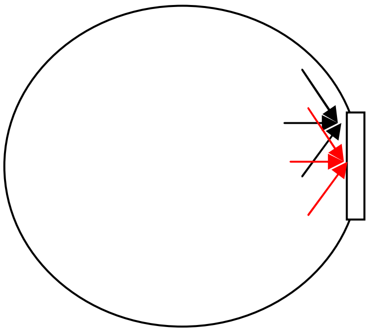
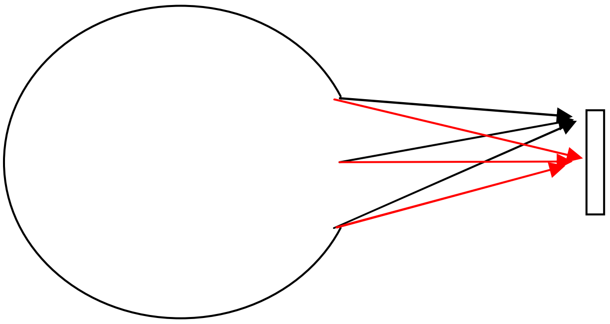
Variation of irradiance and irradiance uniformity

This applies to uniform sources of irradiance. These sources are used for testing non imaging systems as for ex CCD, CMOS detectors. In this case irradiance (W/m² or W/m²/µm or Lux) is the important quantity, and uniformity or irradiance.



If the sample is on the sphere, each point of the sample is receiving the same flux from the sphere

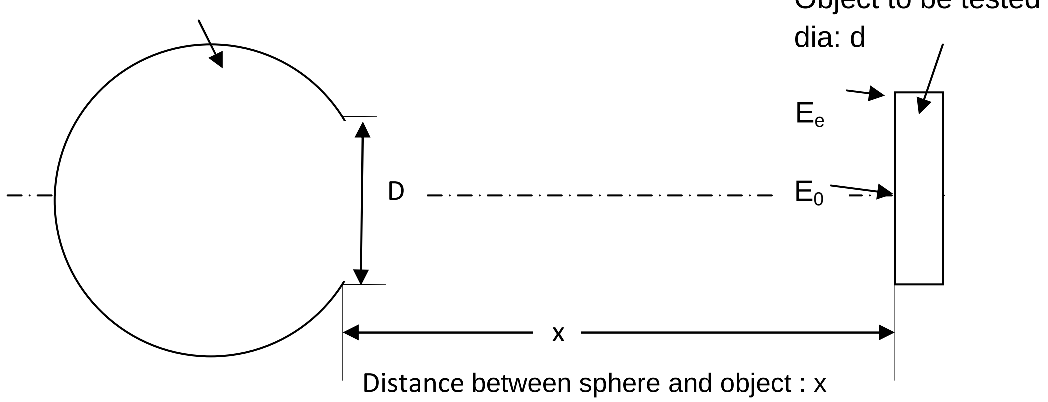


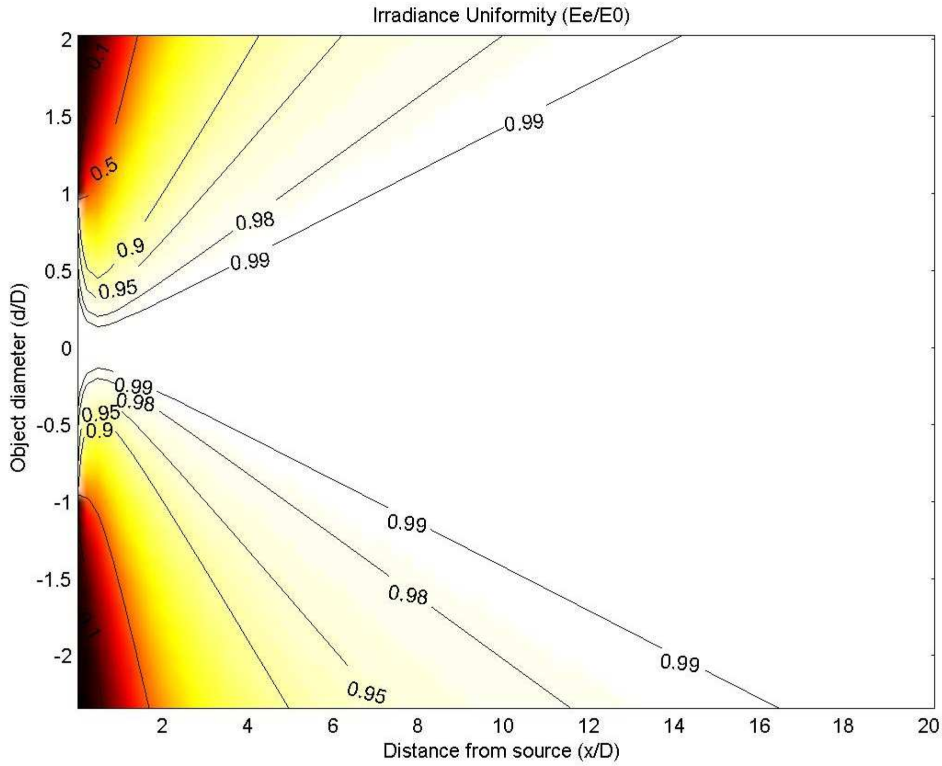
It is not true anymore when the sample is at some distance from the sphere.

It becomes true again, when the sample is enough far from the sphere, but then the irradiance is very low compared to the irradiance at the input port.

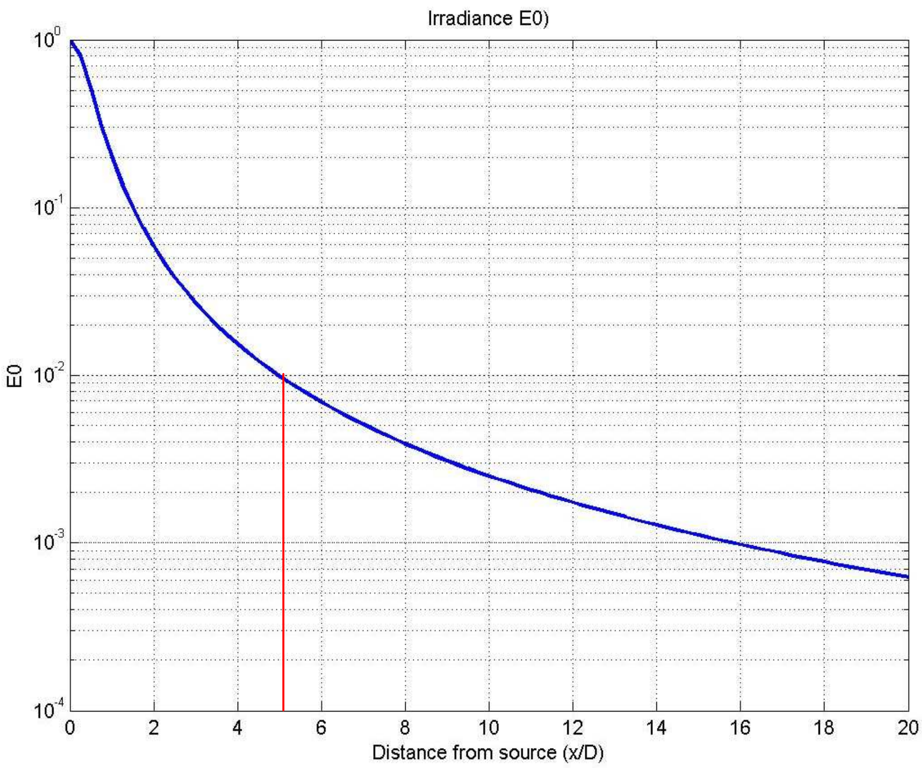
E_0 : Irradiance at the center of the object

E_e : Irradiance at the edge of the object





Graph 1



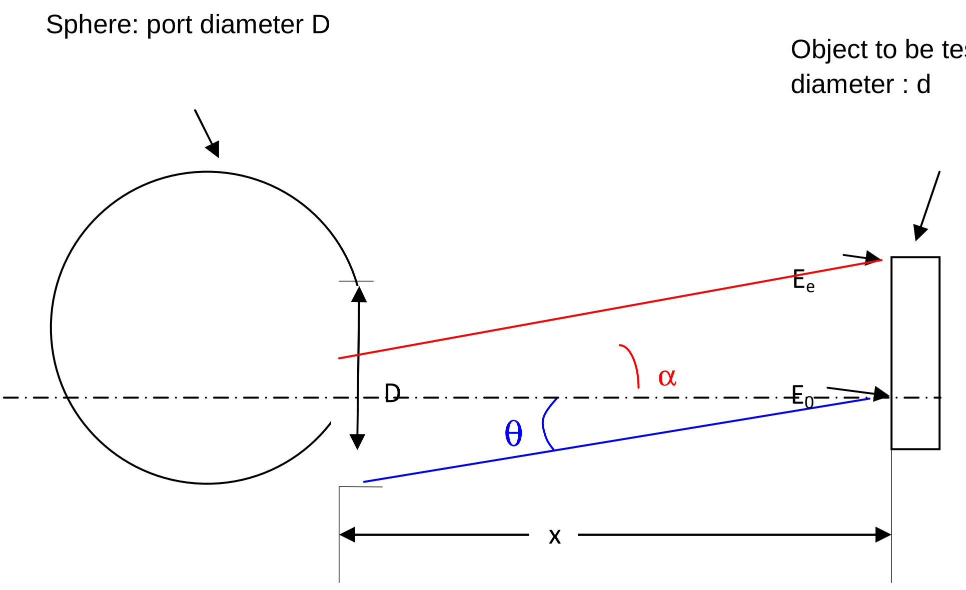
Graph 2: Variation of irradiance at the center of the object

<u>For example:</u>

If a sample is same size as outport of the sphere (d/D = 1), uniformity is again 98%, if the sample to test is placed at 5 times the diameter of the output port of the sphere (x/D=5).
(see red lines on graph 1)

But then irradiance on the sample is 10^{-3} the irradiance on the sphere port.
(see red line on graph 2).

Irradiance calculation:



Distance between sphere and object: x

$$E_0 = \pi \, Ls \sin^2\theta$$

where Ls is the sphere radiance

As long as the angles are small (less than 10°) the irradiance variation at object plane is proportional to $\cos^4\alpha$