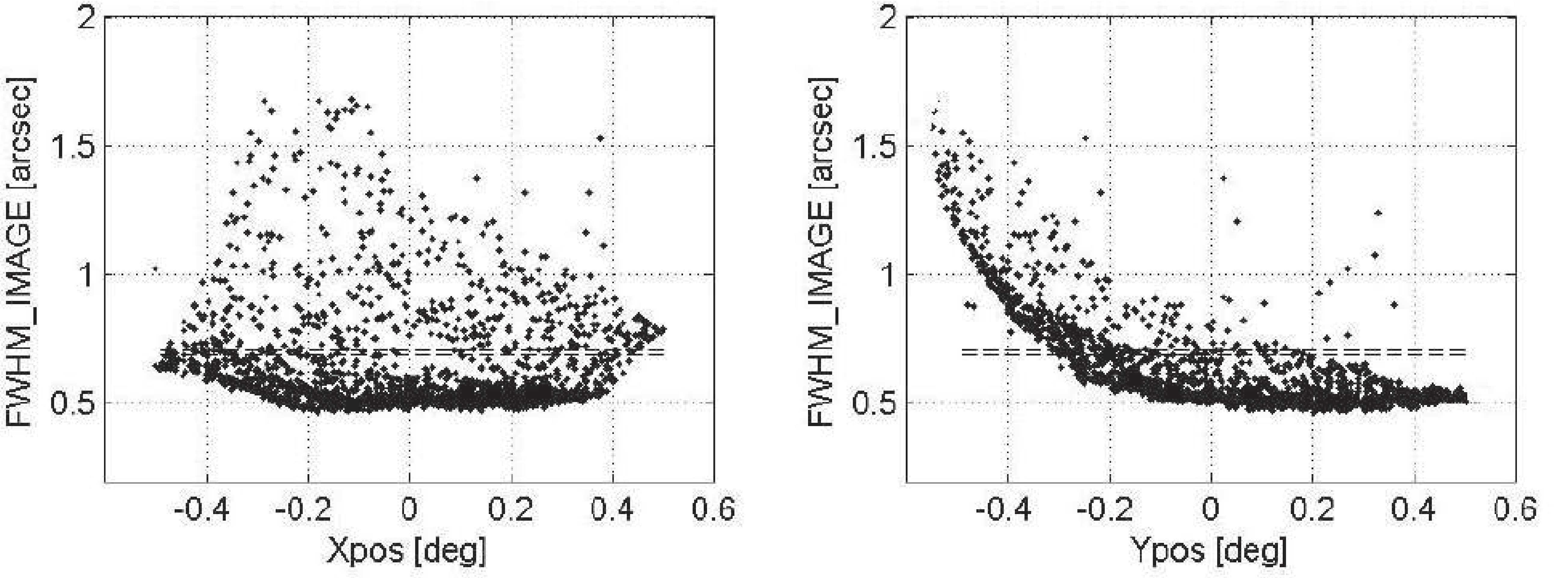
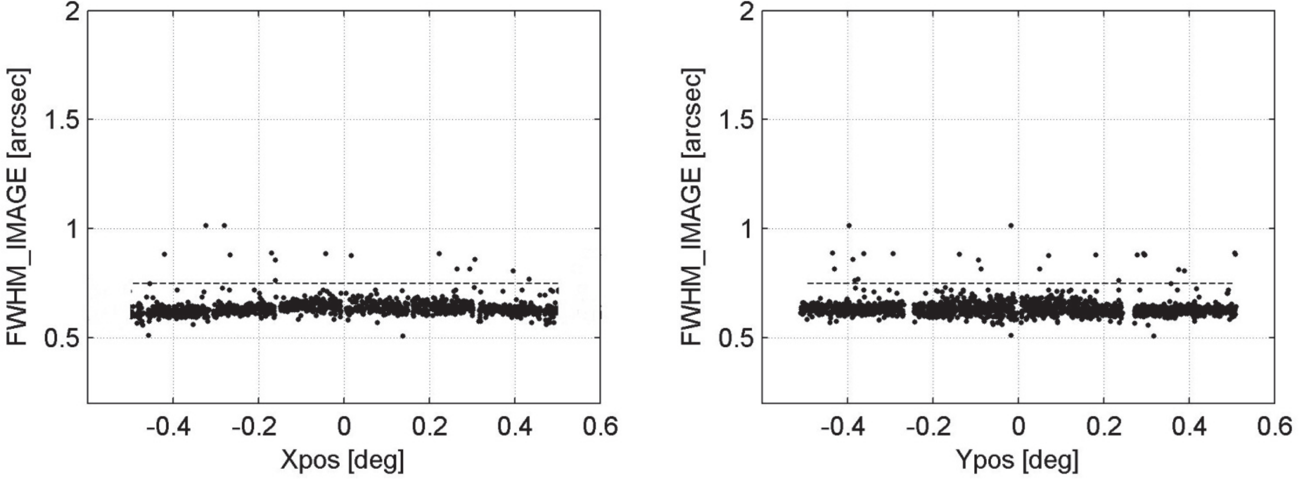
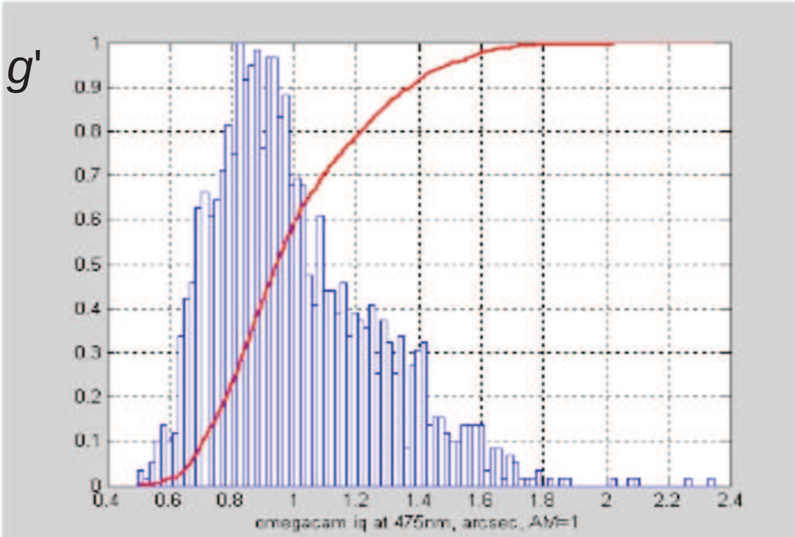
HOW WIDE-FIELD TELESCOPES WORK (WHEN THEY DO)

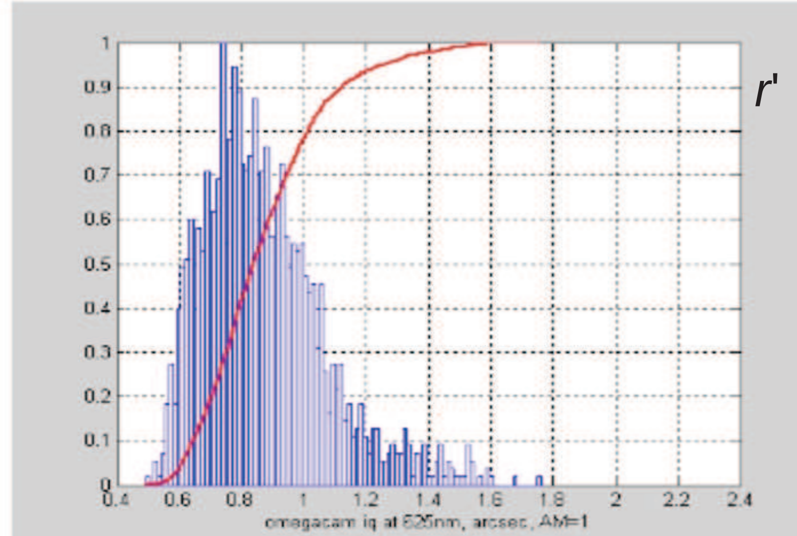

2
1.5
1
0.5
FWHM_IMAGE [arcsec]
-0.4
-0.2
0
0.2
0.4
0.6
Xpos [deg]
2
1.5
1
0.5
FWHM_IMAGE [arcsec]
-0.4
-0.2
0
0.2
0.4
0.6
Ypos [deg]

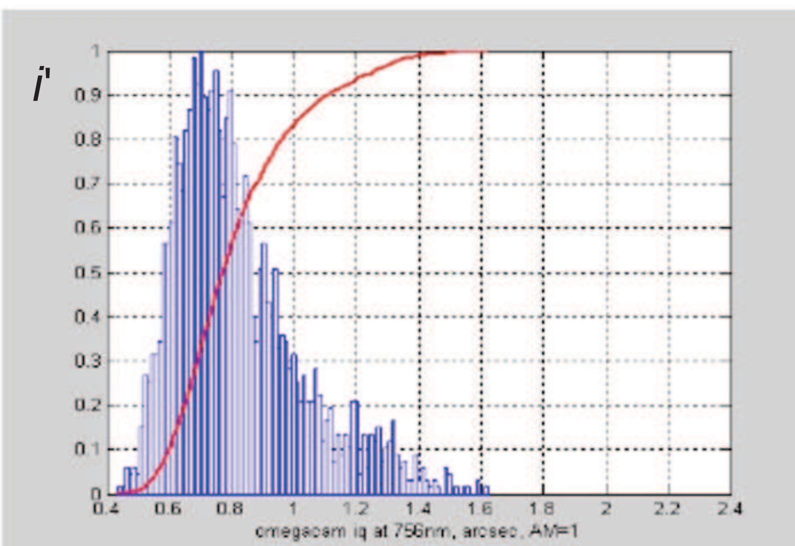

FWHM_IMAGE [arcsec]
2
1.5
1
0.5
-0.4
-0.2
0
0.2
0.4
0.6
Xpos [deg]
FWHM_IMAGE [arcsec]
2
1.5
1
0.5
-0.4
-0.2
0
0.2
0.4
0.6
Ypos [deg]

OmegaCAM IQ distribution August – December 2011

-- each data point is average IQ in one image over full chip array --



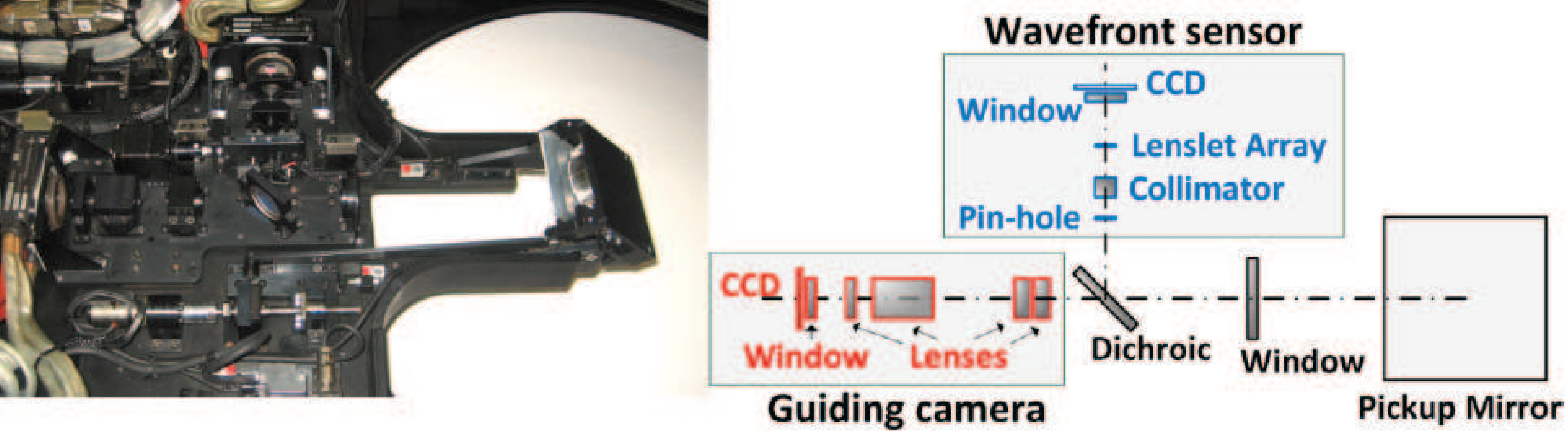




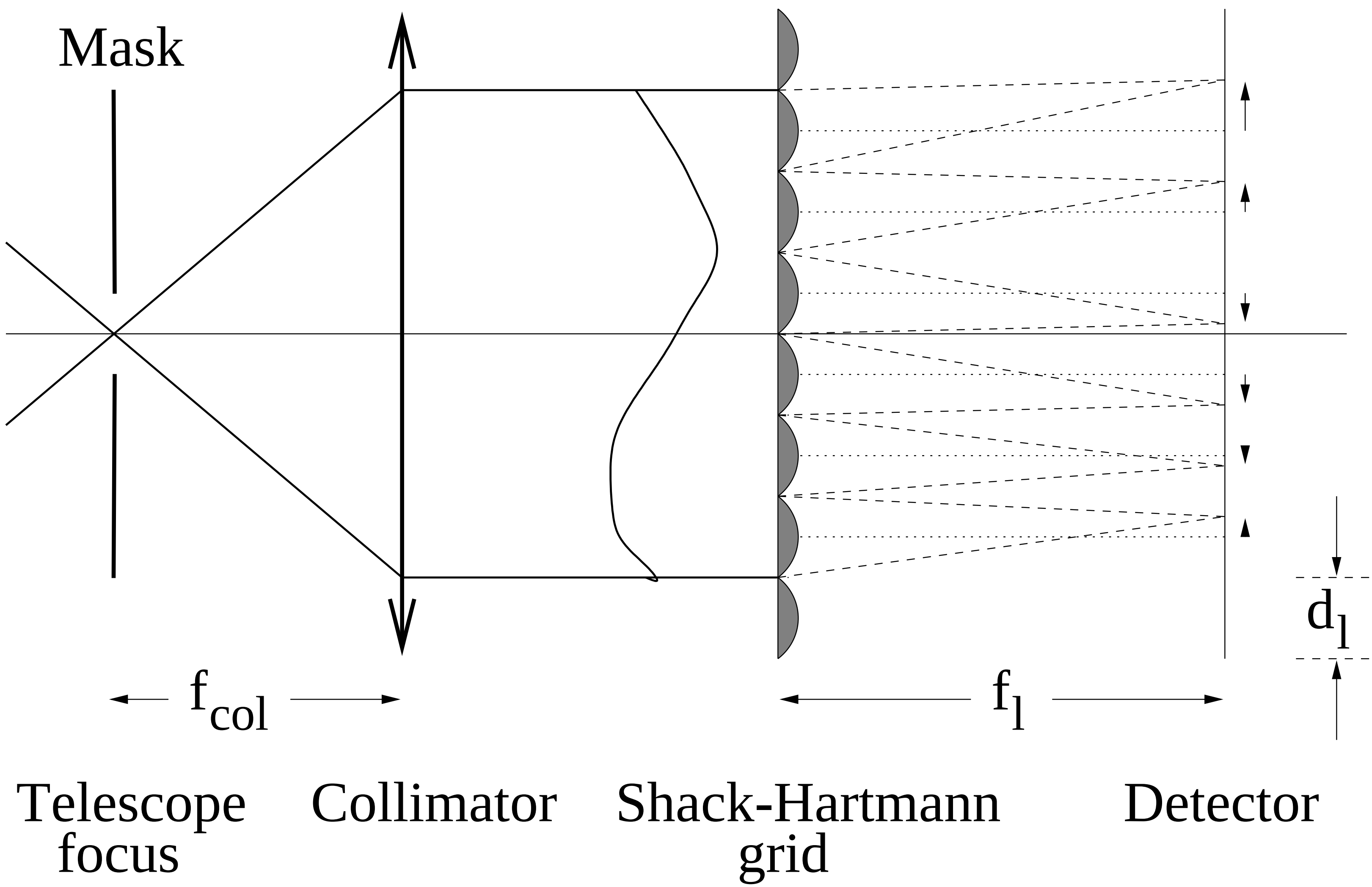
Median IQ in g' ~0.95”
Median IQ in r' ~0.85”
Median IQ in i' ~0.80”

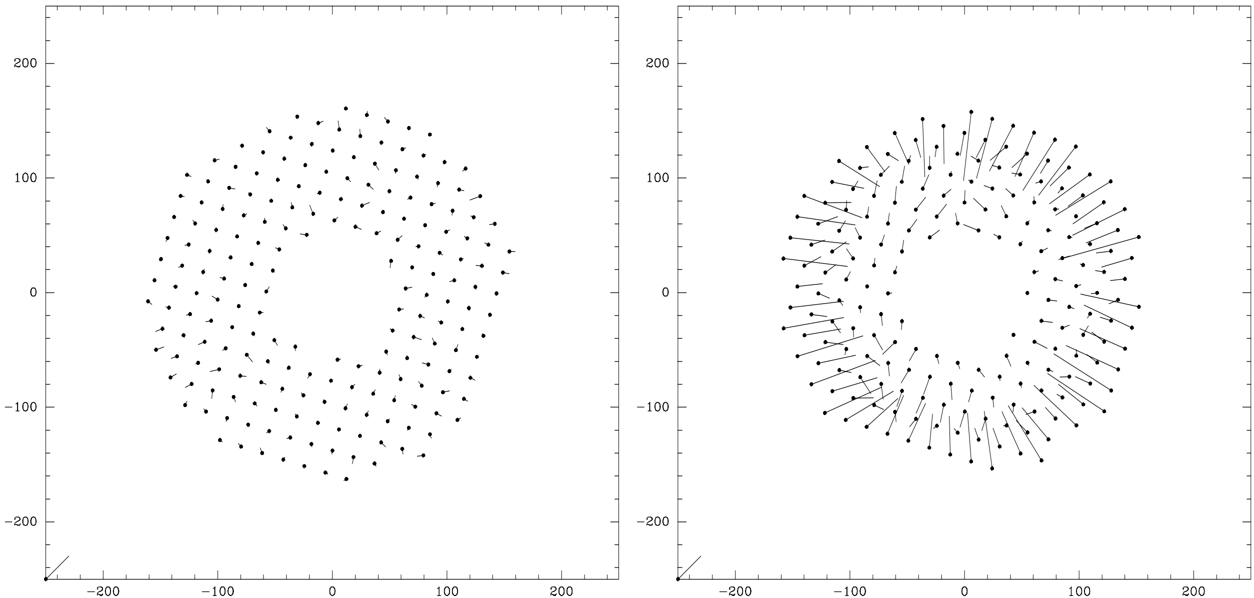
Internal IQ ~0.4-0.5”

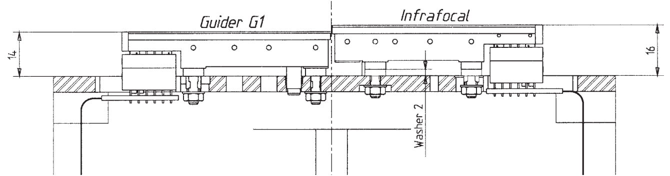
-> Outside median IQ ~ 0.80” @ 600nm



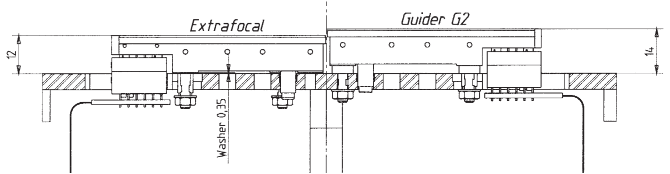
Wavefront sensor
CCD
Window
Lenslet Array
Collimator
Pin-hole
CCD
Window
Lenses
Dichroic
Window
Guiding camera
Pickup Mirror


Mask
f_{col}
f_l
d_l
Telescope focus
Collimator
Shack-Hartmann grid
Detector

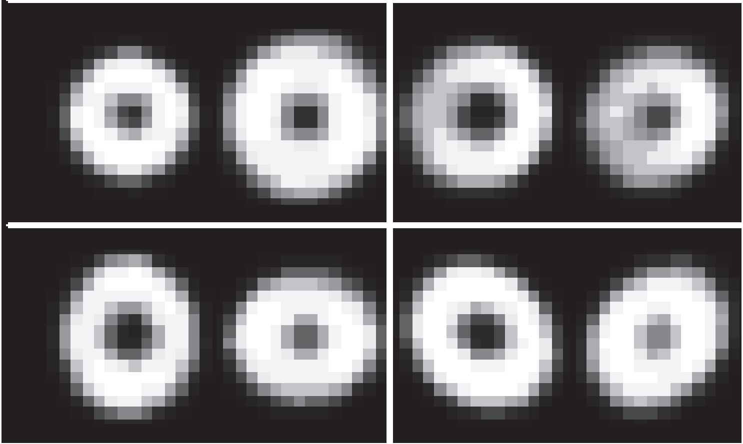

200
100
0
−100
−200
−200
−100
0
100
200
200
100
0
−100
−200
−200
−100
0
100
200



Guider G1
Infrafocal
14
16
Washer 2

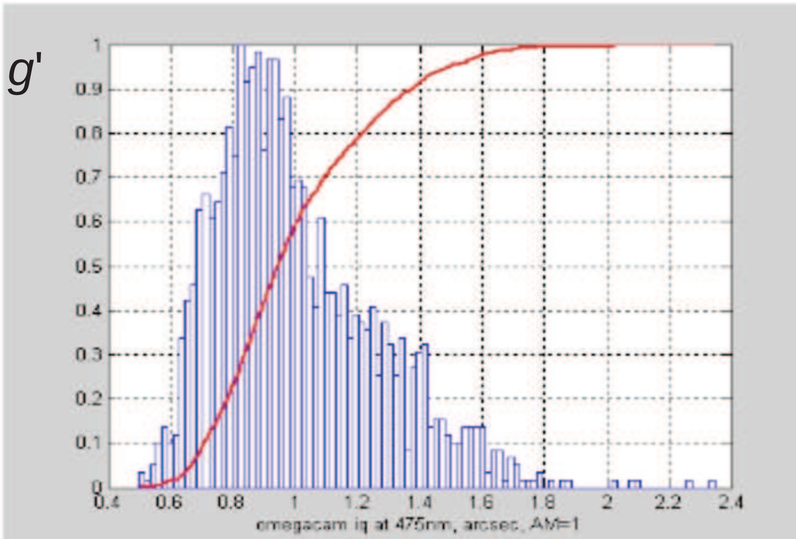


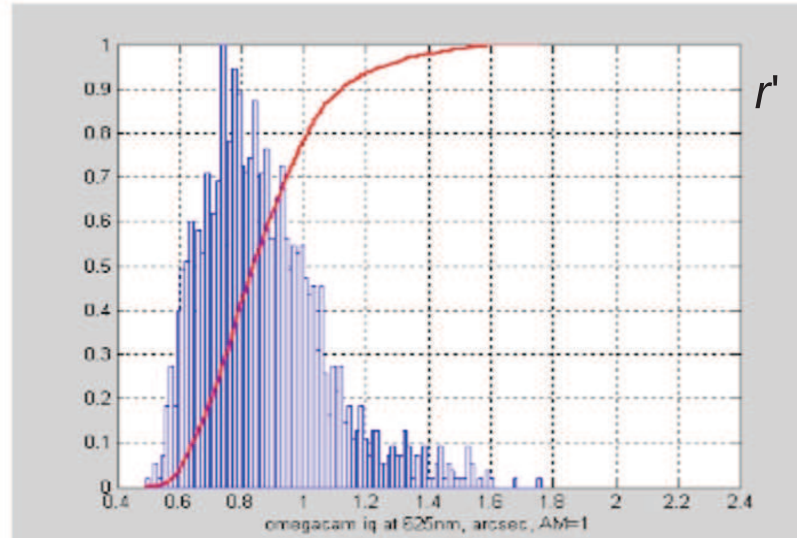
Extrafocal
Guider G2
12
14
Washer 0,35

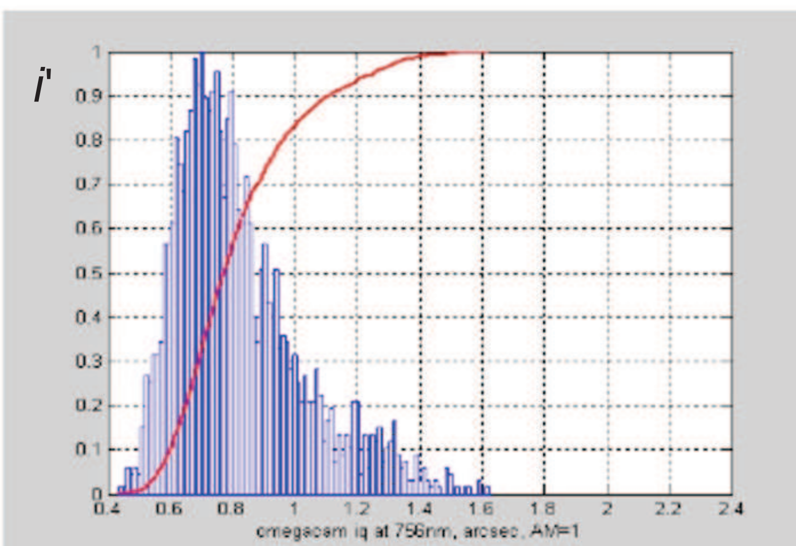


OmegaCAM IQ distribution August – December 2011

-- each data point is average IQ in one image over full chip array --







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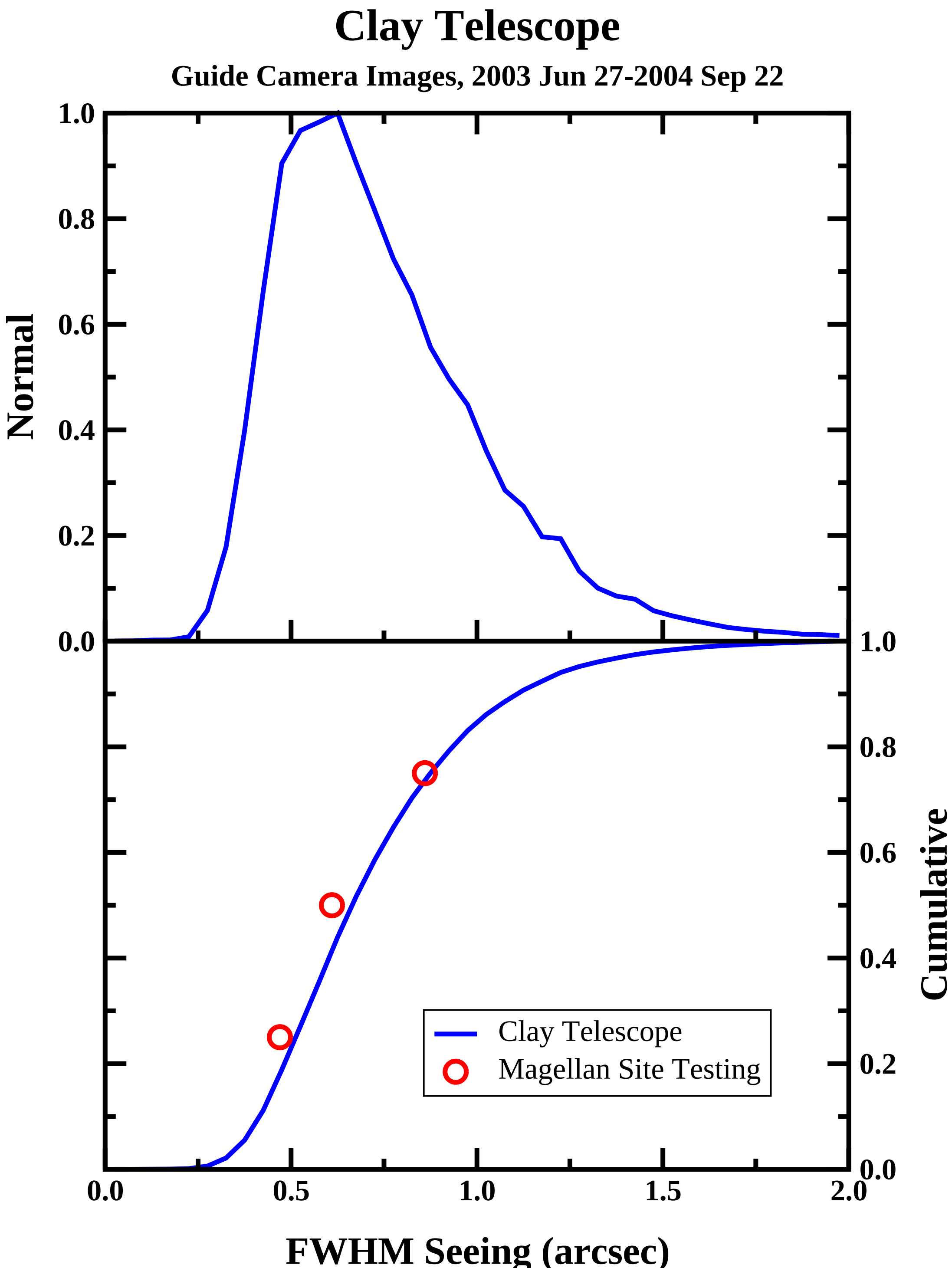


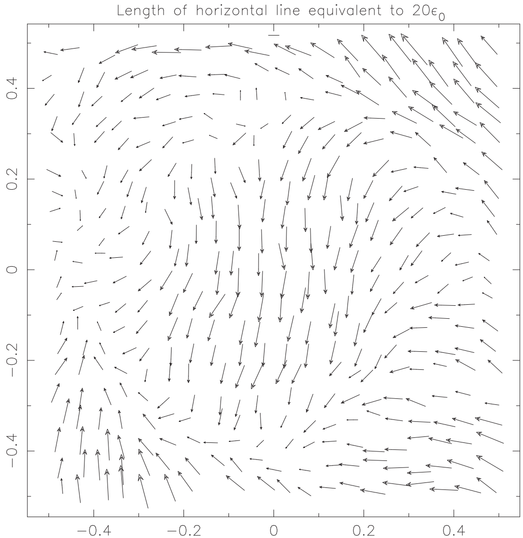
Clay Telescope
Guide Camera Images, 2003 Jun 27-2004 Sep 22
Normal
Cumulative
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
2.0
Clay Telescope
Magellan Site Testing
FWHM Seeing (arcsec)

Moments of Point Spread Function

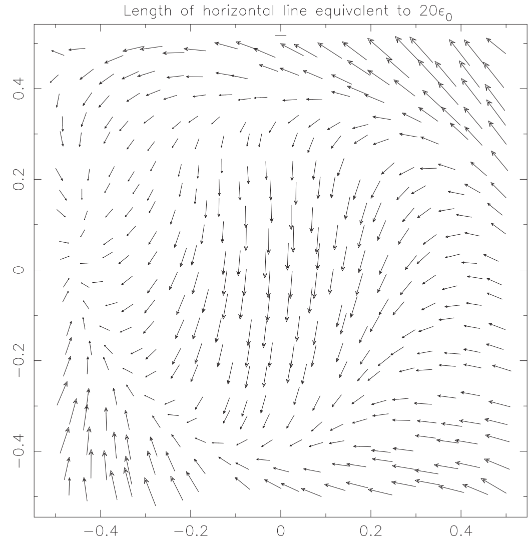
$$z' = x' + iy'$$

$$S(x, y) \equiv \frac{\int dx'dy' I(x', y') \, |z'|^2}{\int dx'dy' I(x', y')}$$

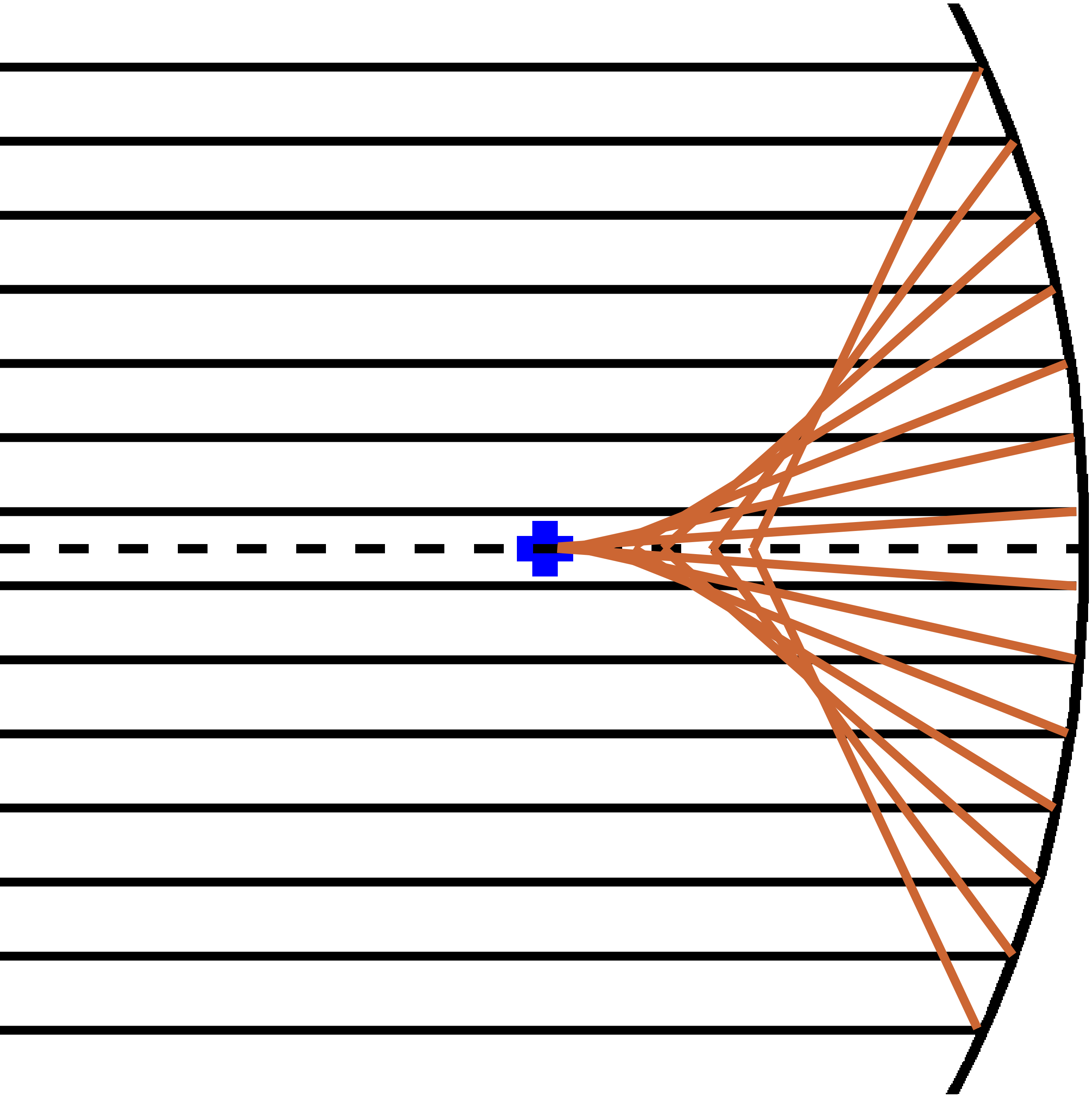
$$Q(x, y) \equiv \frac{\int dx'dy' I(x', y') \, z'^2}{\int dx'dy' I(x', y')}$$

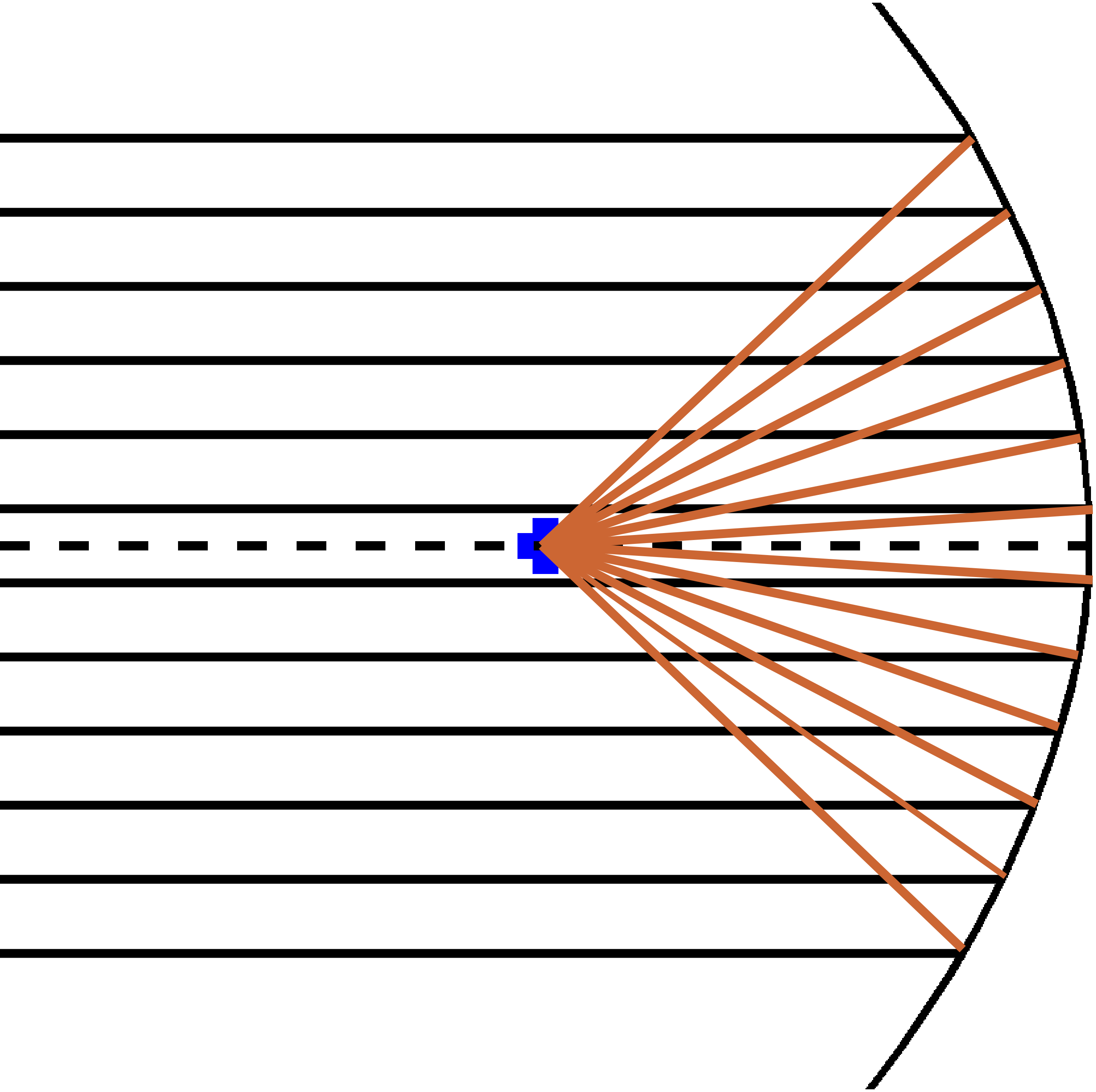


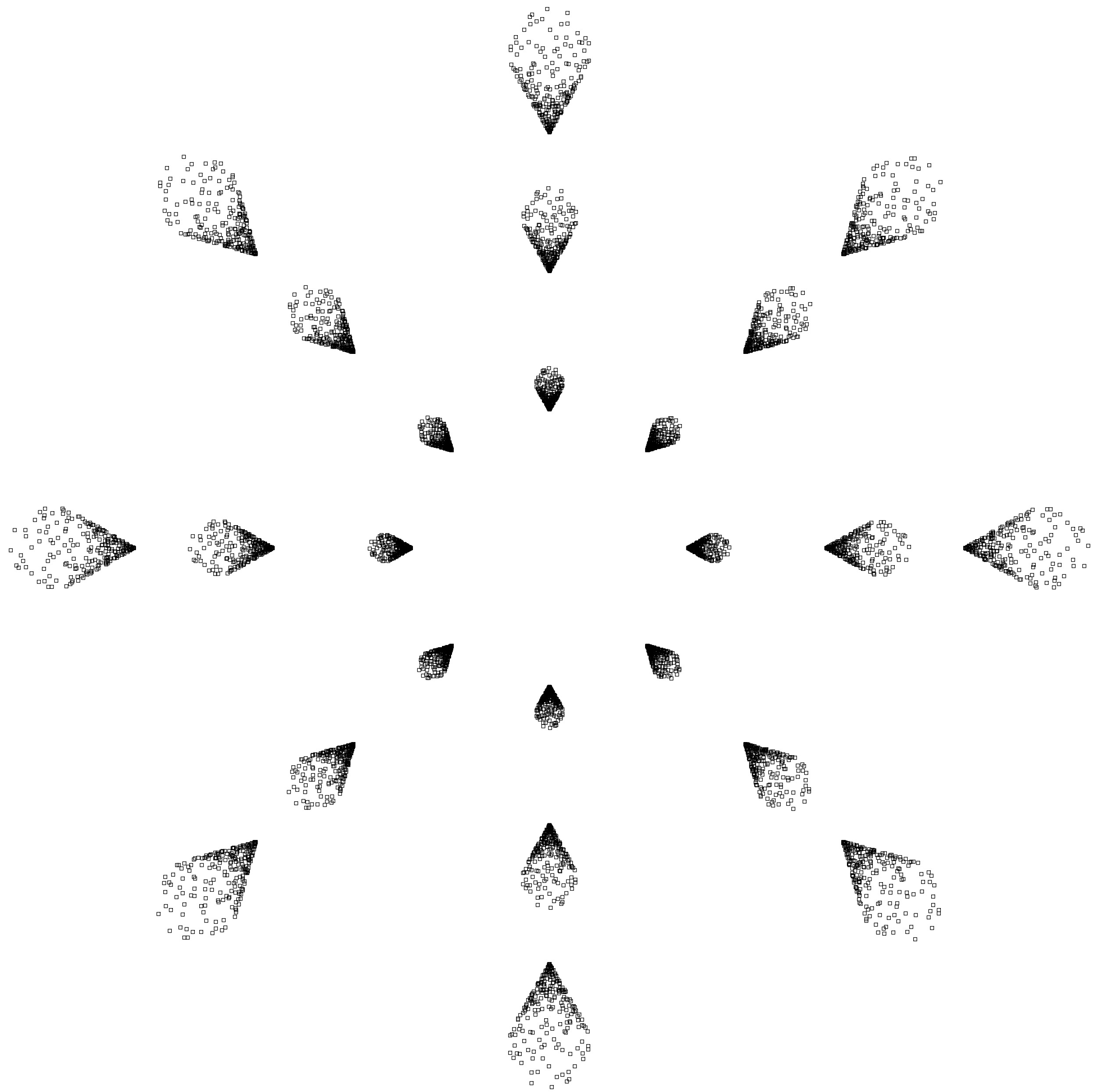
Length of horizontal line equivalent to 20ε0
0.4
0.2
0
−0.2
−0.4
−0.4
−0.2
0
0.2
0.4

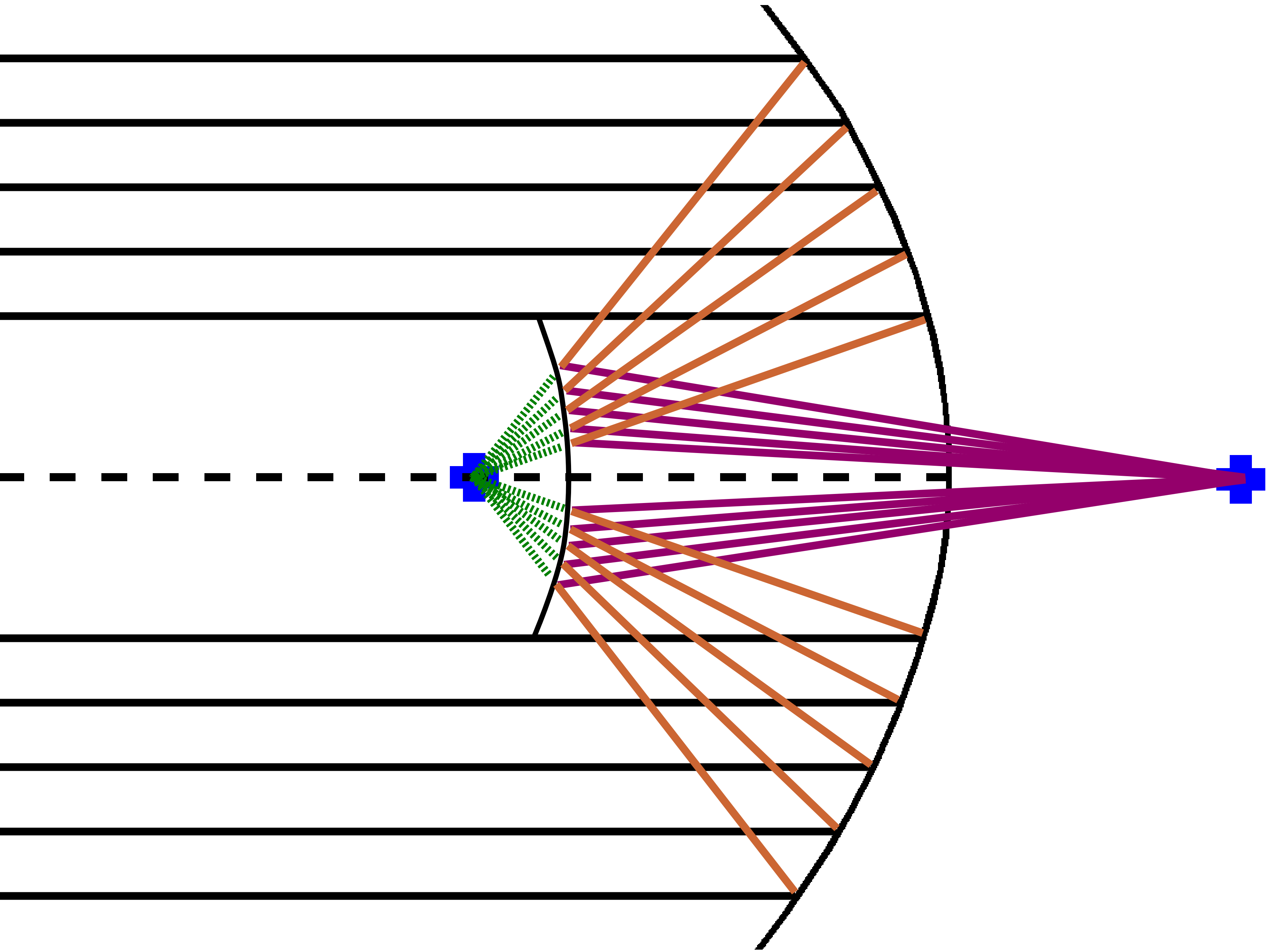


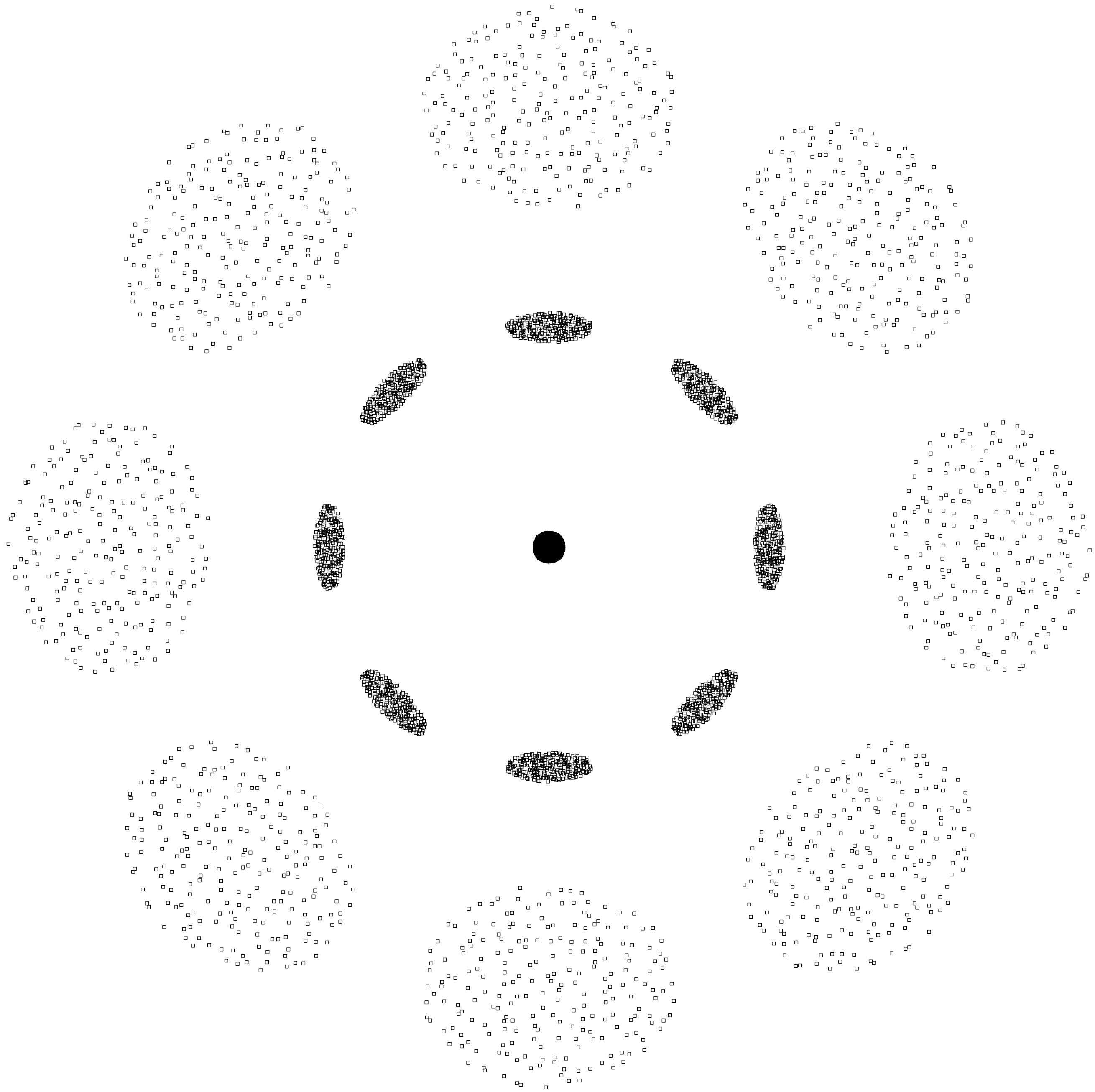
Length of horizontal line equivalent to 20ε0
0.4
0.2
0
−0.2
−0.4
−0.4
−0.2
0
0.2
0.4



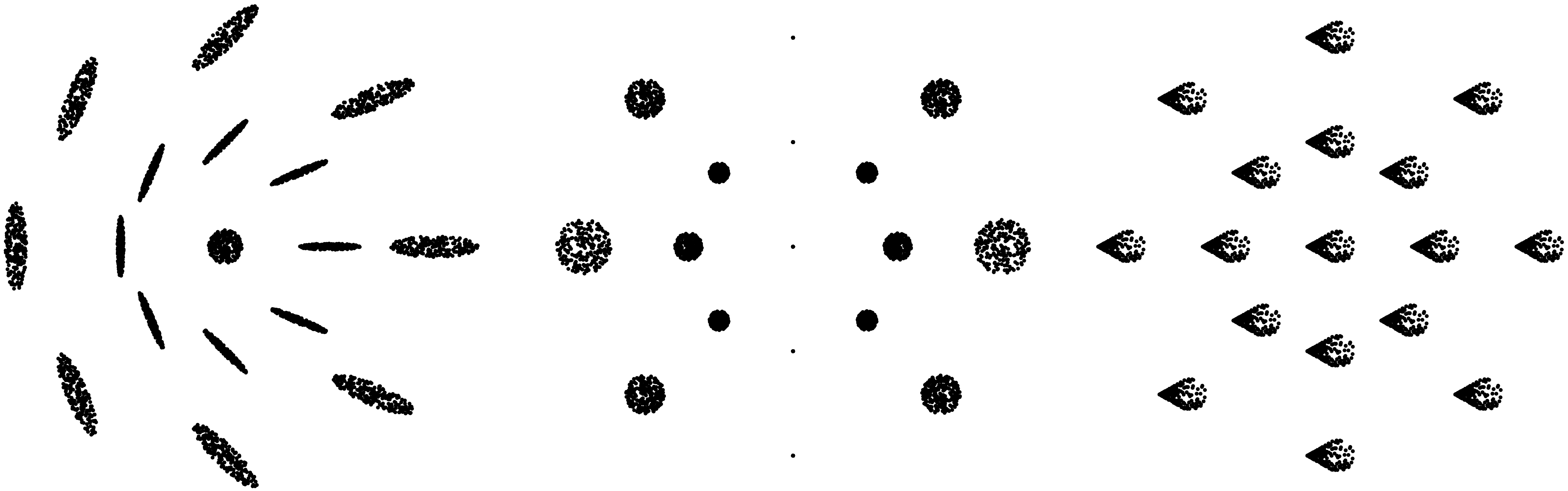




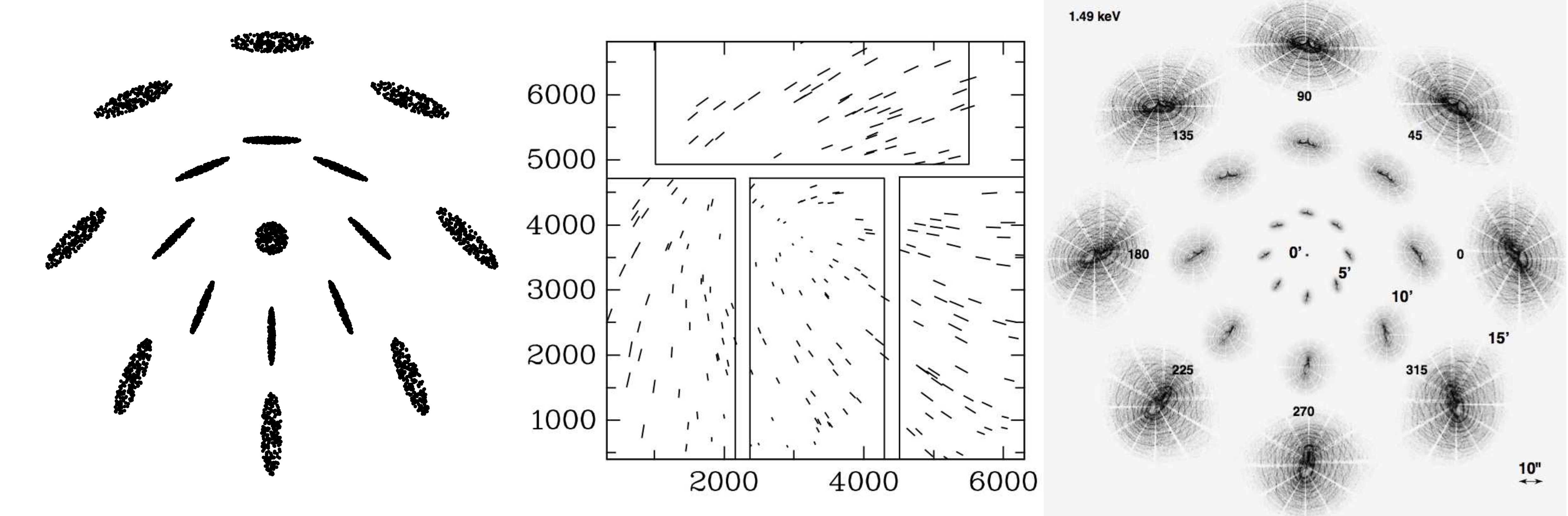




GENERIC MISALIGNMENT ABERRATION PATTERNS

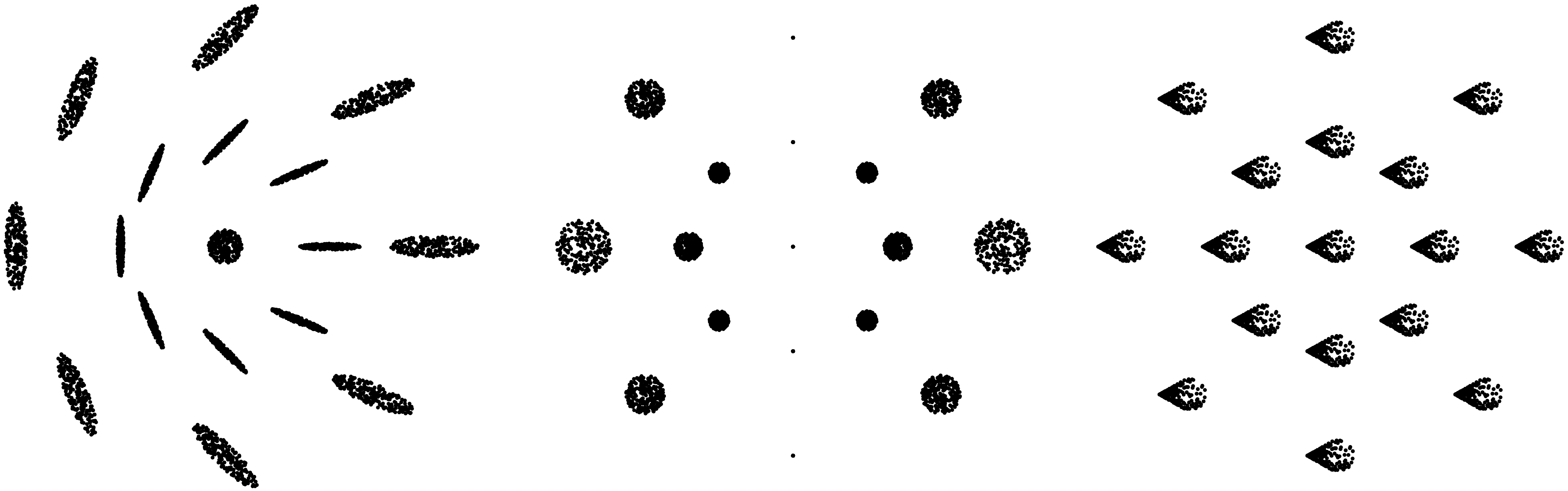


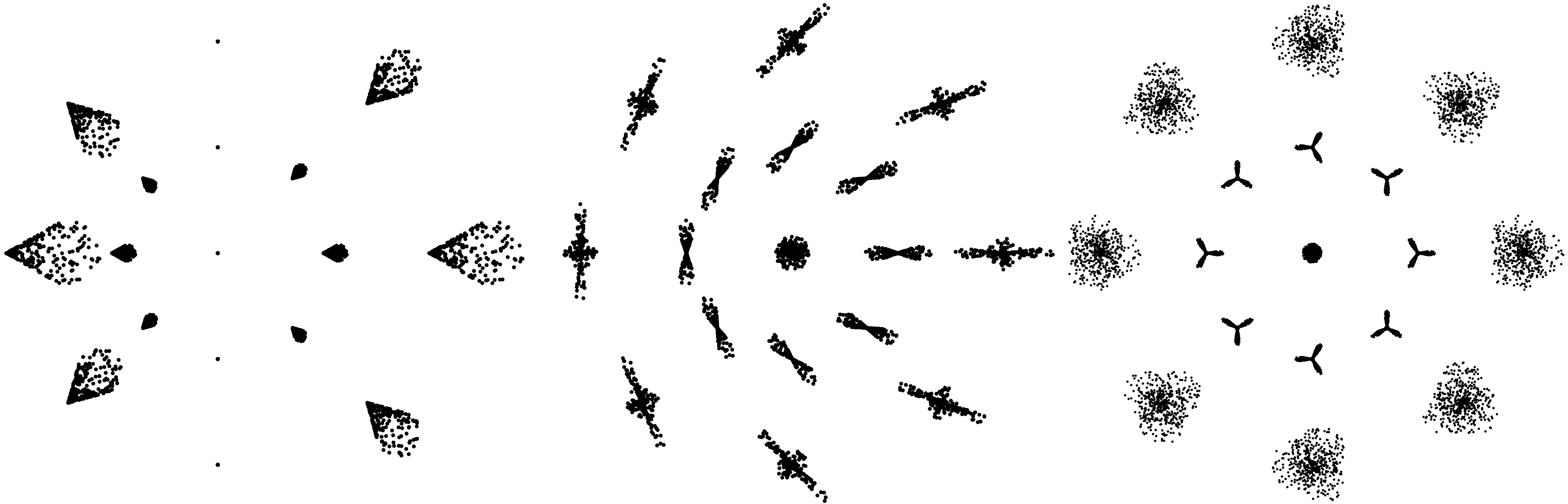
One would assume that the problem of keeping a three mirror telescope aligned has long since been solved.


6000
5000
4000
3000
2000
1000
2000
4000
6000
1.49 keV
90
135
45
180
0'
0
5'
10'
15'
225
315
270
10"

primary mirror	**0 tilts + 0 decenters**
secondary mirror	**2 tilts + 2 decenters**
tertiary mirror	**2 tilts + 2 decenters**

GENERIC MISALIGNMENT ABERRATION PATTERNS





Moments of Point Spread Function

$$z' = x' + iy'$$

$$S(x,y) \equiv \frac{\int dx'dy' I(x',y')\,|z'|^2}{\int dx'dy' I(x',y')}$$

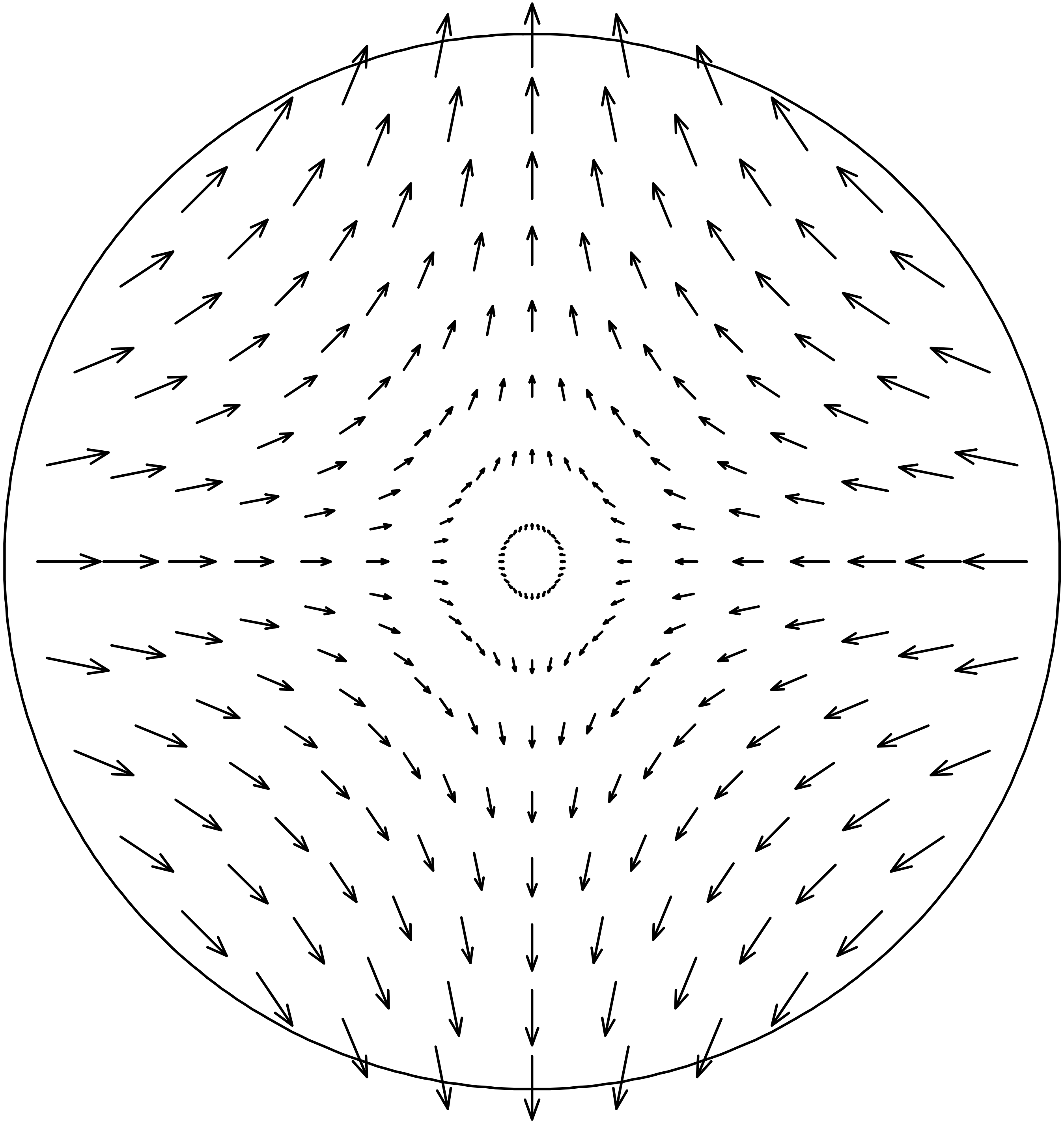
$$Q(x,y) \equiv \frac{\int dx'dy' I(x',y')\,z'^2}{\int dx'dy' I(x',y')}$$

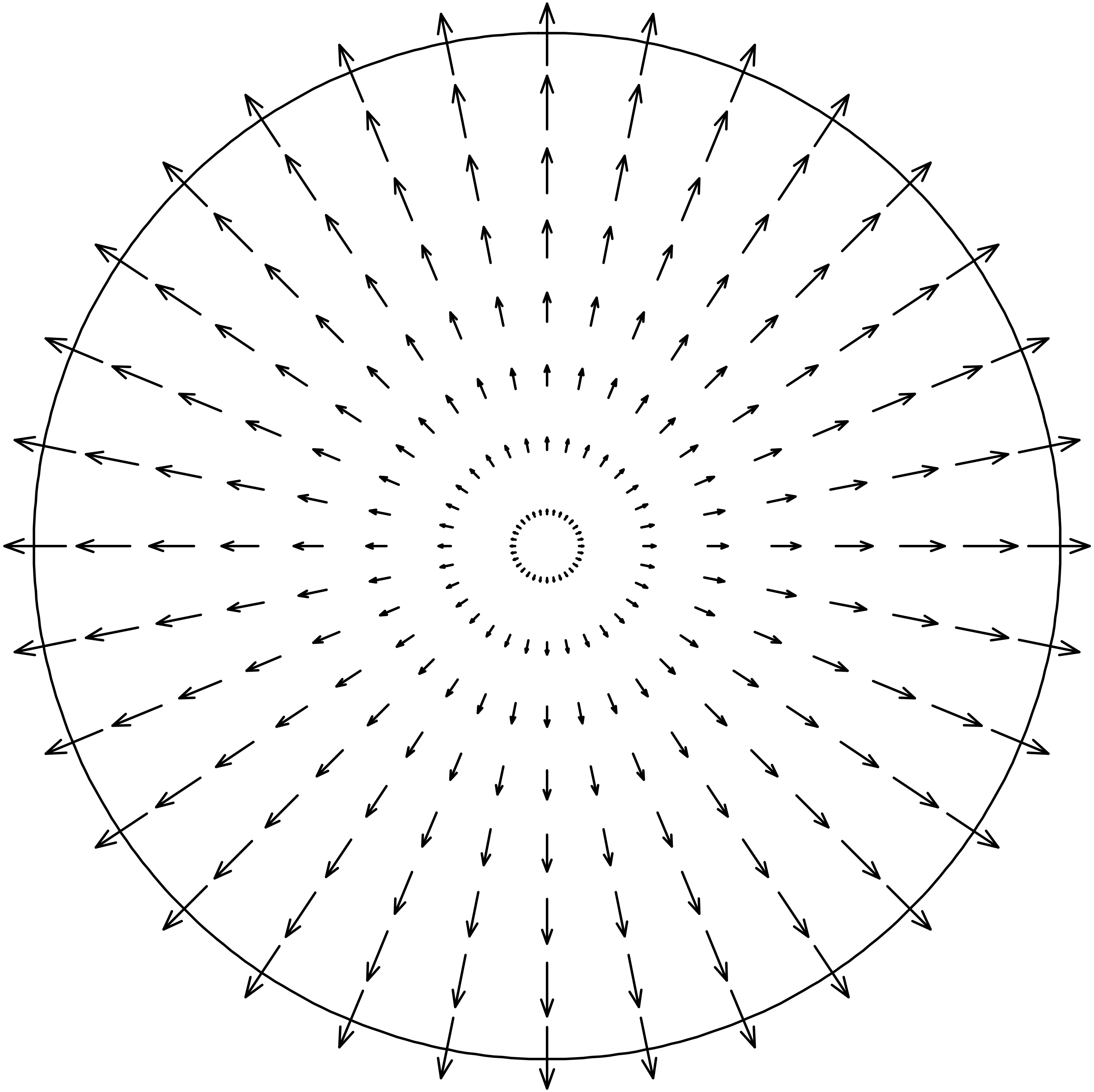
Moments from Aberrations

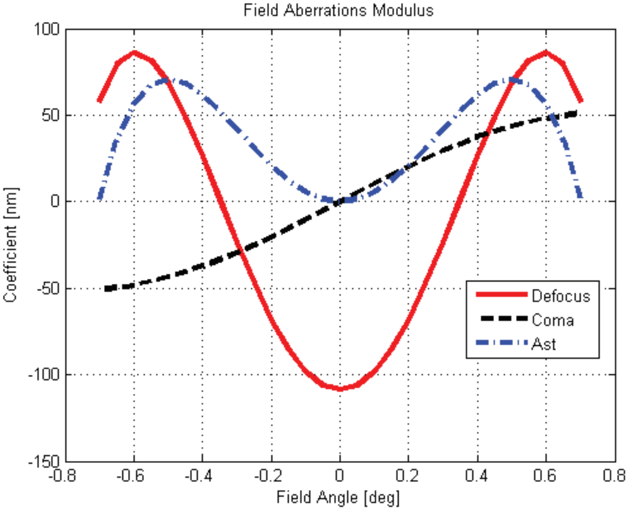
$$S(x,y) = 2\left(d + \frac{4}{3}s\right)^2 + 2|a|^2 + \frac{2}{3}|c|^2 + \frac{4}{9}s^2$$

$$Q(x,y) = 4\left(d + \frac{4}{3}s\right)a + \frac{1}{3}c^2$$

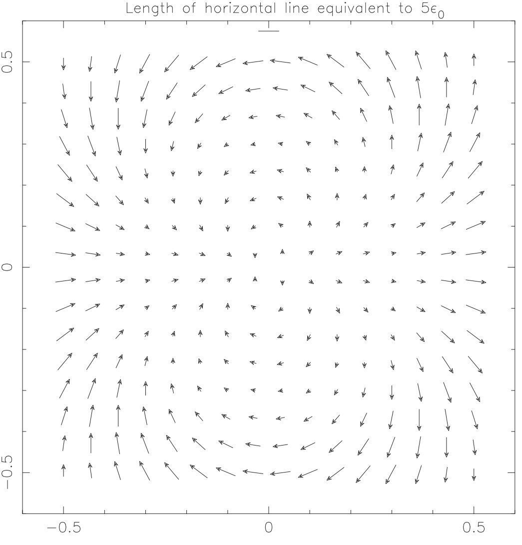
defocus d; spherical s; astigmatism a; coma c

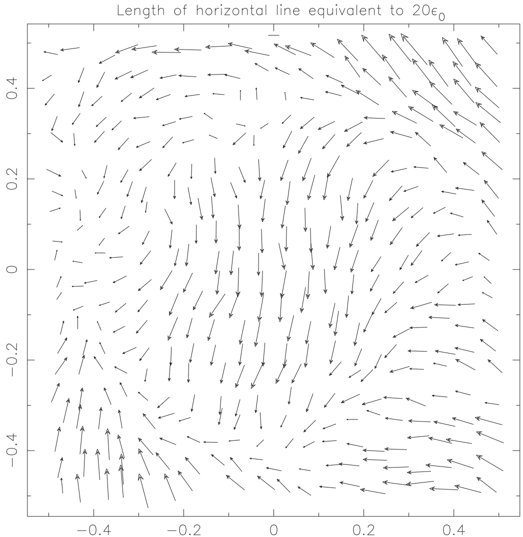




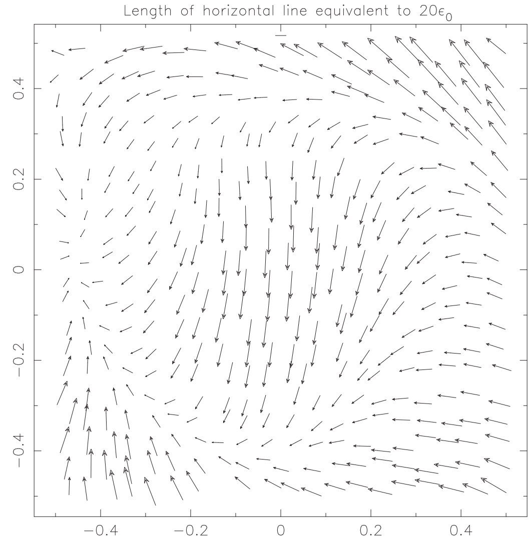


Field Aberrations Modulus
Coefficient [nm]
Field Angle [deg]
100
50
0
-50
-100
-150
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
Defocus
Coma
Ast


Length of horizontal line equivalent to $5\epsilon_0$
0.5
0
−0.5
−0.5
0
0.5



Length of horizontal line equivalent to 20ϵ_0
0.4
0.2
0
−0.2
−0.4
−0.4
−0.2
0
0.2
0.4



Length of horizontal line equivalent to 20ϵ_0
0.4
0.2
0
−0.2
−0.4
−0.4
−0.2
0
0.2
0.4

How do the power series expansions of wavefront on a pupil and time delay in the plane of a lens differ from each other?

Polynomial Expansion of Wavefront in Polar Coordinates (ρ, θ)

radial	angular	optics name	lensing name
ρ^0	1	**piston**	**time delay**
ρ^1	$\sin\theta; \cos\theta$	**tilt**	**deflection**
ρ^2	1	**defocus**	**(magnification)$^{-1}$**
ρ^2	$\sin 2\theta; \cos 2\theta$	**astigmatism**	**shear**
ρ^3	$\sin\theta; \cos\theta$	**coma**	**1-flexion**
ρ^3	$\sin 3\theta; \cos 3\theta$	**trefoil**	**3-flexion**