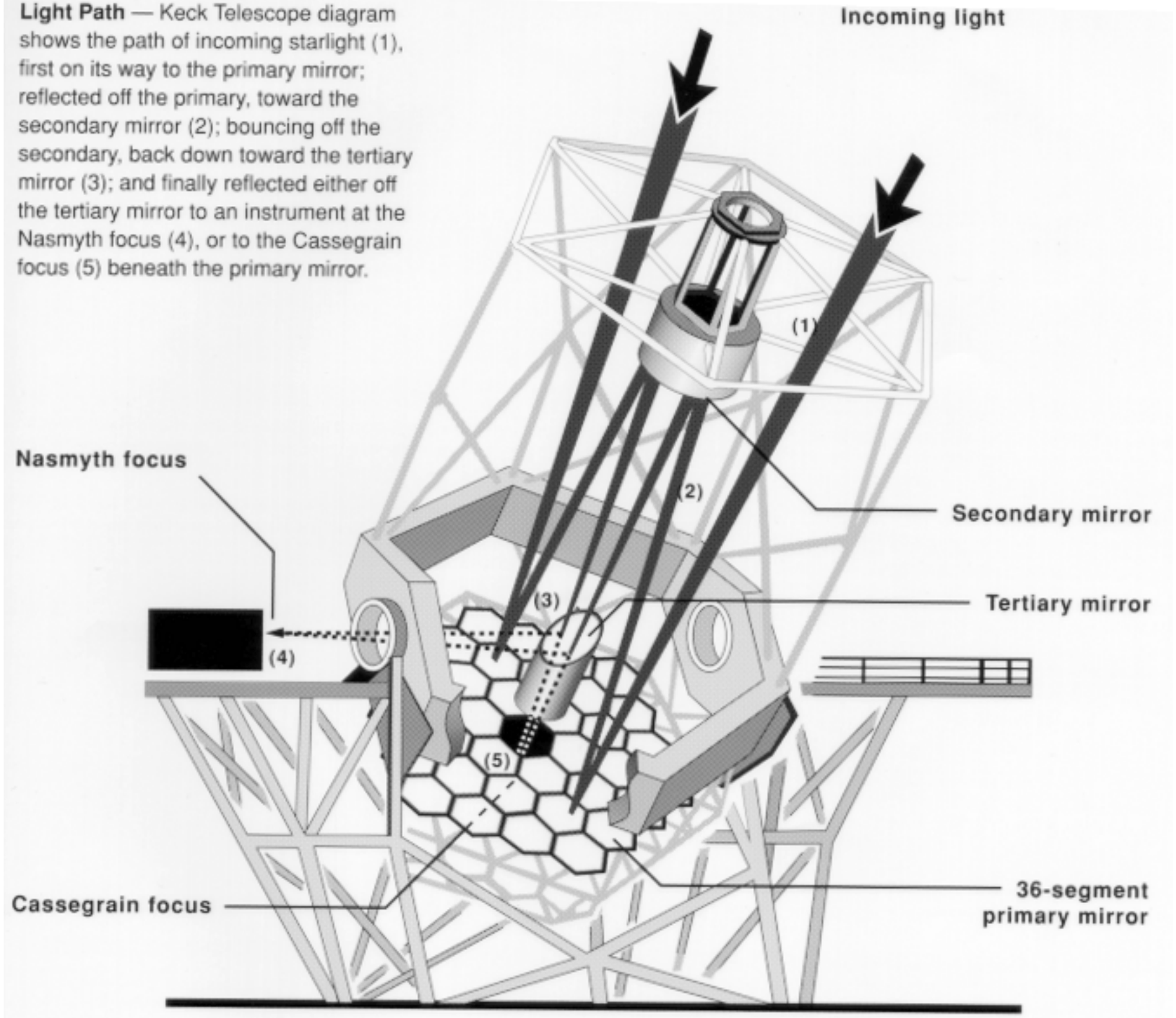
Paraboloid, 3 degrees off-axis: coma



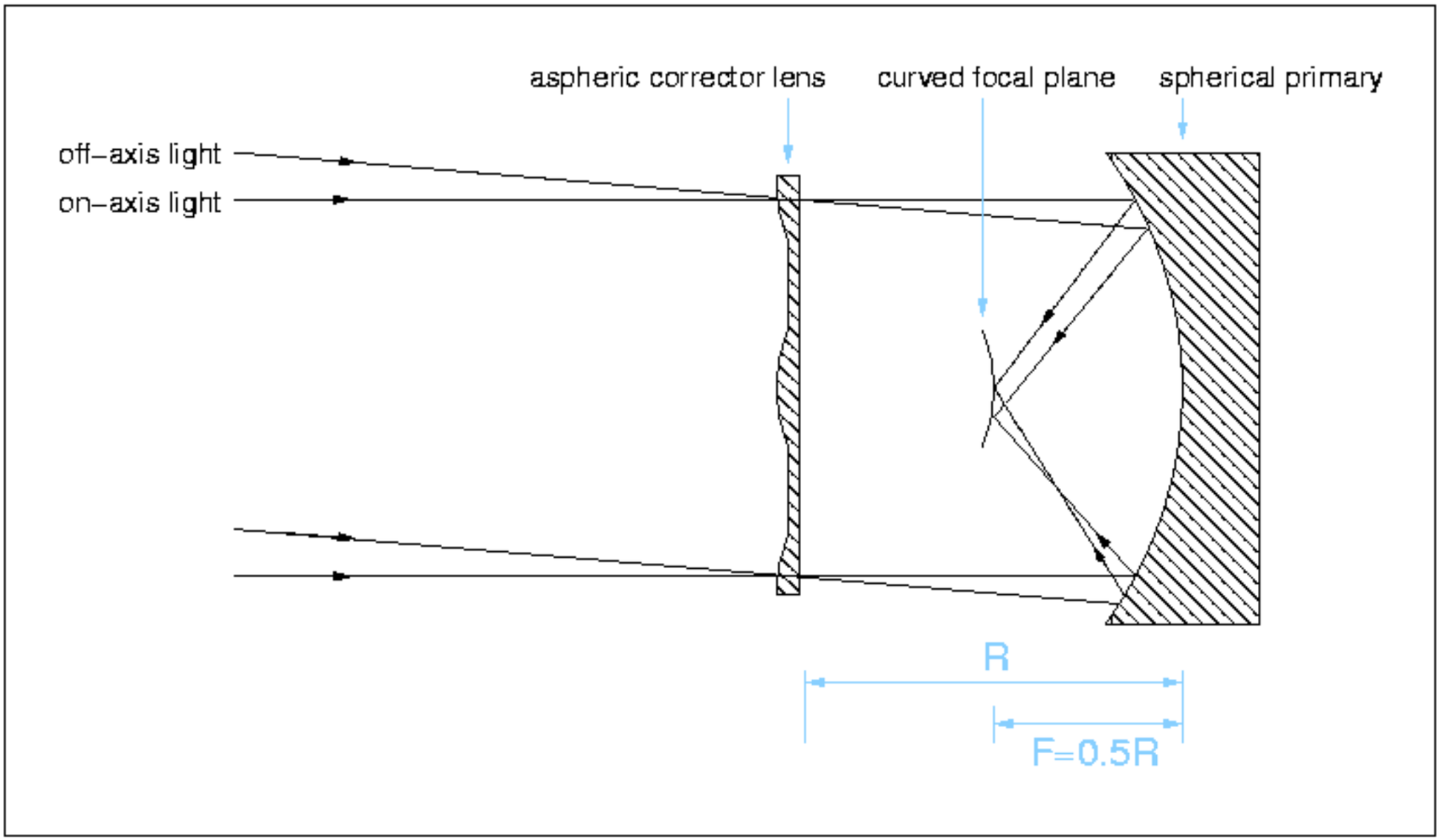
Paraboloid, 5 degrees off-axis: coma

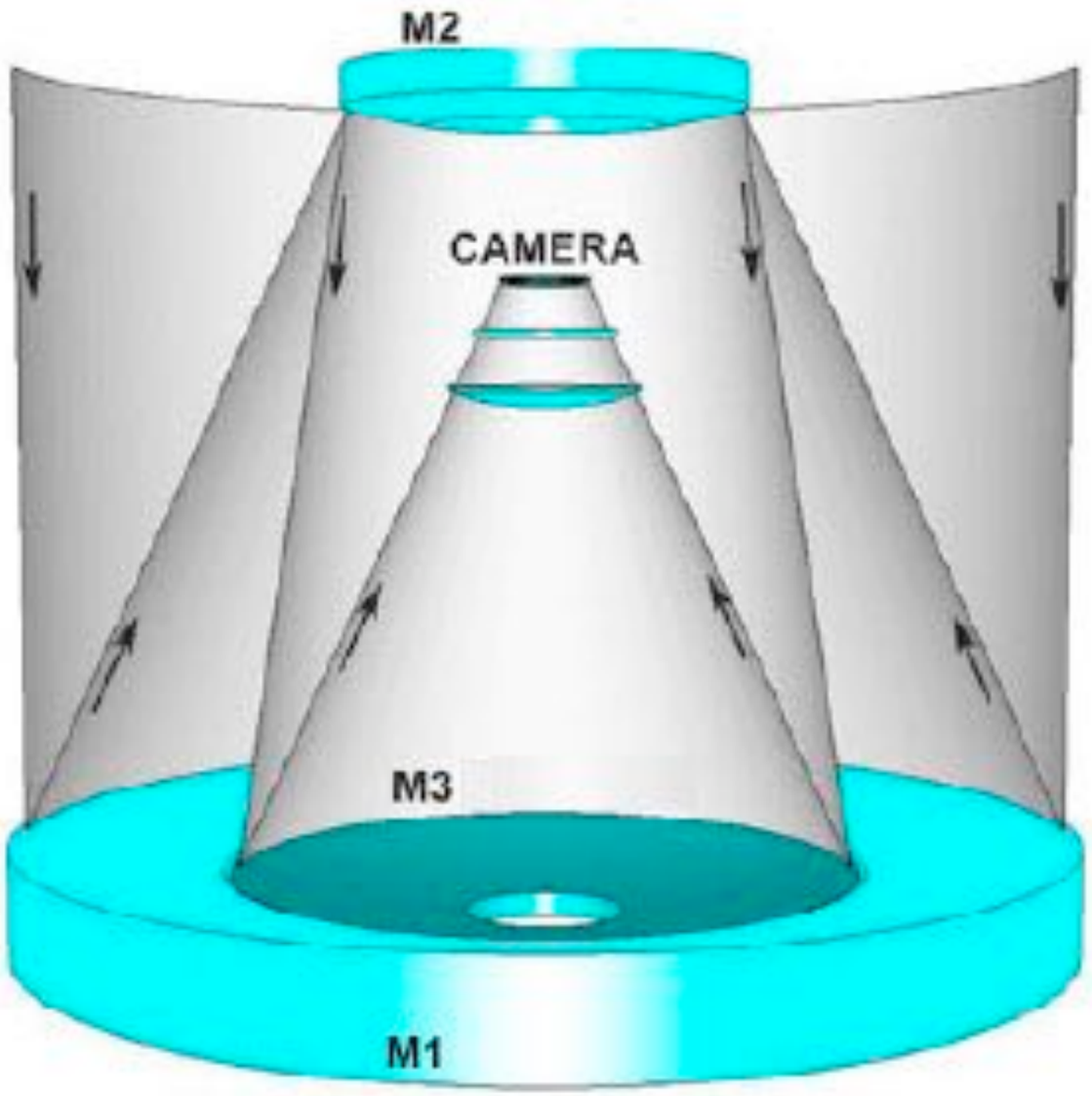


Light Path — Keck Telescope diagram shows the path of incoming starlight (1), first on its way to the primary mirror; reflected off the primary, toward the secondary mirror (2); bouncing off the secondary, back down toward the tertiary mirror (3); and finally reflected either off the tertiary mirror to an instrument at the Nasmyth focus (4), or to the Cassegrain focus (5) beneath the primary mirror.

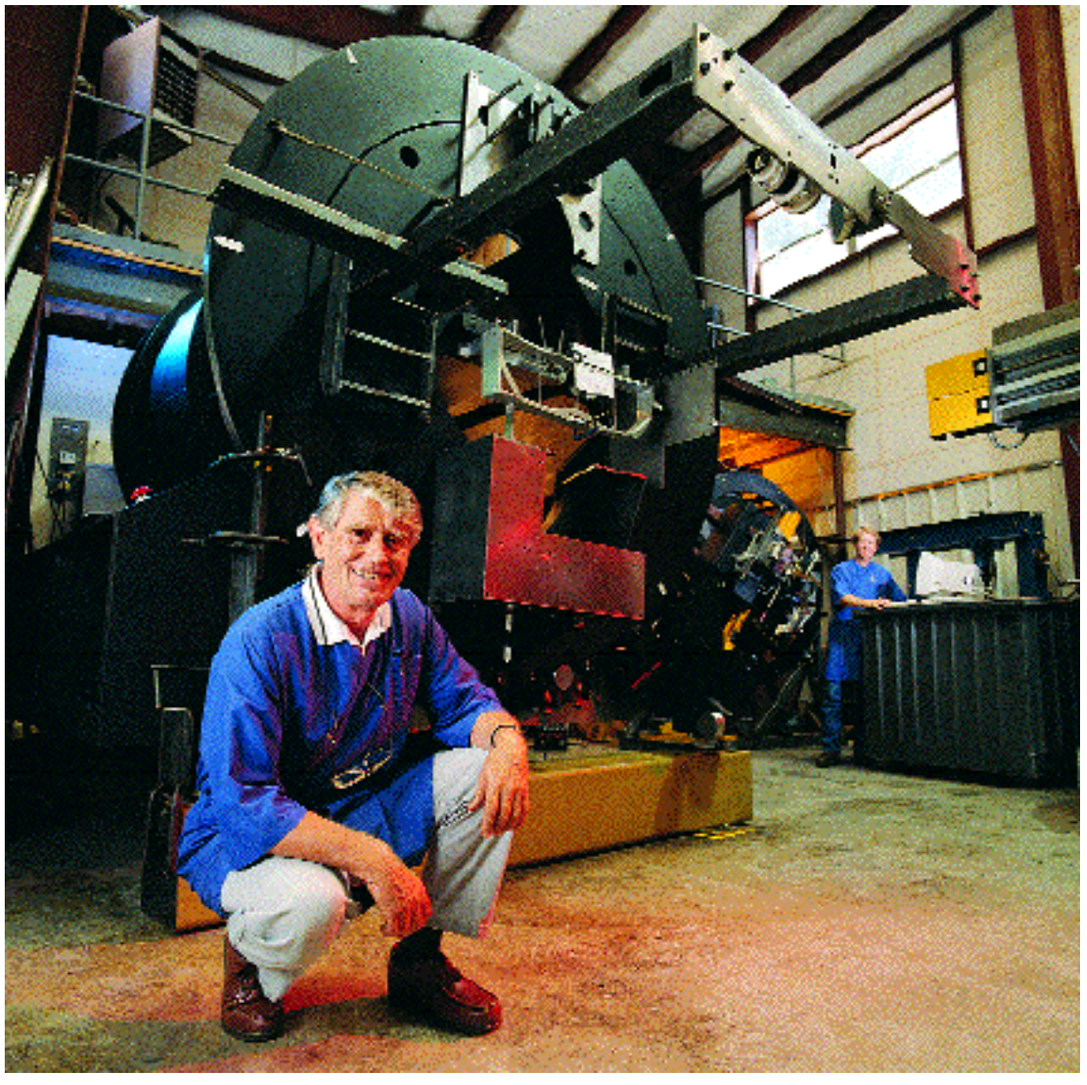


Credit: California Association for Research in Astronomy

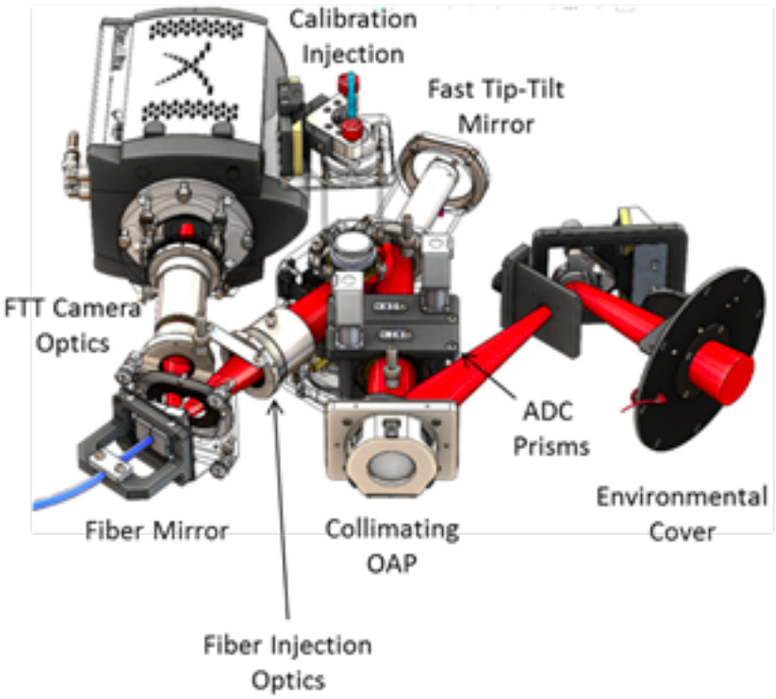

aspheric corrector lens
curved focal plane
spherical primary
off–axis light
on–axis light
R
F=0.5R


M2
CAMERA
M3
M1

TYPE	PRIMARY MIRROR	SECONDARY MIRROR	COMMENTS
PRIME FOCUS	Parabola		Focus inside telescope Add refractive corrector for wide field
NEWTONIAN	Parabola	Flat	Focus at side/top of telescope
CASSEGRAIN	Parabola	Hyperbola (convex)	Focus below primary
RITCHEY-CHRETIEN	Hyperbola	Hyperbola (convex)	Focus below primary. Zero coma & spherical aberration
COUDE	Various	Various	Tertiary flat directs light to fixed focus below polar axis
NAYSMITH	Various	Various	(Alt-Az): Tertiary flat directs light to focus outside altitude axis
SCHMIDT	Spherical		Catadioptric: Uses refractive corrector to provide wide field without spherical aberration. Focus inside telescope body

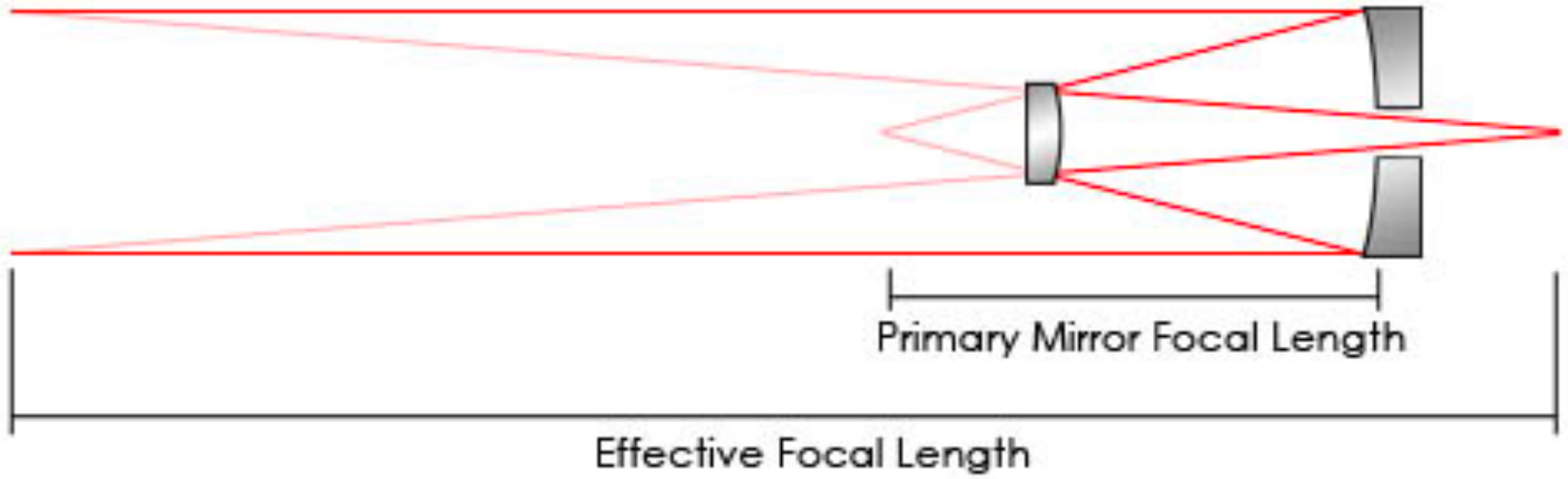


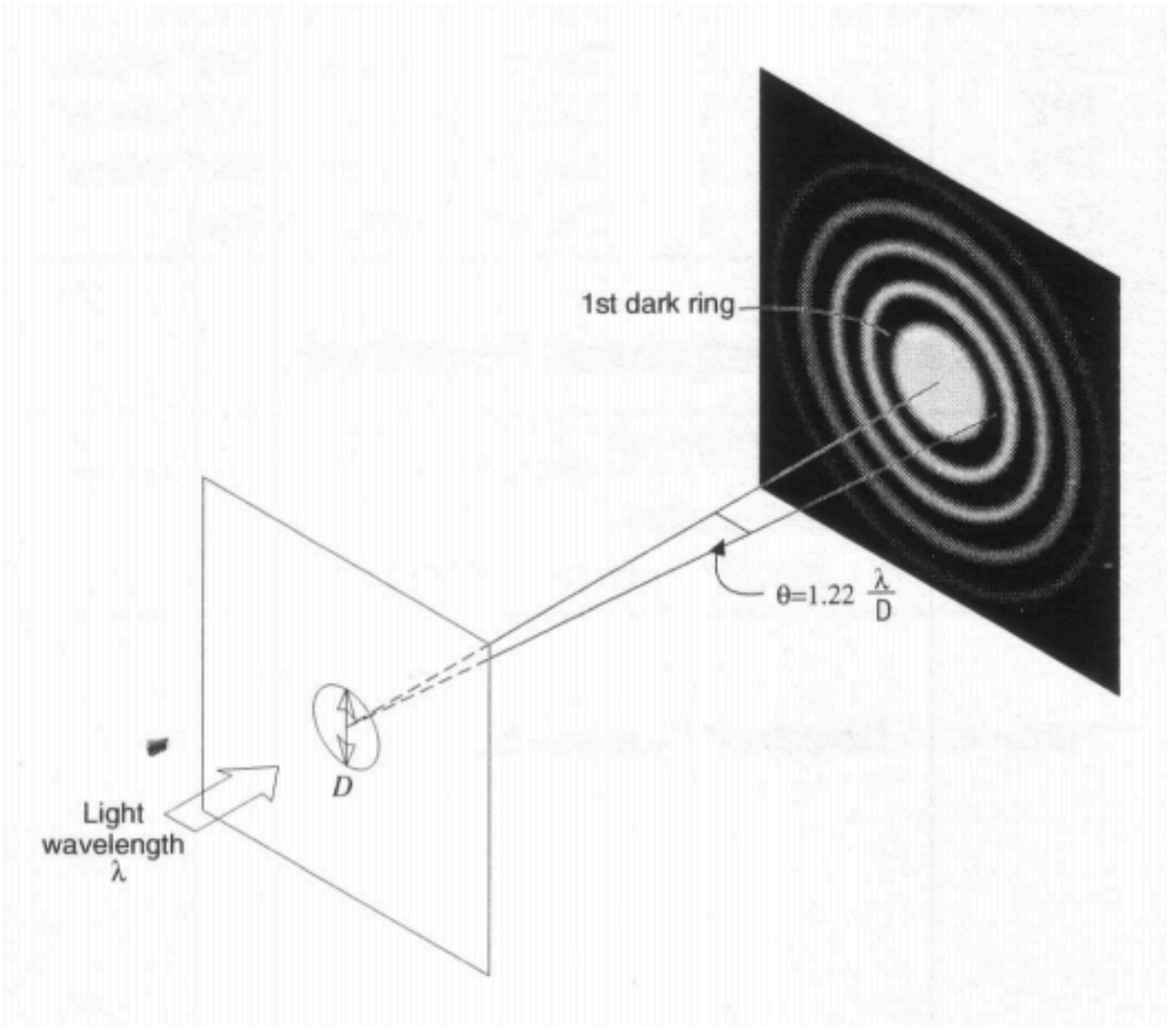
FTT EMCCD


Calibration
Injection
Fast Tip-Tilt
Mirror
FTT Camera
Optics
ADC
Prisms
Environmental
Cover
Fiber Mirror
Collimating
OAP
Fiber Injection
Optics

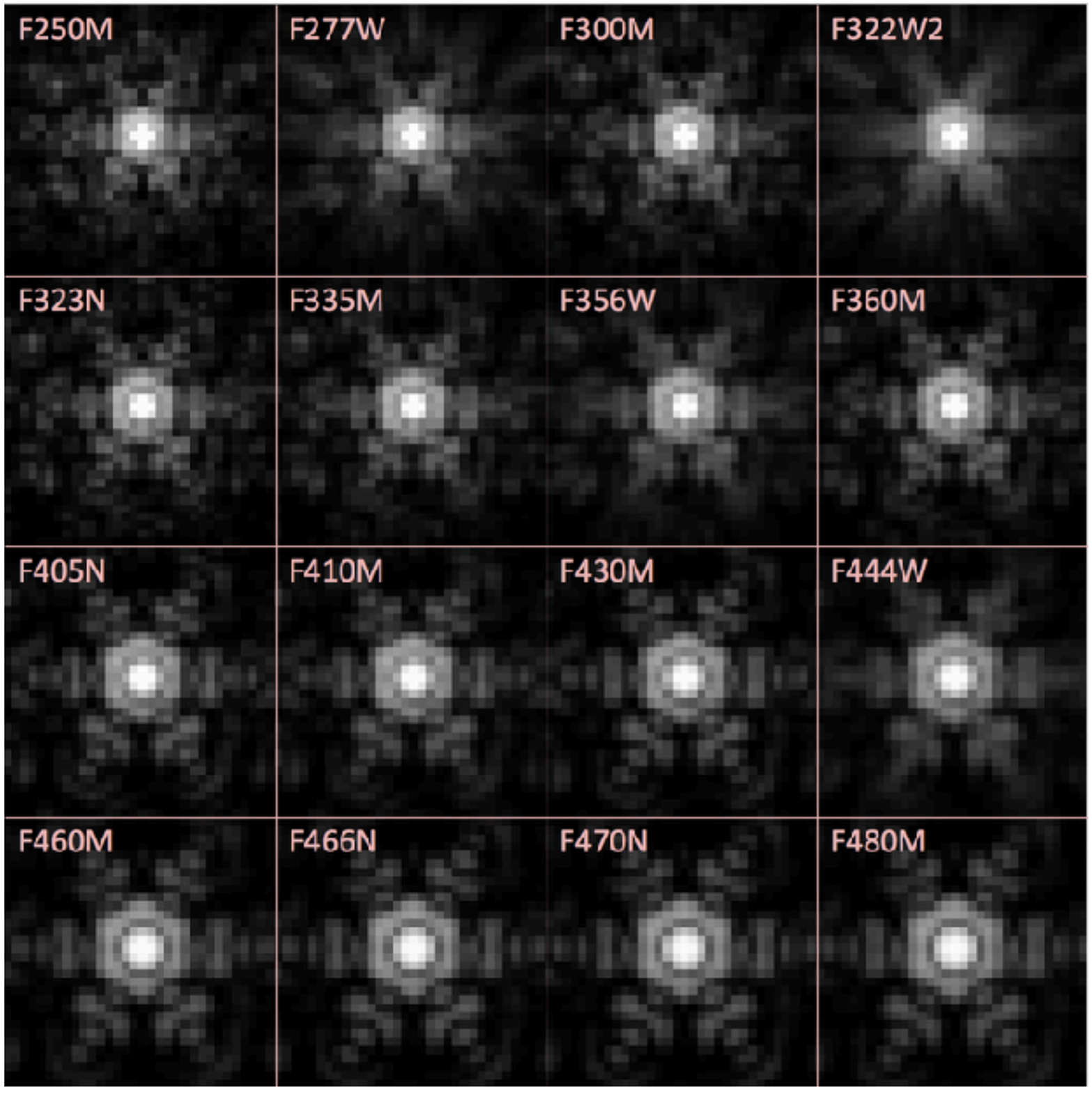
f/1.8 ($100,000,000)

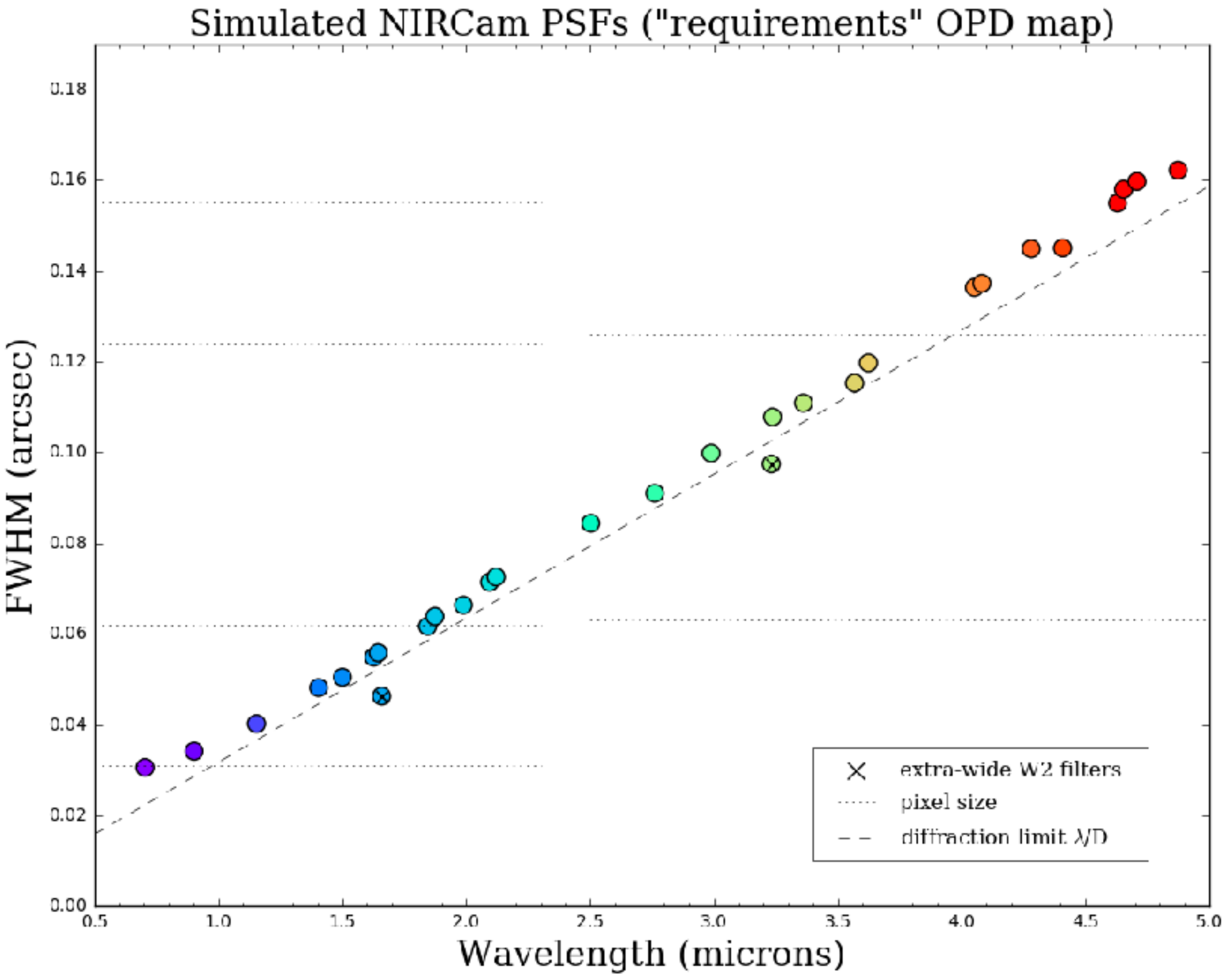
f/1.8 ($110)

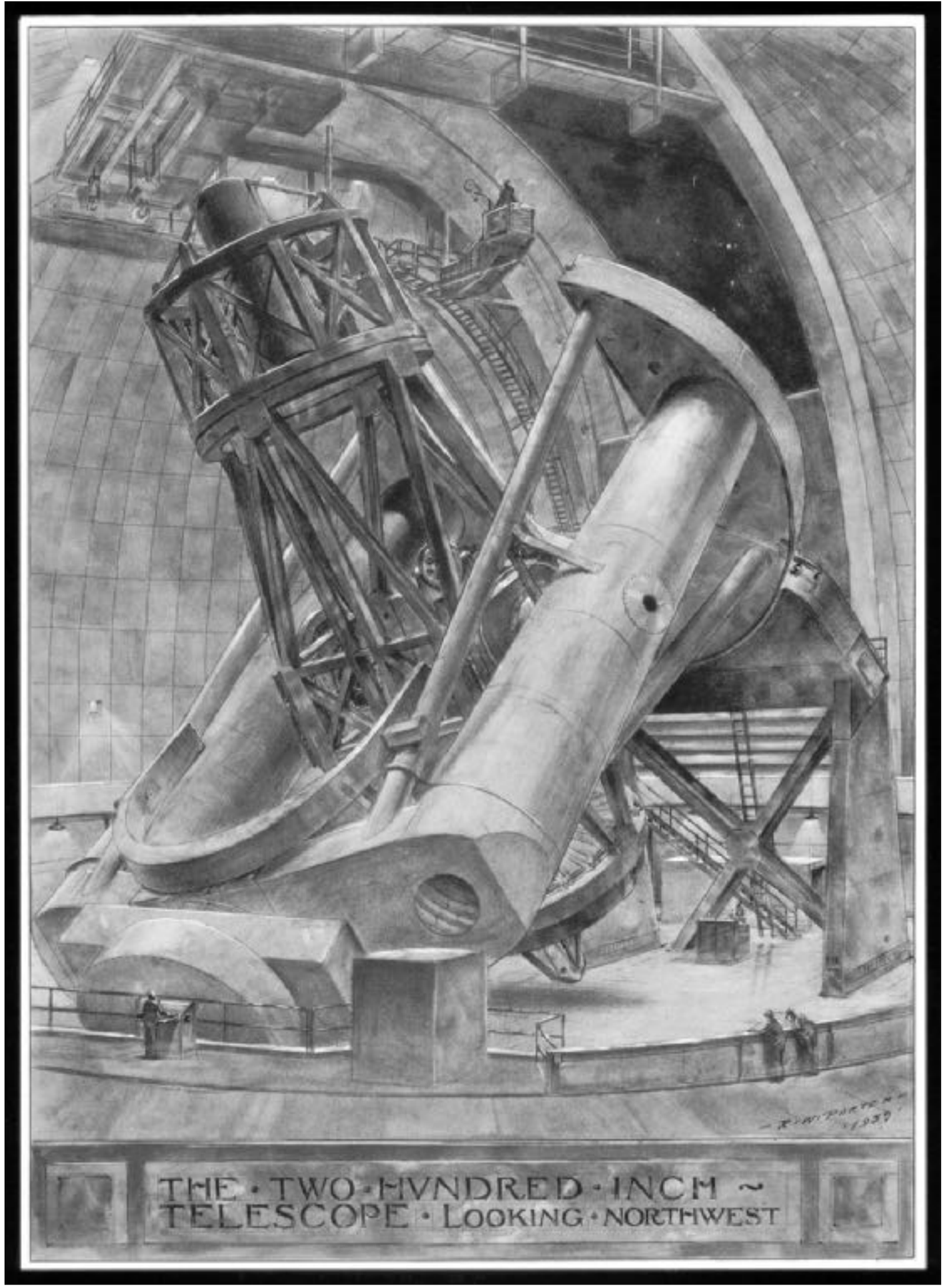

Primary Mirror Focal Length
Effective Focal Length


1st dark ring
θ=1.22 λ/D
D
Light
wavelength
λ

JWST NIRCAM simulated PSFs




Simulated NIRCam PSFs ("requirements" OPD map)
FWHM (arcsec)
Wavelength (microns)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
extra-wide W2 filters
pixel size
diffraction limit λ/D



Russell Porter drawing
of 200 inch

GMT Design

36 meters high
25.3 meters across

Alt-Az structure
- ~1000 tons moving mass

Primary mirror (f/0.7)
- 7 segments 8.4 meters each
- Cast borosilicate honeycomb
- Segments position controlled to ~10 μm

3.2-m segmented secondary mirror
- corrects for PM position errors
- deformable mirror for adaptive optics

Instruments mount below primary at the Gregorian focus