Computer Graphics :Assignment 3

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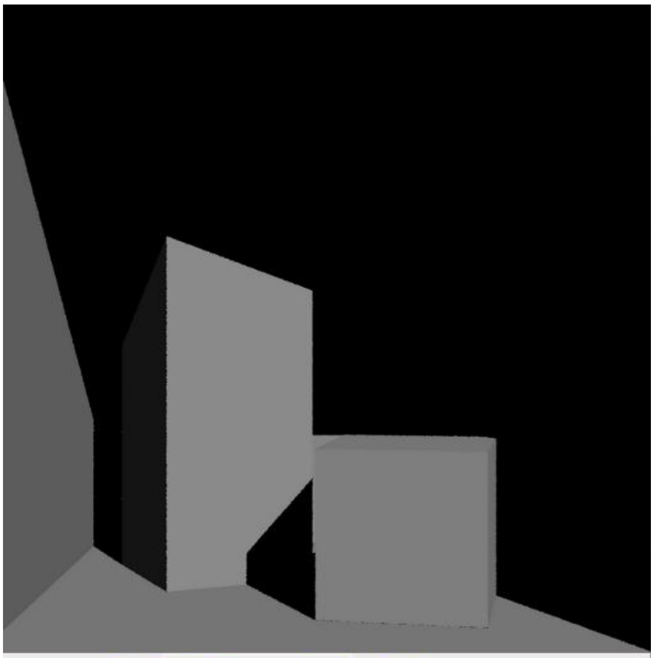


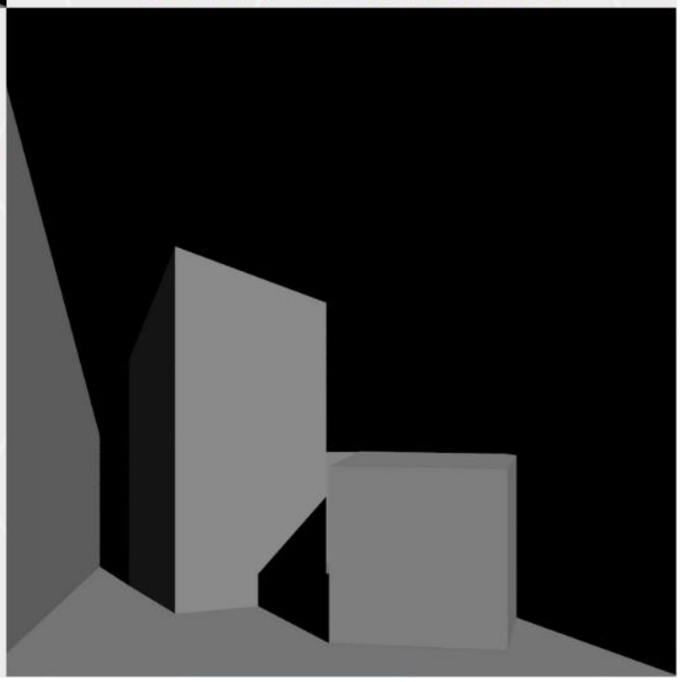
While running :
select option :4

32 SPP : 28.735 sec

1 SPP : 0.944 sec

Pixel Subsampling for Anti-aliasing 1

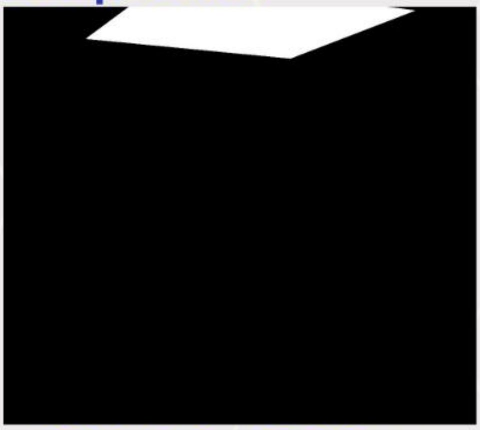
Doing pixel subsampling to Anti-alias the rendering: would remove the jagged edges due to undersampling of the underlying signal.



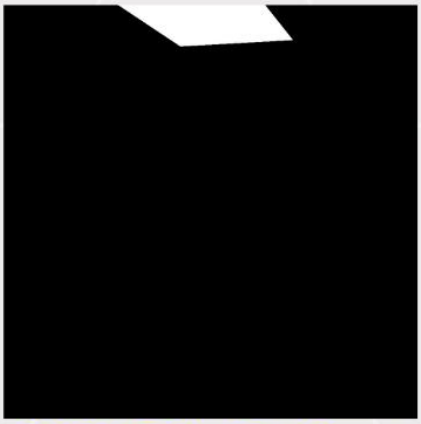
Intersection 2: WITH 32 SPP

while running select option :4

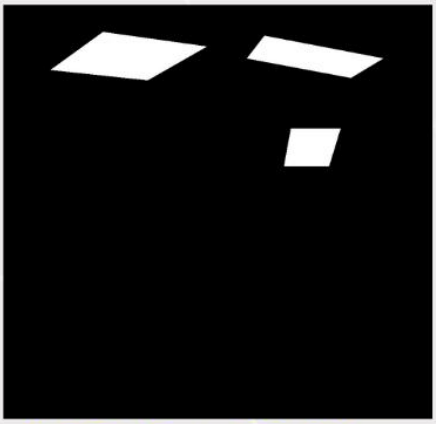
SCENE 1 : 15.64sec



SCENE 2 : 15.98sec



SCENE 3: 15.48sec



SCENE 4 : 21.08sec

Q1. Why can't we render point and directional lights with uniform hemisphere sampling or cosine weighted sampling?

1. Point Lights: Point light is represented by single point. When sampling directions on the surface, the chances of randomly selecting a direction that intersects with a point light source are extremely low or practically non-existent. The probability of a randomly sampled direction from the surface coinciding with the exact direction toward the point light is minuscule.
2. Directional Lights: Directional lights emit parallel light rays from infinitely far away, effectively illuminating the entire scene uniformly. When sampling directions on the surface using techniques like uniform hemisphere sampling or cosine-weighted sampling, there's a possibility that the sampled ray might be oriented in the opposite direction to the directional light. In such cases, the dot product of the directional light's normal and the sampled direction would be greater than zero, indicating that the sampled direction does not intersect with the directional light.

As a result, the contribution of the point light and direction light to the surface illumination may not be adequately captured, leading to inaccuracies or an absence of the direction and point light's effect on the surface.

Q2. Why does the noise increase for the same number of samples in the case of uniform hemisphere and cosine weighted sampling as the size of the area light decreases?

Concept:

cosine sampling is just a updated version of uniform sampling to eliminate more mathematical bias towards light more inclined to normal as compared to light more inclined to surface i.e. thetha term

in unifrom hemisphere sampling it's pdf= 1/ (2*PI) in uniform sampling Lo = Li * f * cos(thetha).

so we modify pdf= cos(thetah)/PI and cos() is cancelled

Lo = Li * f

So, now in cosine sampling equal contribution is considered about all directions

As the size of the area light decreases, the number of samples hitting the light source also decreases proportionally. With fewer samples hitting the area light, there's a reduced contribution to the overall illumination of the scene. Consequently, the rendered image exhibits increased noise because the limited number of samples falls to adequately capture the true lighting conditions.

The renderer should be invoked as follows:

./render <scene_path> <output_path> <spp> <sampling_method>

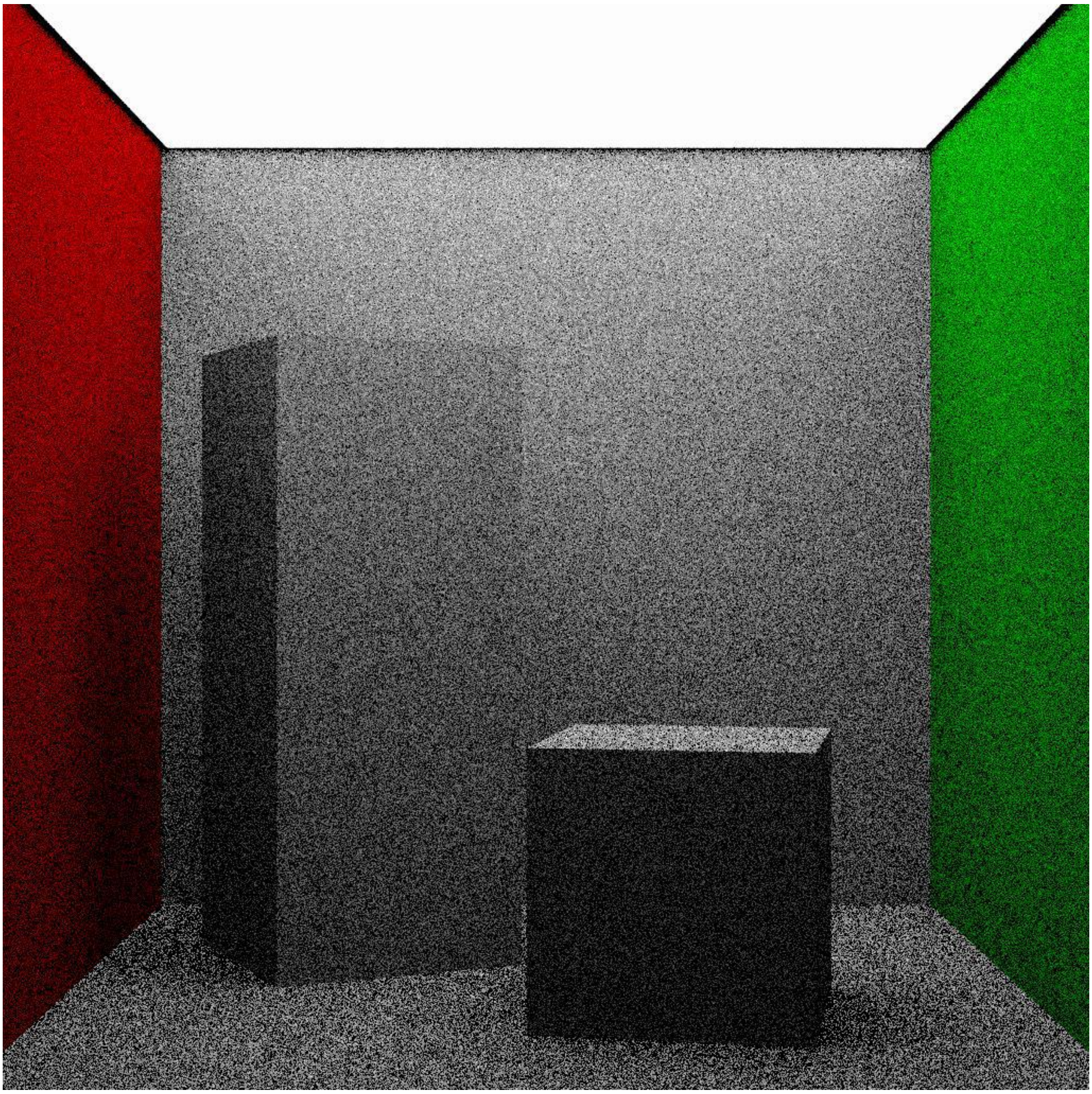
The sampling method will be an integer from 0 –2 where each integer is defined as follows:

- 0: Uniform Hemisphere sampling
- 1: Cosine weighted sampling
- 2: Light sampling

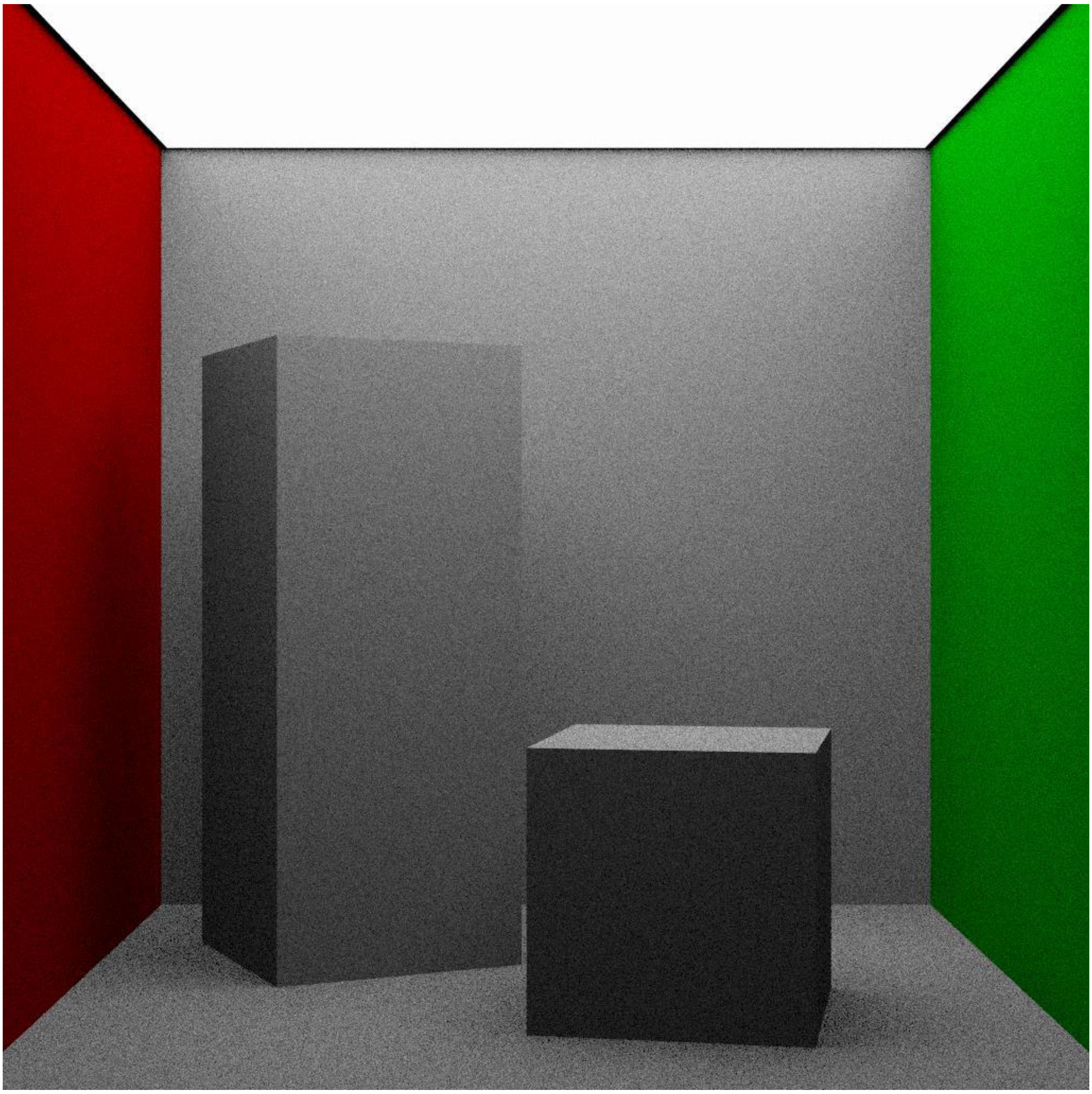
Number in image_name represents spp(samples per pixel)

Big :

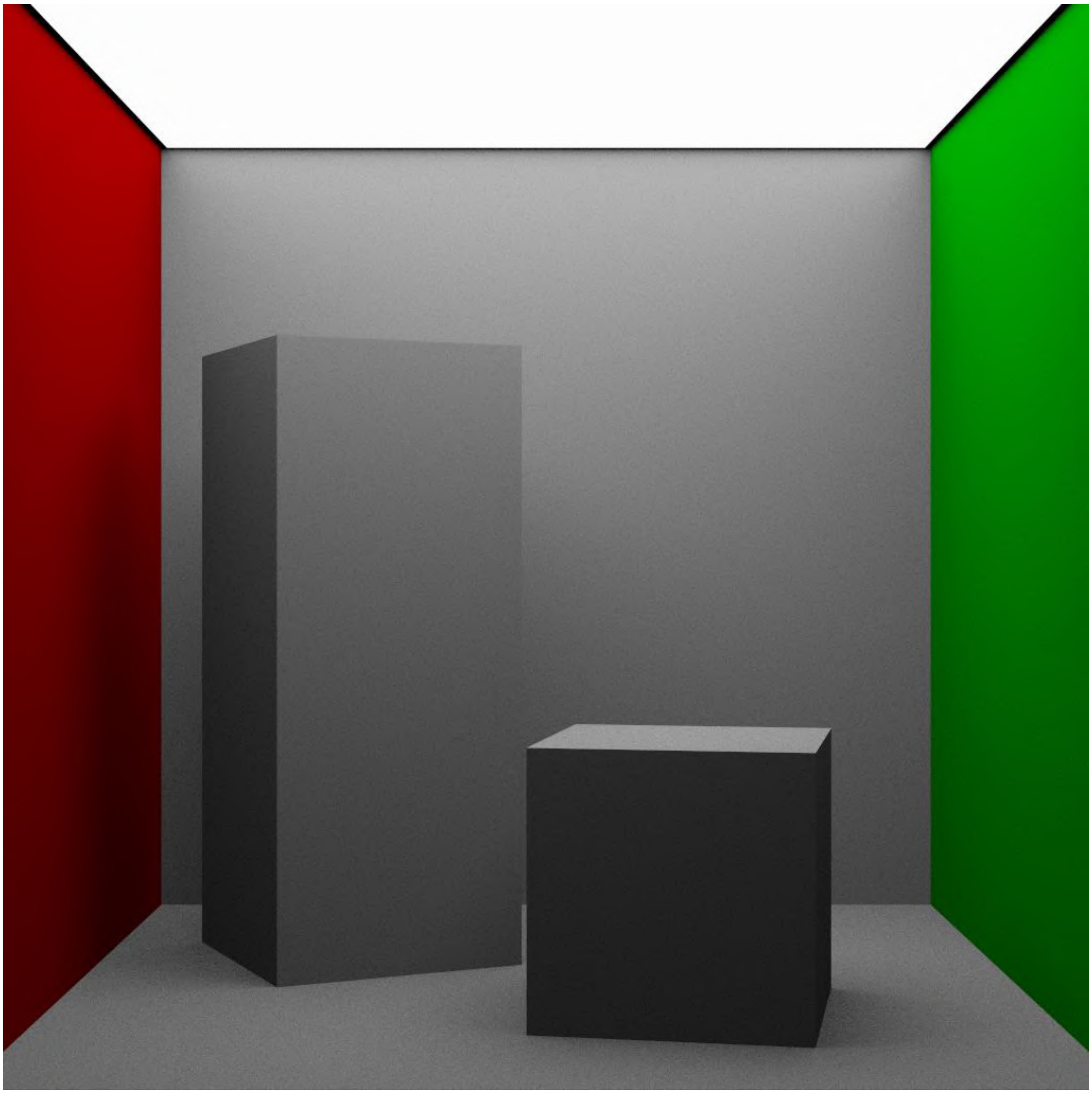
0: Uniform Hemisphere sampling



Big10 :10.4 sec

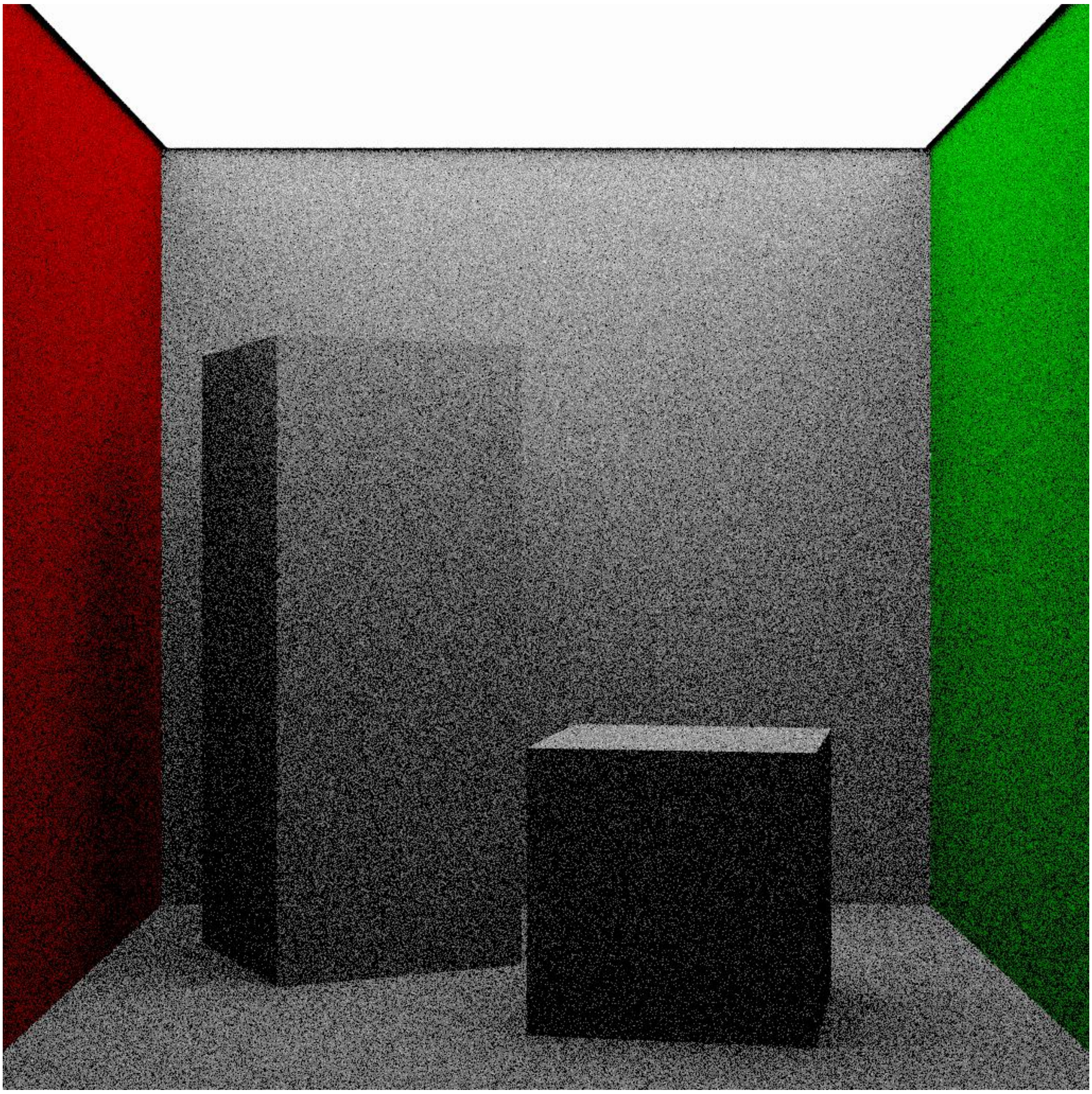


Big100 : 105.55sec

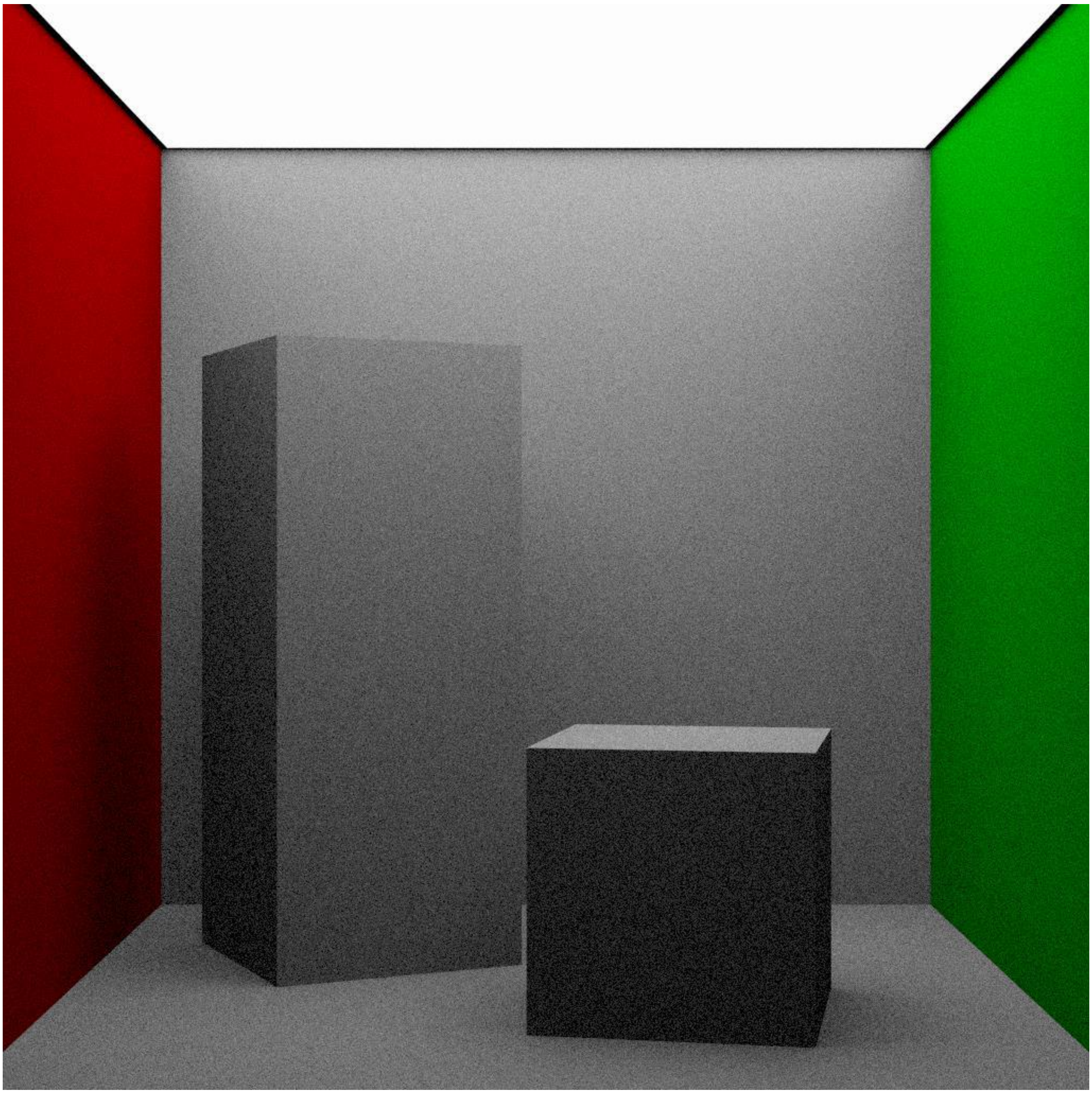


Big1000 : 1178.01 sec

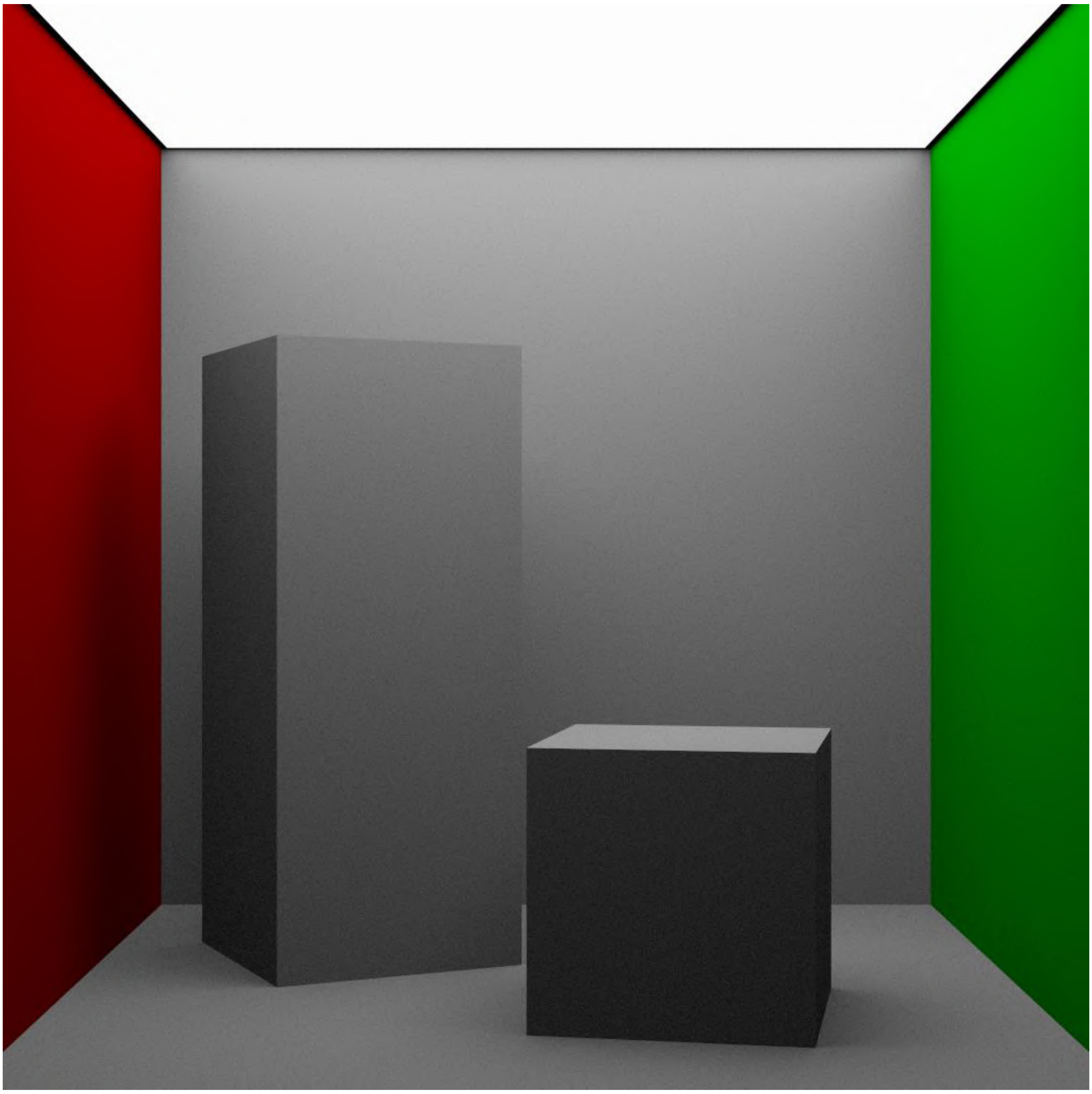
1: Cosine weighted sampling



big_c_10 :12.24 sec

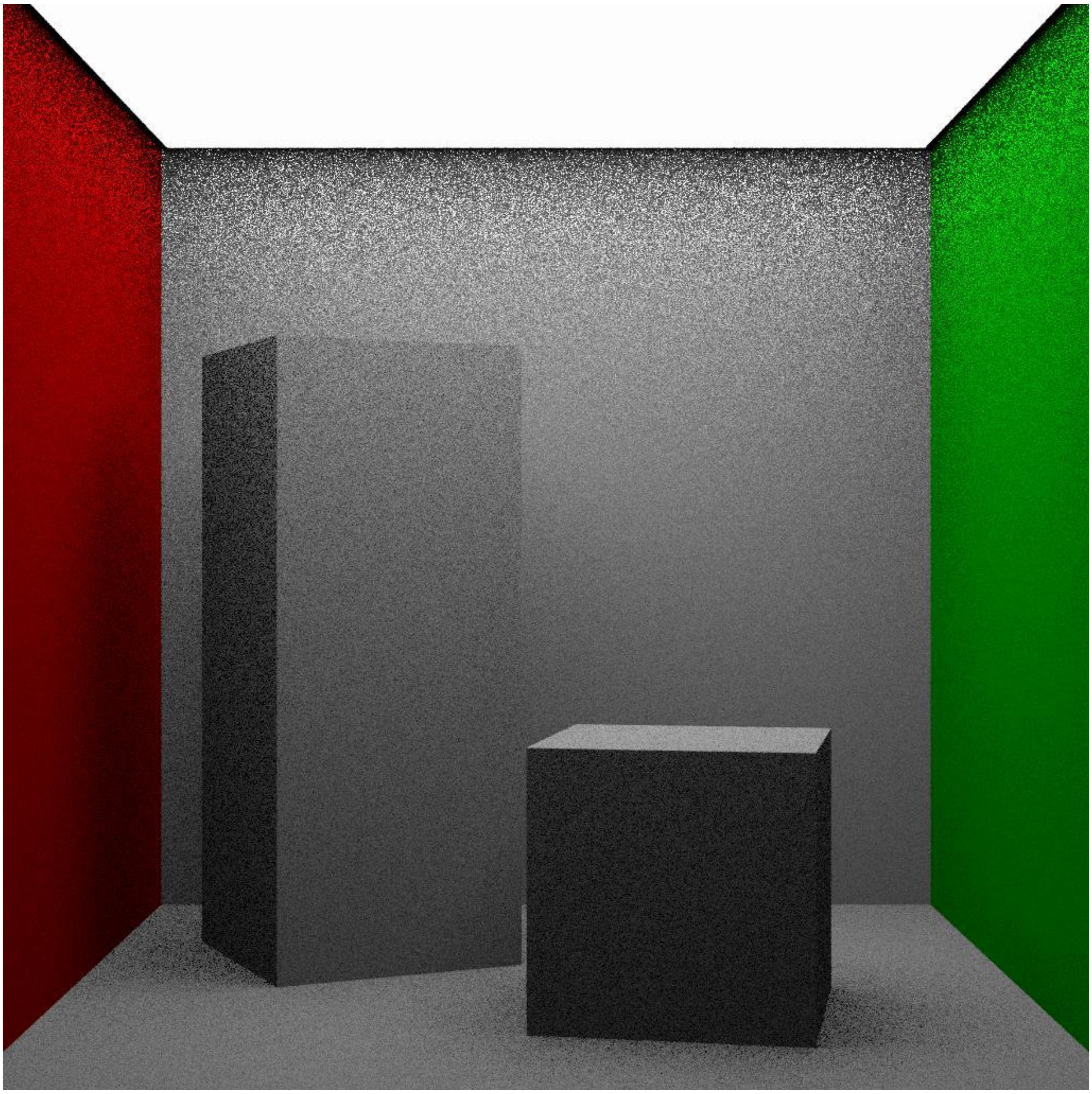


Big_c_100: 130.04 sec

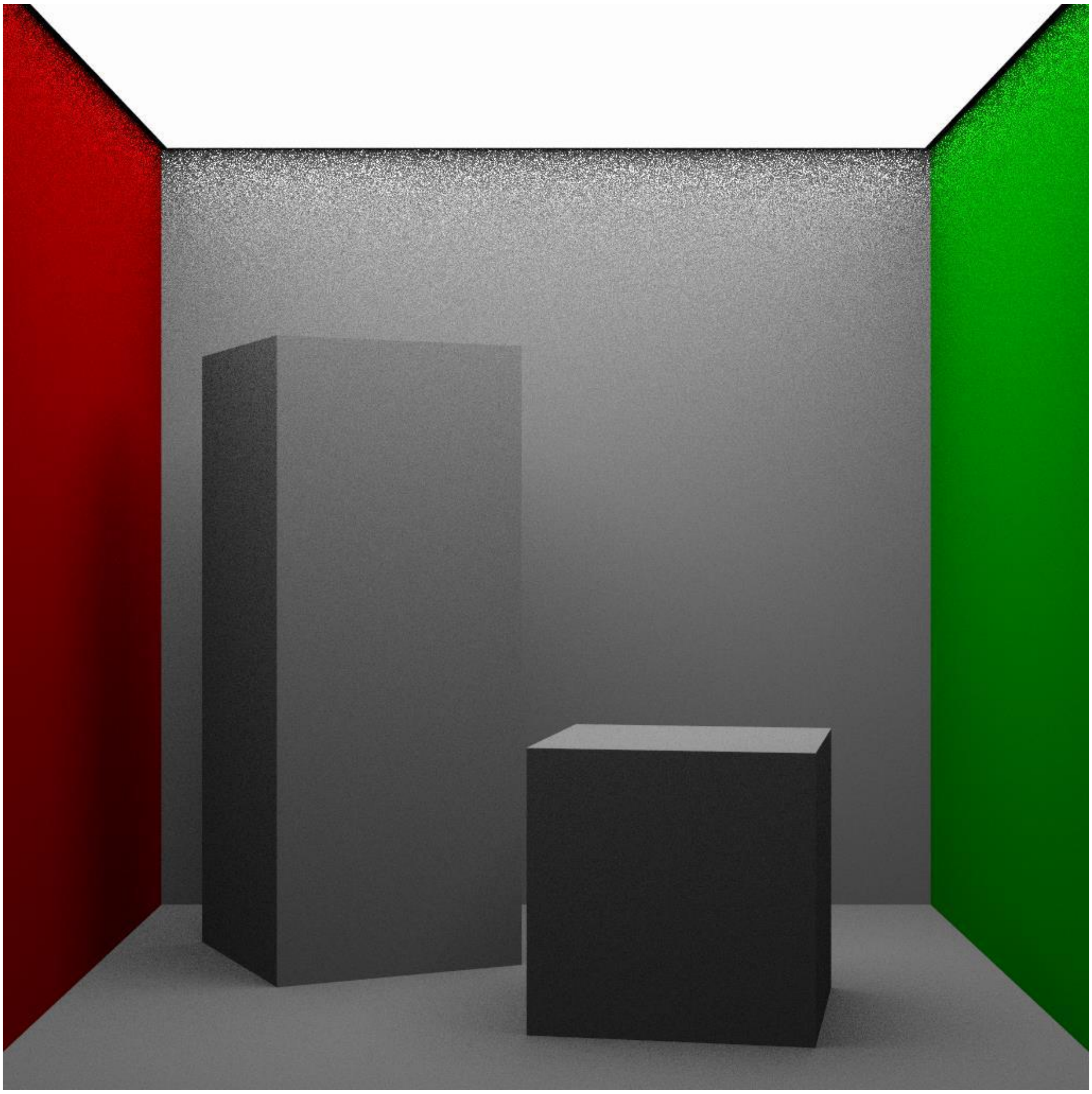


Big_c_1000: 1509.721 sec

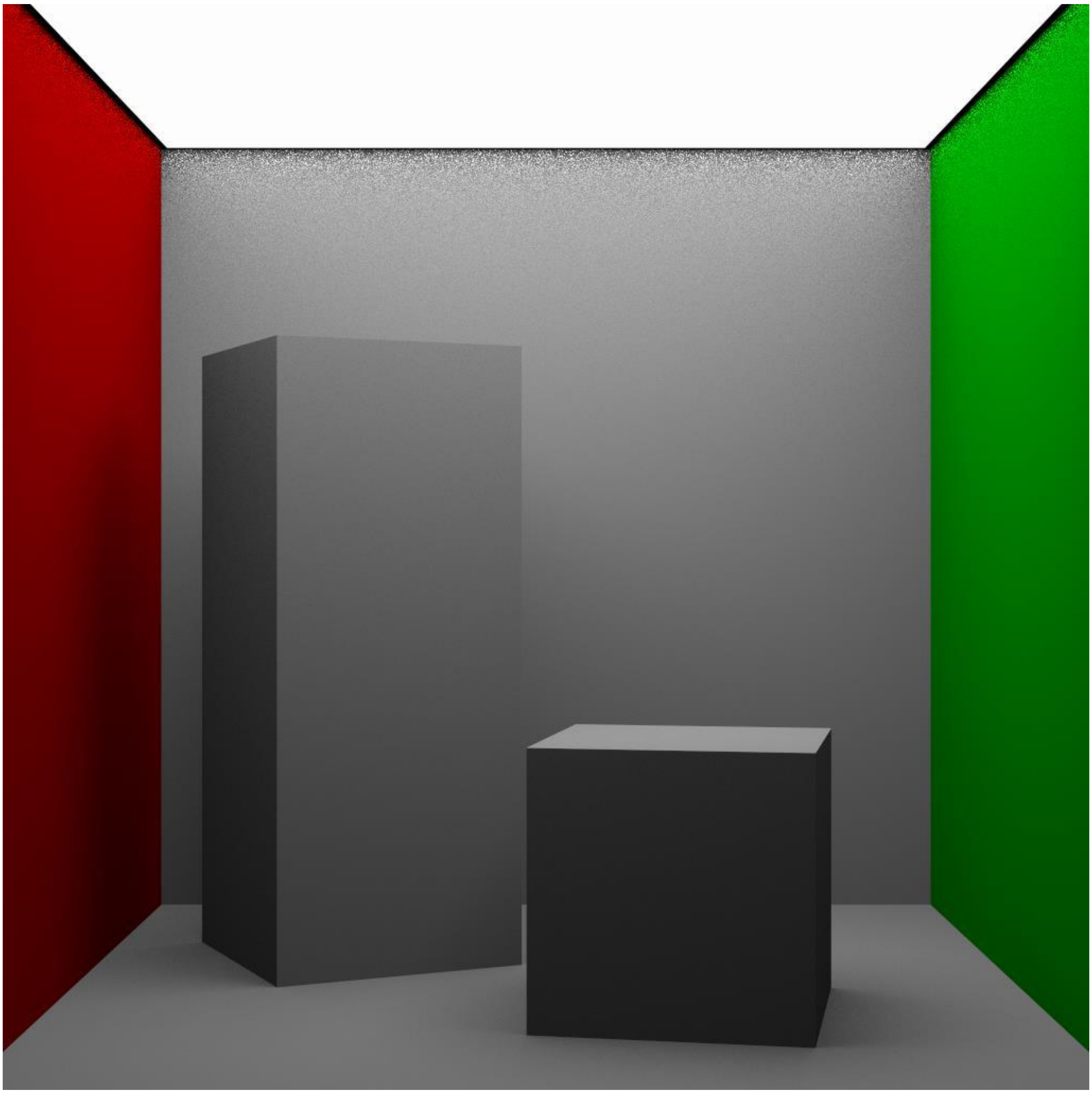
2: Light sampling



Big_li_10: 16.25 sec



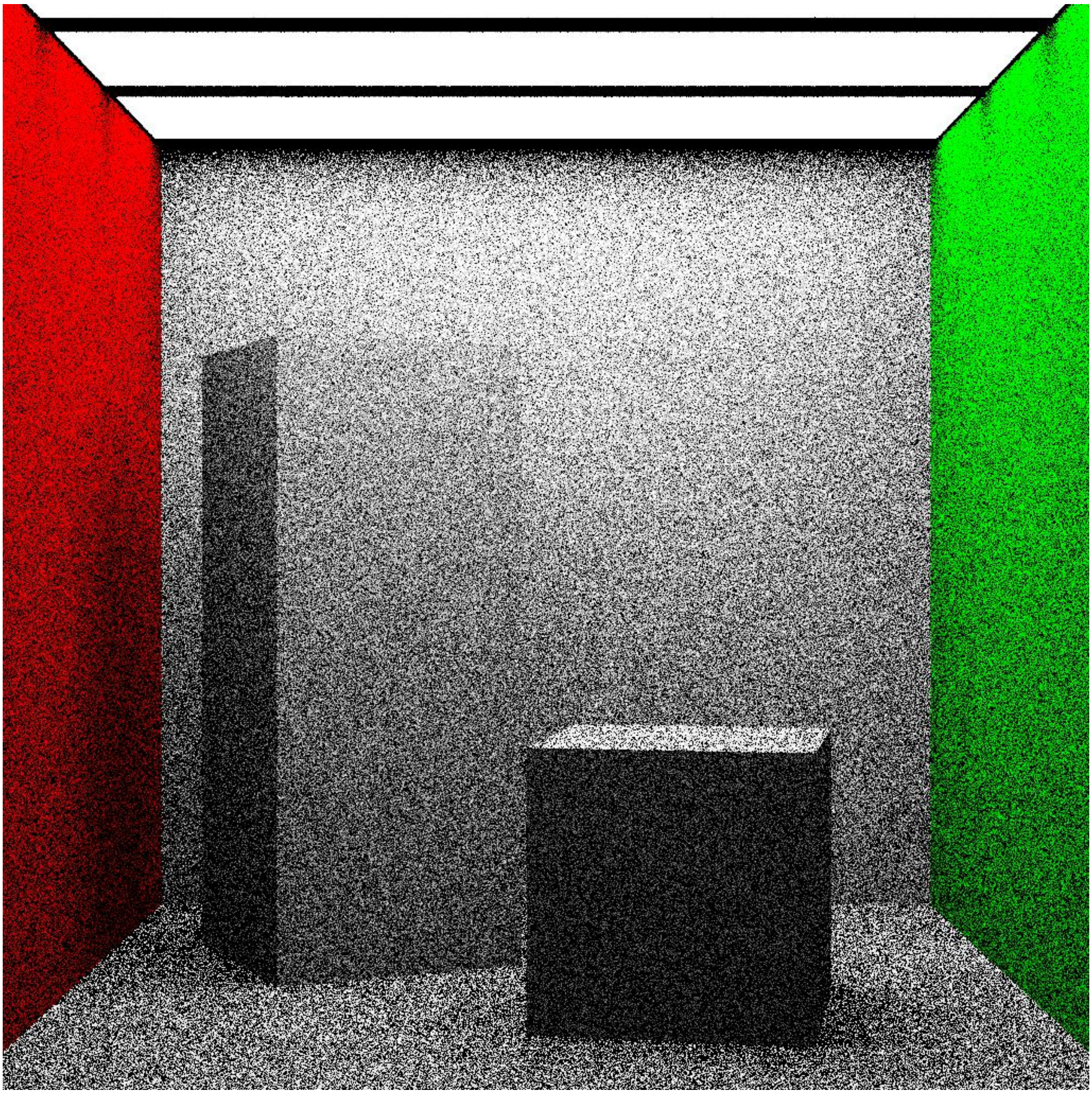
Big_li_100: 165.95 sec



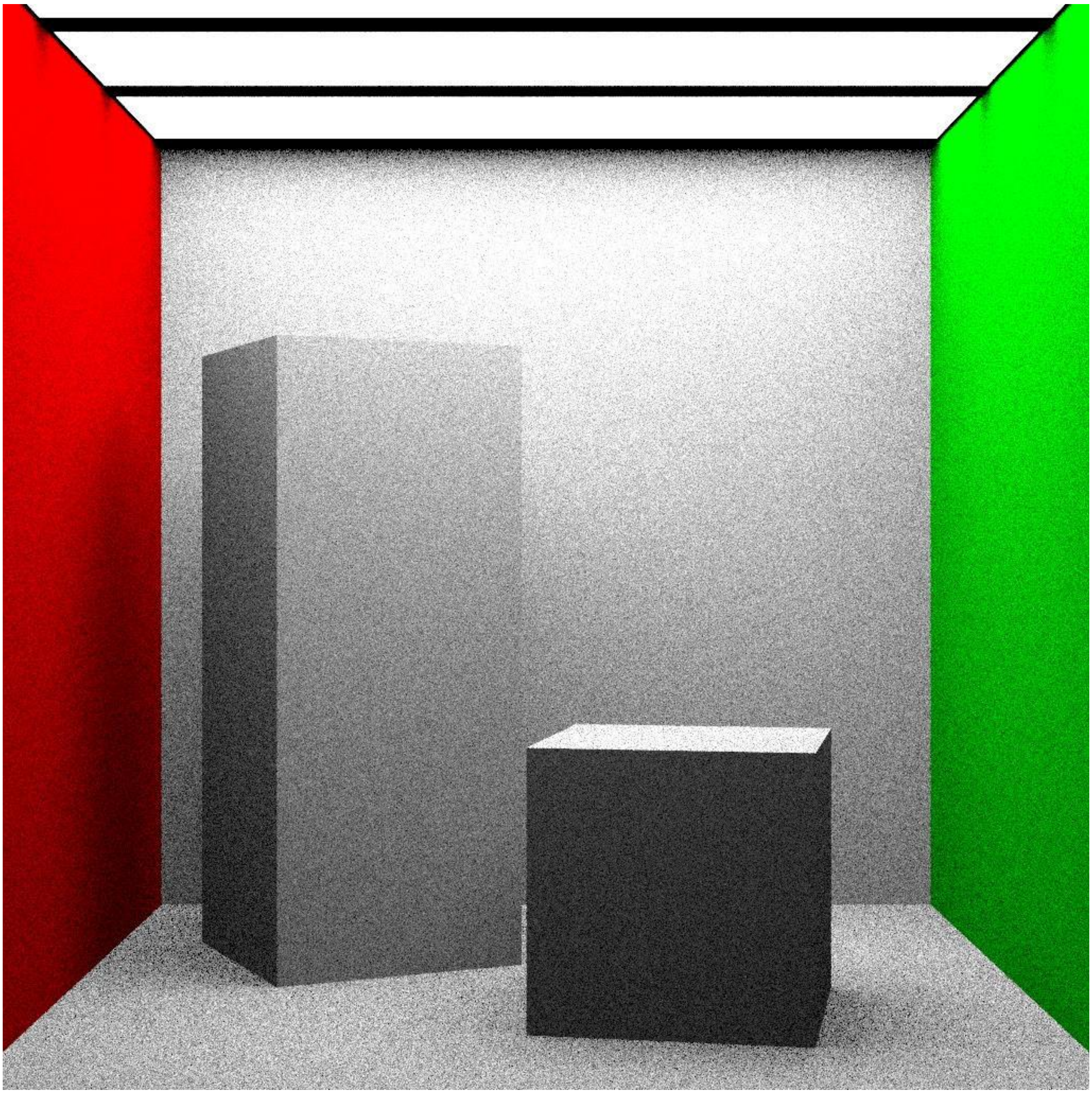
Big_li_1000: 1586.42 sec

Many

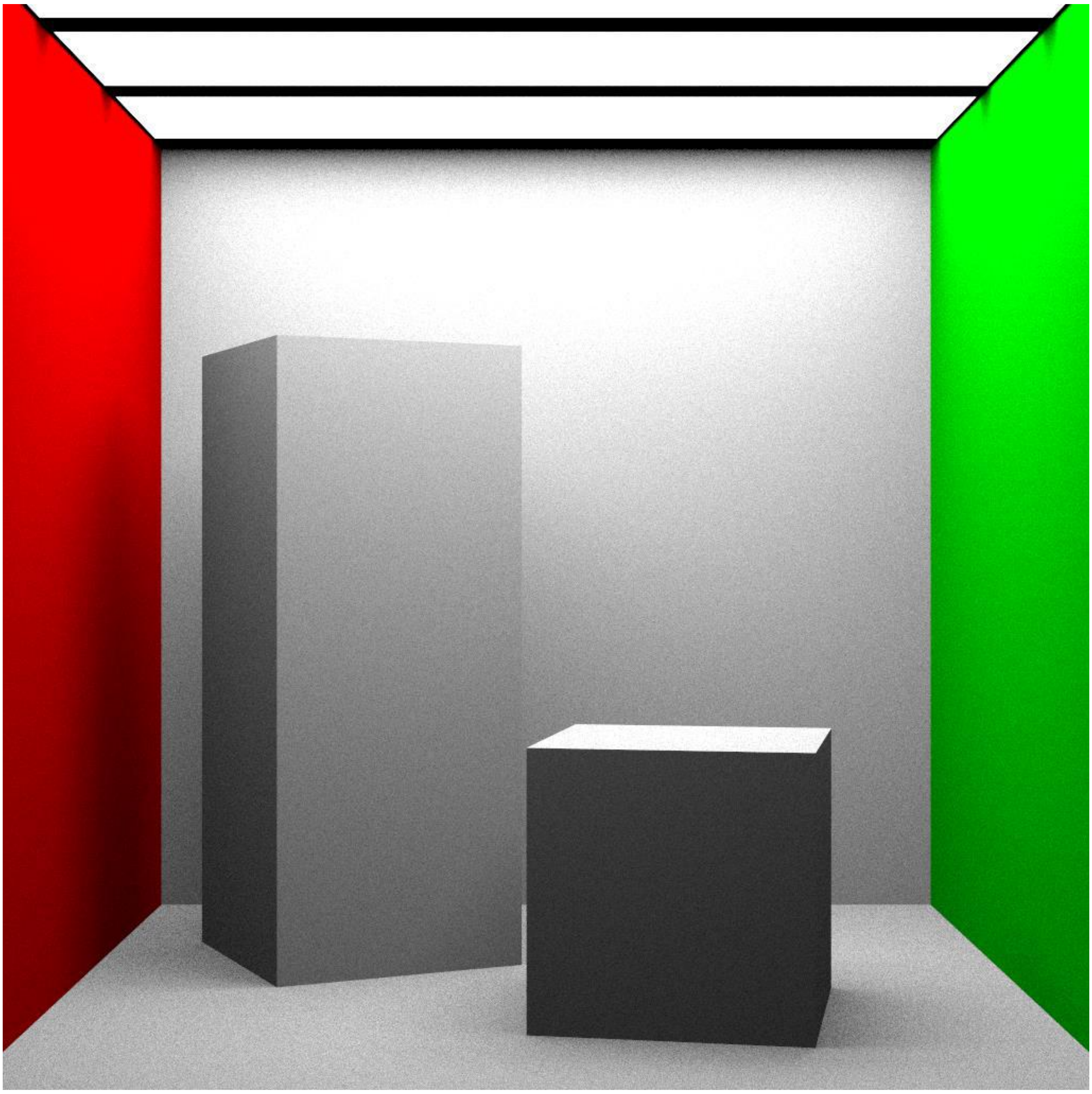
Uniform Hemisphere sampling



Many10: 23.34 sec

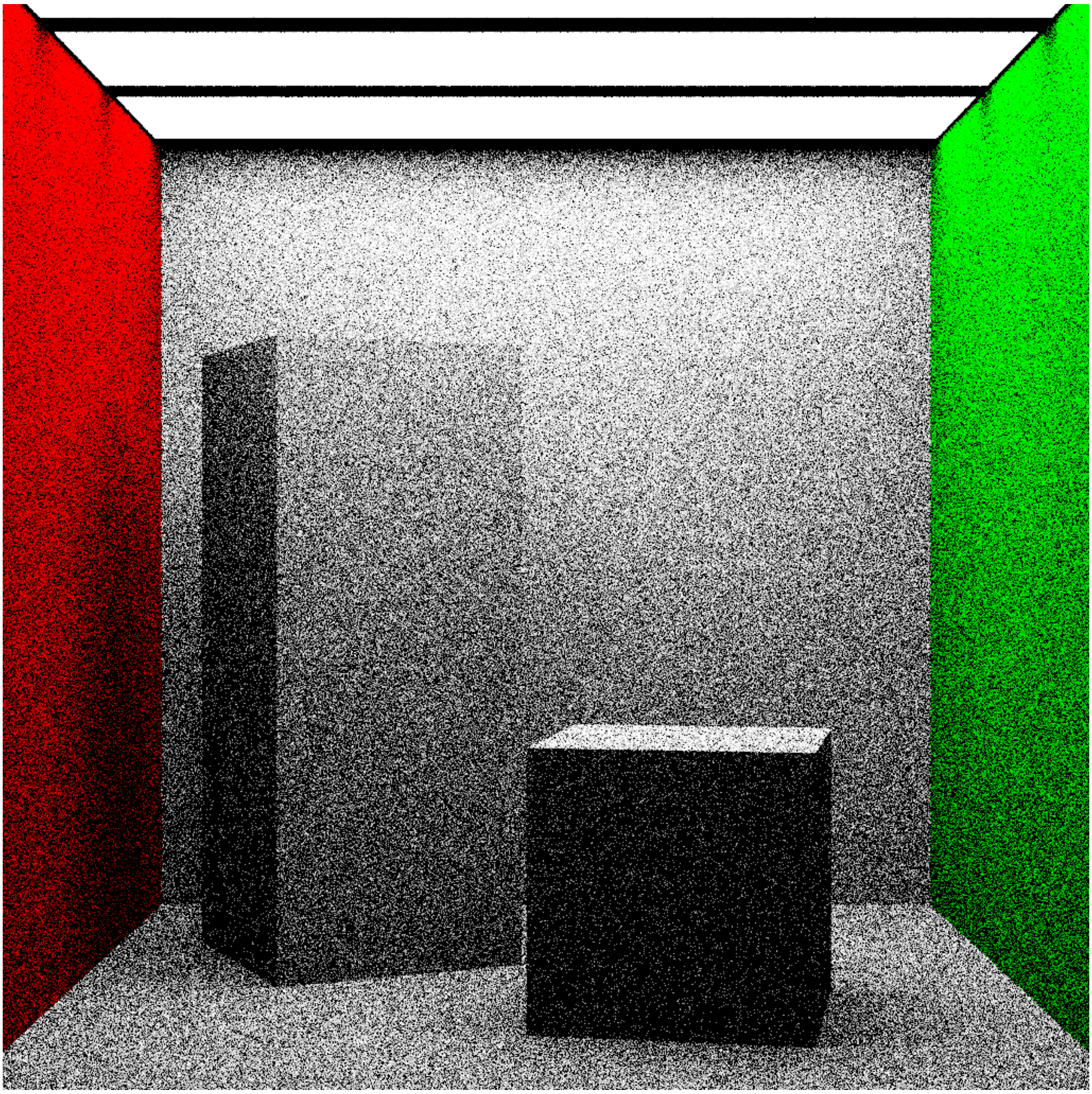


Many100 : 262.70 sec

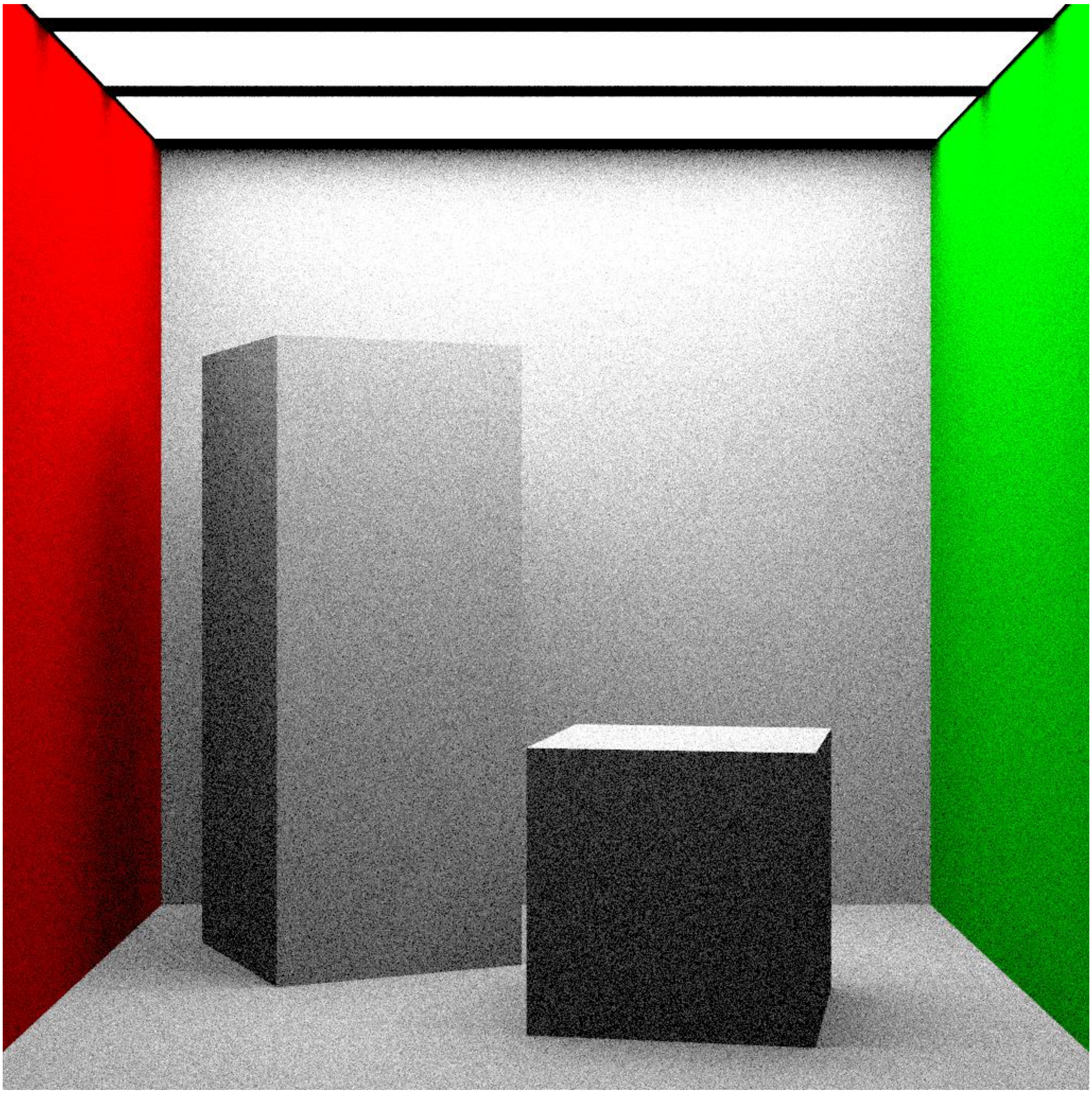


Many1000 :2729.50 sec

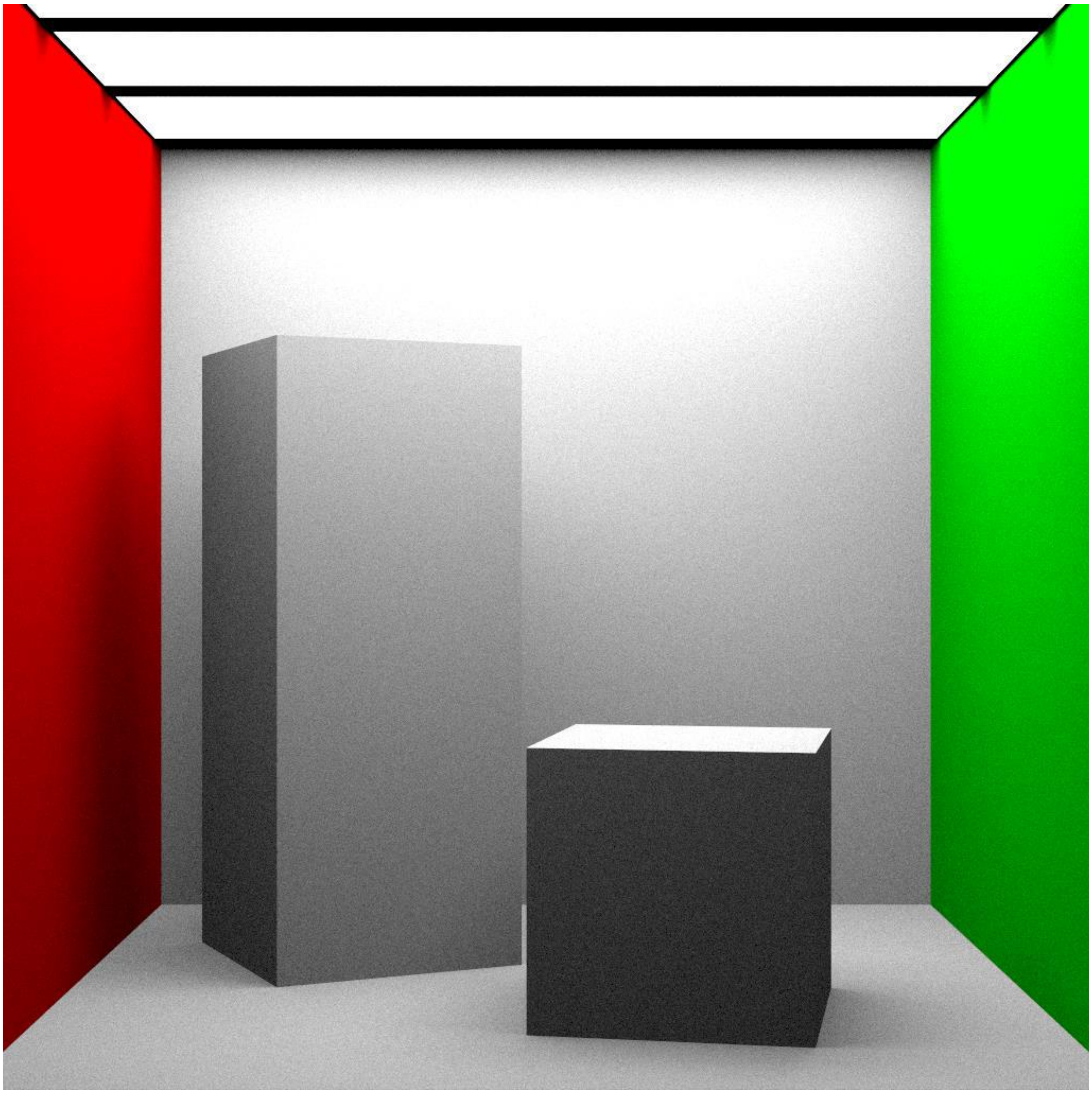
1: Cosine weighted sampling



Many_c_10: 41.49 sec

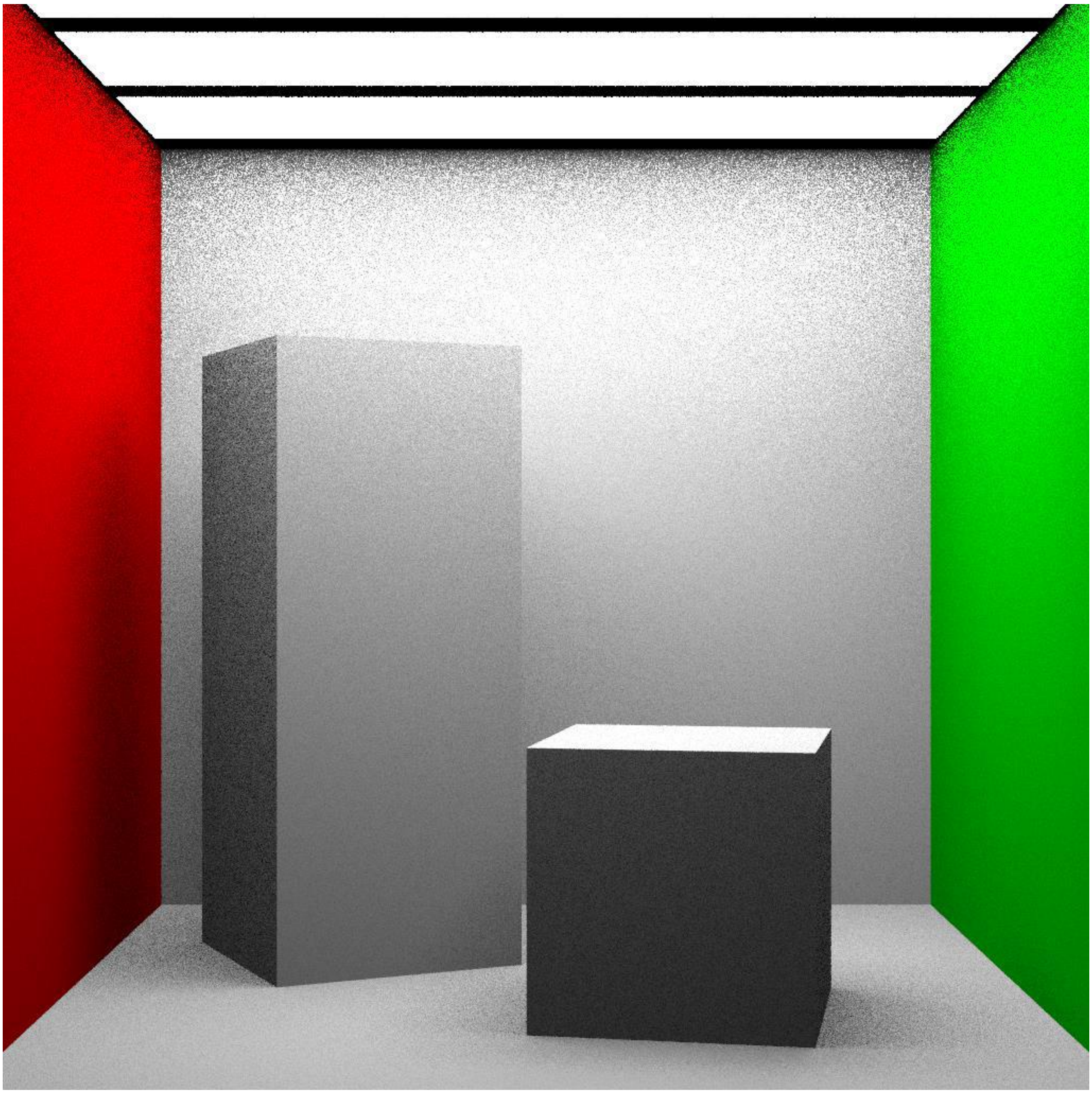


Many_c_100: 386.42 sec

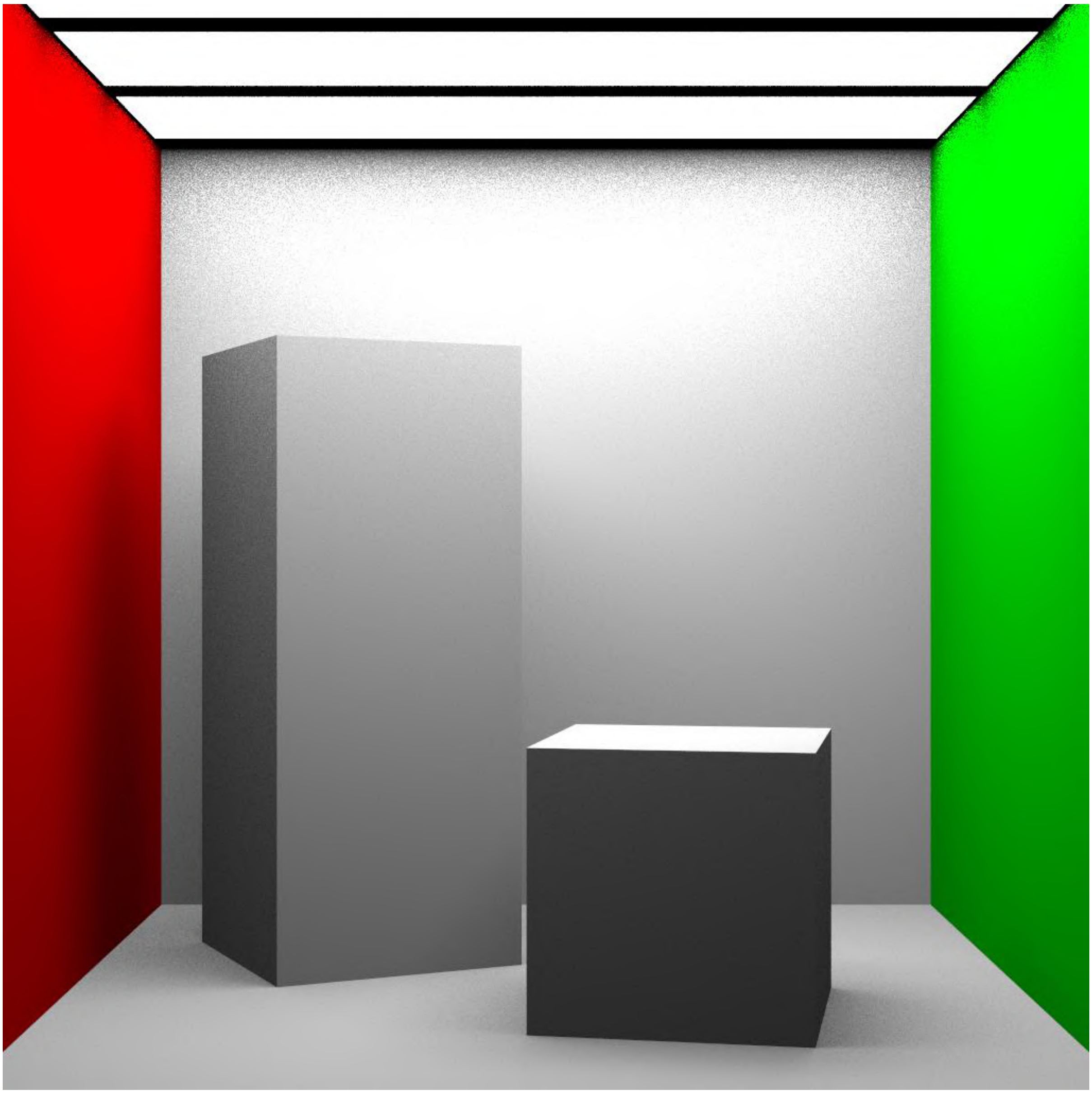


Many_c_1000: 3511.07 sec

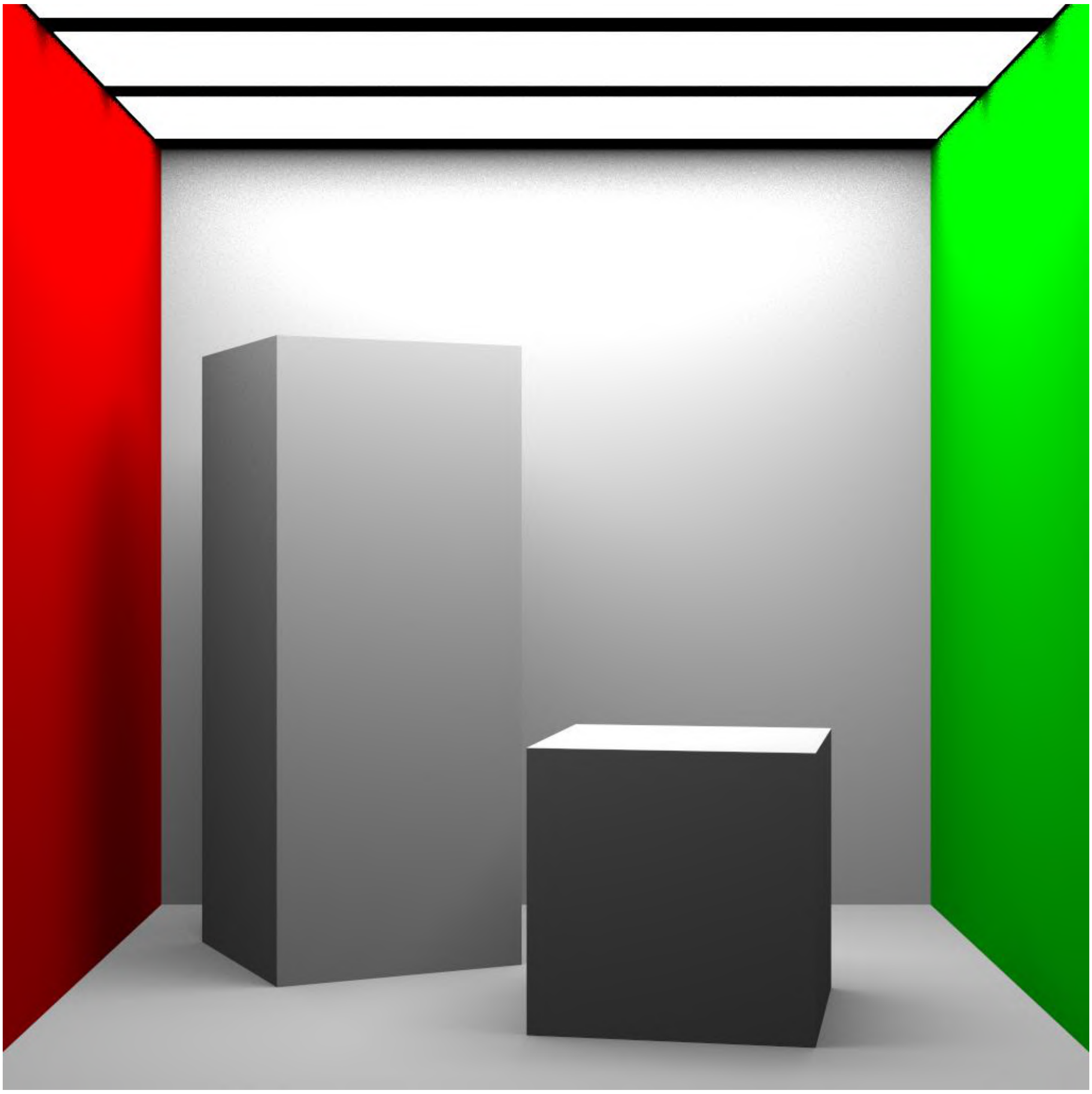
2: Light sampling



many_li_10 : 40.88 sec



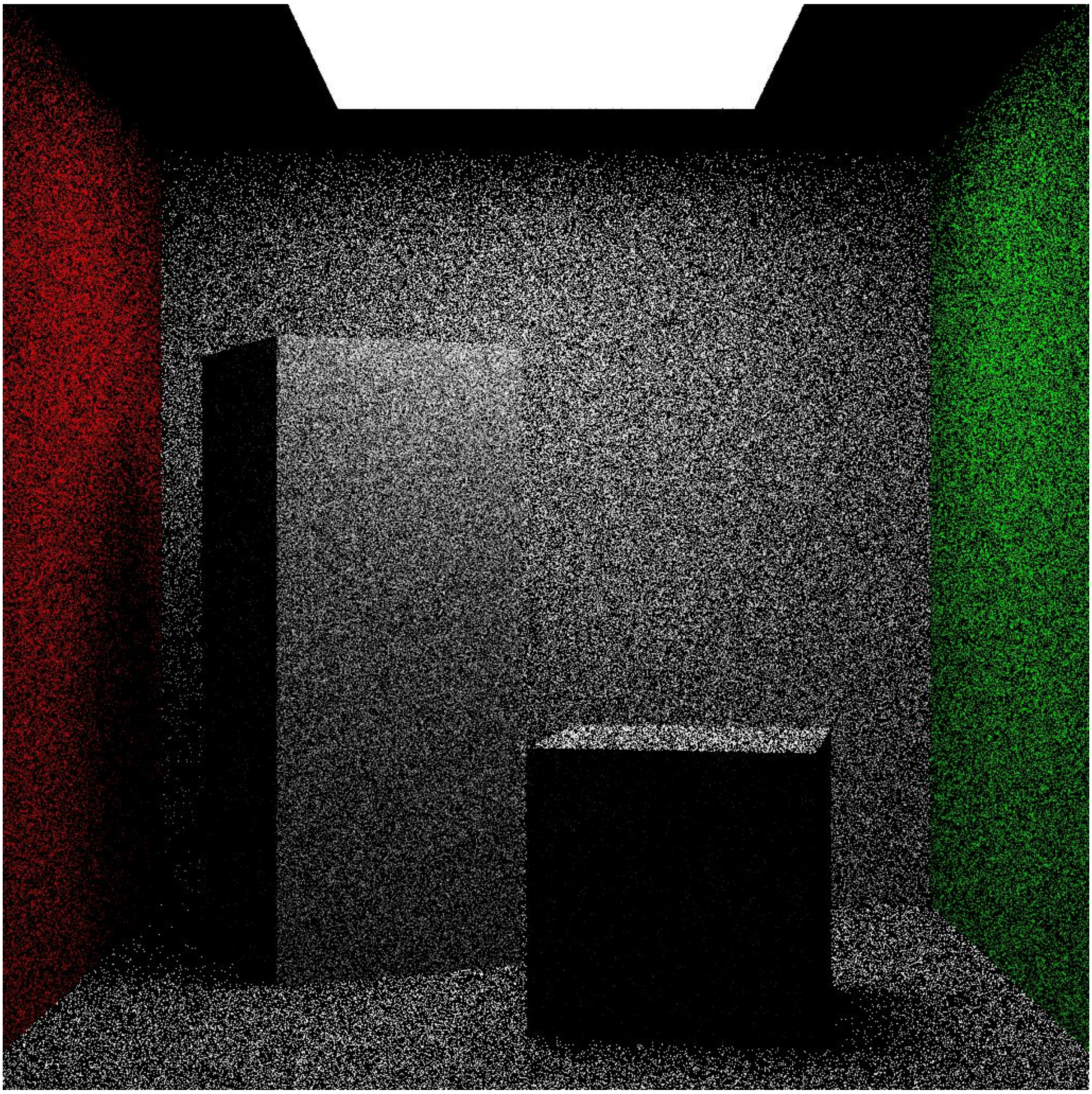
Many_li_100 : 343.104 sec



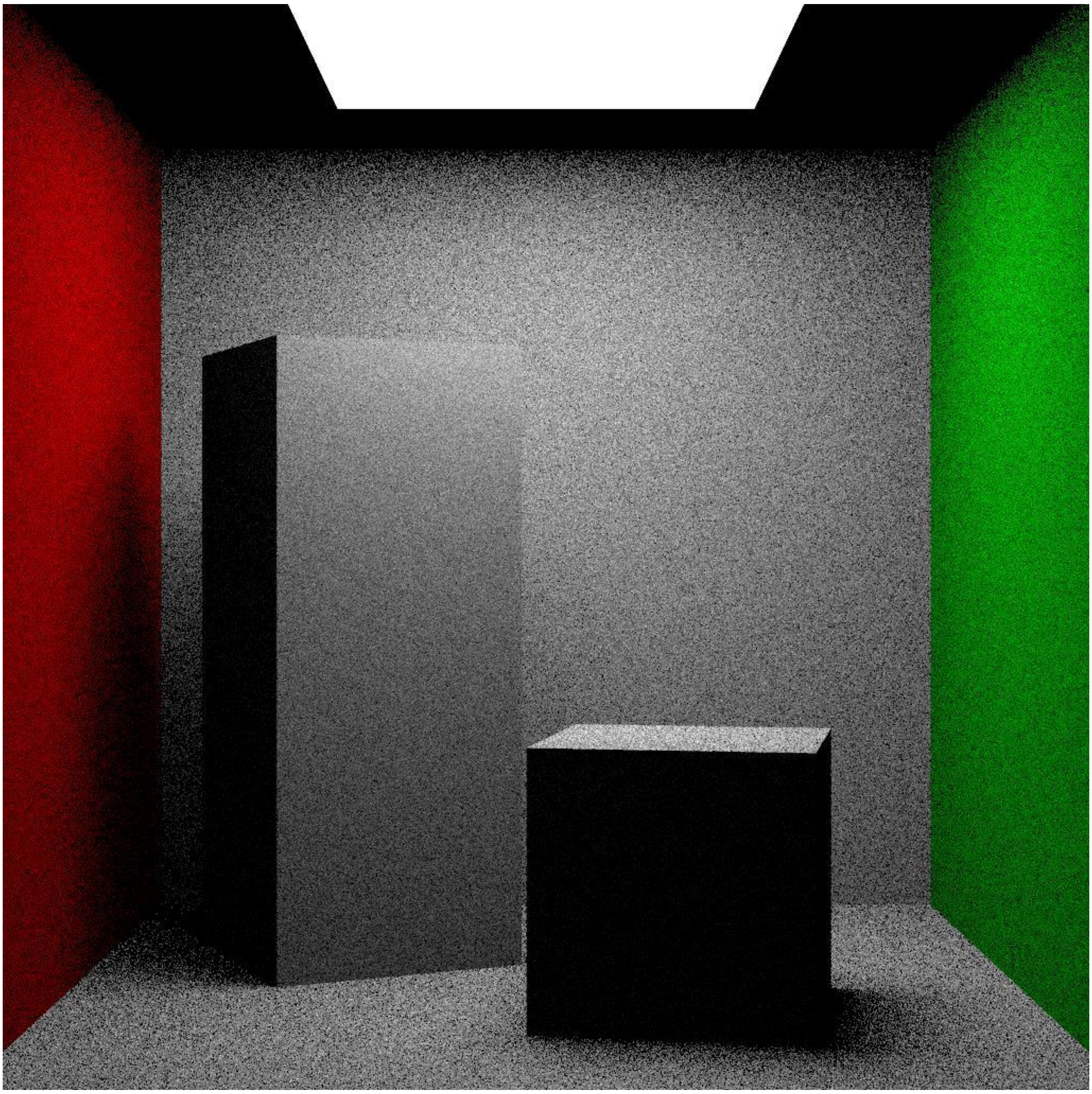
Many_li_1000: 2740.44 sec

Med

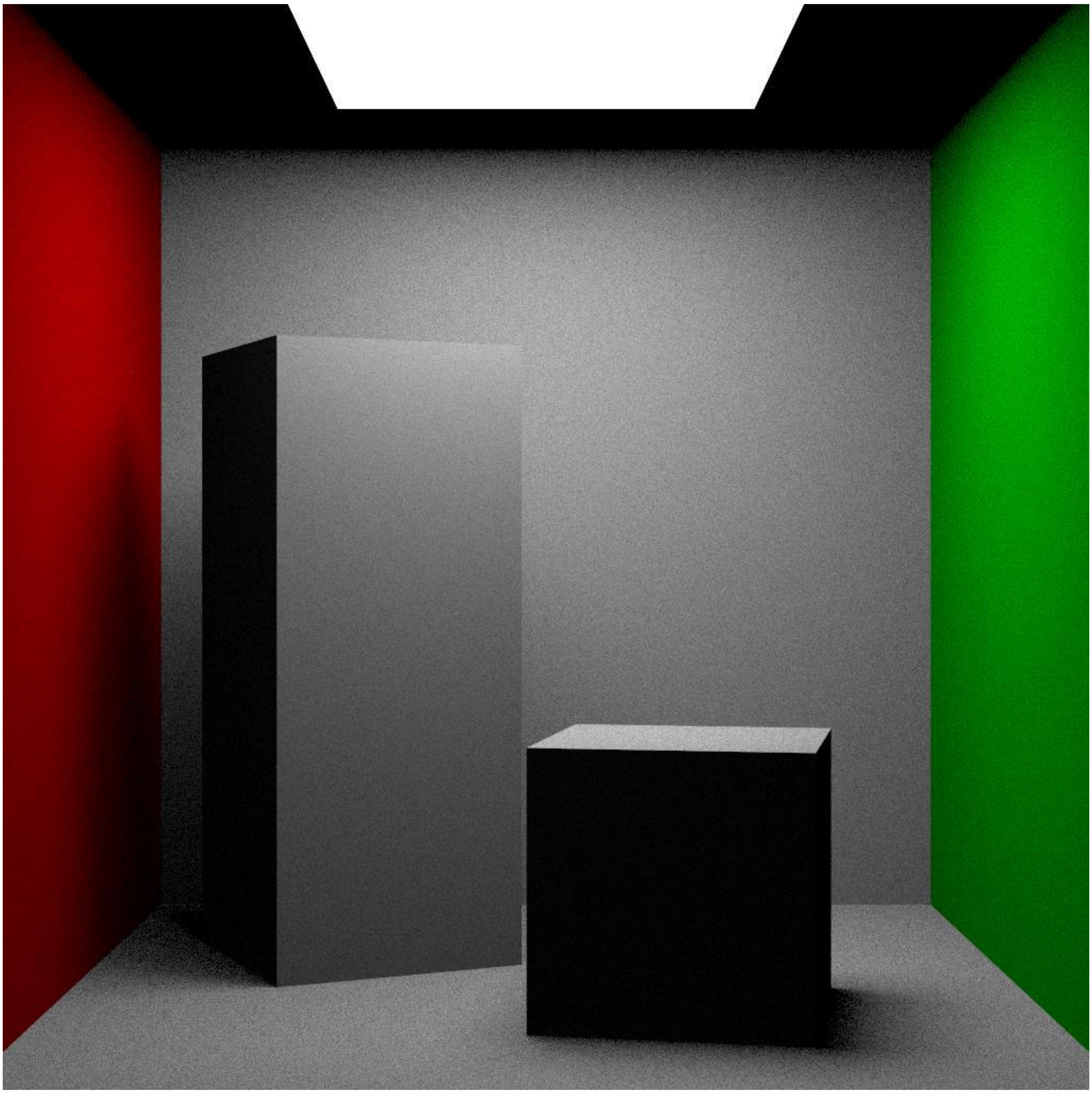
0: Uniform Hemisphere sampling



Med10: 11.52 sec

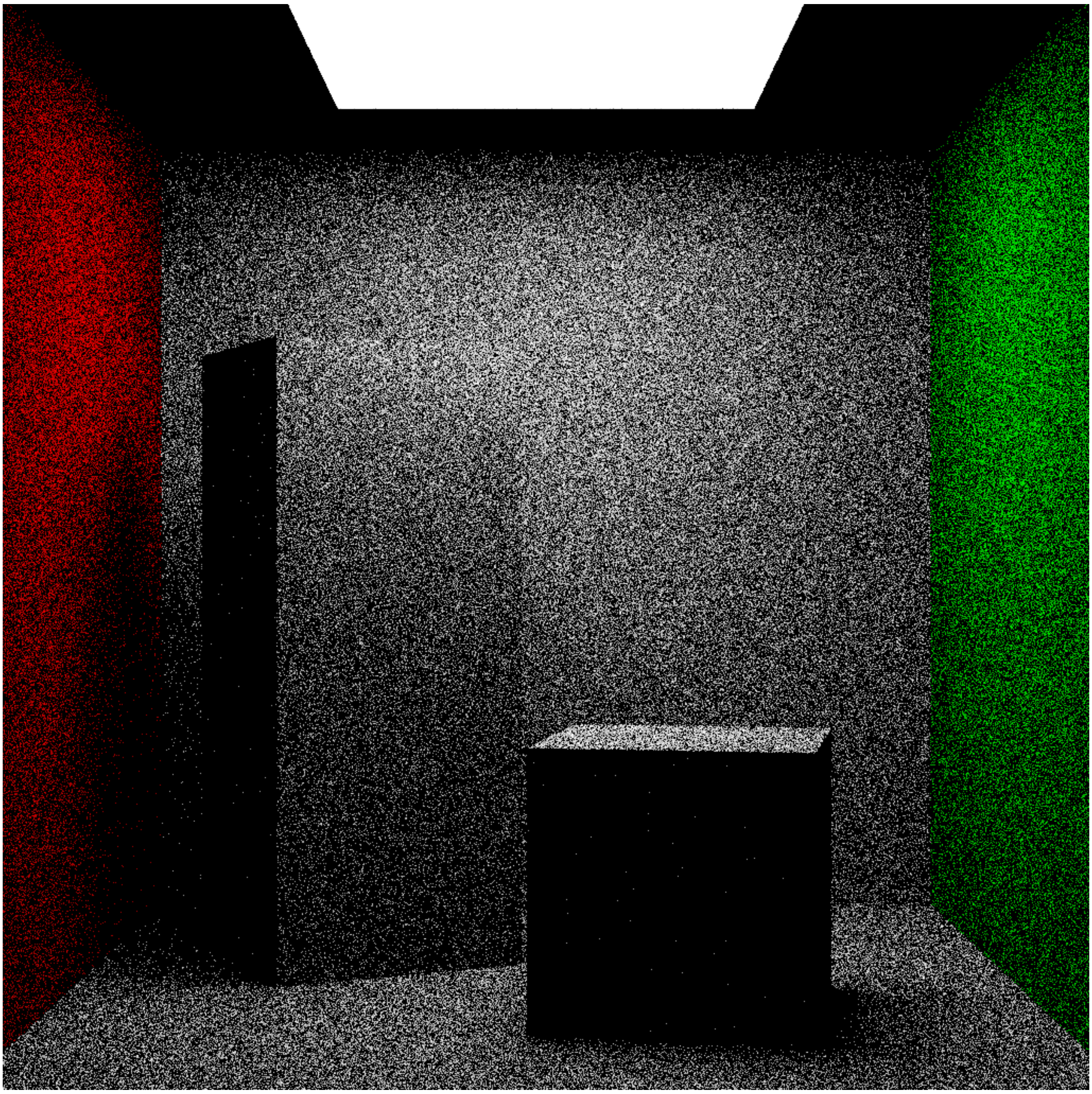


Med100 : 130.137 sec

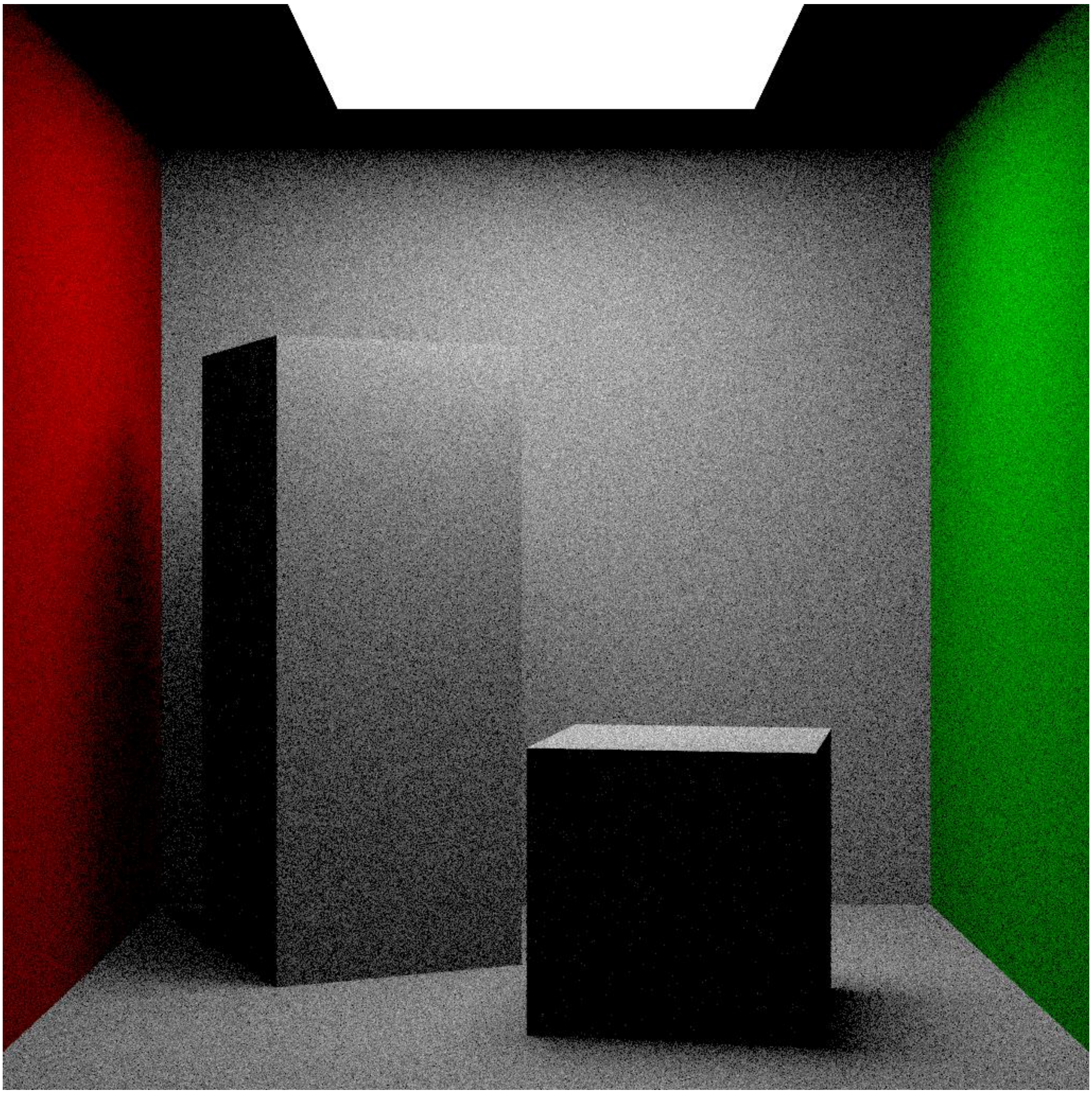


Med1000 : 1243.38 sec

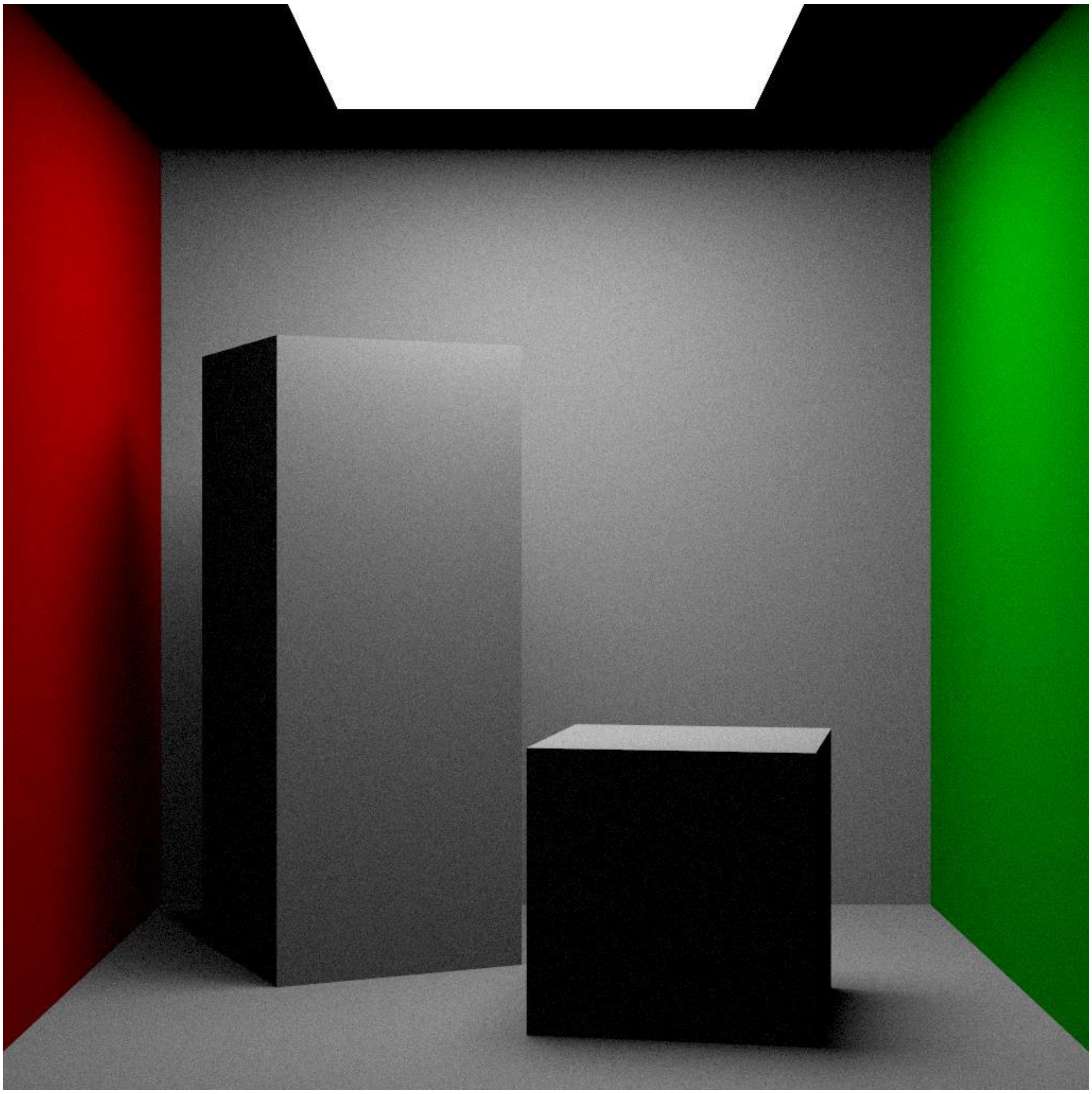
1: Cosine weighted sampling



Med_c_10 : 19.35 sec

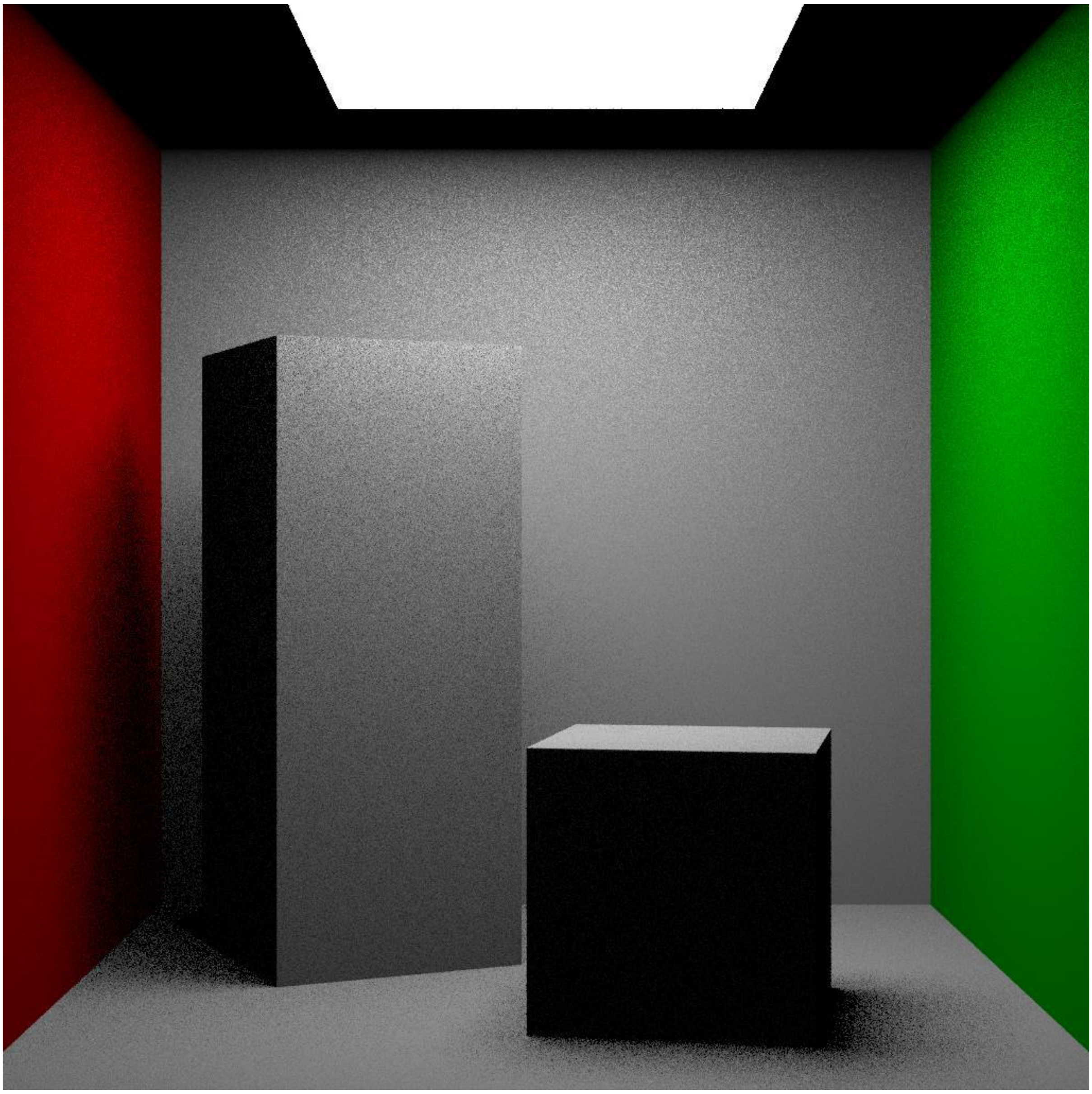


Med_c_100 : 189.74

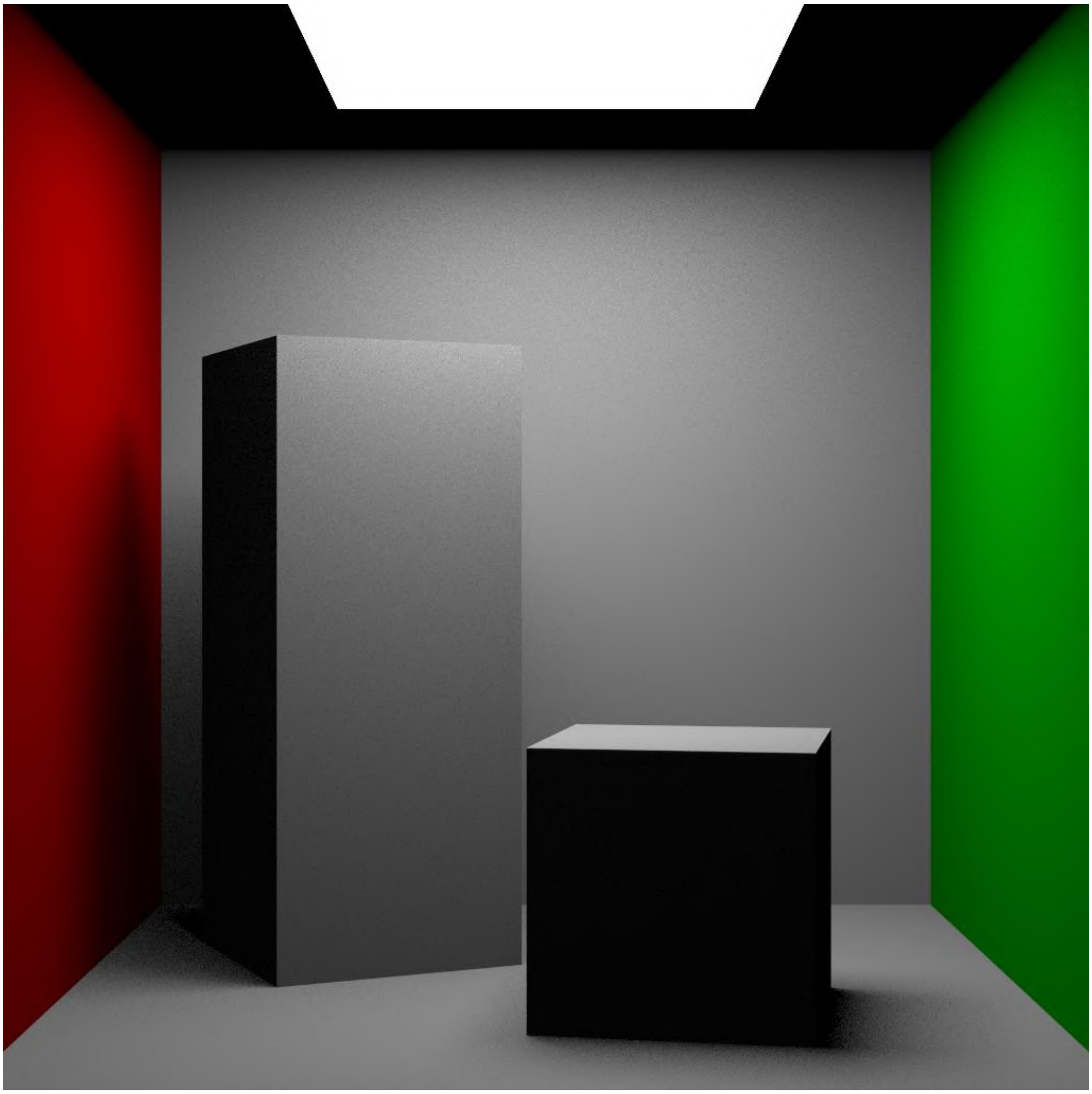


Med_c_1000 : 1635.81

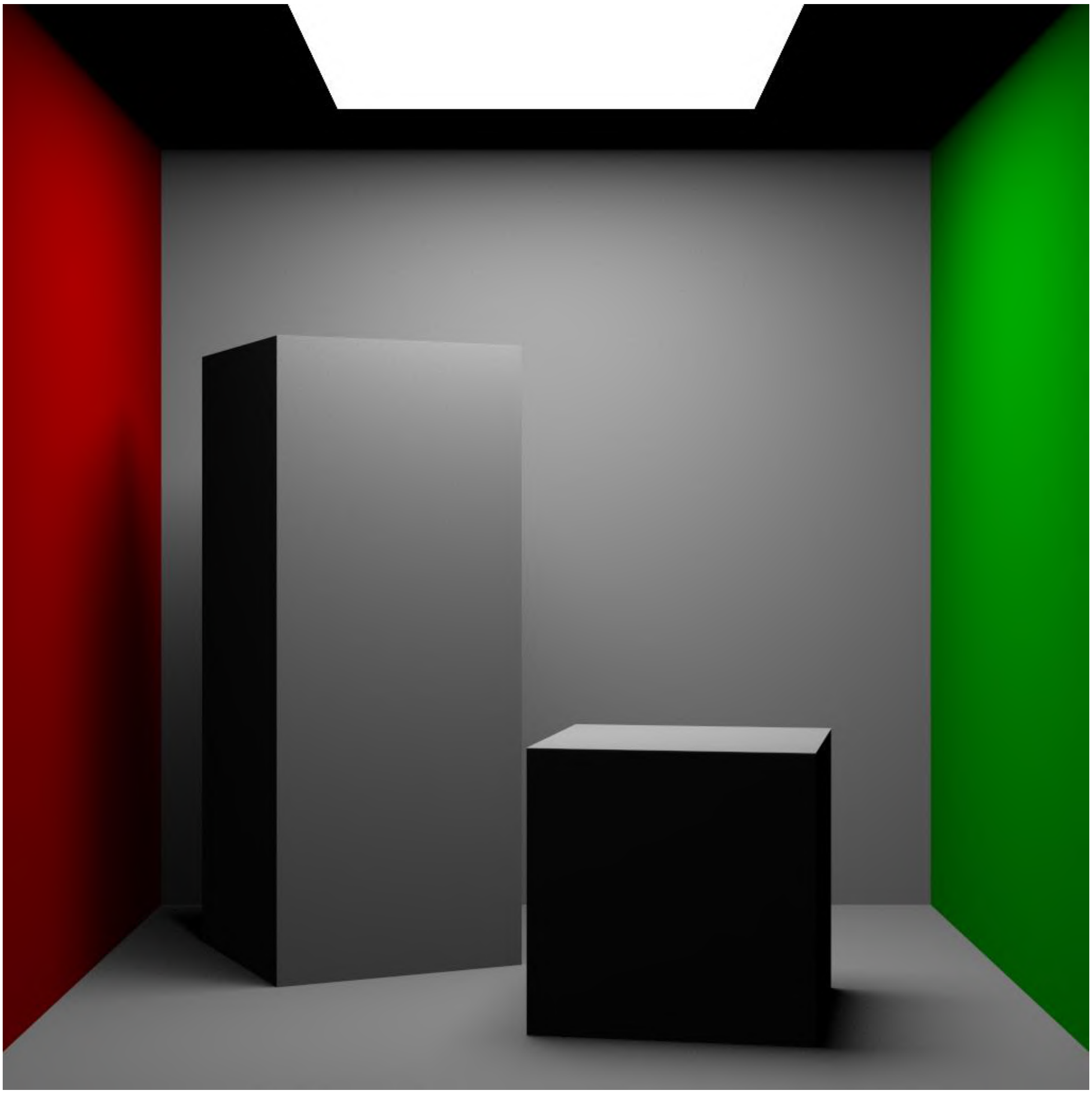
2: Light sampling



Med_li_10 : 17.10 sec



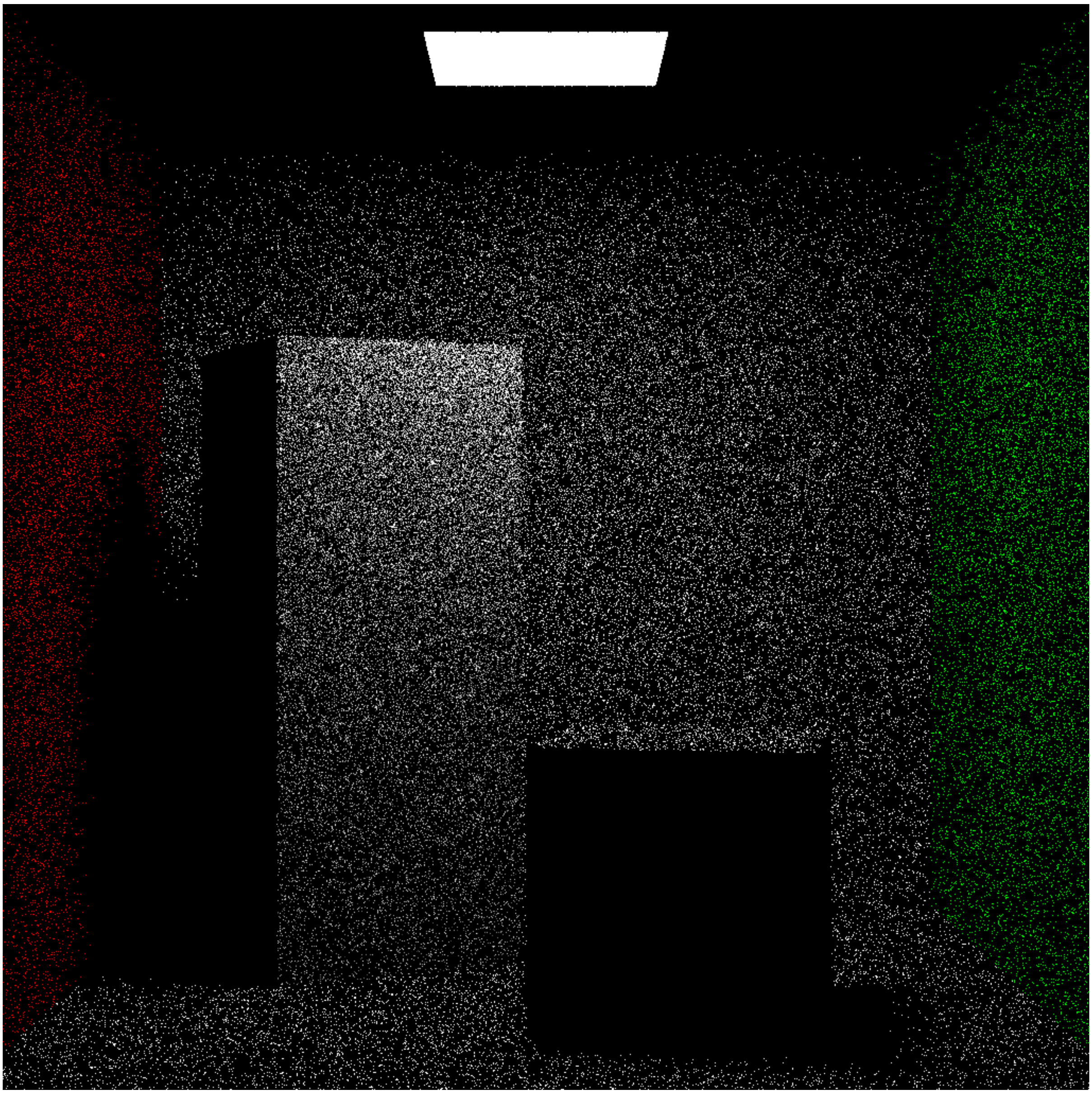
Med_li_100: 166.83 sec



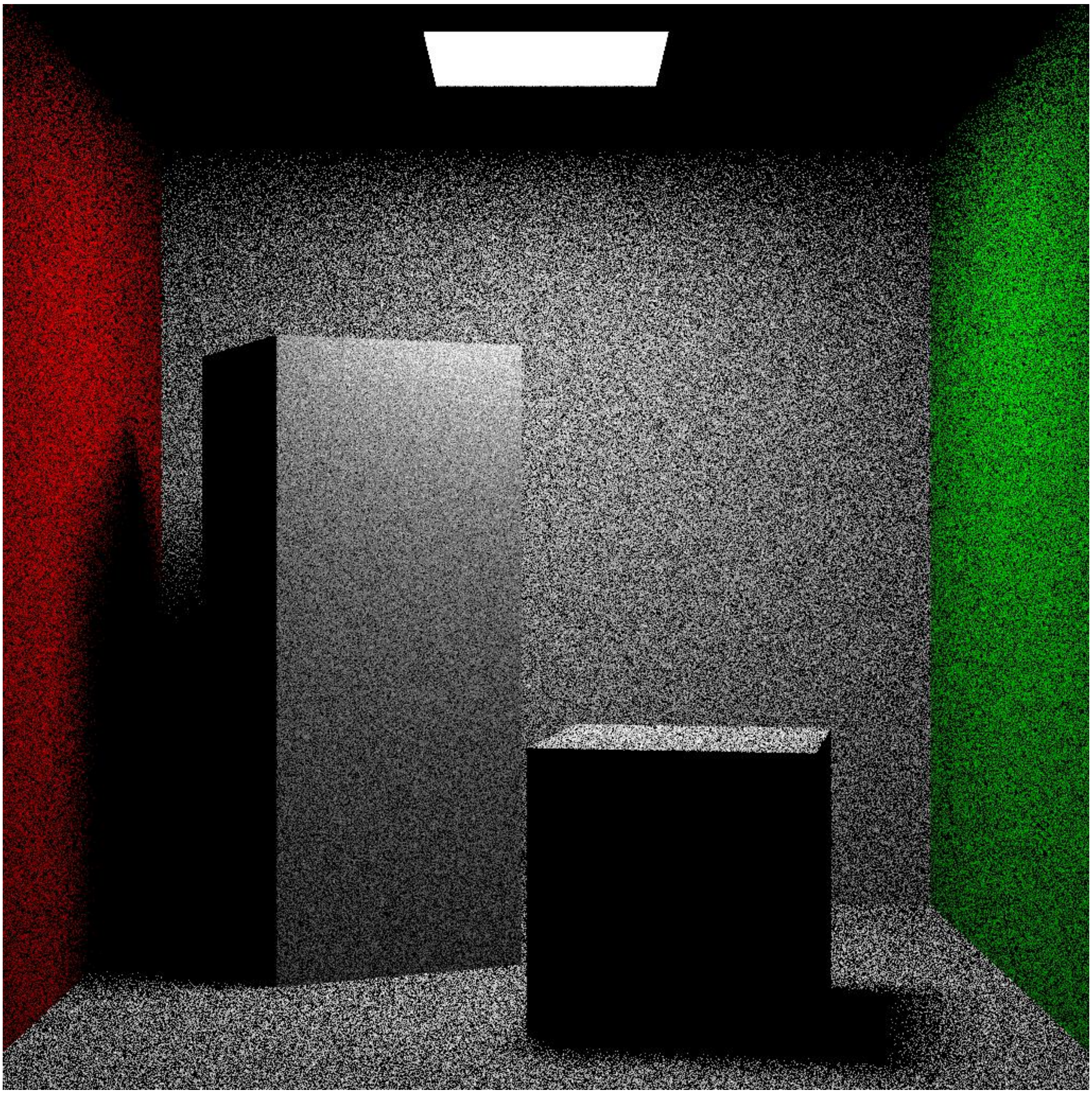
Med_li_1000 : 1505.80 sec

Small

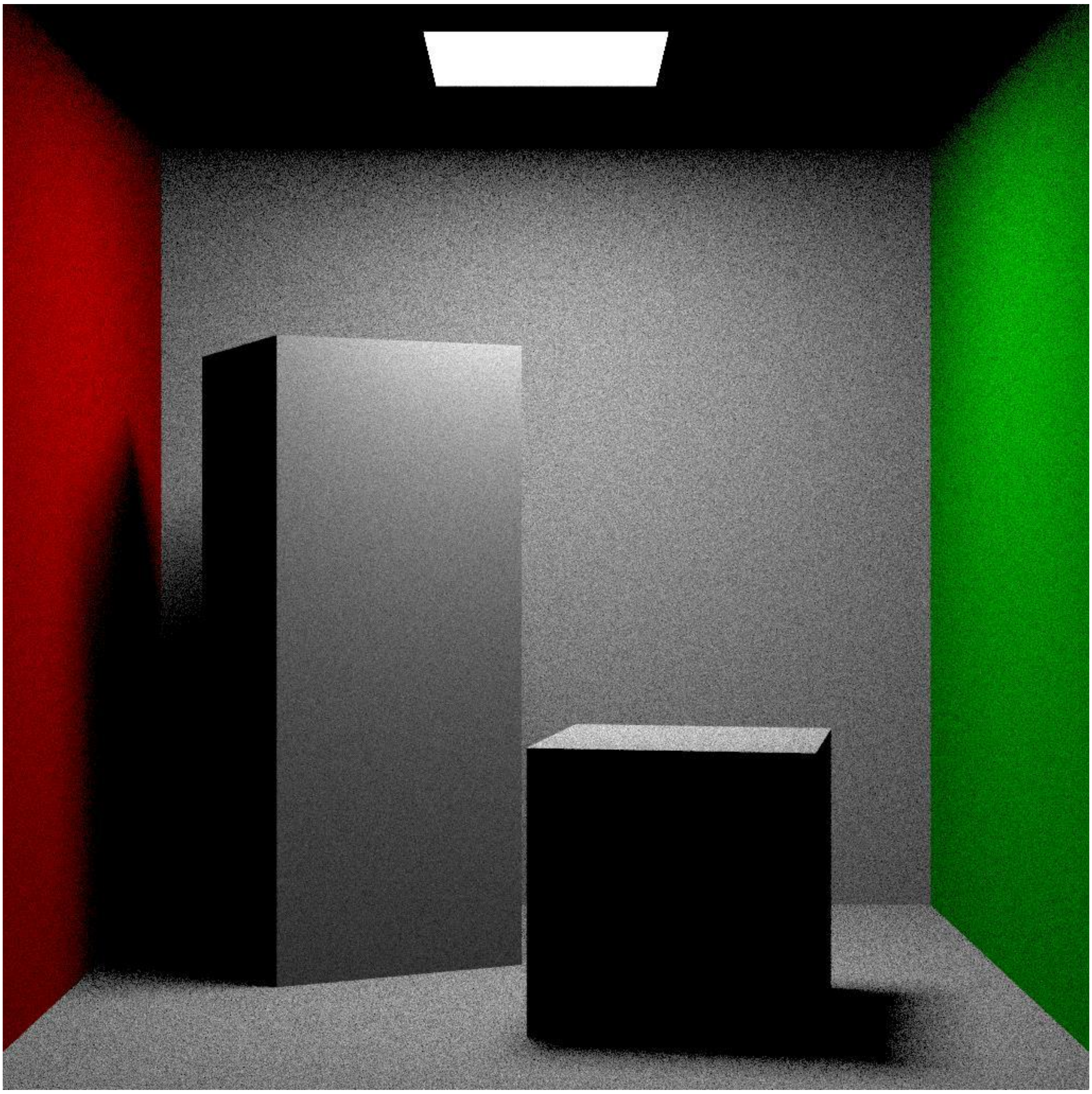
0: Uniform Hemisphere sampling



Small10 : 14.83 sec

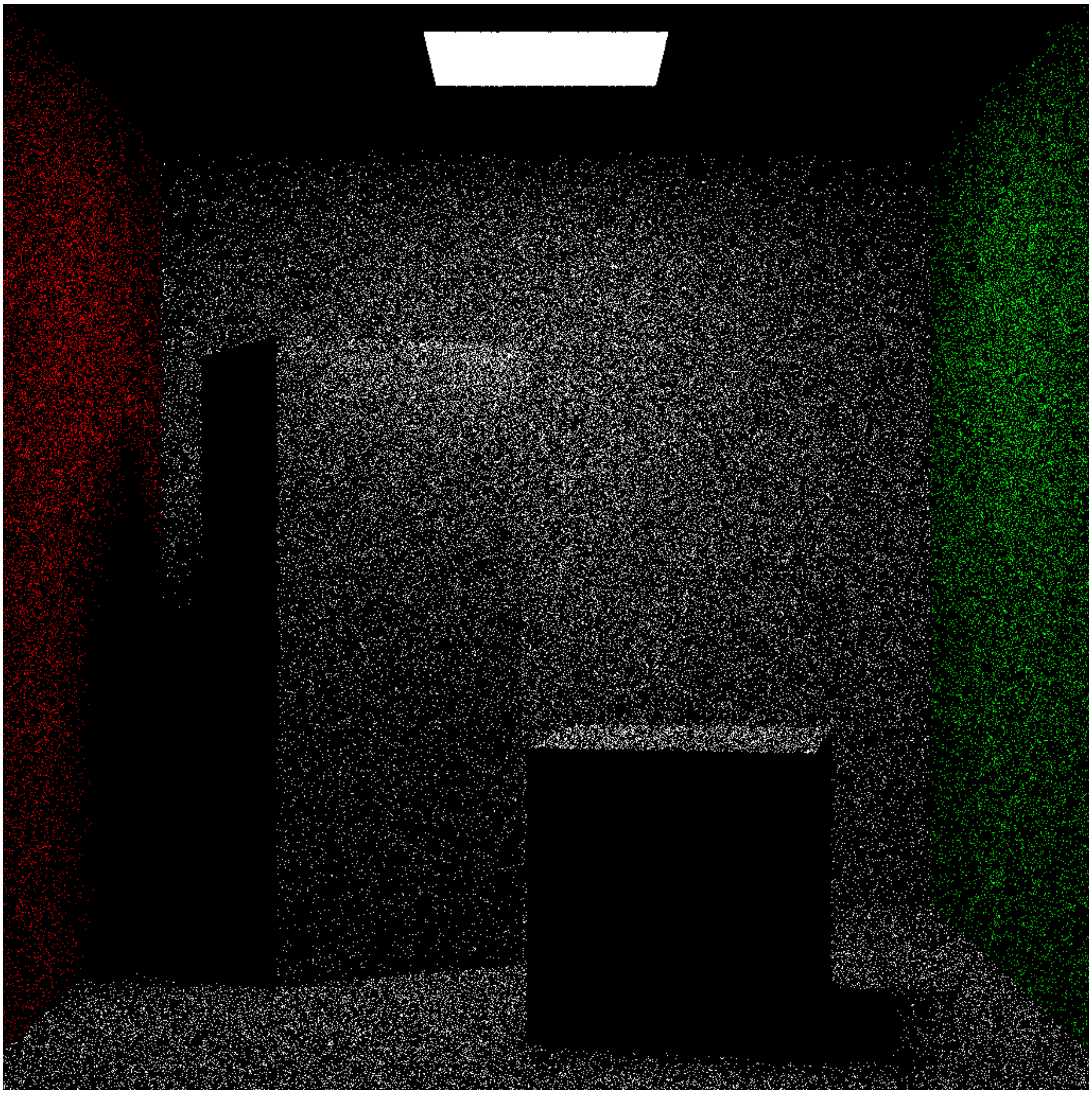


Small100 : 131.84 sec

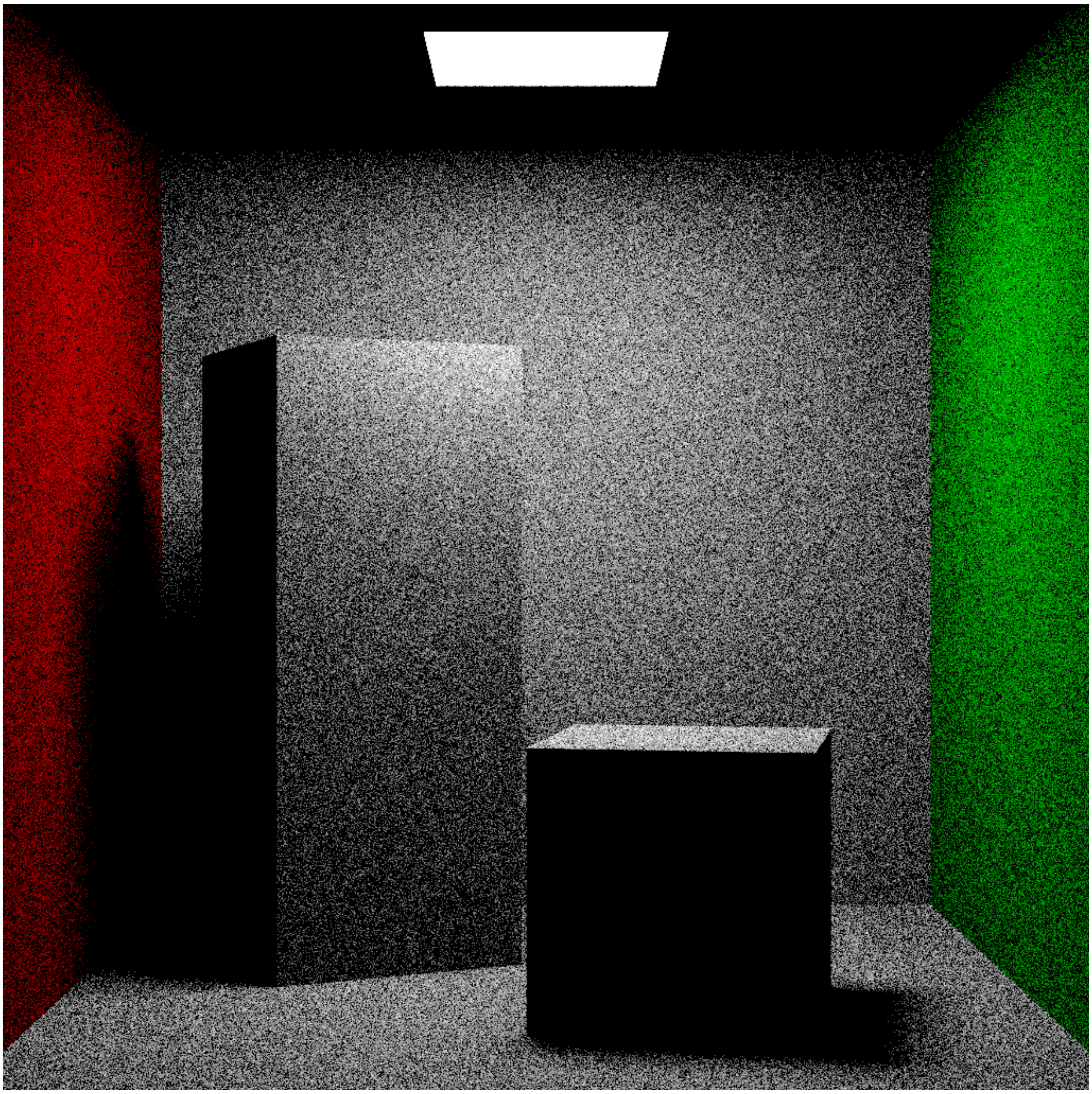


Small1000 : 1346.19sec

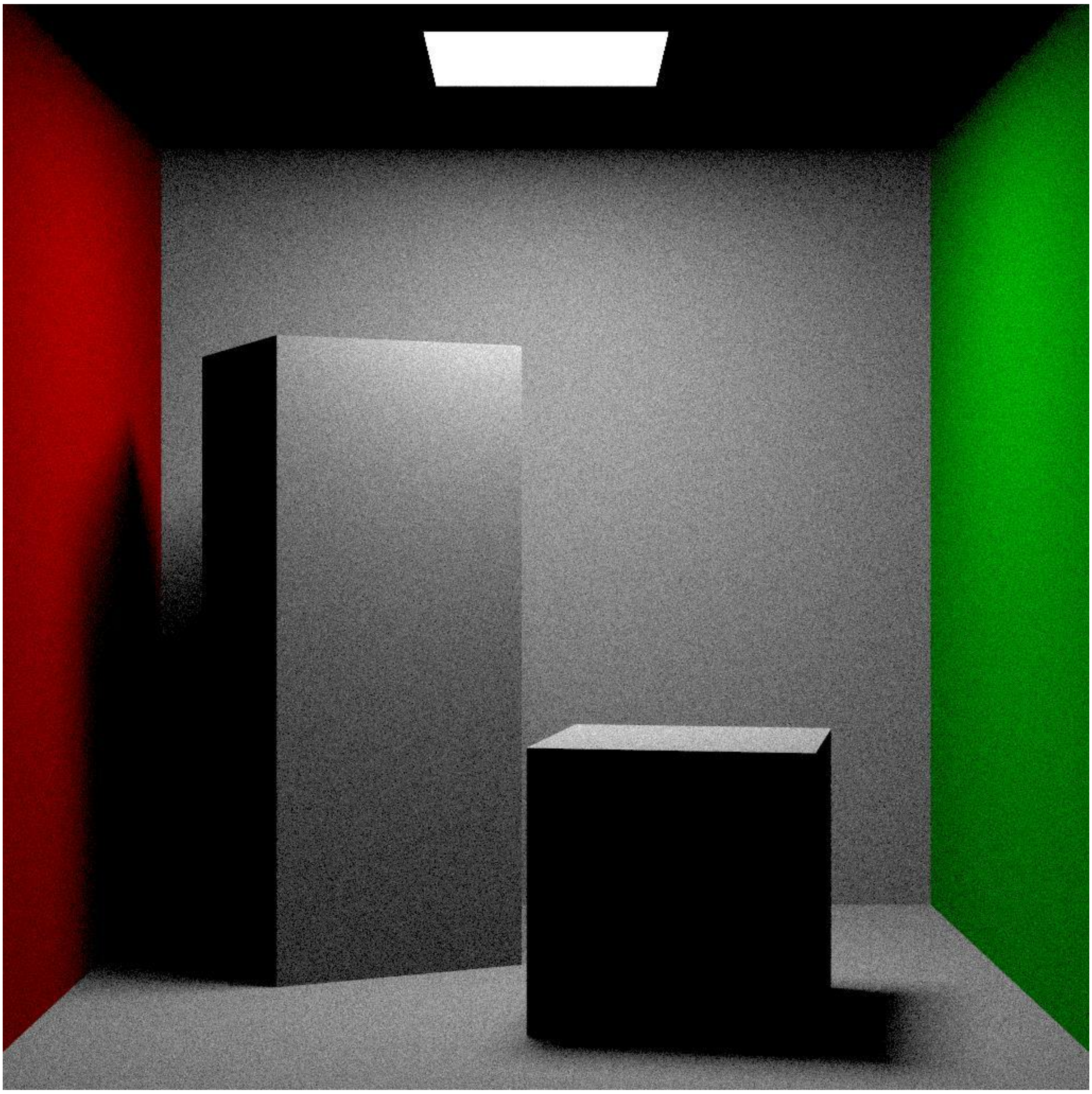
1: Cosine weighted sampling



Small_c_10 : 21.59 sec

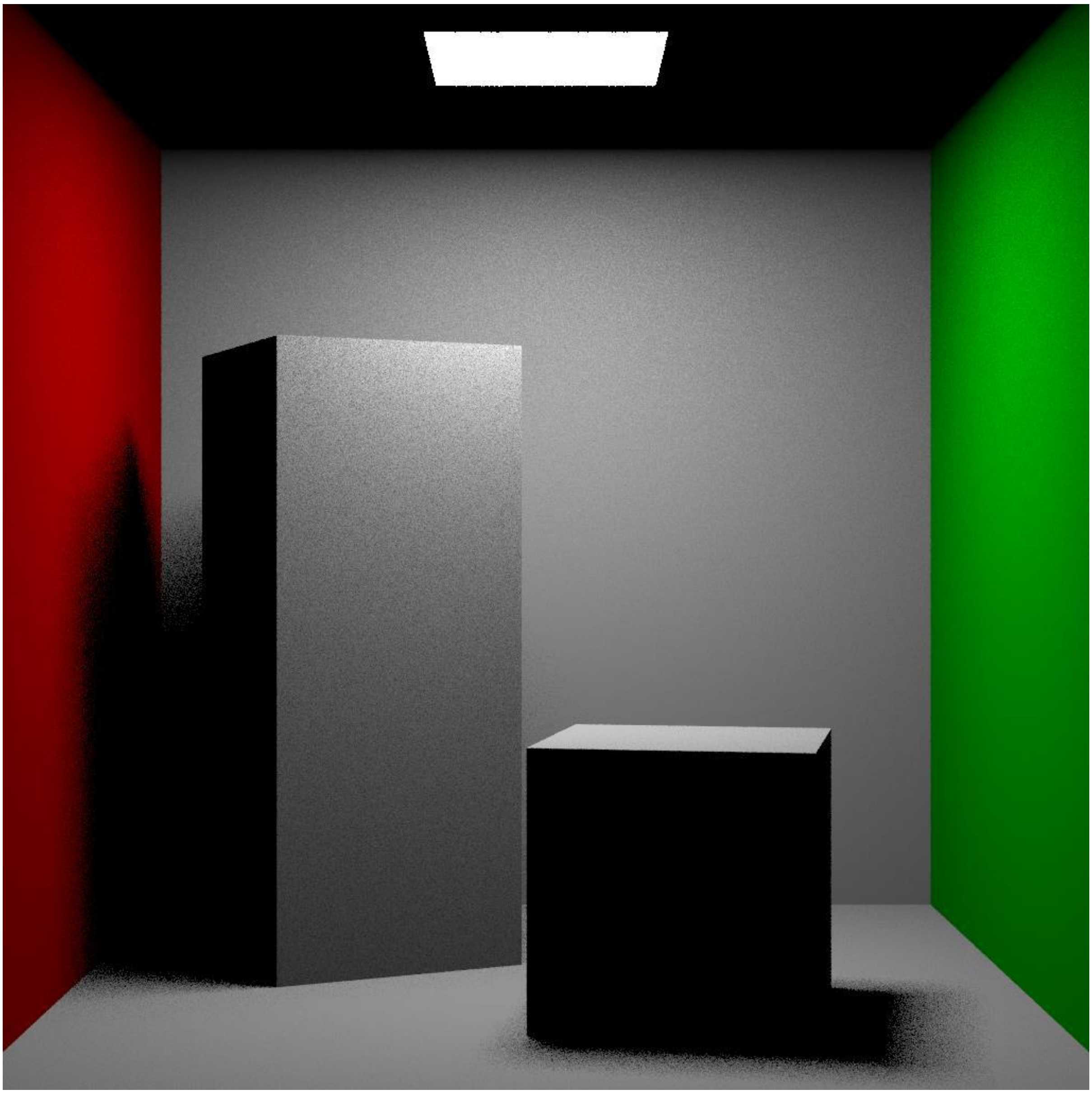


Small_c_100: 183.229 sec

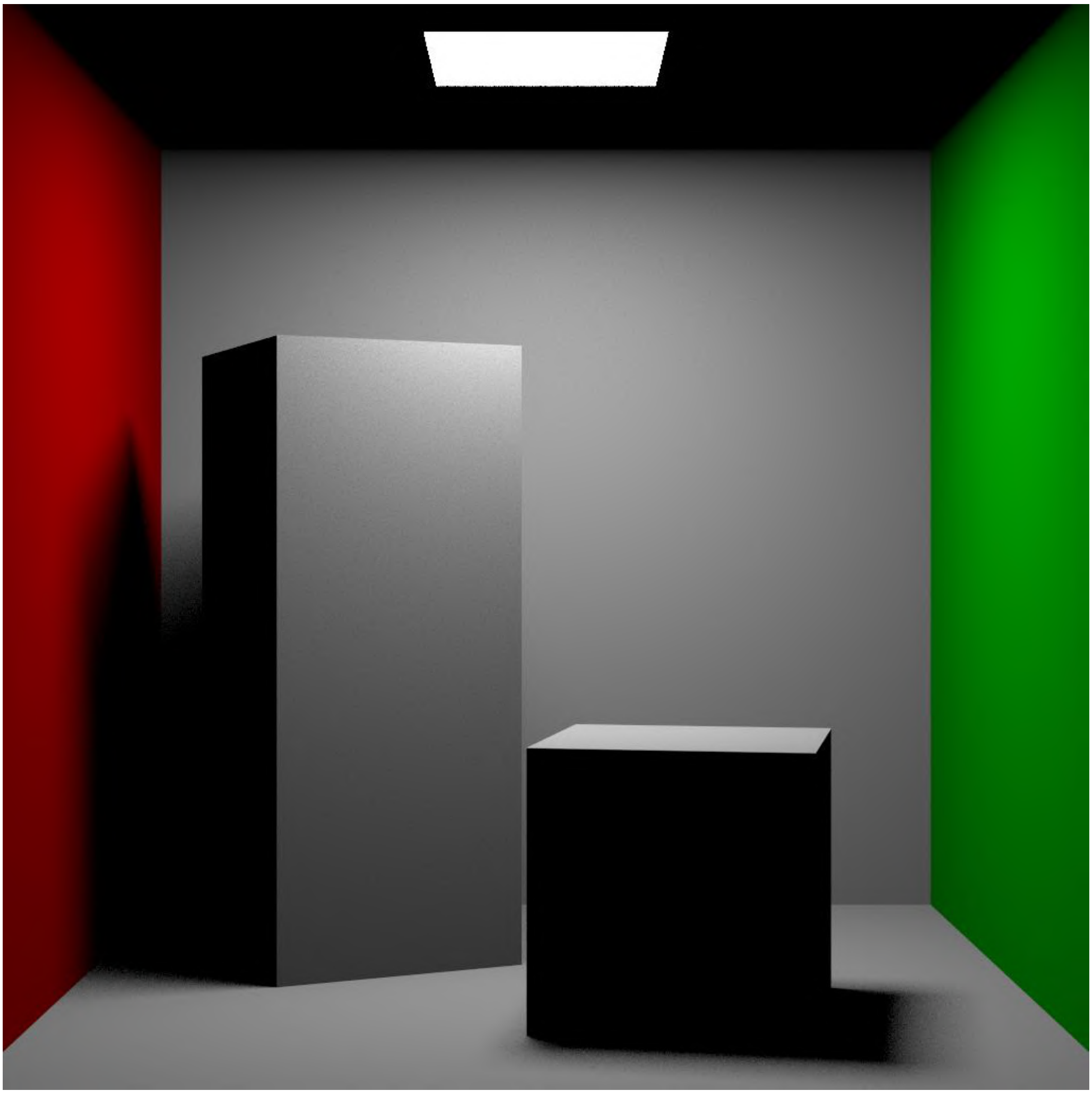


Small_c_1000 : 1671.47 sec

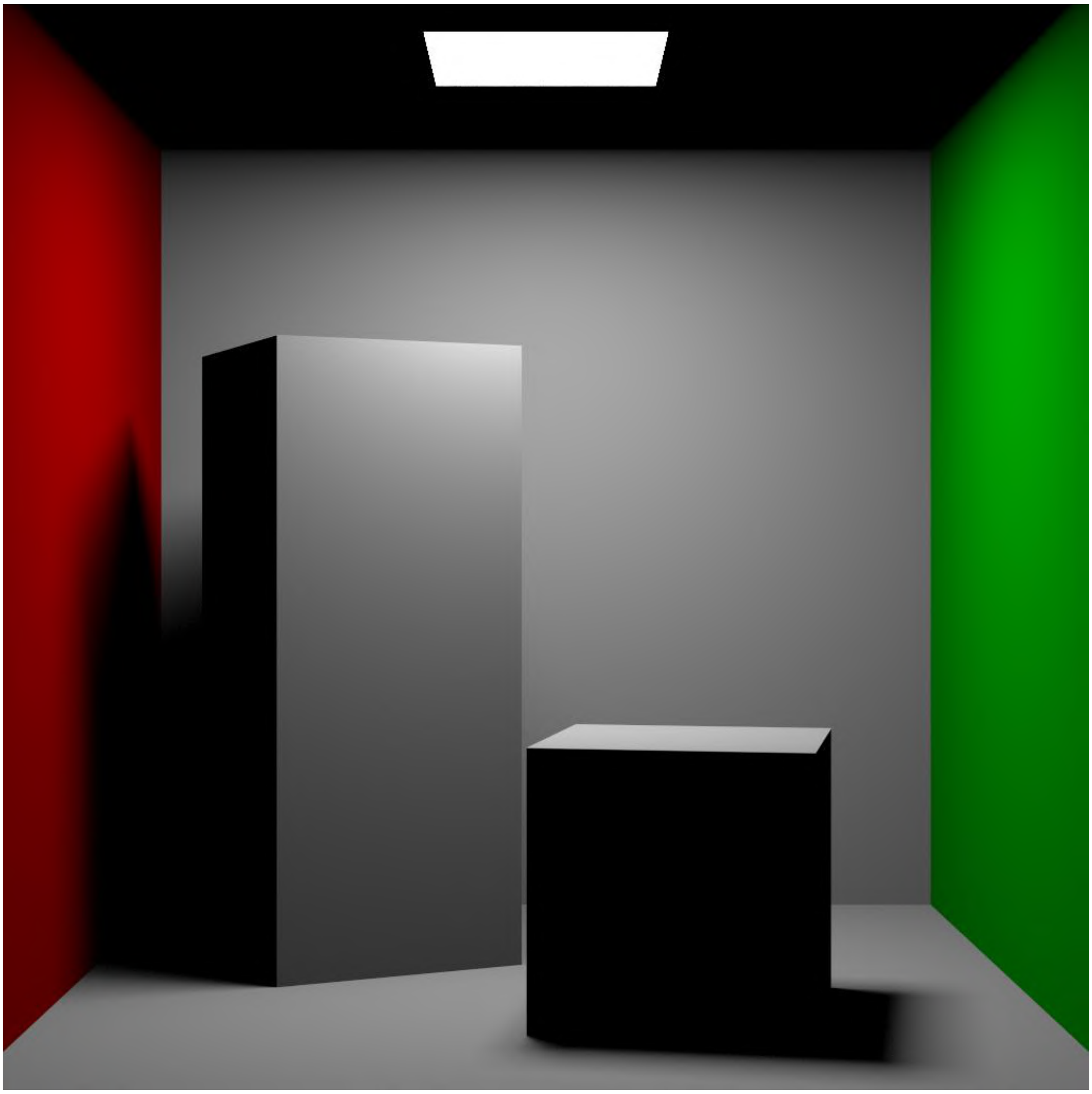
2: Light sampling



Small_li_10 : 18.130 sec



Small_li_100 : 172.19 sec



Small_li_1000 : 1466.06 sec