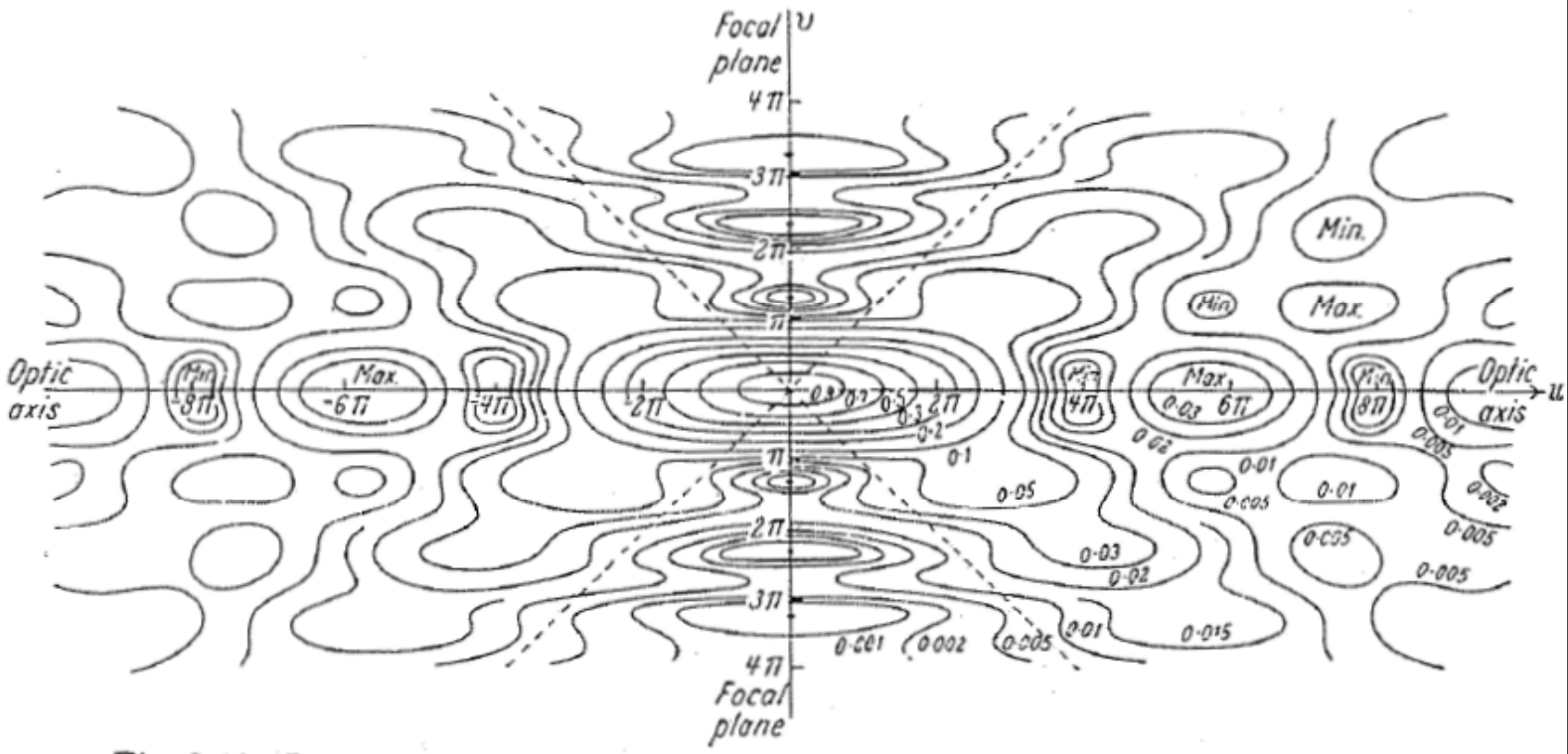
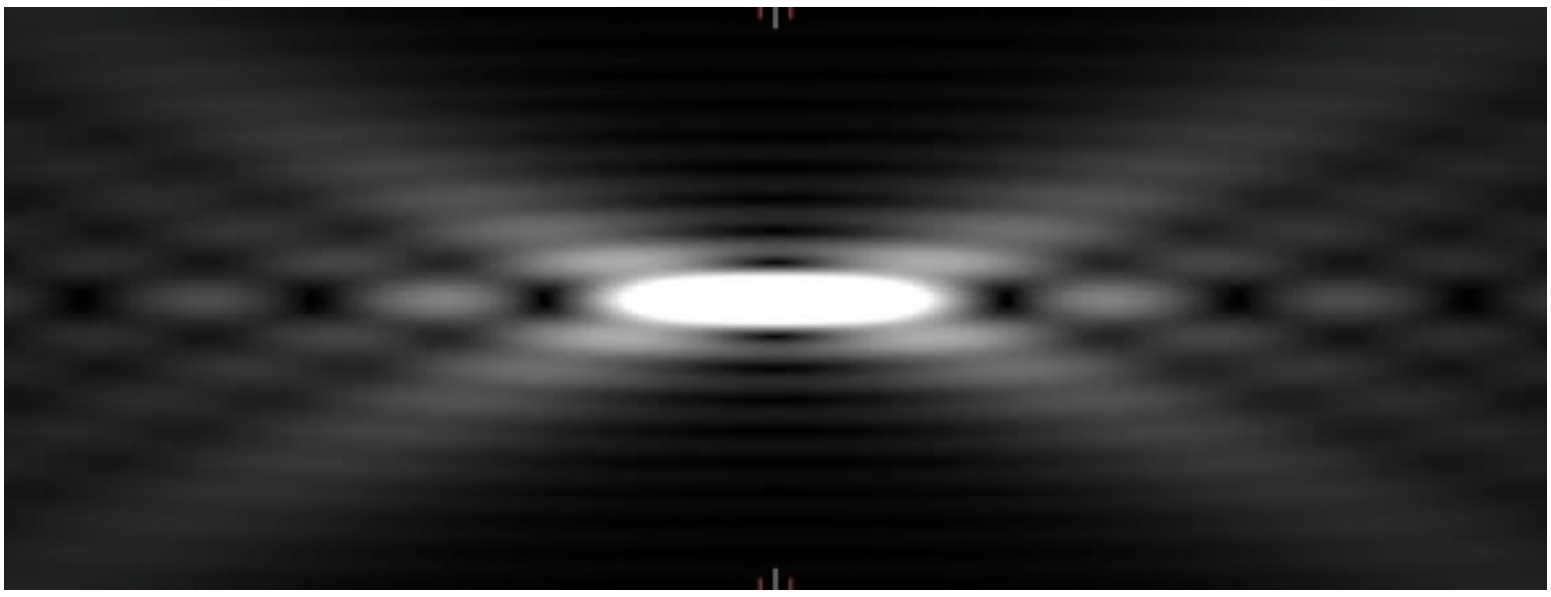


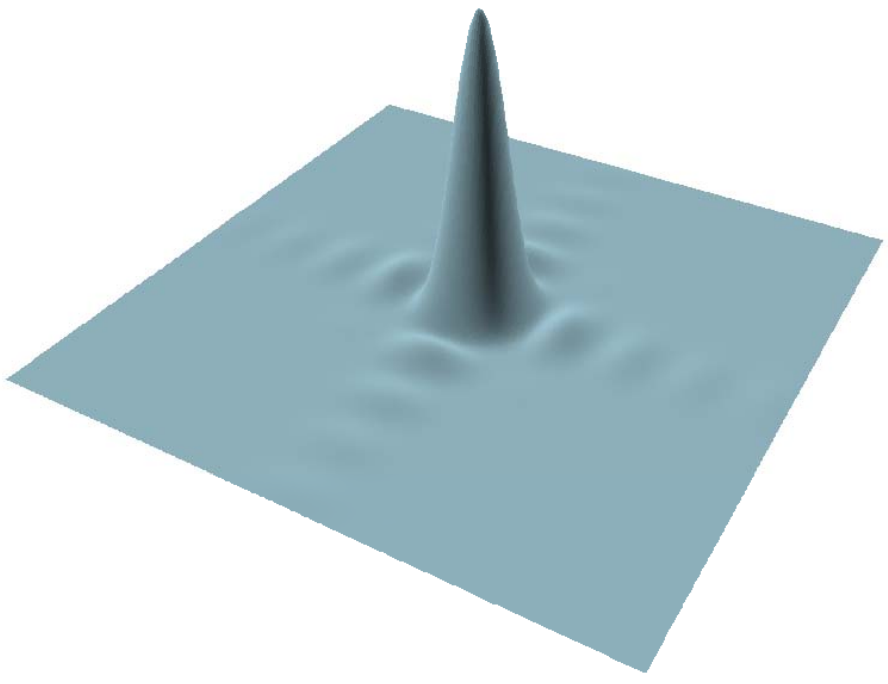
Fig. 8.41. Isophotes [contour lines of the intensity $I(u, v)$] in a meridional plane near focus of a converging spherical wave diffracted at a circular aperture. The intensity is normalized to unity at focus. The dotted lines represent the boundary of the geometrical shadow. When the figure is rotated about the u-axis, the minima on the v-axis generate the AIRY dark rings.

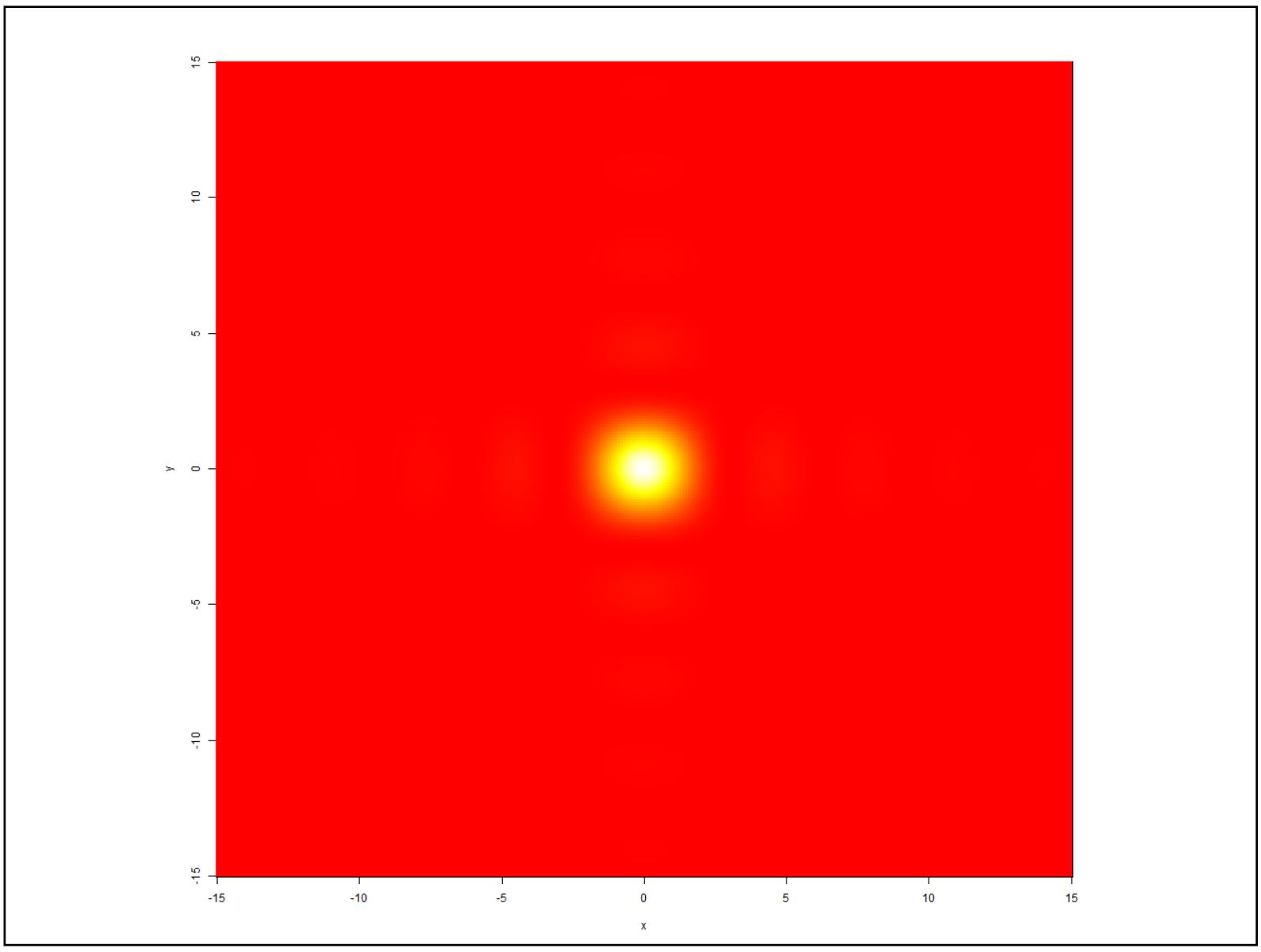
(Adapted from E. H. LINFOOT and E. WOLF, *Proc. Phys. Soc.*, B, 69 (1956), 823.)



$$\theta = \frac{\lambda}{D}$$

(within a factor of two, usually much better)

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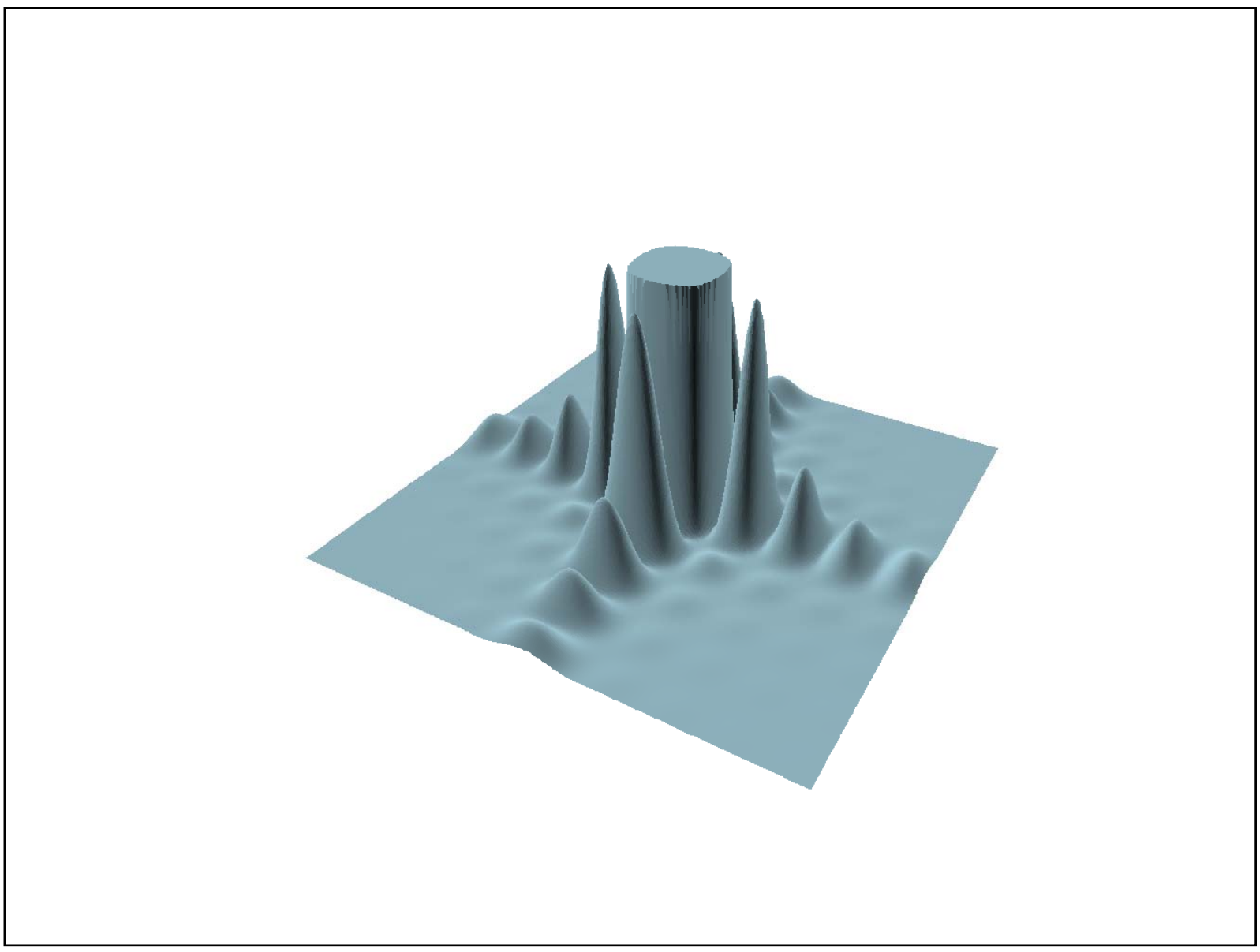
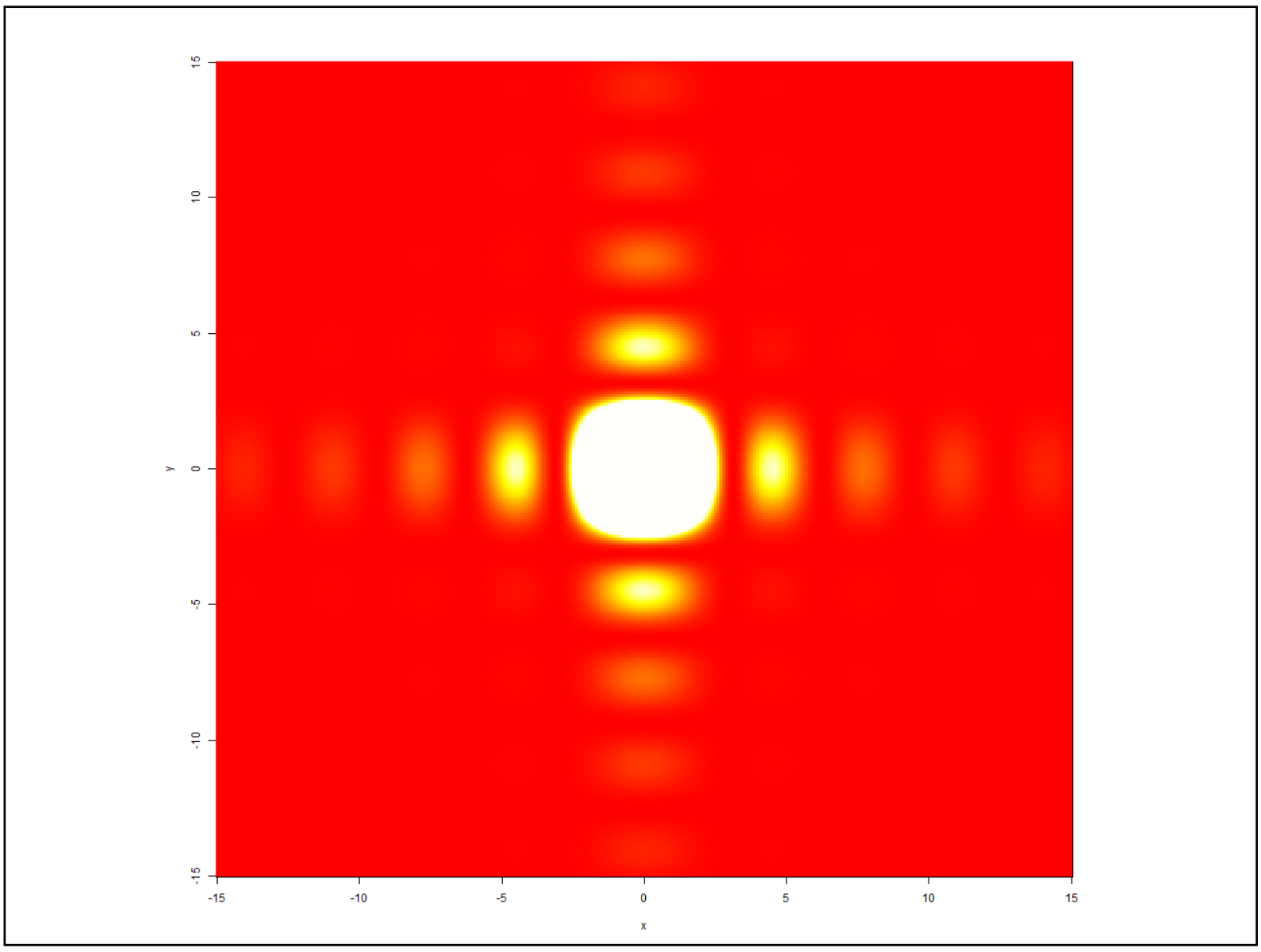
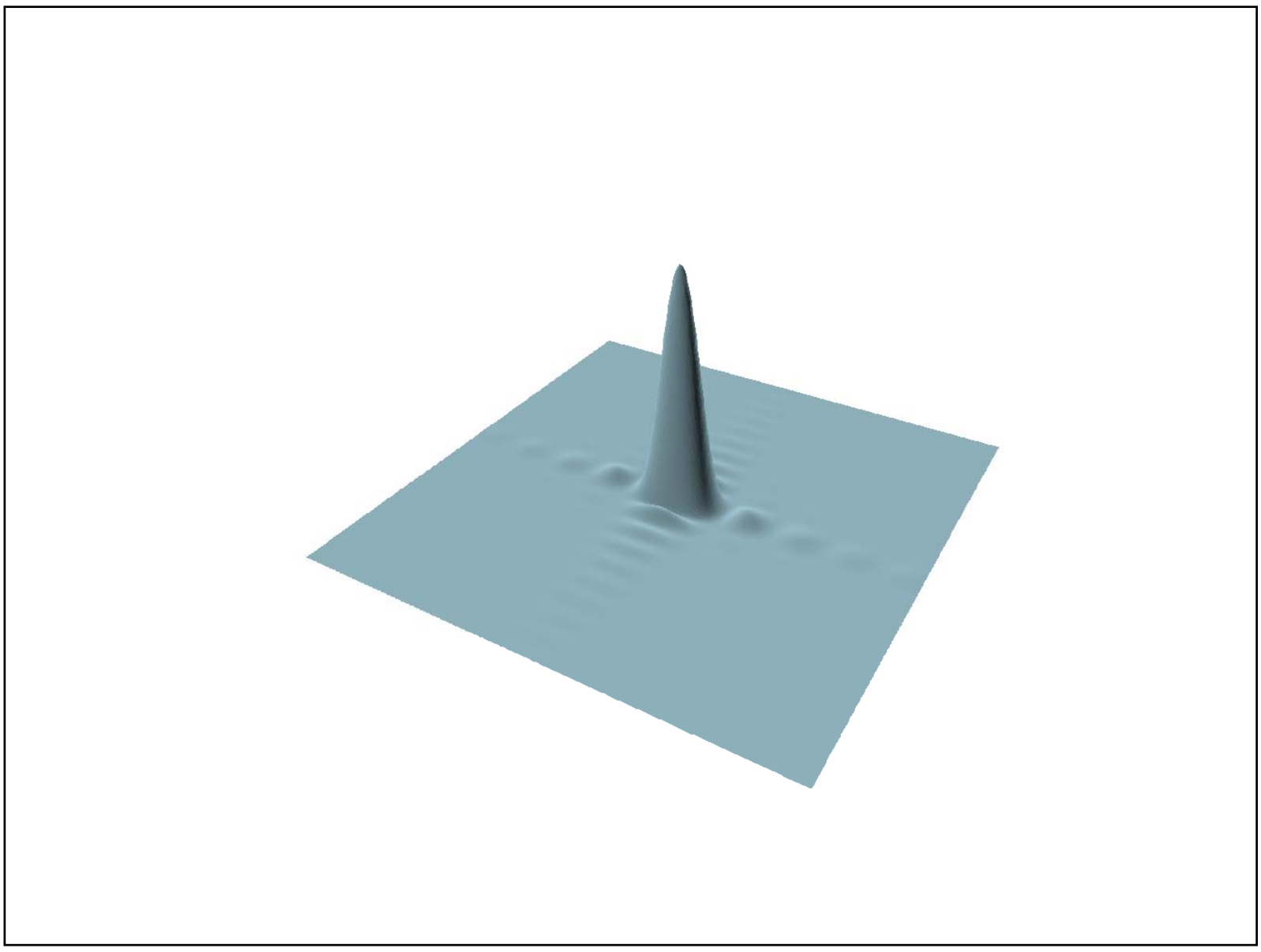
-10
-15
y
-15
-10
-5
0
5
10
15
x

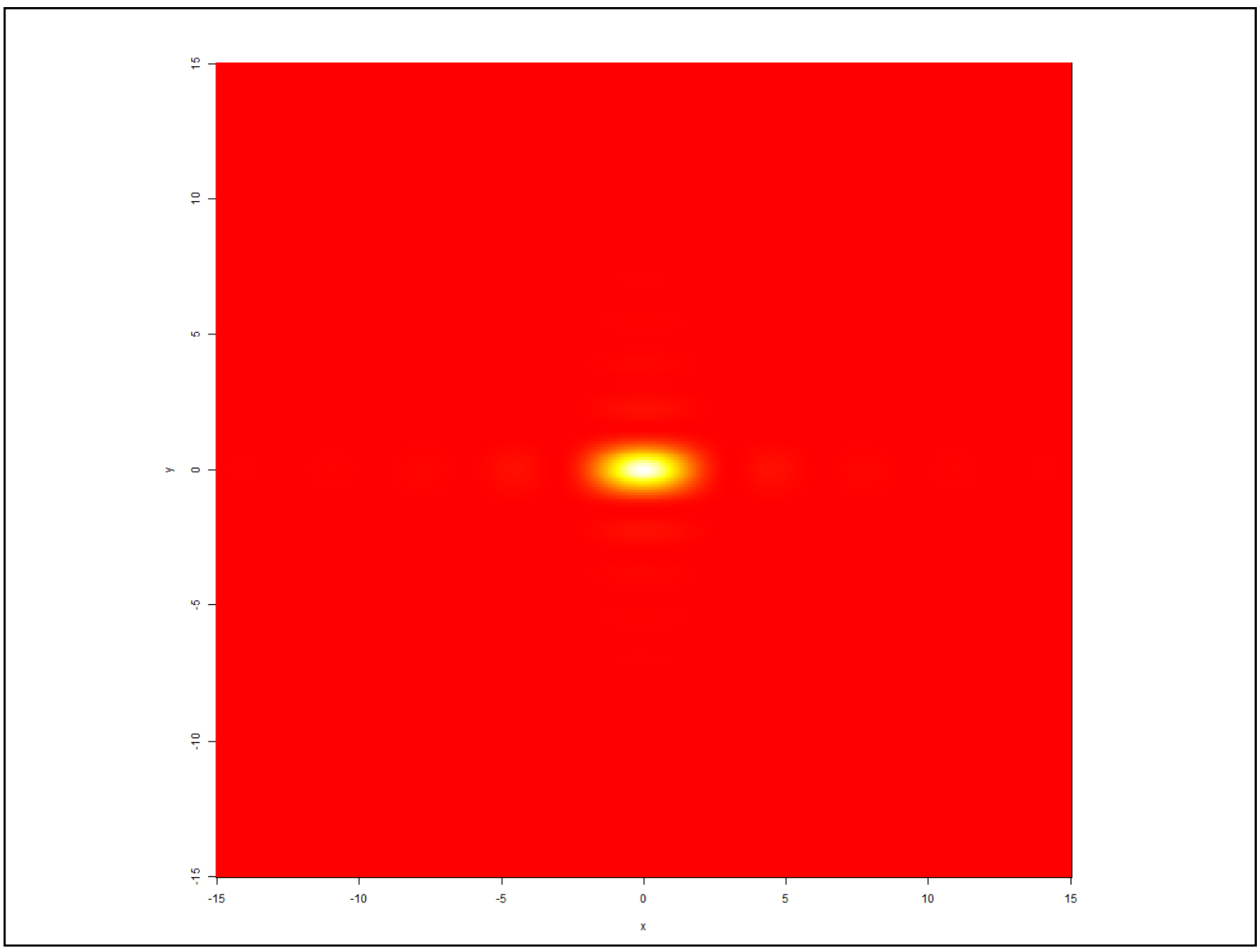




$$\theta = \frac{\lambda}{D}$$

(within a factor of two, usually much better)

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y
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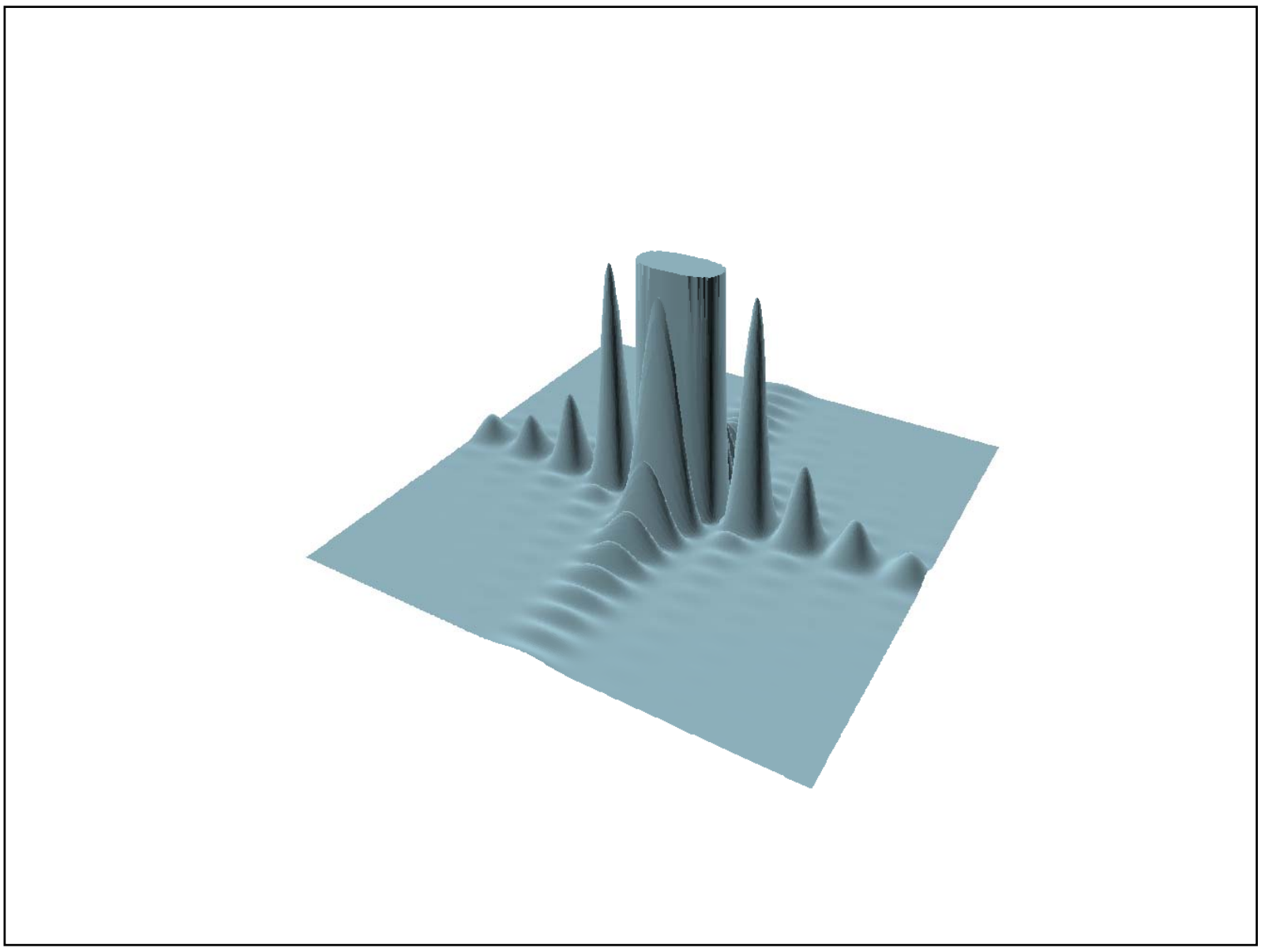
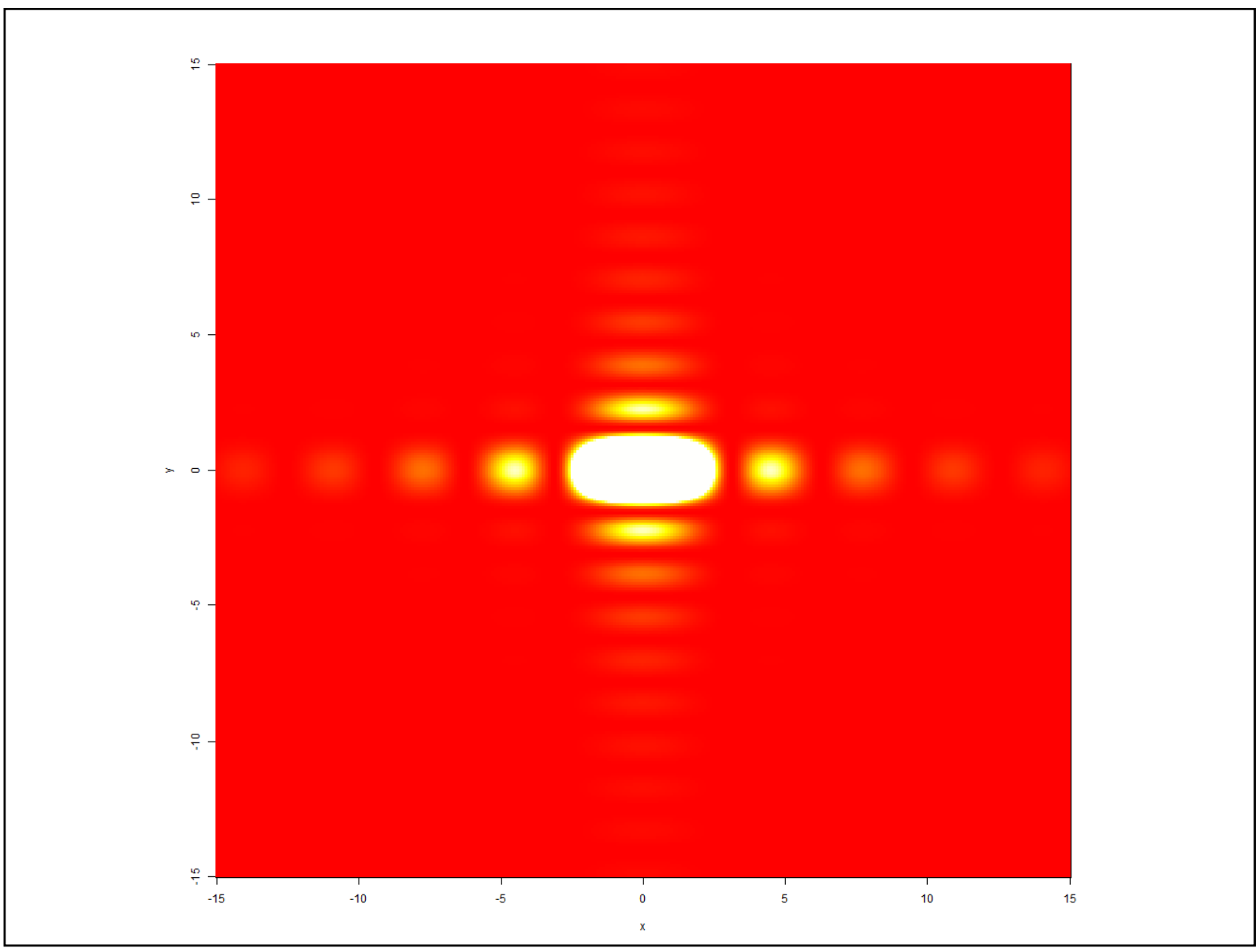
5
10
15
x

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-15
y
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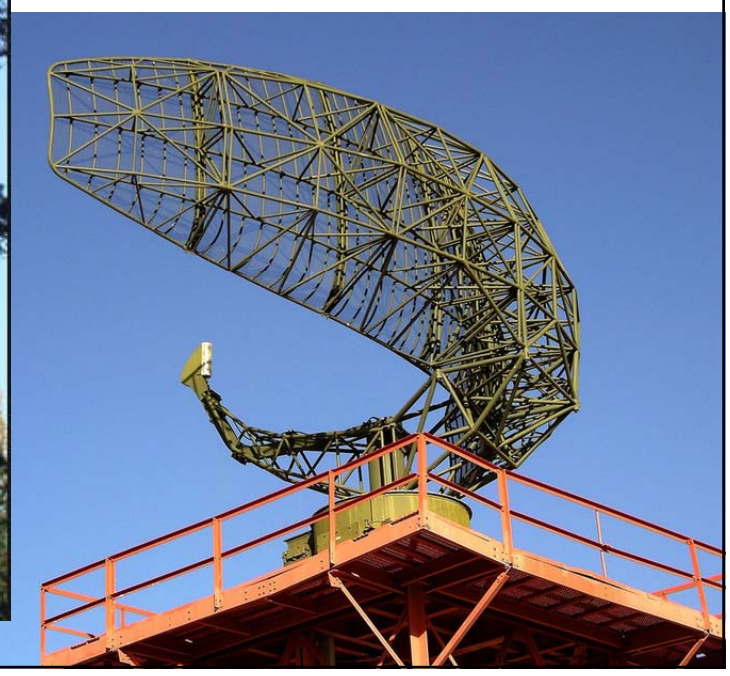
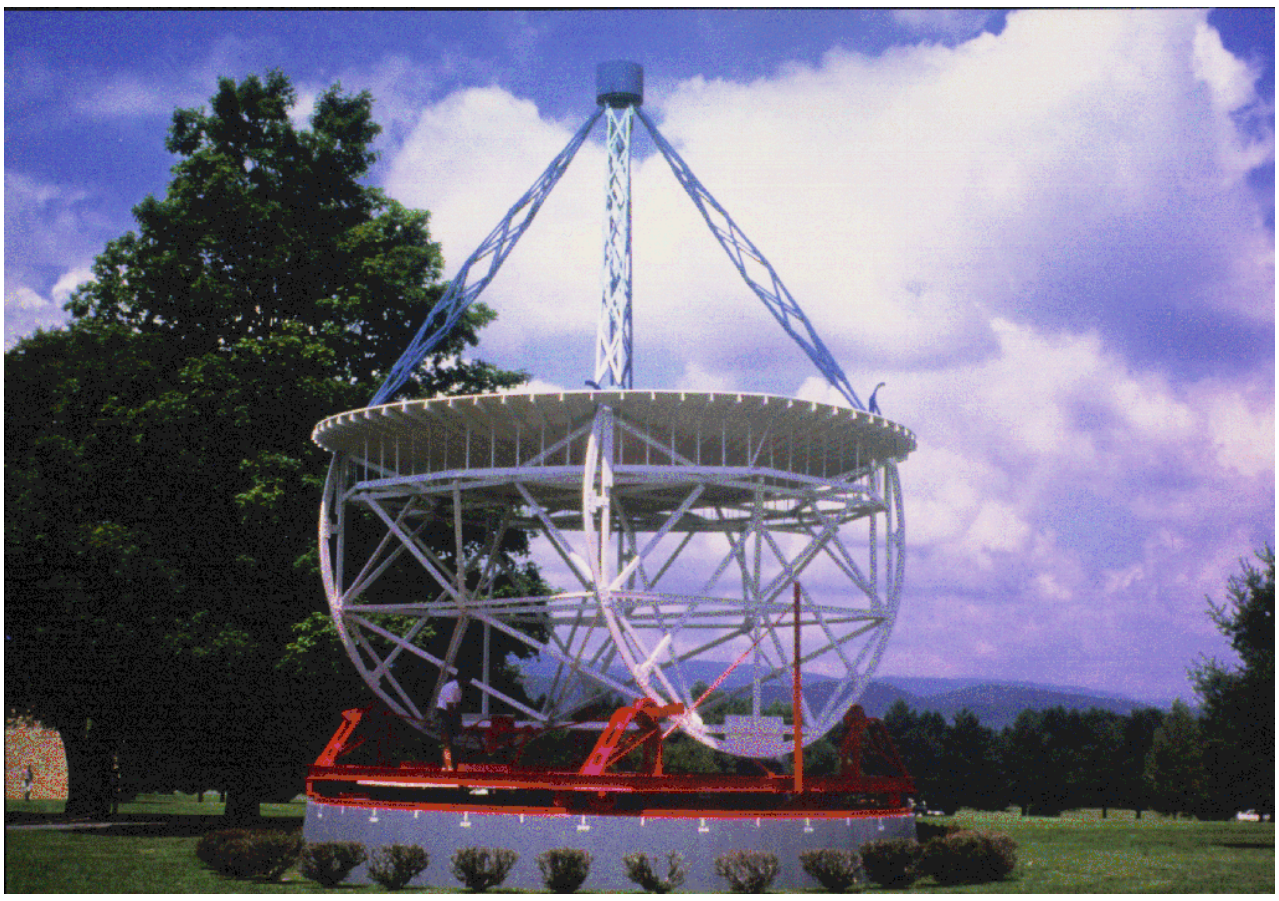
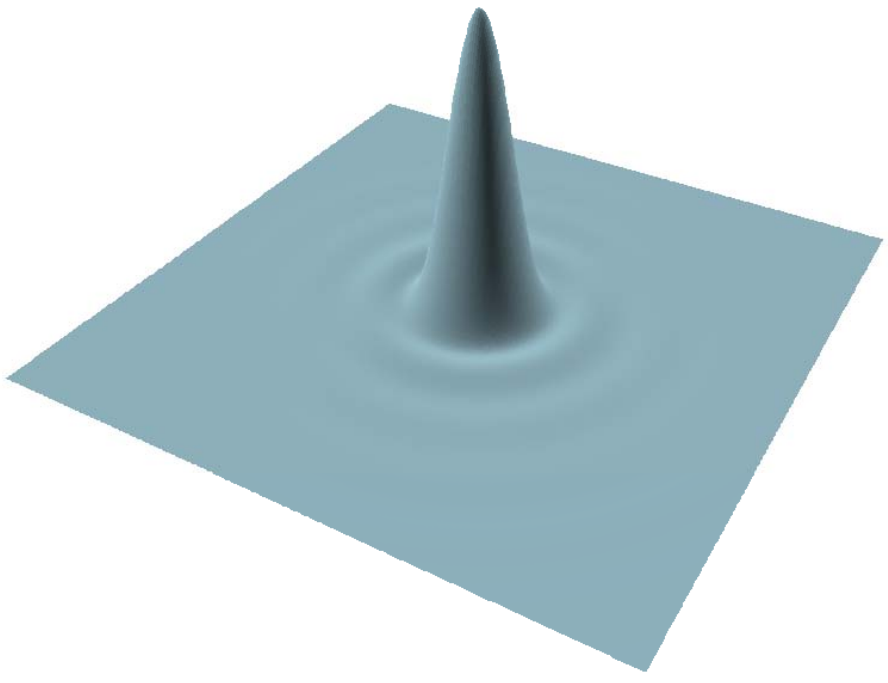
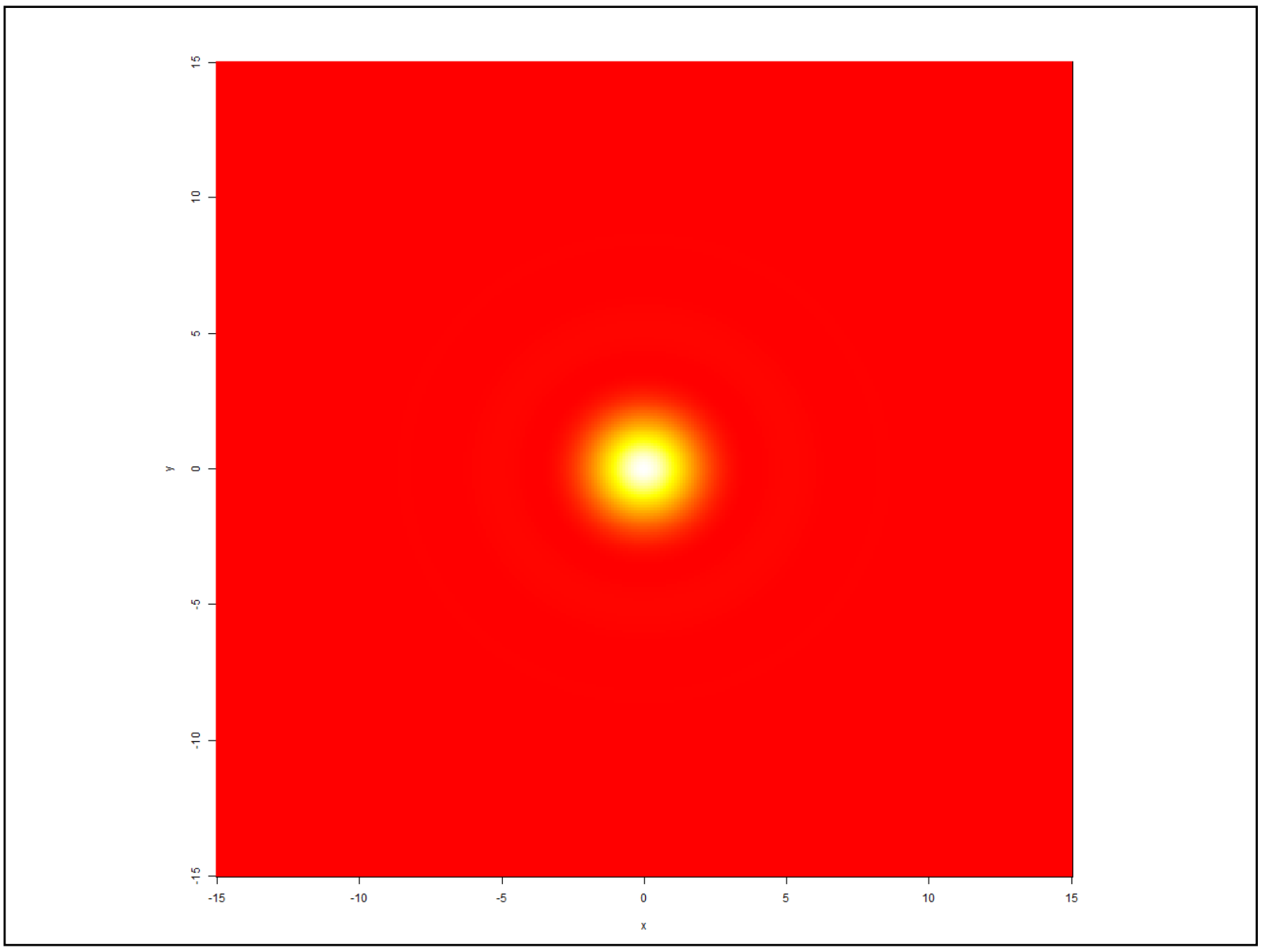
-5
0
5
10
15
x



Reber's telescope



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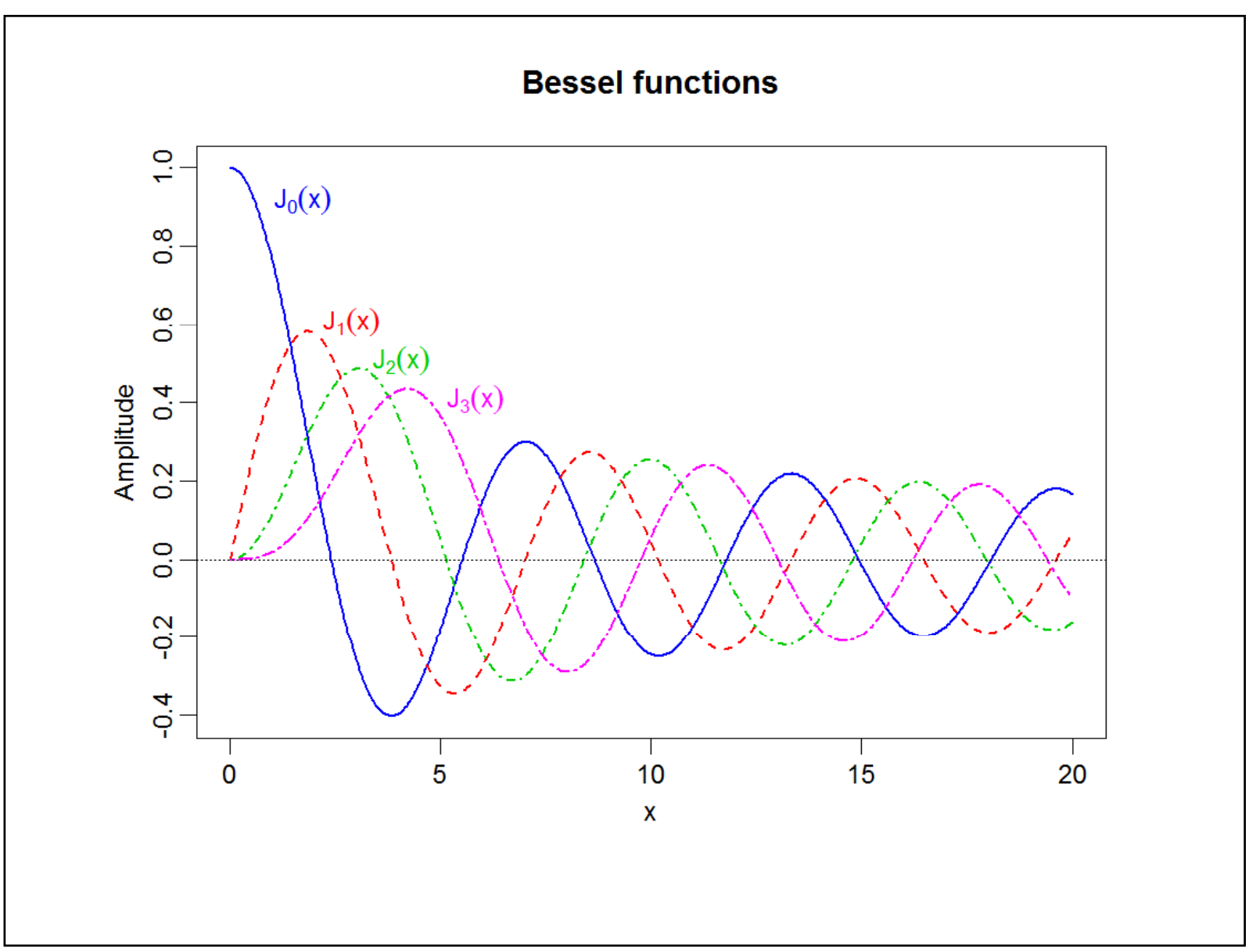
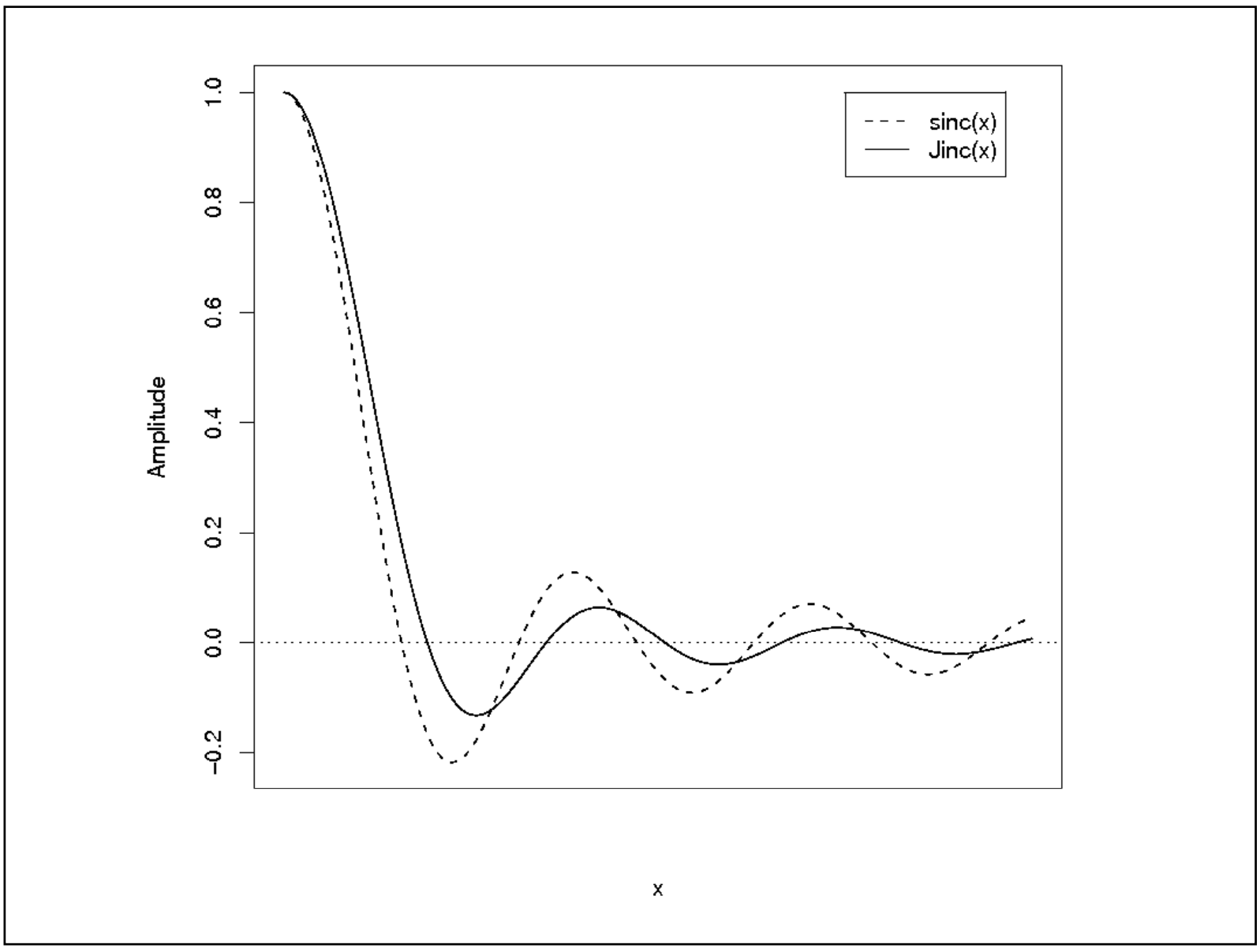
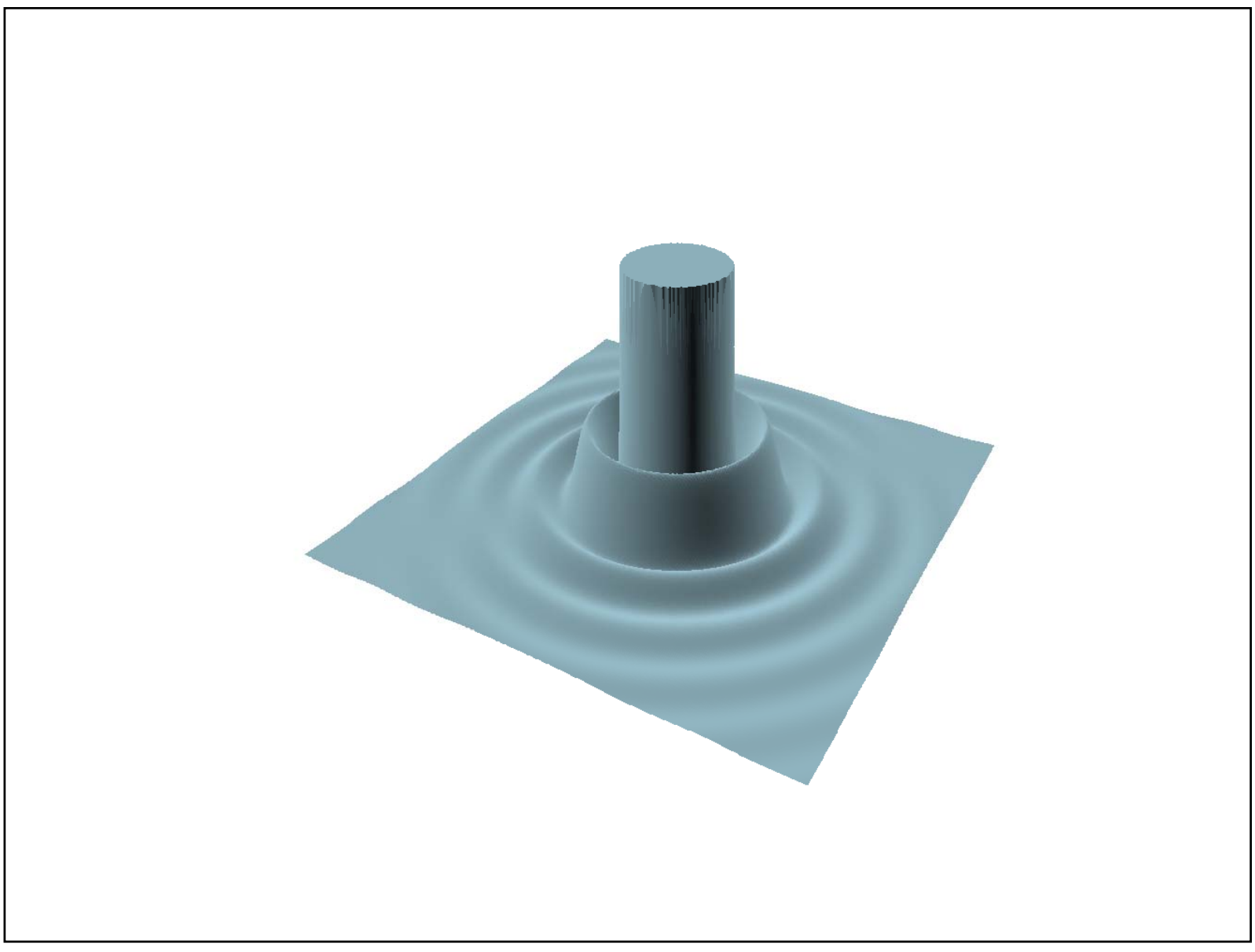
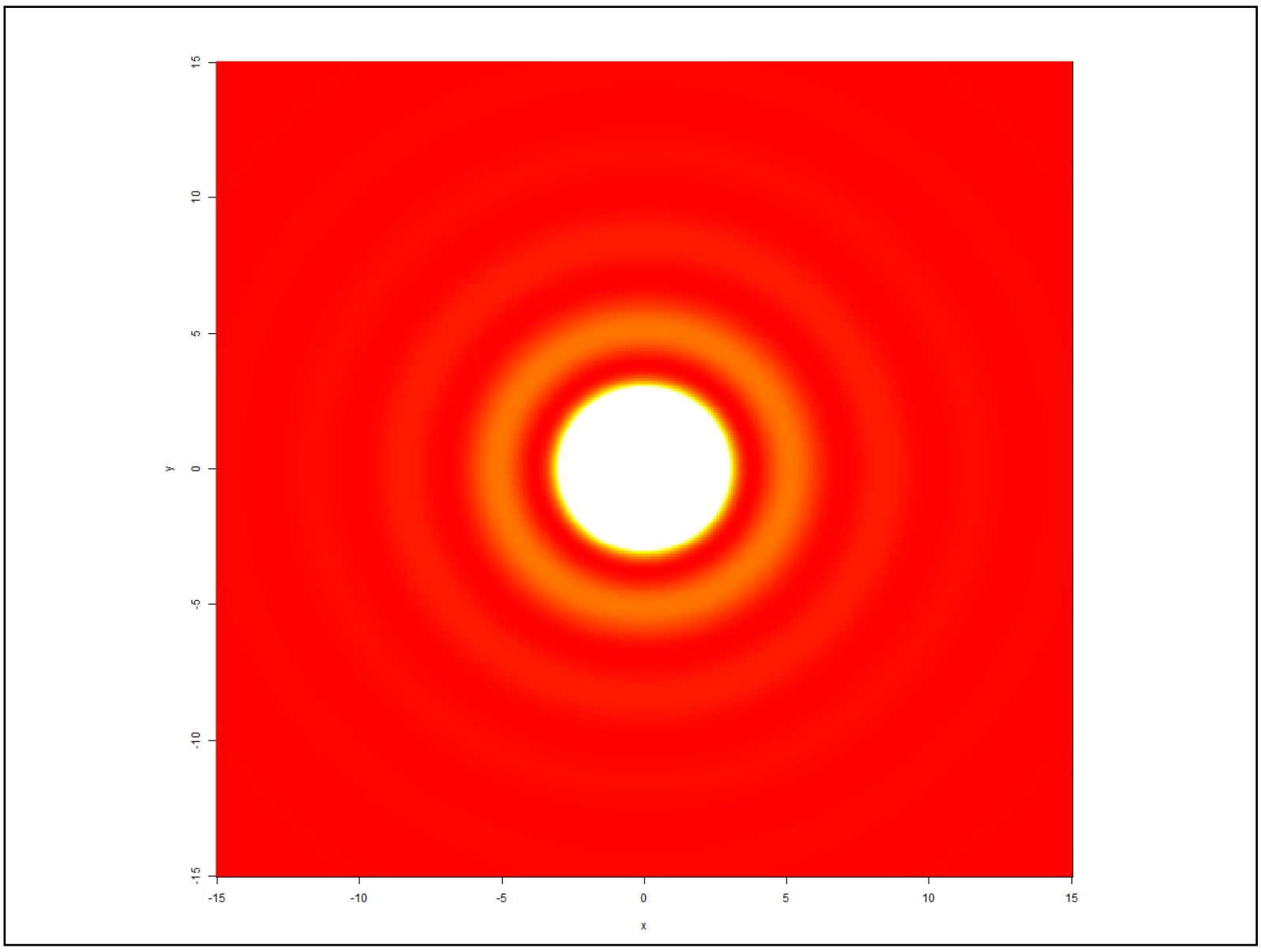
-5
-10
-15
y
-15
-10
-5
0
5
10
15
x


Bessel functions
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
Amplitude
J0(x)
J1(x)
J2(x)
J3(x)
0
5
10
15
20
x


sinc(x)
Jinc(x)
Amplitude
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
x

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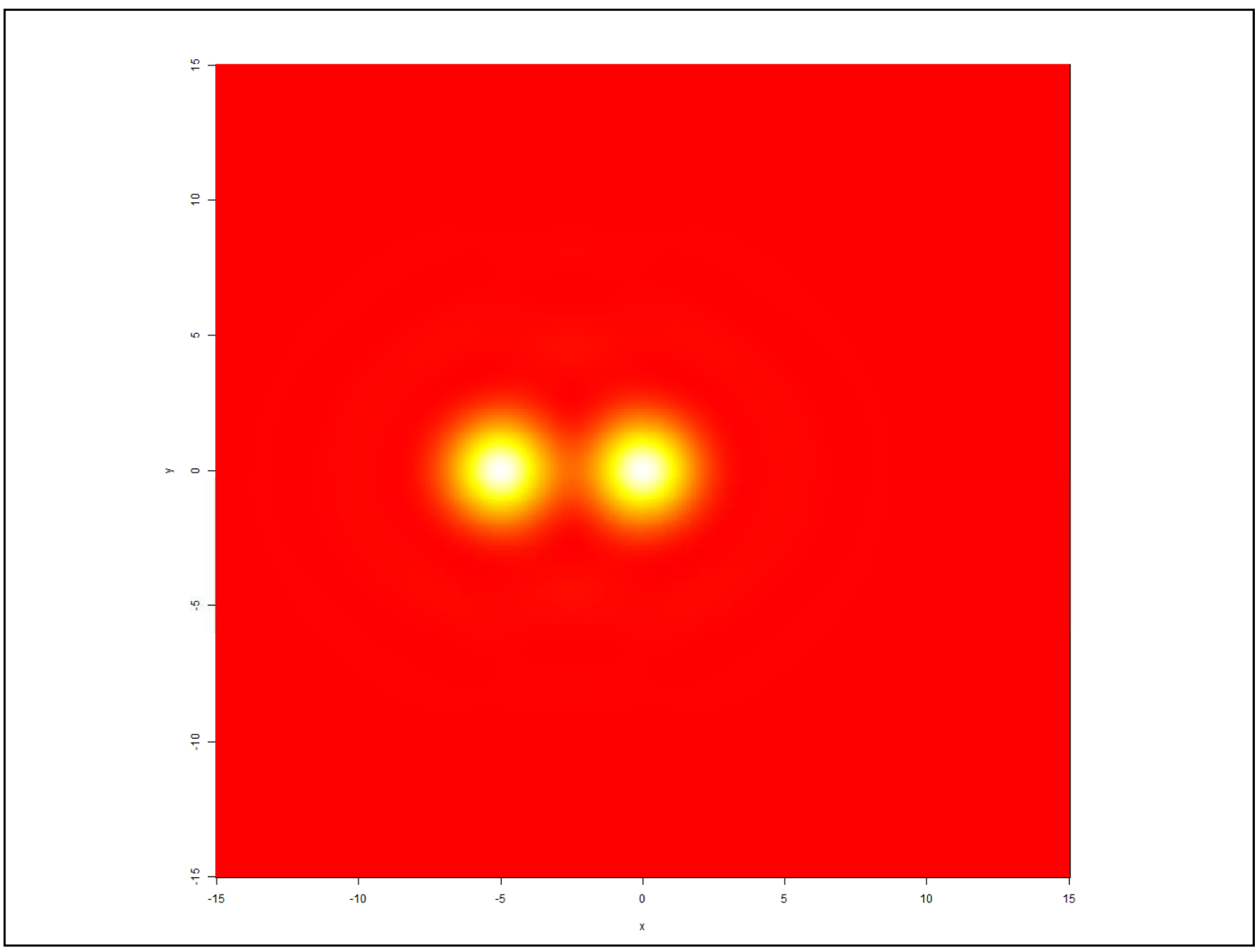
5
0
-5
-10
-15
y
-15
-10
-5
0
5
10
15
x


15
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5
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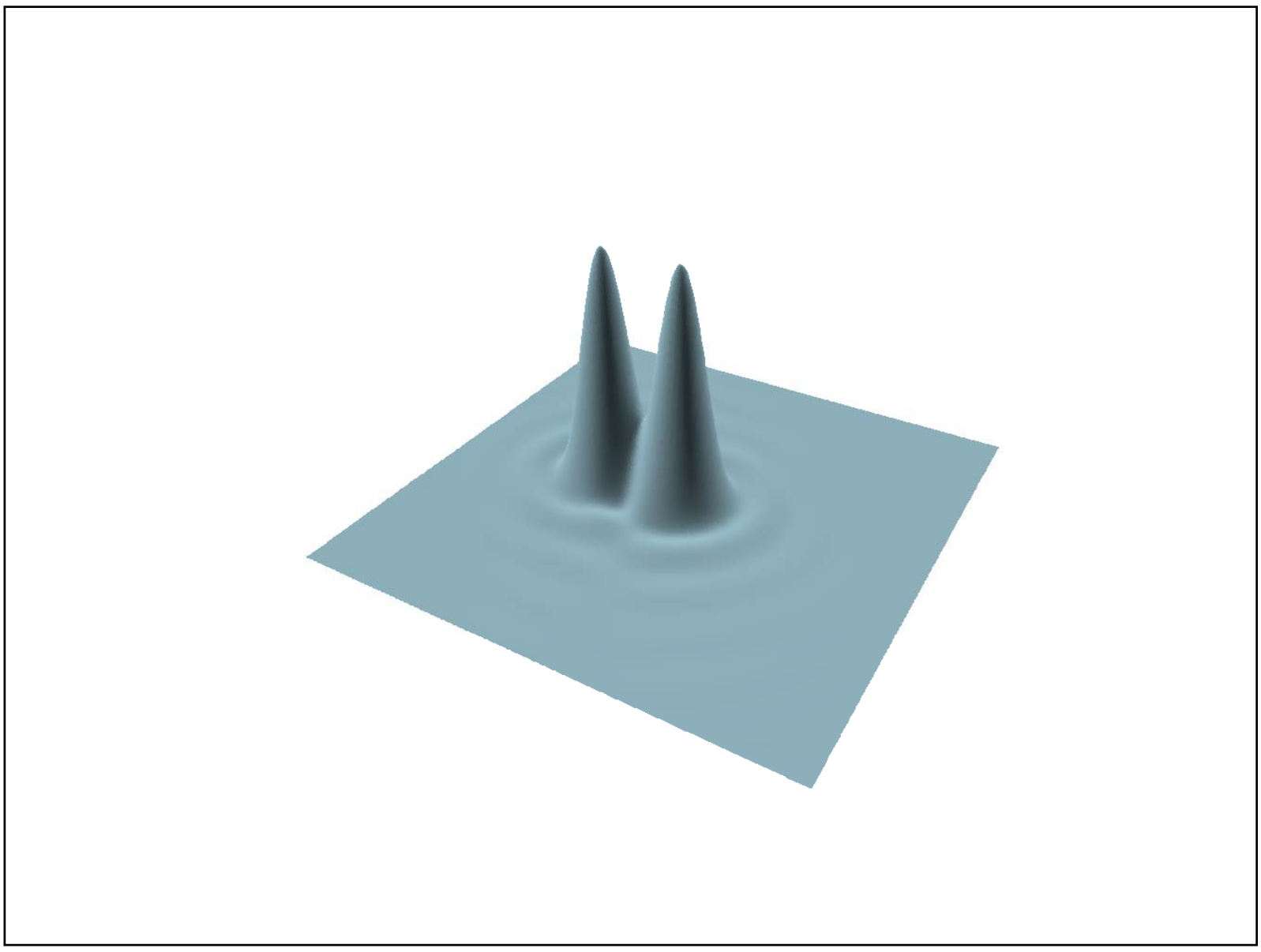
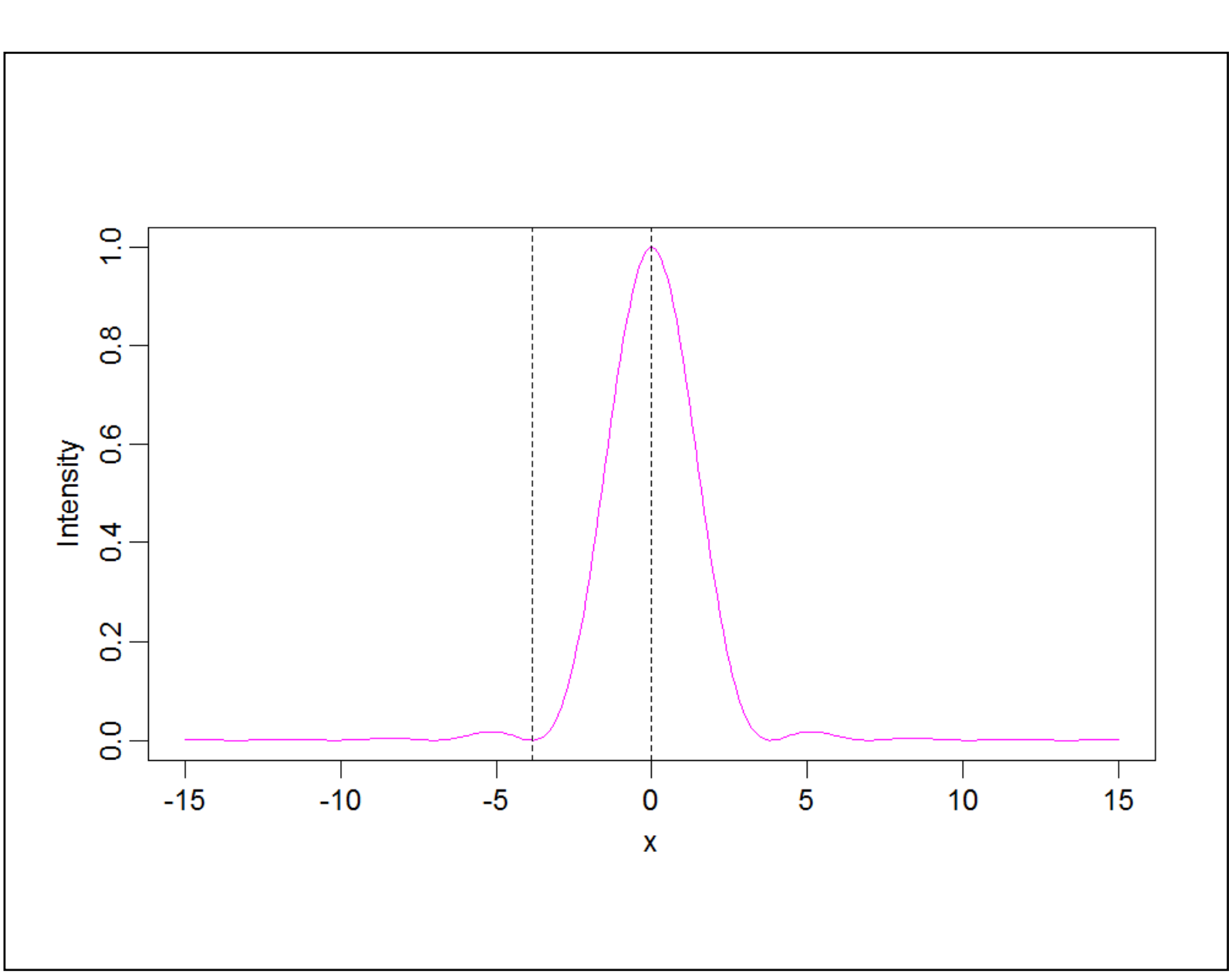
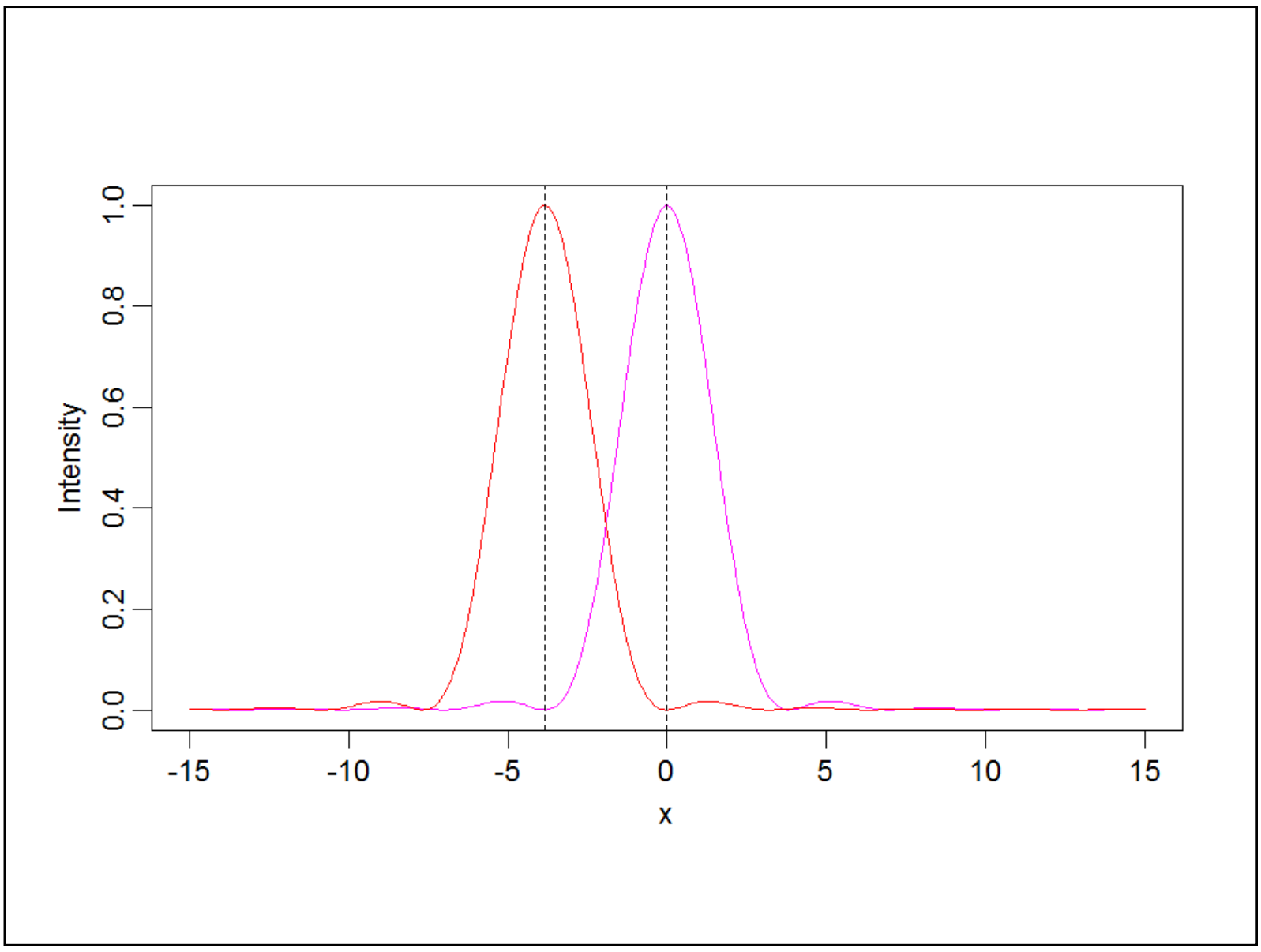
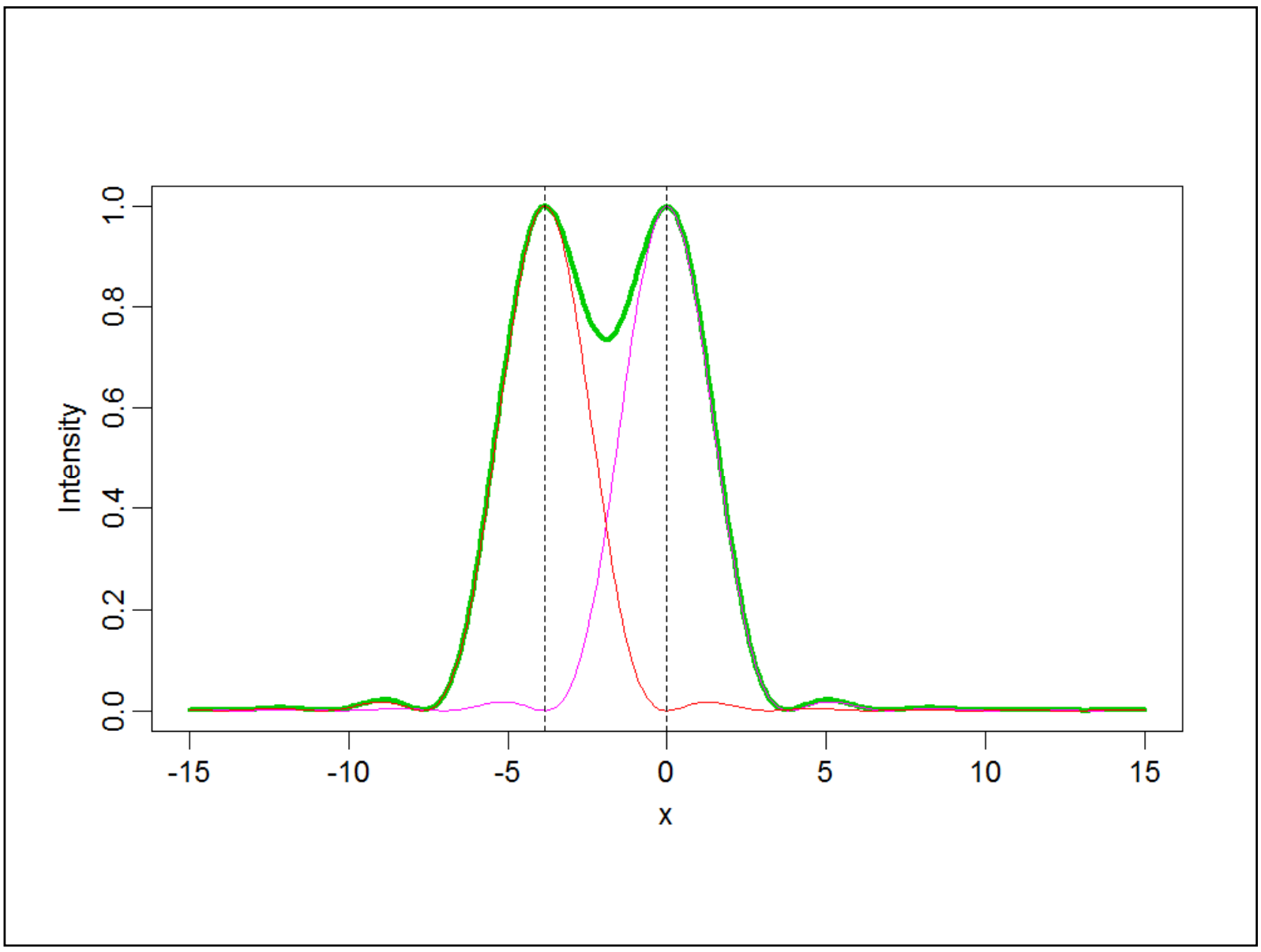
-5
-10
-15
y
-15
-10
-5
0
5
10
15
x




Intensity
0.0
0.2
0.4
0.6
0.8
1.0
-15
-10
-5
0
5
10
15
x


Intensity
0.0
0.2
0.4
0.6
0.8
1.0
-15
-10
-5
0
5
10
15
x


Intensity
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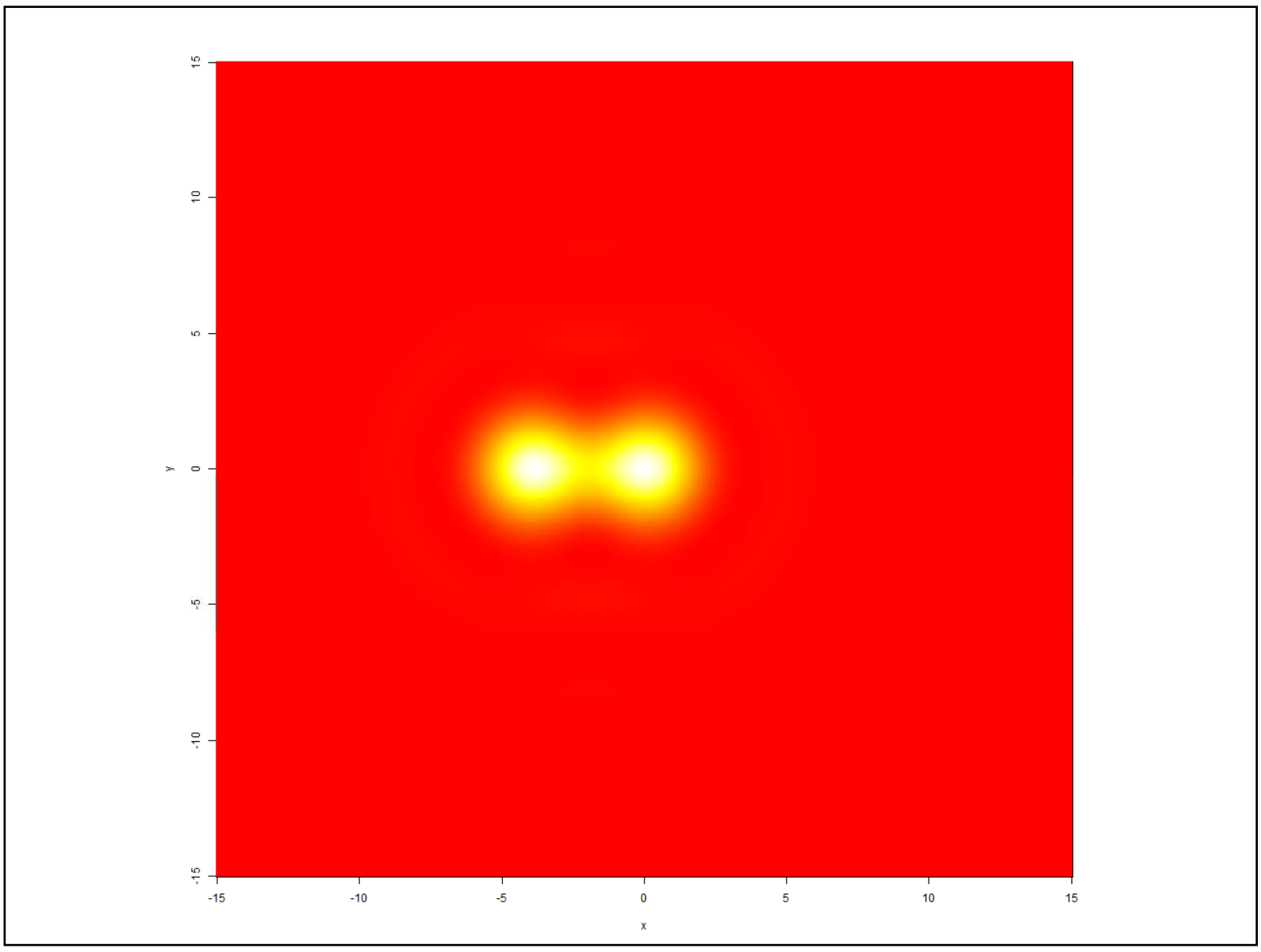
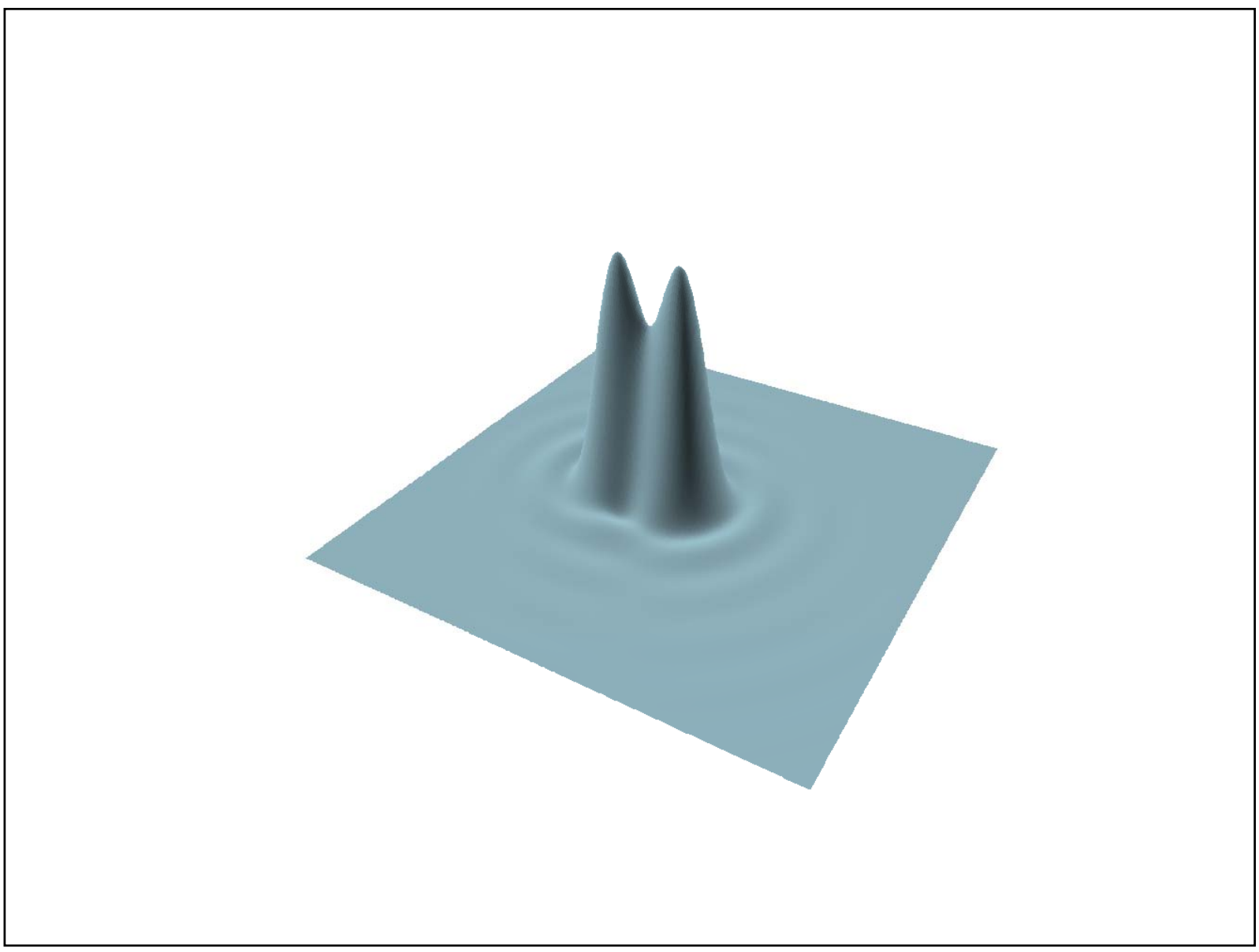
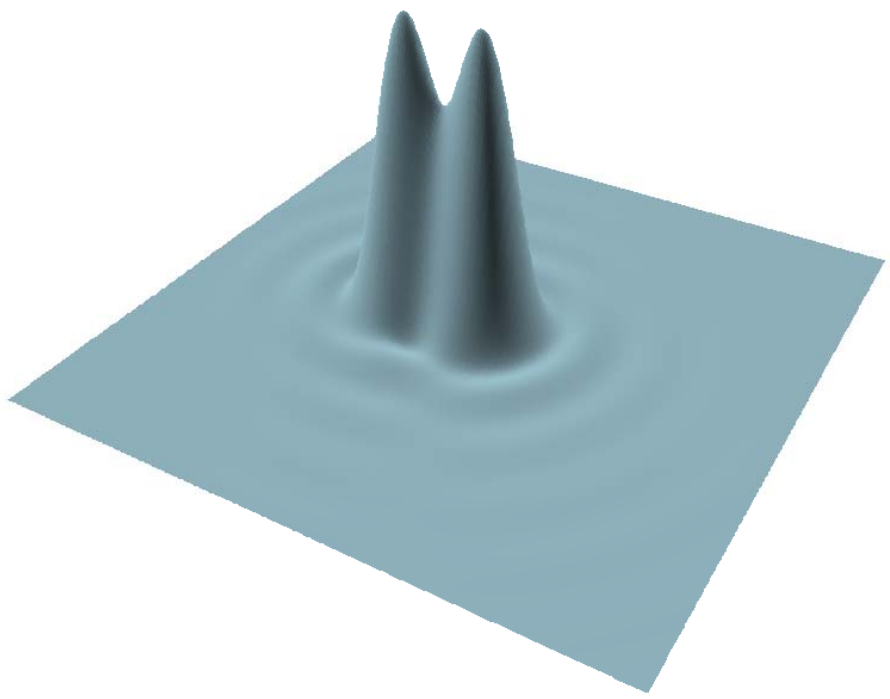
0.4
0.6
0.8
1.0
-15
-10
-5
0
5
10
15
x

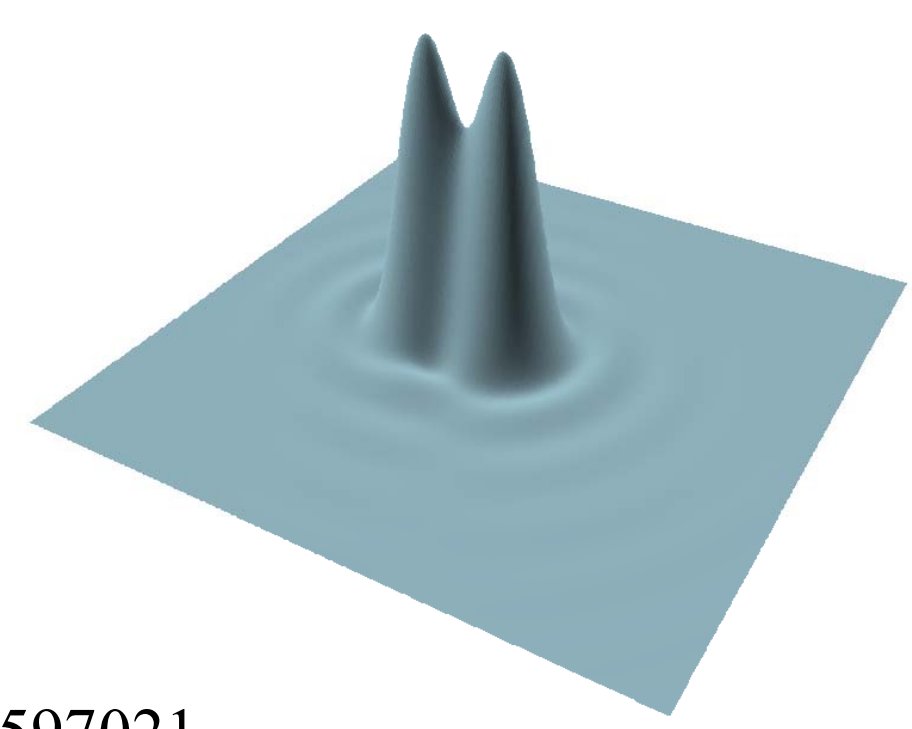

15
10
5
0
-5
-10
-15
y
-15
-10
-5
0
5
10
15
x



$$I(\theta) \propto \left(2 \frac{J_1\left(ka\sin(\theta)\right)}{ka\sin(\theta)} \right)^2$$



$$I(\theta) \propto \left(2 \frac{J_1\left(ka\sin(\theta)\right)}{ka\sin(\theta)} \right)^2$$



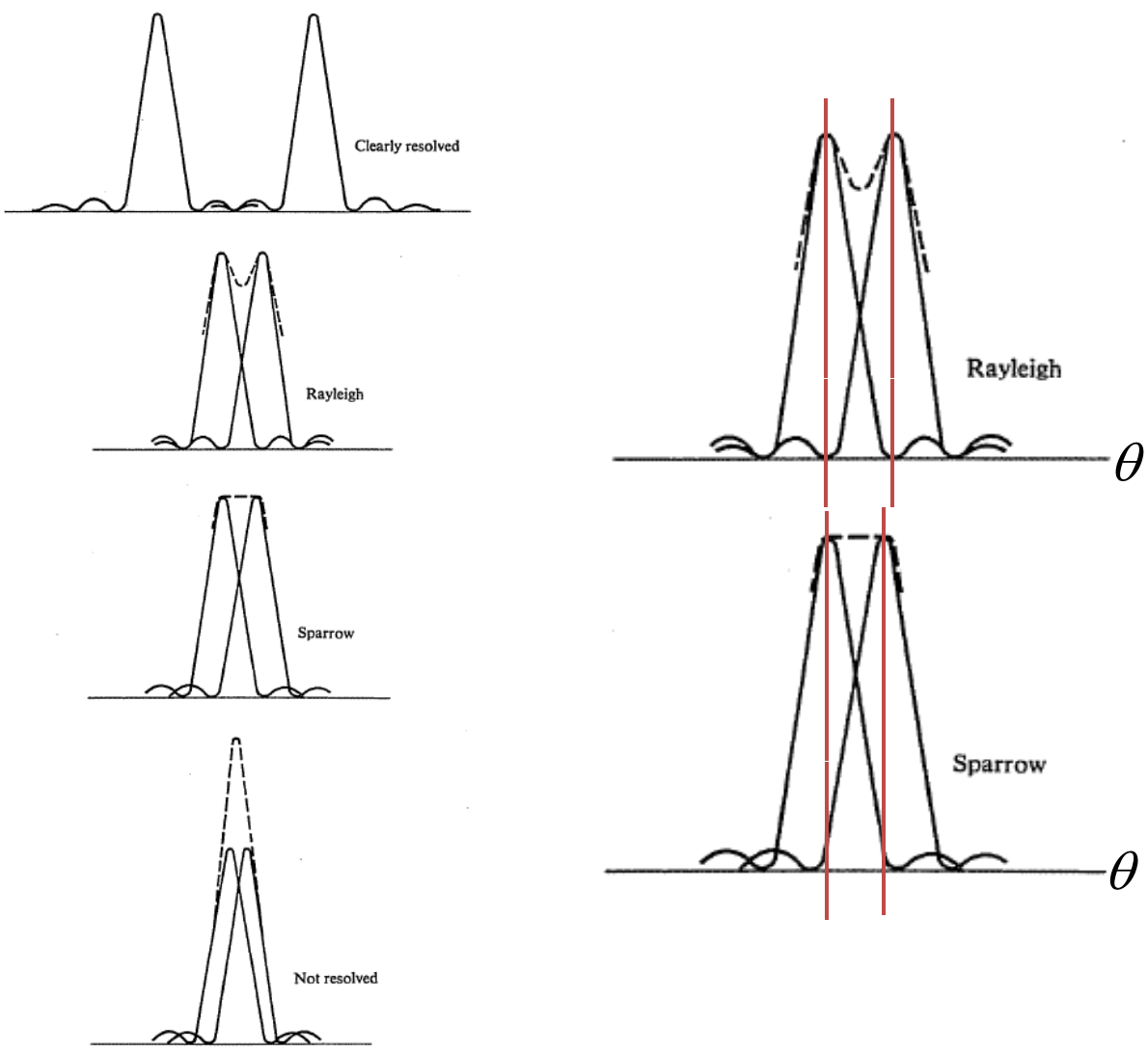
$$\frac{3.83170597021\ldots}{\pi} = 1.21966989127\ldots \approx 1.22$$

$$\theta = \frac{\lambda}{D}$$

(within a factor of two, usually much better)

$$\theta = (1.219669127...)\frac{\lambda}{D} \approx 1.22\frac{\lambda}{D}$$

For the **special case** of a uniformly illuminated unblocked circular aperture, according to the Rayleigh criterion



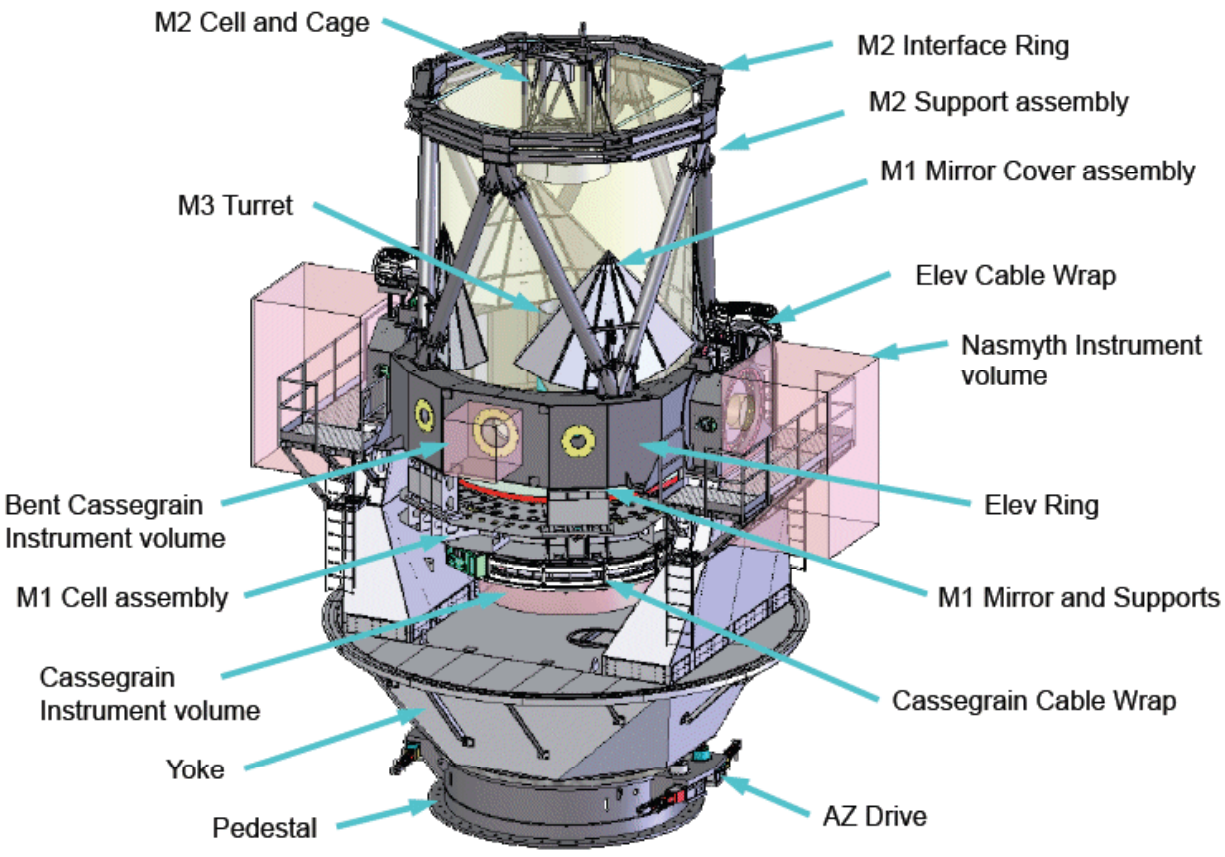
$$\theta = 1.22\frac{\lambda}{D}$$

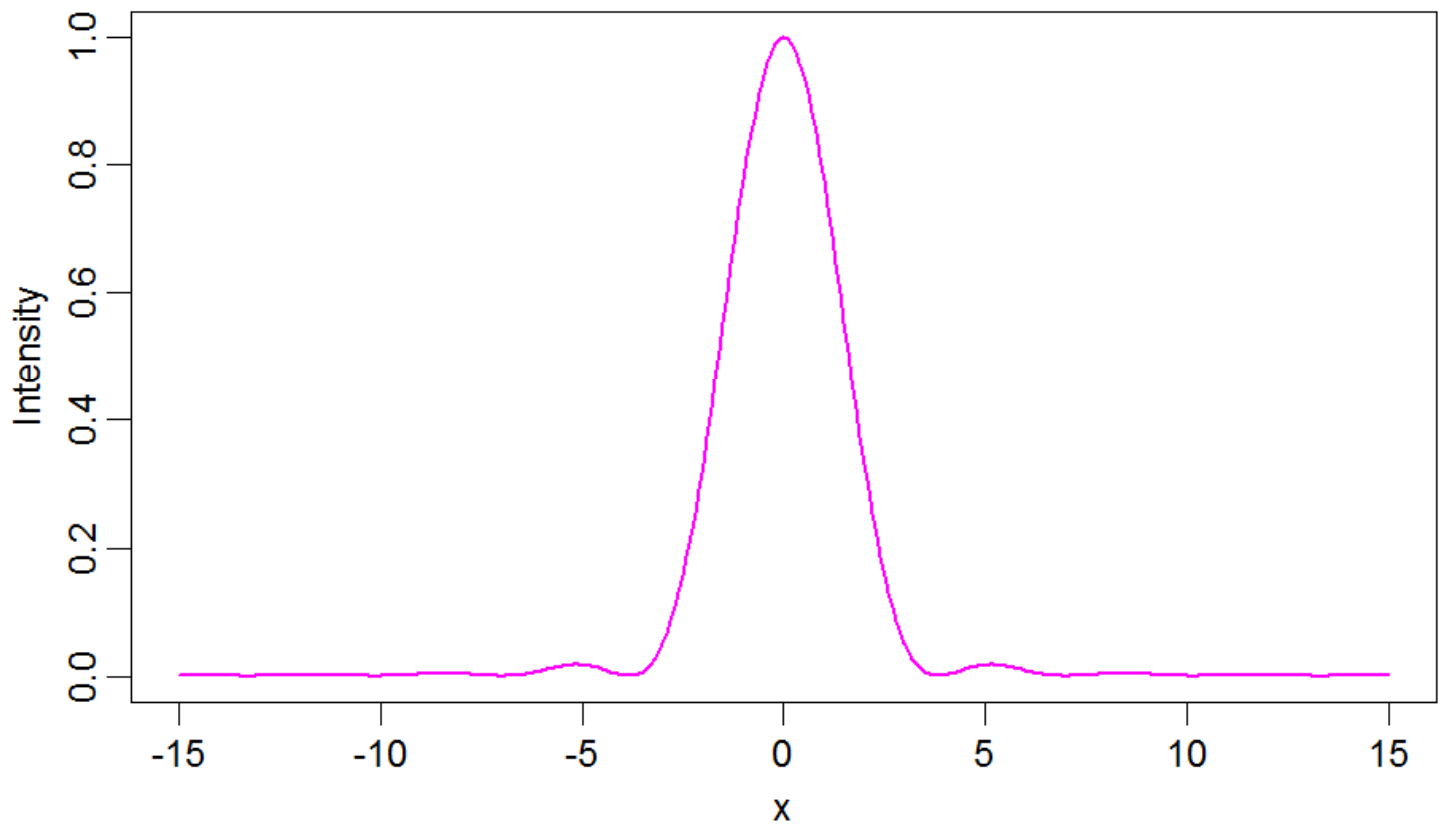
$$\theta < 1.22\frac{\lambda}{D}$$

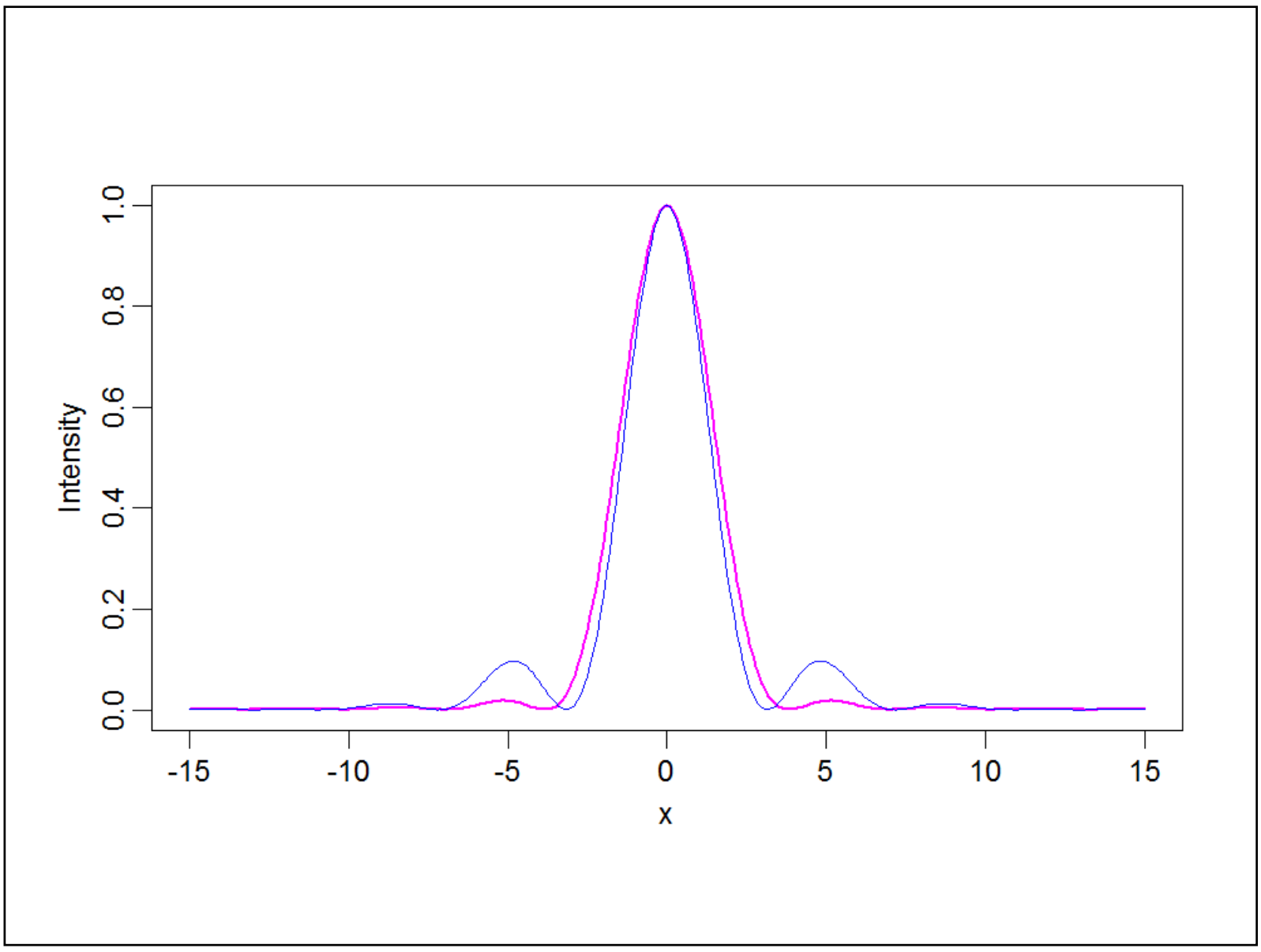
Figure 10.26 The Rayleigh and Sparrow criteria for overlapping point images.

From Hecht, "Optics"

Discovery Channel Telescope






Intensity
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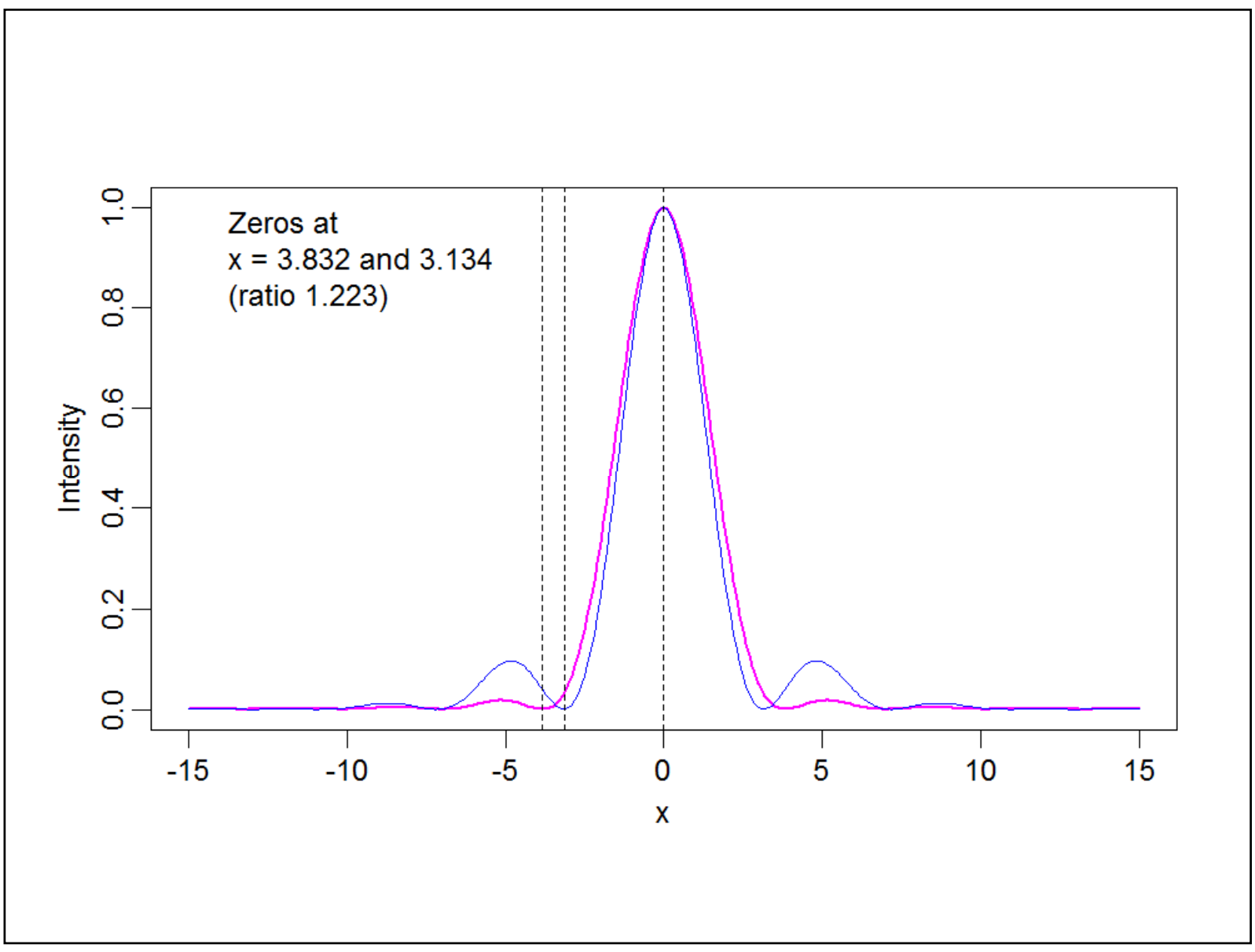
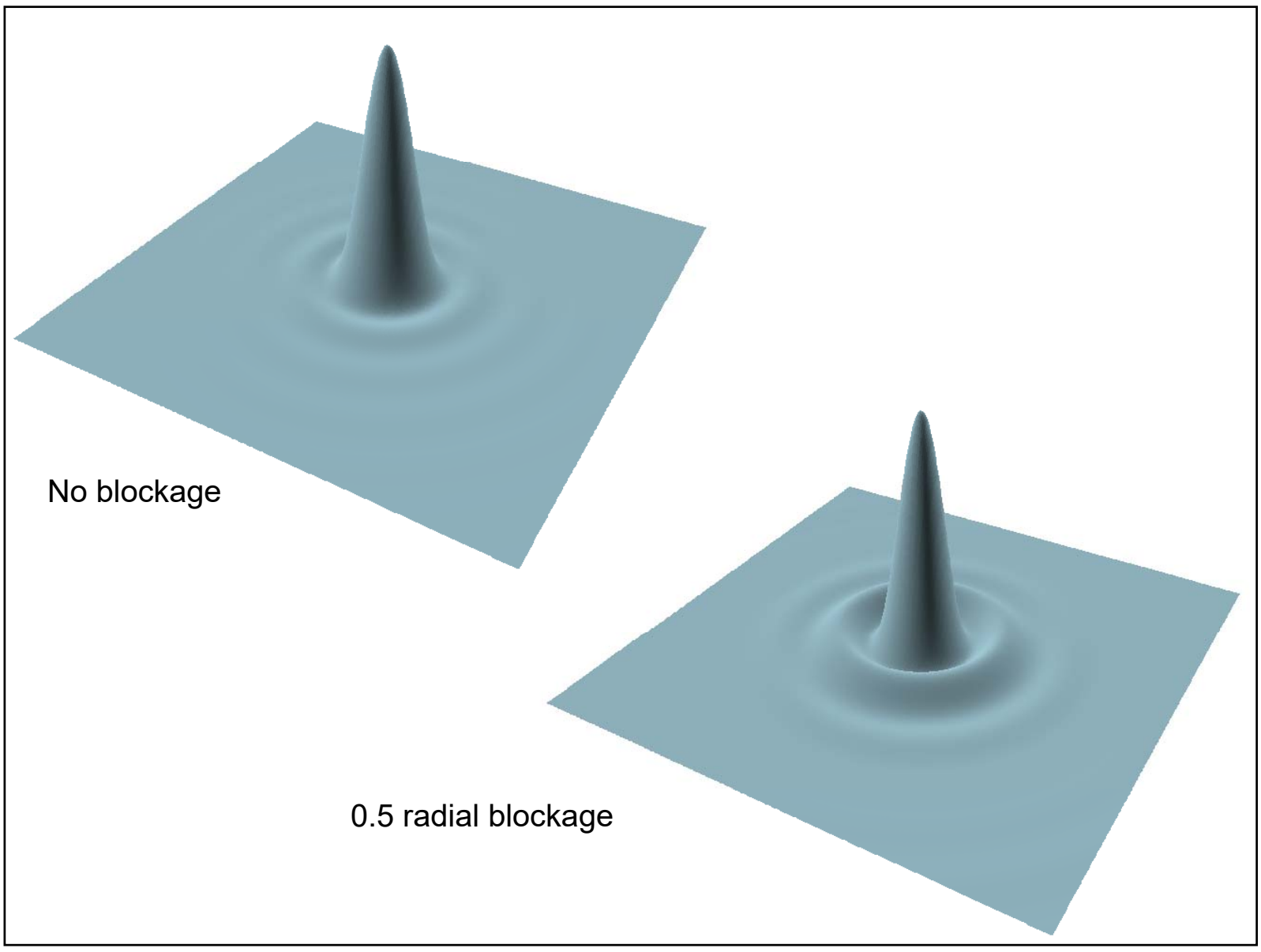
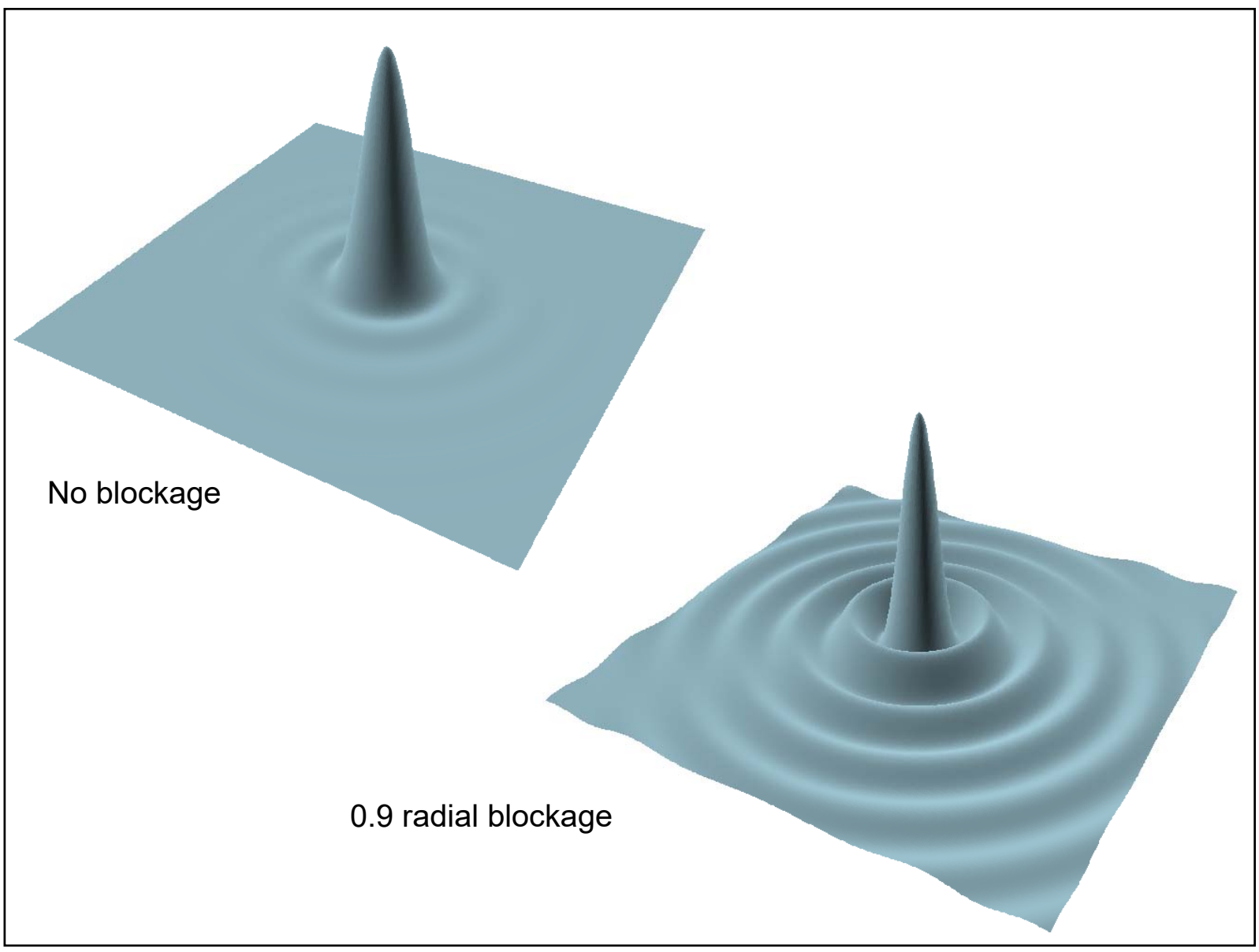
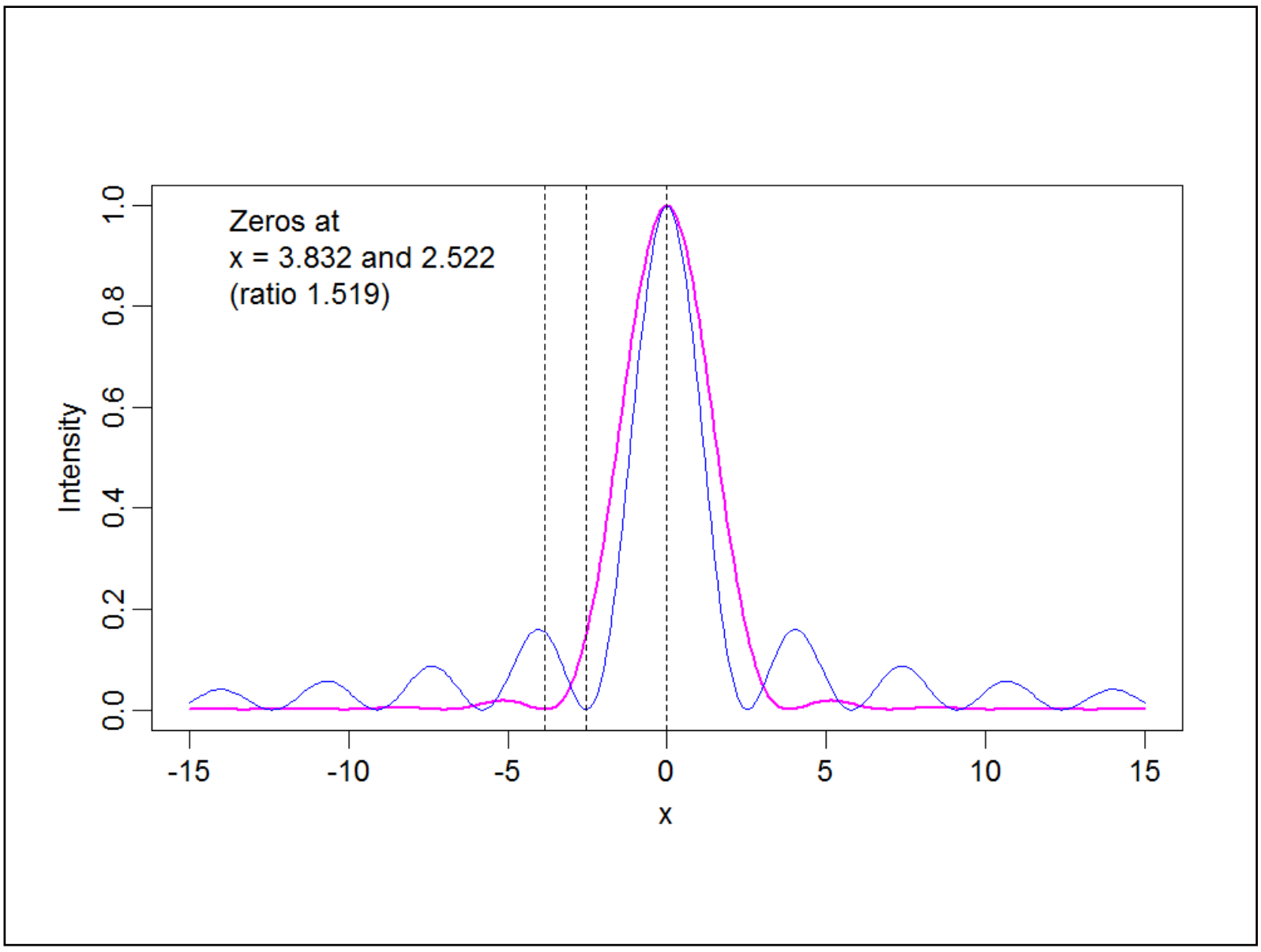
0.4
0.6
0.8
1.0
-15
-10
-5
0
5
10
15
x


Zeros at
x = 3.832 and 3.134
(ratio 1.223)
Intensity
0.0
0.2
0.4
0.6
0.8
1.0
-15
-10
-5
0
5
10
15
x


No blockage
0.5 radial blockage


No blockage
0.9 radial blockage



$$\theta = \frac{\lambda}{D}$$

(within a factor of two, usually much better)

$$\theta = \left(1.219669127...\right)\frac{\lambda}{D} \approx 1.22\frac{\lambda}{D}$$

For the **special case** of a uniformly illuminated unblocked circular aperture, according to the Rayleigh criterion