CSC4140 Assignment VII

Computer Graphics

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Ray Tracing II

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This assignment represents my own work in accordance with University regulations.

Signature:

1 Overview

In this project, the program was extended to make more effects. Added support for microfacets, implemented environment light as a light source, and added the ability to change focal length/lens radius to simulate thin lenses.

2 Part2: Microfacet Material

2.1 Change Alpha

when the alpha is decreasing, the object will be more glossy.

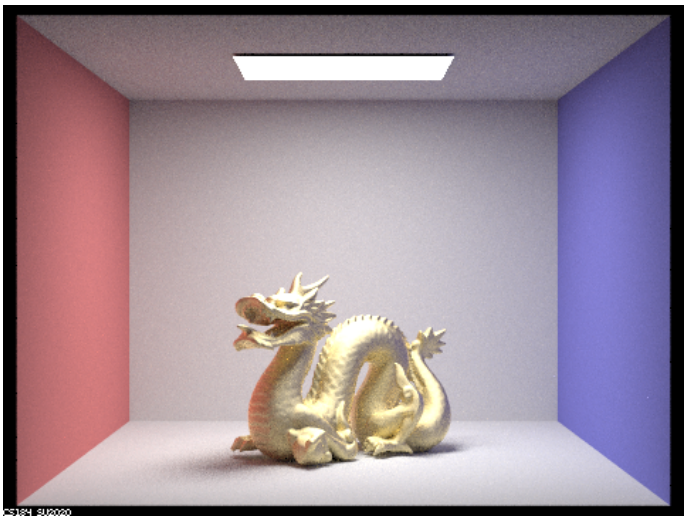

Figure 1: alpha = 0.5

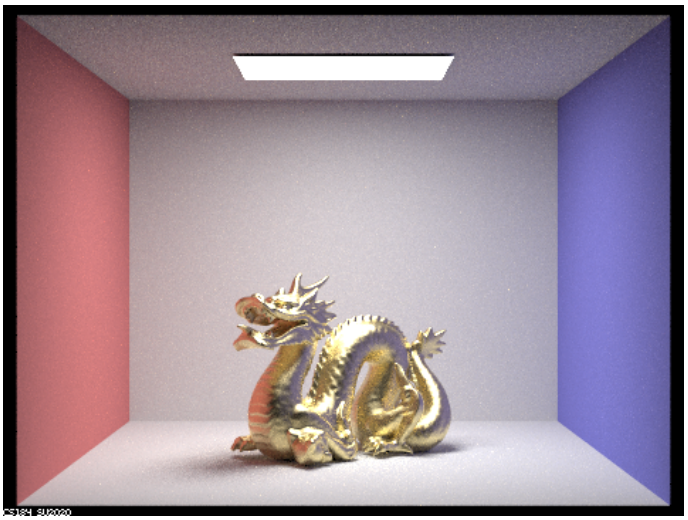

Figure 2: alpha = 0.25

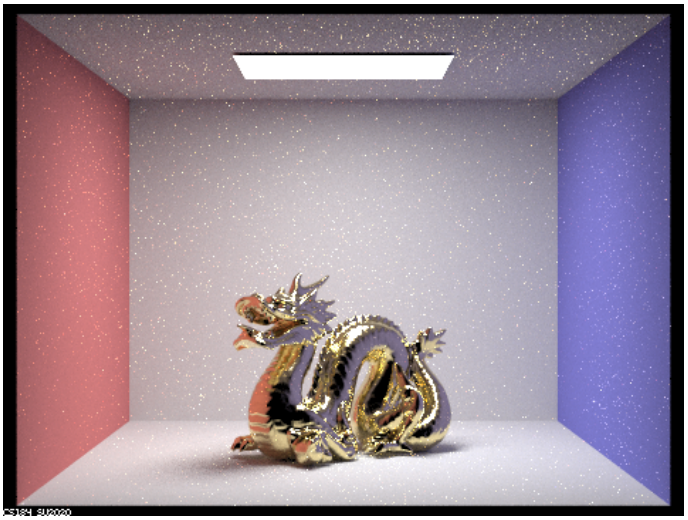

Figure 3: alpha = 0.05

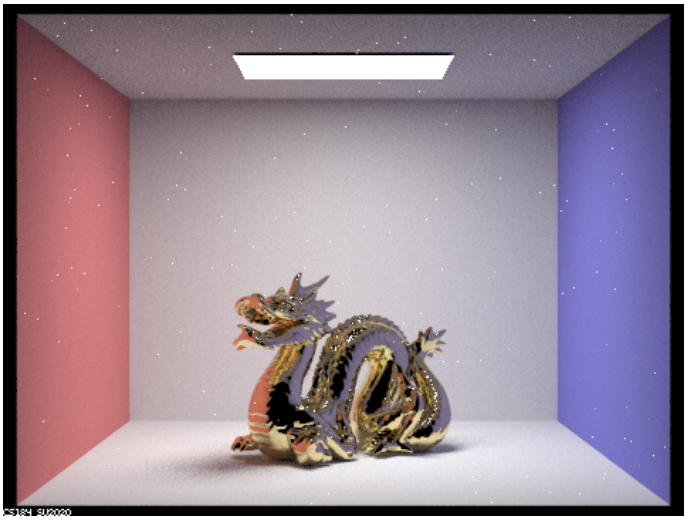

Figure 4: alpha = 0.005

2.2 Uni and Imp

Importance sample have less noise point than uniform sample.

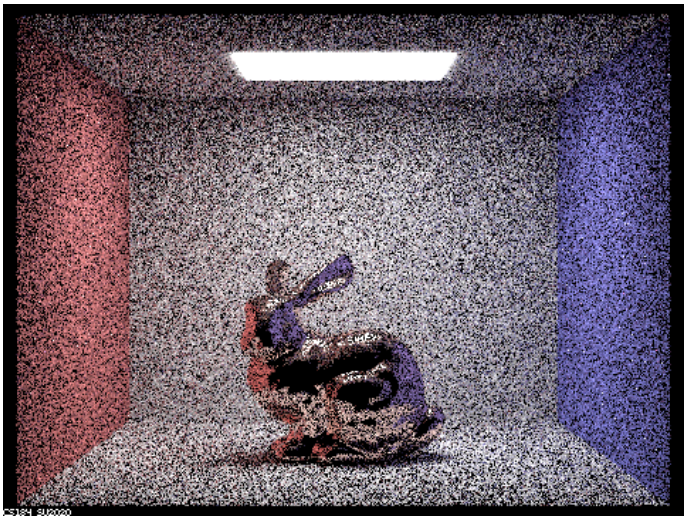

Figure 5: Uniform Sample

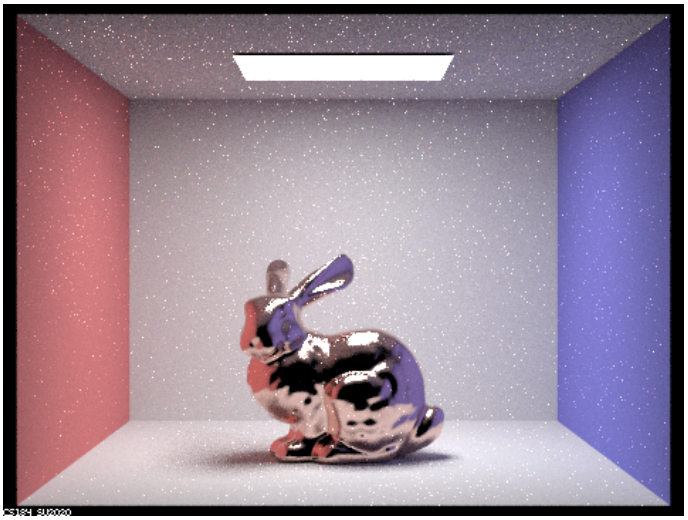

Figure 6: Importance Sample

2.3 eta and k

Change eta and k to the information of AL.

```
<microfacet>
  <alpha>0.05</alpha>
  <!-- <eta>0.33228 1.0162 1.2474</eta>
  <k>3.1646 2.5785 2.4603</k> -->
  <eta>1.3352 1.0109 0.68955</eta>
  <k>7.3398 6.6157 5.6471</k>
</microfacet>
```

Figure 7: eta and k of AL

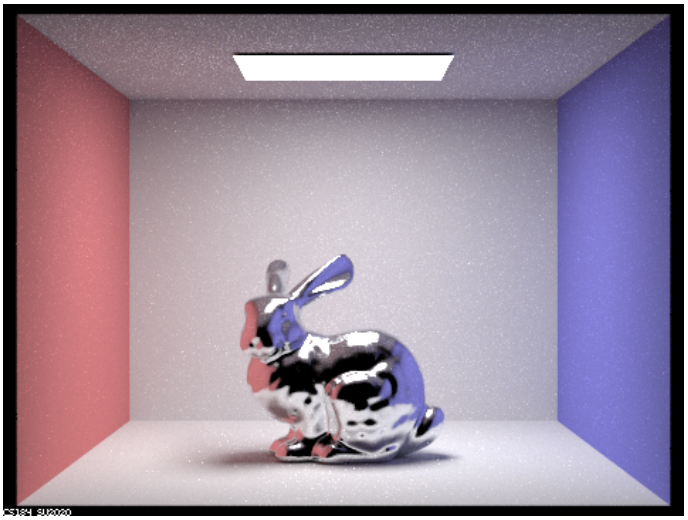

Figure 8: Bunny With AL

3 Part3: Environment Light

3.1 Idea

The idea of environment light is to use the environment texture as an infinite light source and light on the object. Then we can have a more real picture. We implement environment light by sampling texture in each direction. Convert the 3D direction to 2D texture coordinates and get the values. We also use importance sampling by sampling brighter points with higher probability.

3.2 Picture and Probability Debug

Figure 9: Texture Picture

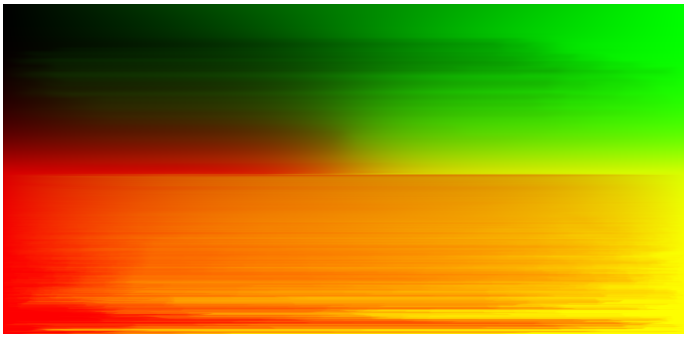

Figure 10: Probability Debug Graph

3.3 Uni and Imp Bunny

Importance sampling on environment light will have less noise point than Uniform Sampling. This effect can see clearly on the ass of Bunny.

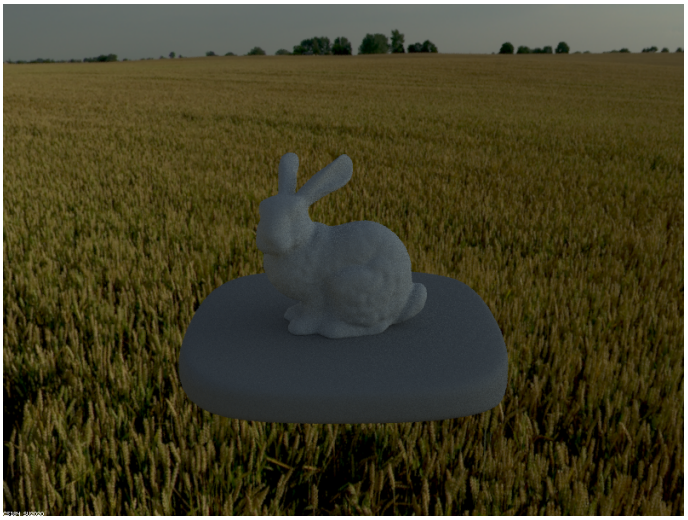

Figure 11: Uniform Sample Bunny

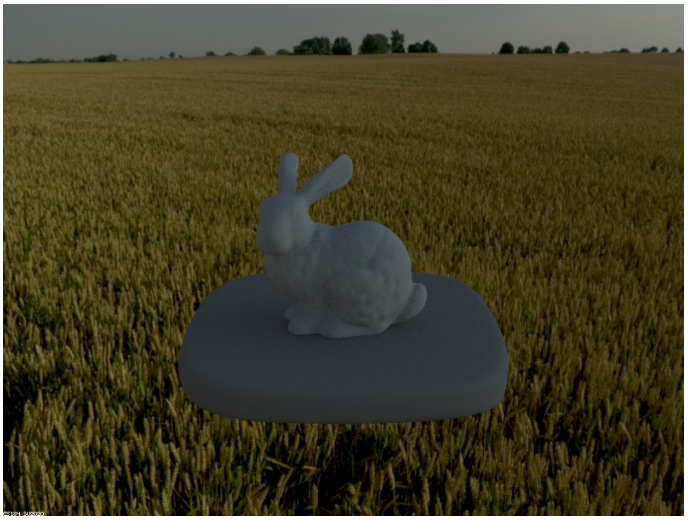

Figure 12: Importance Sample Bunny

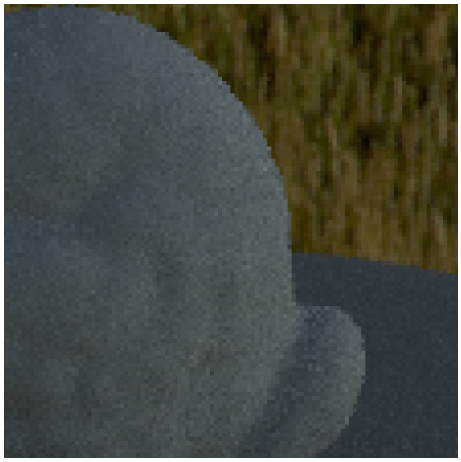

Figure 13: Uniform Sample Bunny Ass

Figure 14: Importance Sample Bunny

3.4 Uni and Imp Microfacet Bunny

Importance sampling on environment light will have less noise point than Uniform Sampling. This effect can see clearly on the ass of Bunny.

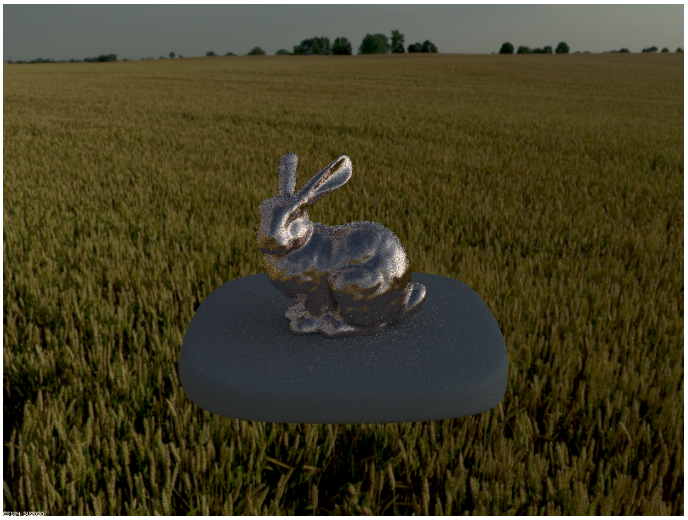

Figure 15: Uniform Sample Microfacet Bunny

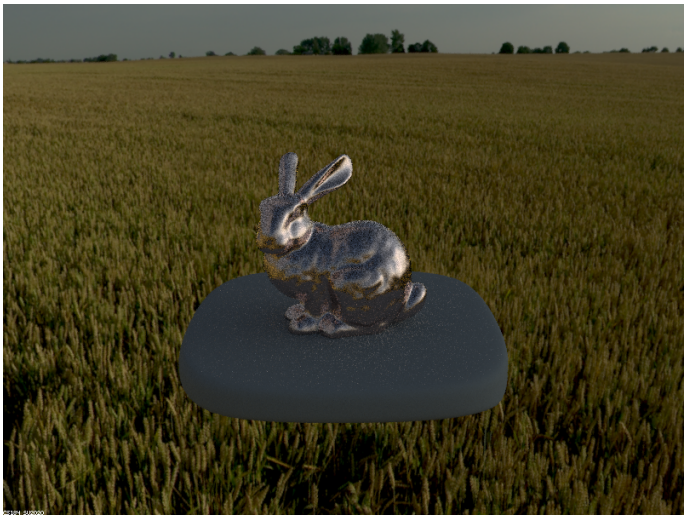

Figure 16: Importance Sample Microfacet Bunny

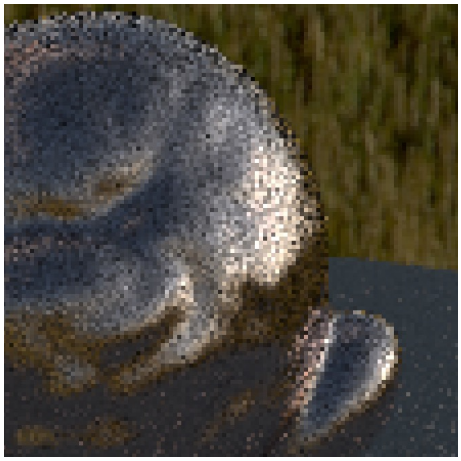

Figure 17: Uniform Microfacet Bunny

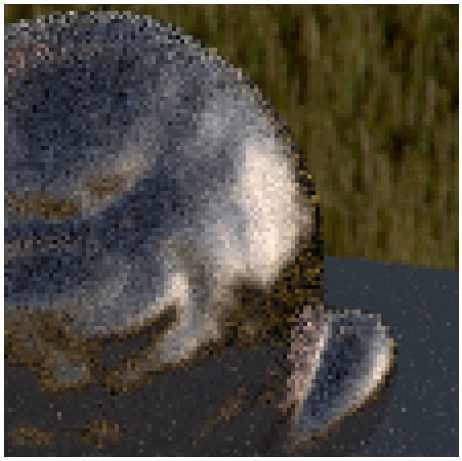

Figure 18: Importance Microfacet Bunny

4 Part4: Depth of Field

4.1 Idea

For pin-hole camera, all light received comes from the direction of the pinhole point. However, for thin-lens cameras, light comes from different directions on thin lens. This leads to the concept of depth of field, that only objects on "focal" in focus.

4.2 Change focal

Change focal with still radius.

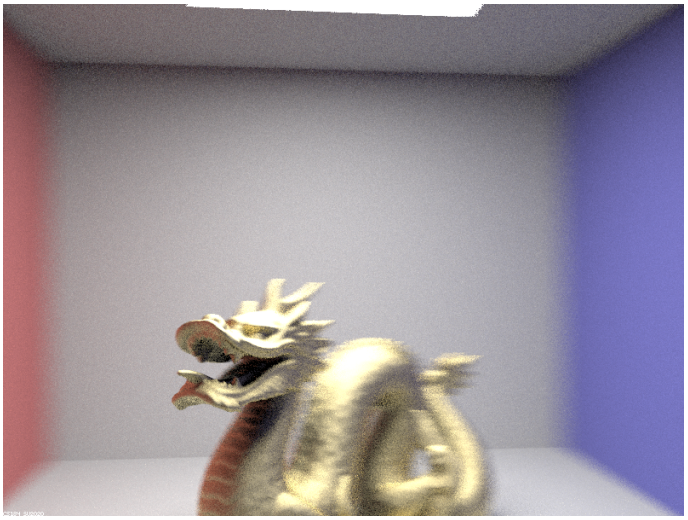

Figure 19: focal = 1.6 (still radius = 0.1)

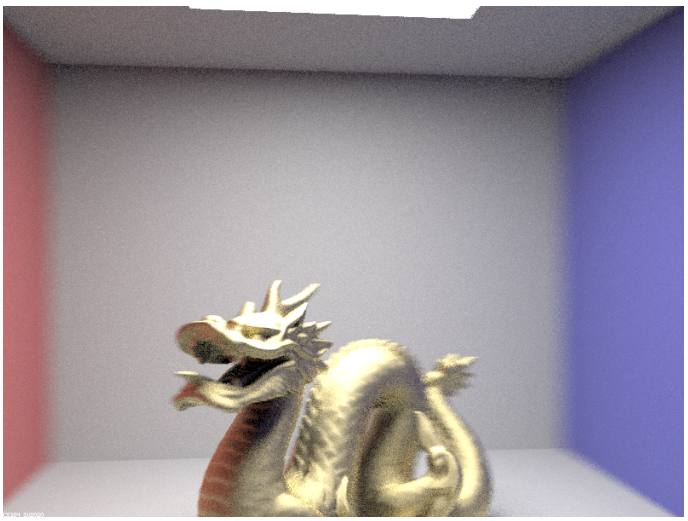

Figure 20: focal = 1.8 (still radius = 0.1)

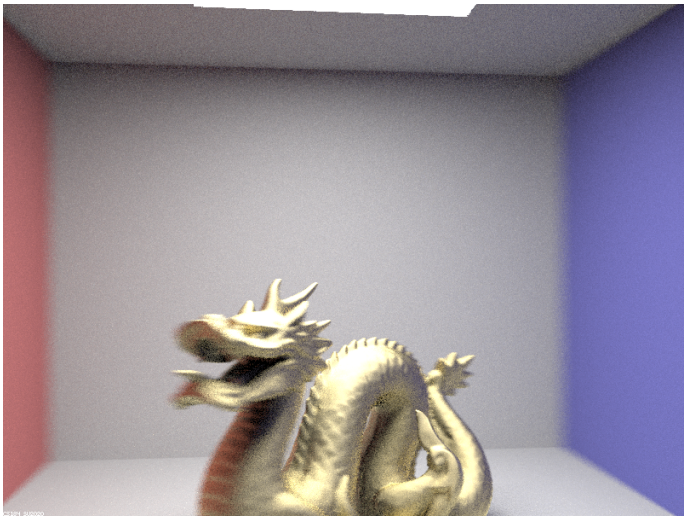

Figure 21: focal = 2.0 (still radius = 0.1)

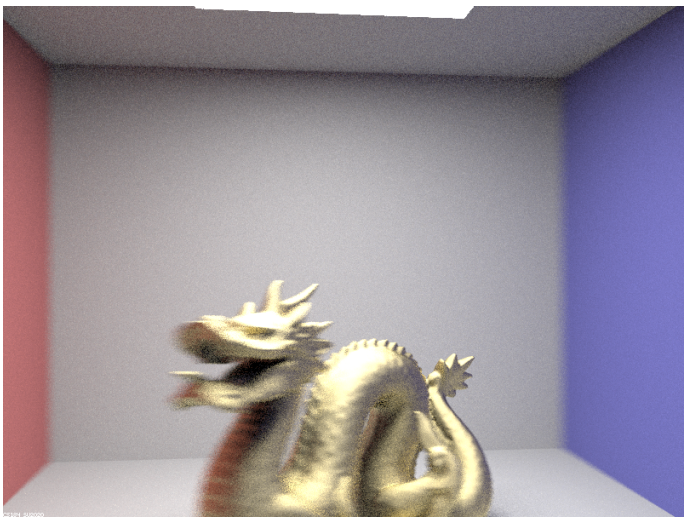

Figure 22: focal = 2.2 (still radius = 0.1)

4.3 Change radius

Change radius with still focal.

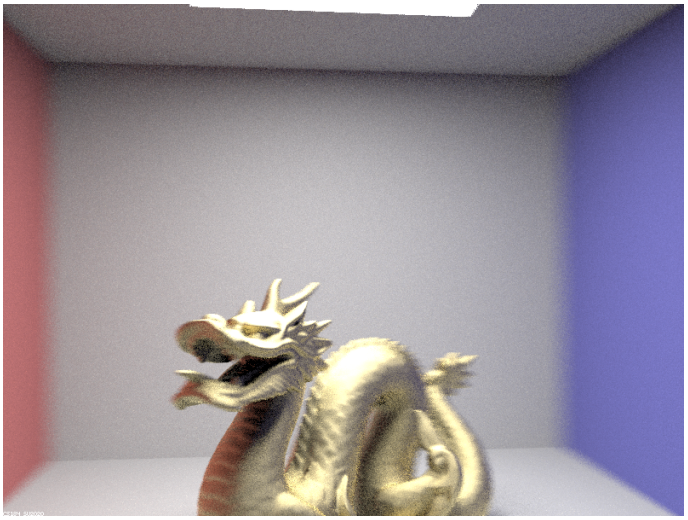

Figure 23: radius = 0.1 (still focal = 1.8)

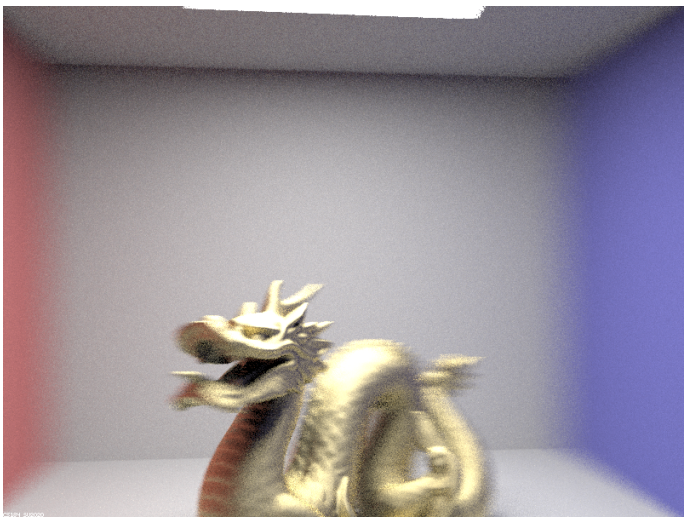

Figure 24: radius = 0.2 (still focal = 1.8)

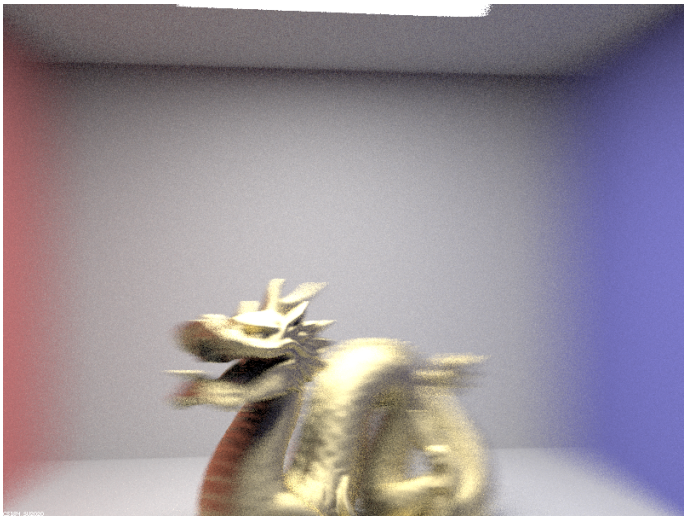

Figure 25: radius = 0.3 (still focal = 1.8)

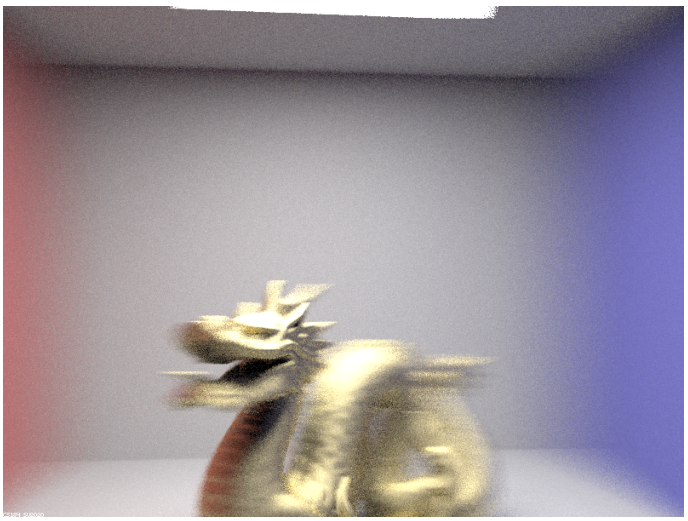

Figure 26: radius = 0.4 (still focal = 1.8)