

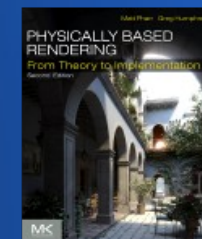
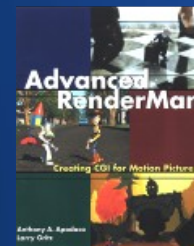
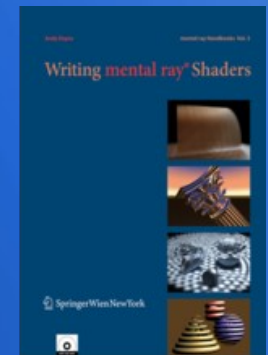
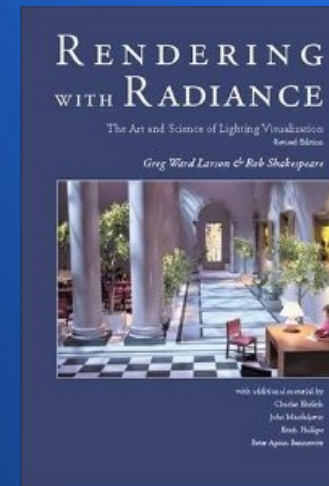
# Comparing Global Illumination Renderers

Jan Walter - The Mill (London)



# Books

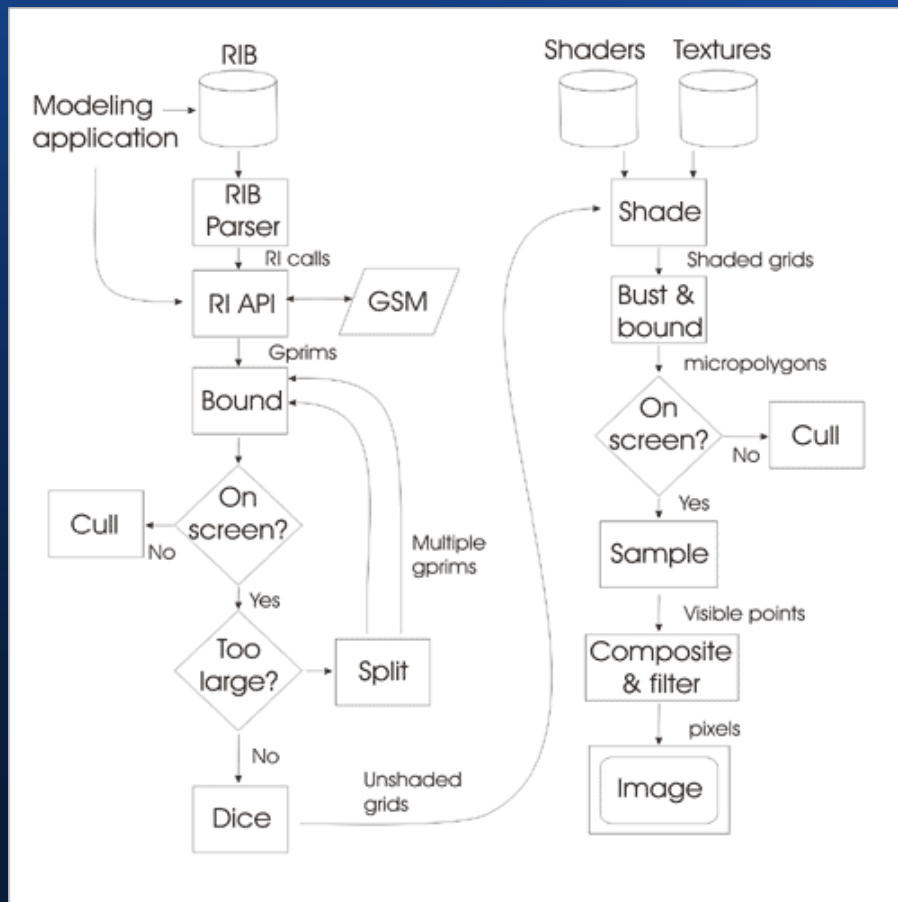
- Advanced RenderMan
- Production Rendering
- Writing mental ray Shaders
- Physically Based Rendering
- Rendering with Radiance



# Phases

- Reyes
  - Shading language (RSL, C/C++, Meta/OSL)
  - SIMD (Single Instruction, Multiple Data)
- Raytracing techniques
  - Reflection / refraction
  - Ambient occlusion
- HDR (High Dynamic Range)
- GI (Global Illumination) algorithms

# Reyes



- Renders Everything You Ever Saw
- Smooth, curved surfaces
- Surface texturing
- Motion blur
- Depth of field

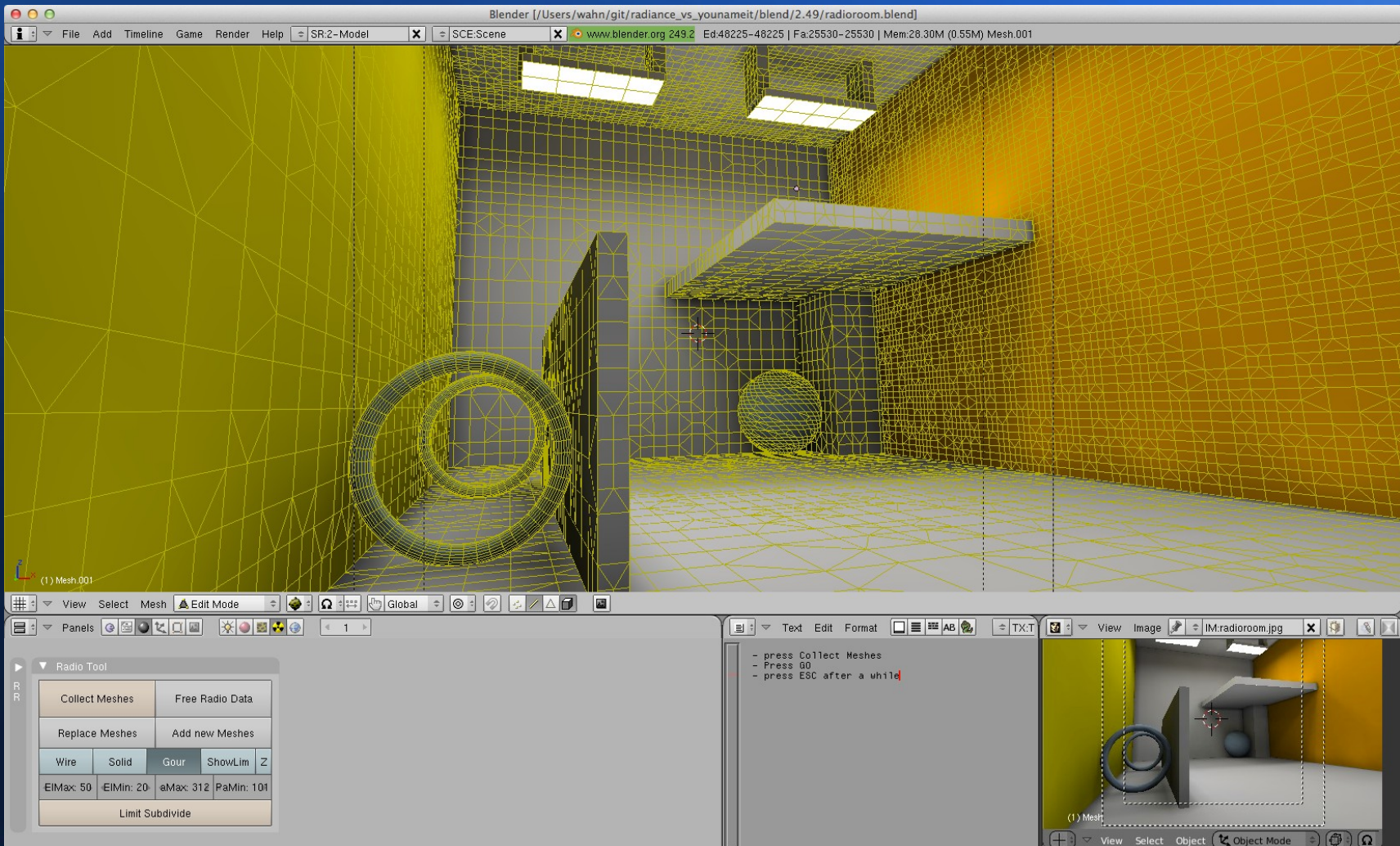
# Raytracing Techniques

- Reflections vs. environment lookups
- Refractions
  - IOR (index of refraction)
- Acceleration structures
  - Octree
  - BSP (binary space partition)
  - K-d tree (k-dimensional tree)
- Ambient Occlusion

# Global Illumination

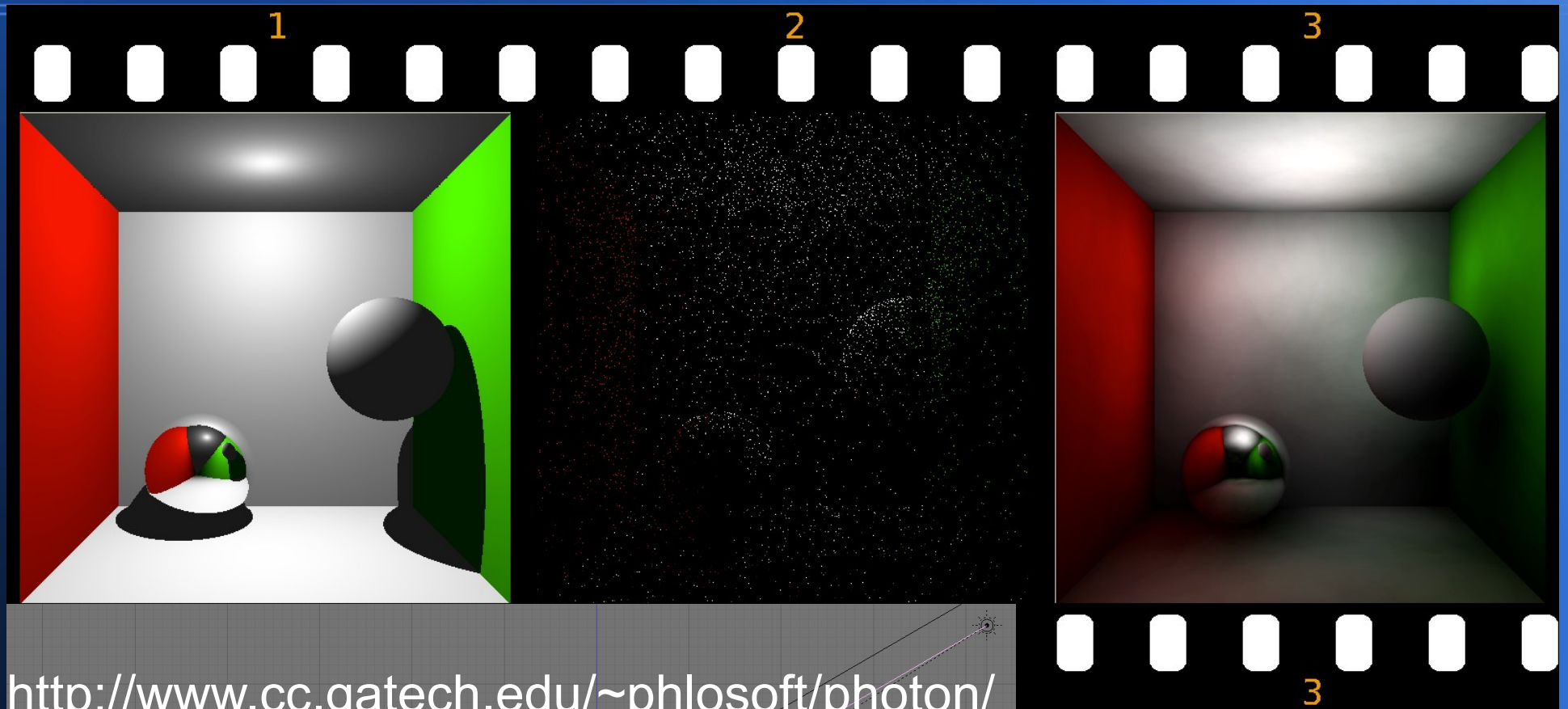
- Radiosity ( $LD^*E$ , purely diffuse surfaces)
- Photon Mapping (biased, caustics)
- Path Tracing (soft shadows, caustics, AO)
- Metropolis Light Transport (MLT) - quicker
- Final Gather (mental ray world)
- Irradiance Maps (V-Ray world)
- Light Caches (V-Ray world)

# Radiosity

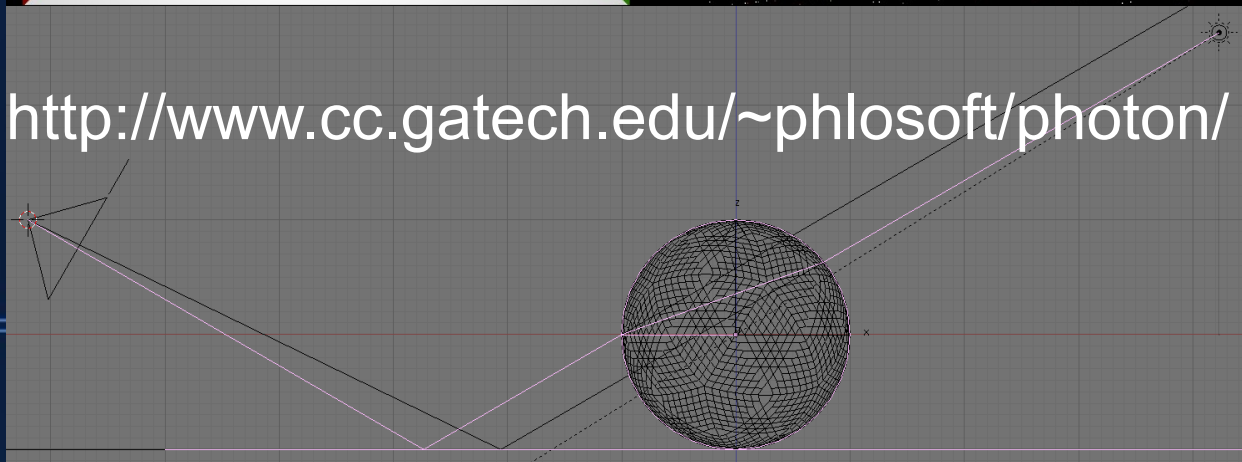


radioroom.blend

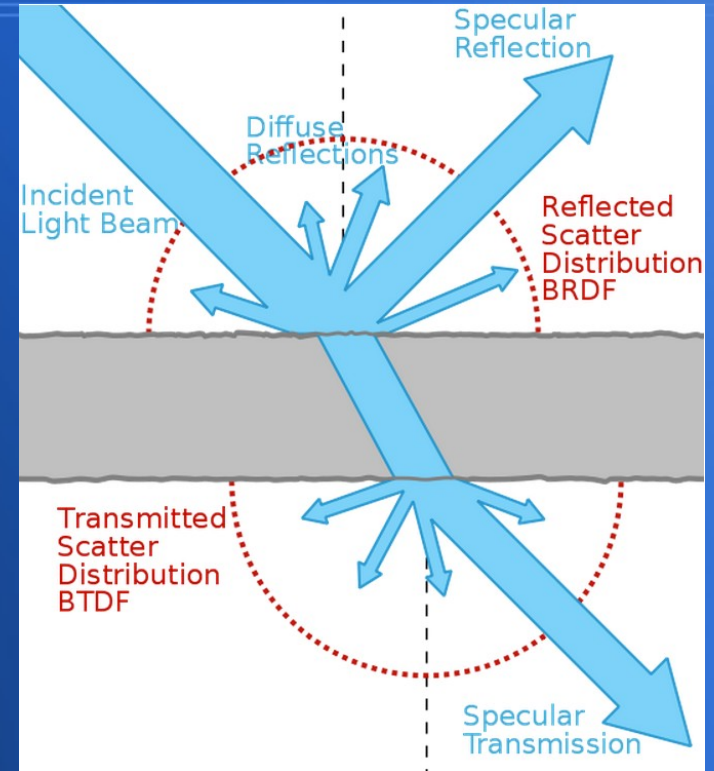
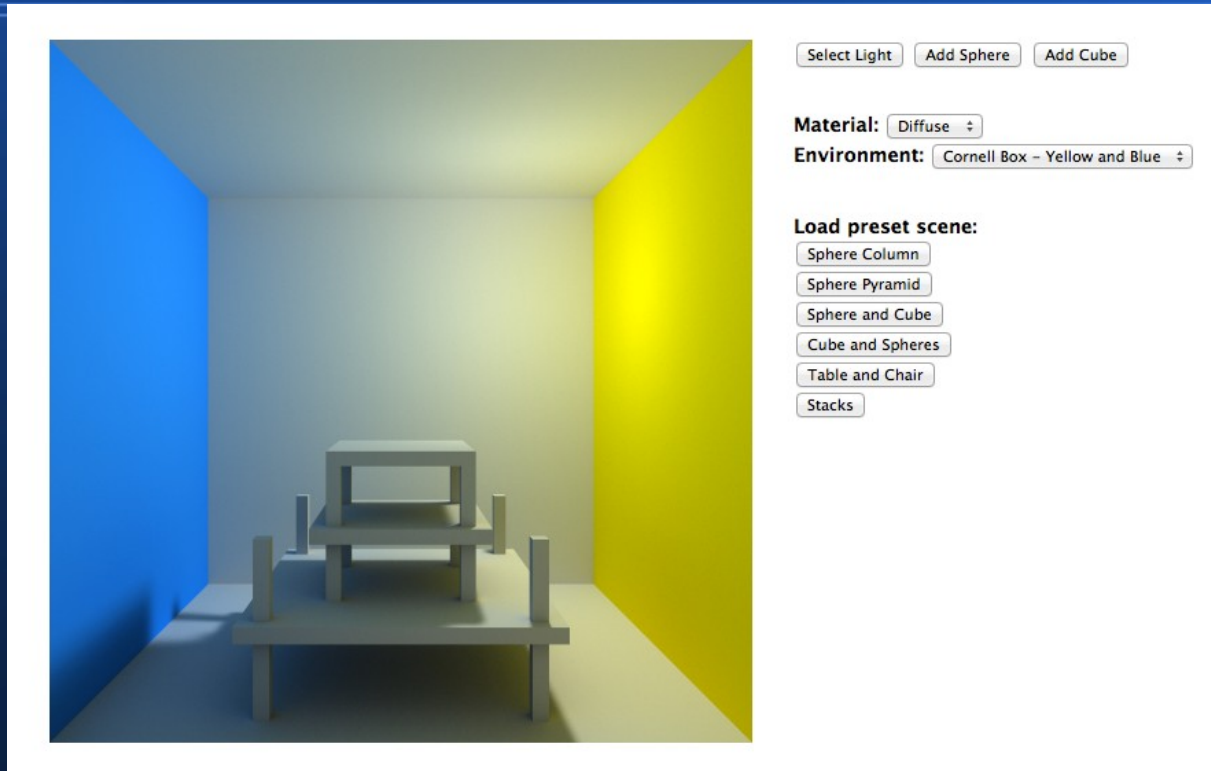
# Photon Mapping



<http://www.cc.gatech.edu/~phlosoft/photon/>



# Path Tracing

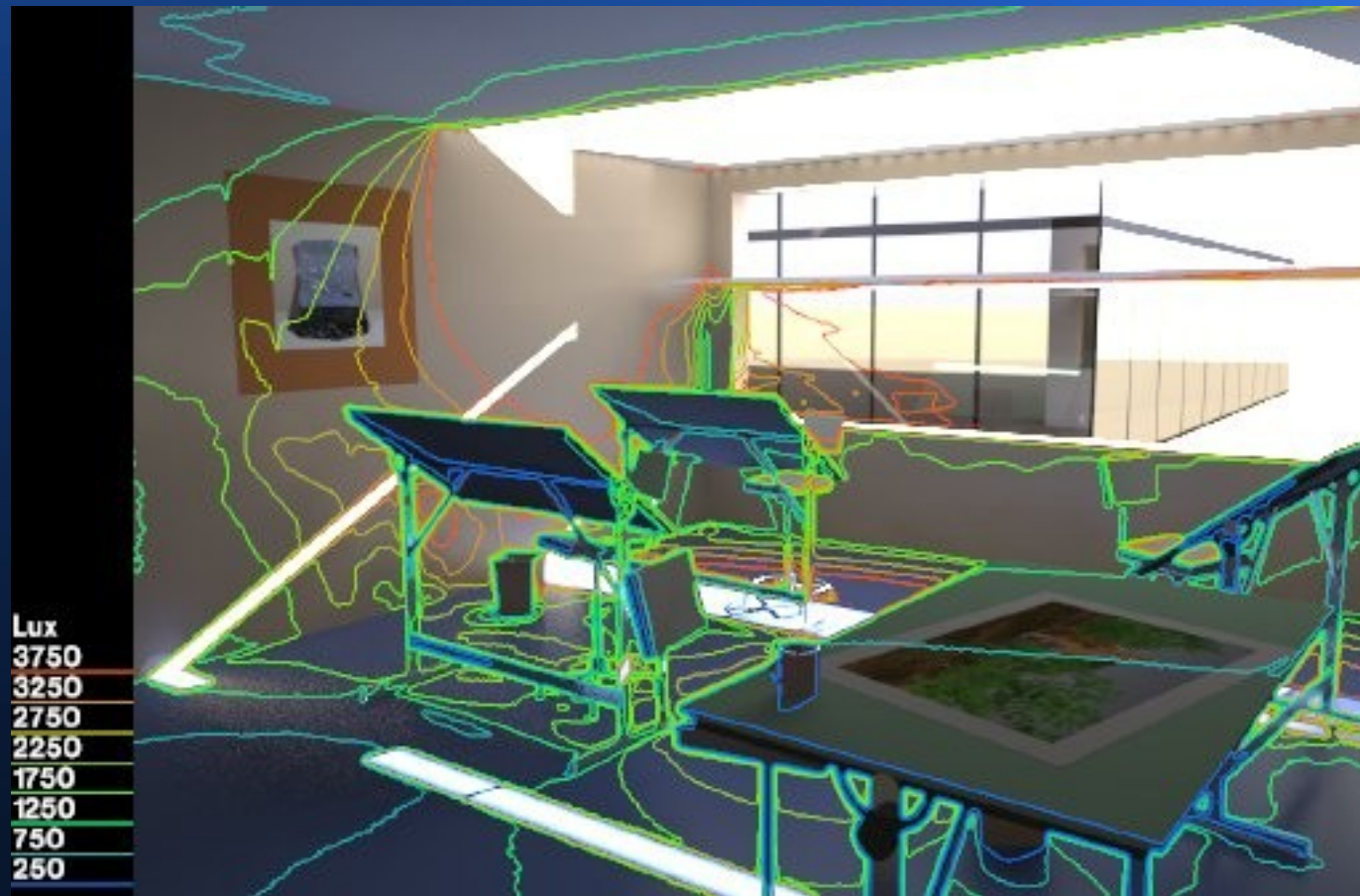


- <http://madebyevan.com/webgl-path-tracing/>
- Made by Evan Wallace in 2010

# GI Renderers

- Radiance - <http://radsite.lbl.gov/radiance/>
- Arnold - <http://www.solidangle.com/>
- V-Ray - <http://www.chaosgroup.com/>
- Maxwell - <http://maxwellrender.com/>
- Indigo - <http://www.indigorenderer.com/>
- iray / mental ray / neuray - [irayrender.com](http://irayrender.com)
- Luxrender - <http://www.luxrender.net/>
- Octane - <http://www.refractivsoftware.com/>

# Radiance

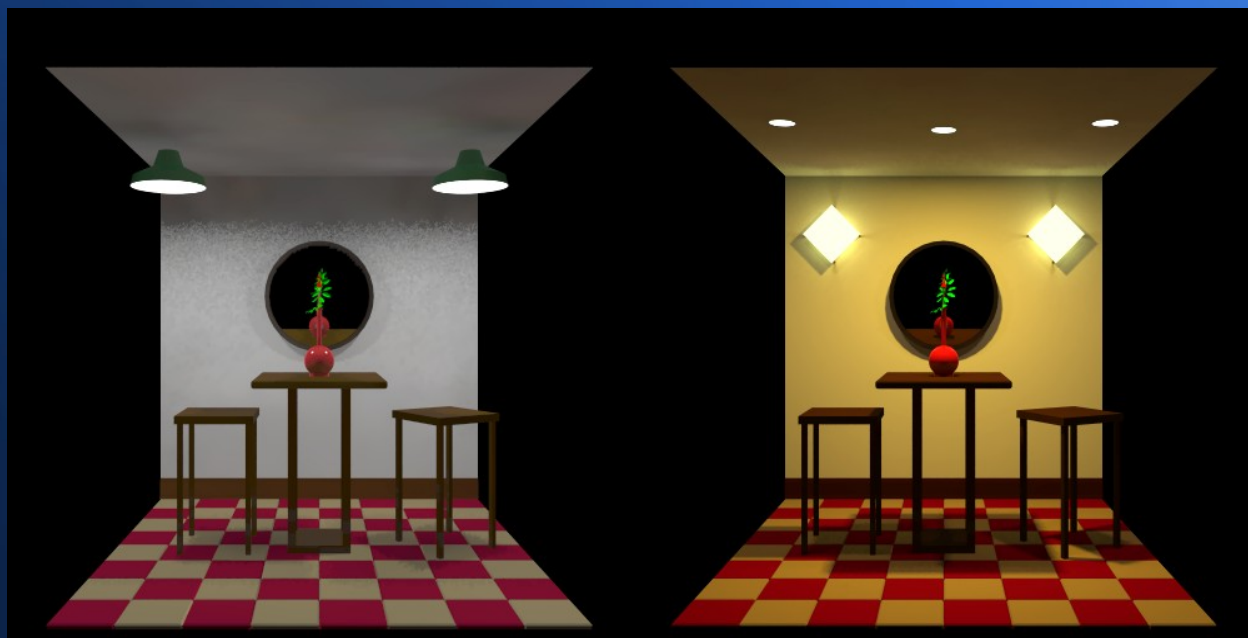
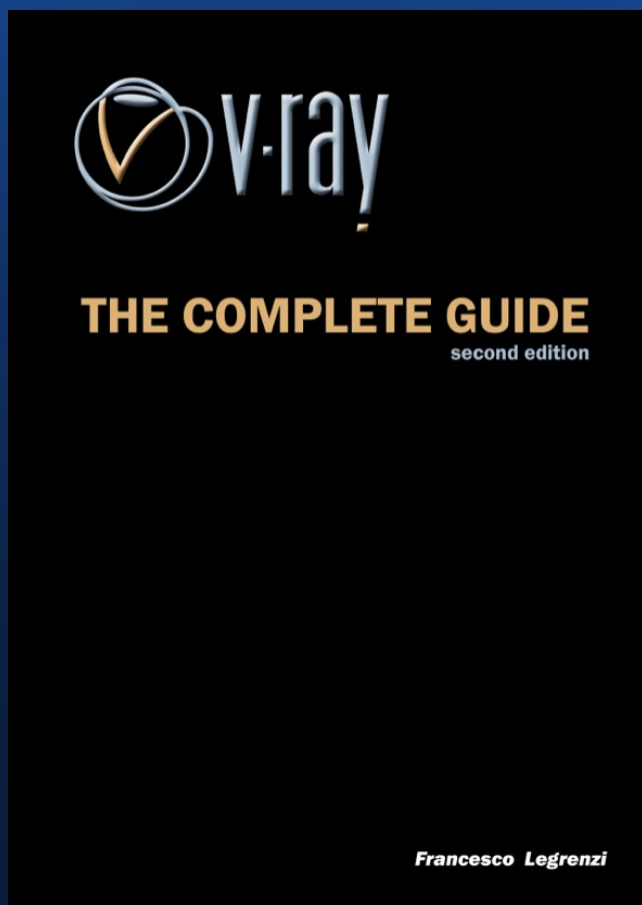


# Arnold



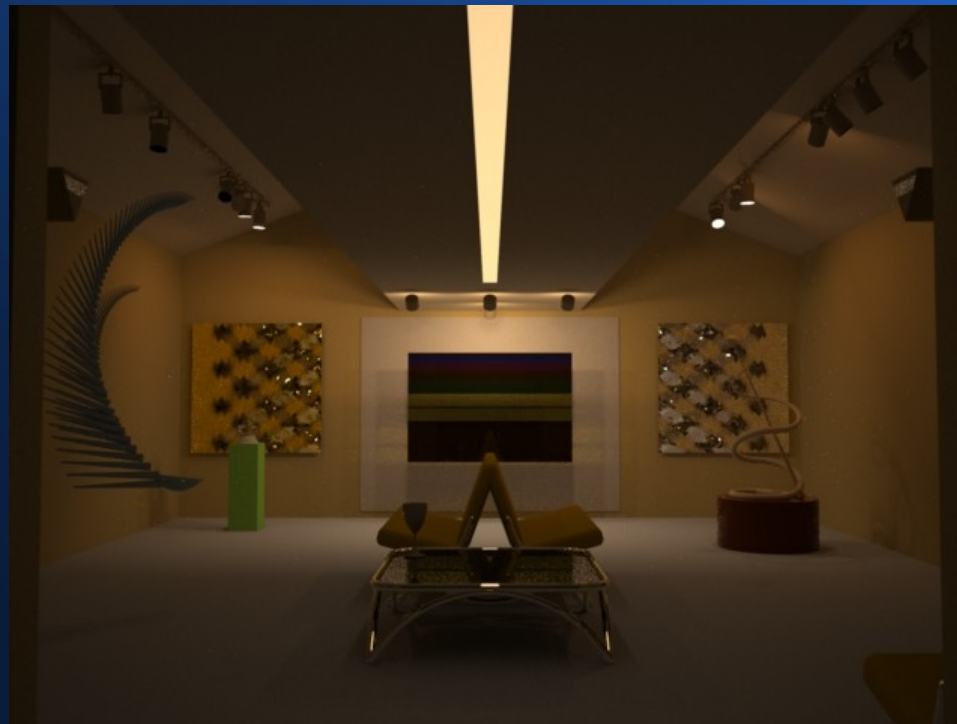
# V-Ray

- [www.spot3d.com](http://www.spot3d.com)
- [www.francescolegrenzi.com](http://www.francescolegrenzi.com)



# Maxwell

- First tests of the Radiance gallery back in 2005
- <http://www.deathfall.com/forums/content.php?5057-A-look-into-Physical-Sky-by-Jan-Walter>



# Indigo

- Without MLT



- With MLT



model courtesy of Anders Lejczak

# iray



<http://www.mentalimages.com/products/iray/iray-integration-framework/iray-integration-framework-introduction.html>

# Luxrender

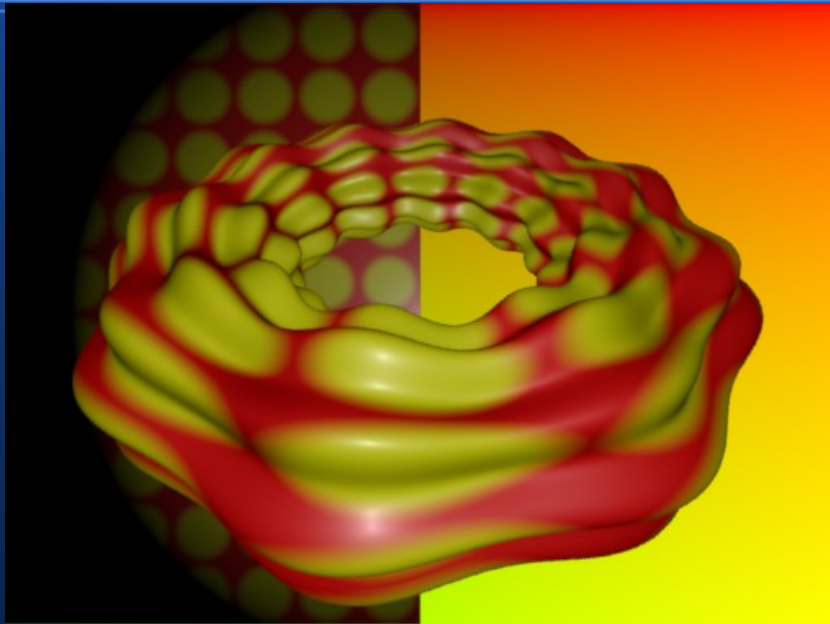
- Austrian Emperor Crown by Martin Lubich
- [http://www.loramel.net/blender\\_minutes/2009/03/austrian-imperial-crown-finished/](http://www.loramel.net/blender_minutes/2009/03/austrian-imperial-crown-finished/)



# Octane Render



# Very Short Look at RIB



Rendered with 3Delight ( <http://www.3delight.com> )

```
shaderdl -o myImager.sdl myImager.sl
```

```
shaderdl -o myLight.sdl myLight.sl
```

```
shaderdl -o mySurface.sdl mySurface.sl
```

```
shaderdl -o myDisplacement.sdl myDisplacement.sl
```

```
renderdl -d shadertest.08.rib
```

```
Terminal — emacs — 63x29

# shadertest.rib
Exposure 1.0 2.2
Display "shadertest.tiff" "file" "rgba"
Format 508 380 1.0
Projection "perspective" "fov" [ 90 ]
Imager "myImager"                                     # <- shader
Declare "near" "float"
Declare "far" "float"
LightSource "myLight" 0 "near" [ 3 ] "far" [ 15 ]      # <- shader
WorldBegin
  Attribute "displacementbound" "sphere" [0.2]
  Surface "mySurface"                                  # <- shader
# Patch
  AttributeBegin
    Translate -10 0 10
    Scale 10 10 10
    Patch "bilinear" "p"
    [ -1.0 -1.0 0.0 1.0 -1.0 0.0 -1.0 1.0 0.0 1.0 1.0 0.0 ]
  AttributeEnd
# Torus
  AttributeBegin
    Translate 0 1 5
    Rotate 45 1 0 0
    Displacement "myDisplacement"                       # <- shader
    Torus 3.0 1.0 0.0 360.0 360.0
  AttributeEnd
WorldEnd
--uu-:---F1  shadertest.08.rib  All L1  (RIB)-----
Loading rib-mode...done
```

# Primitives & CSG



there are 31 lights and 2748 objects:

135 polymeshes

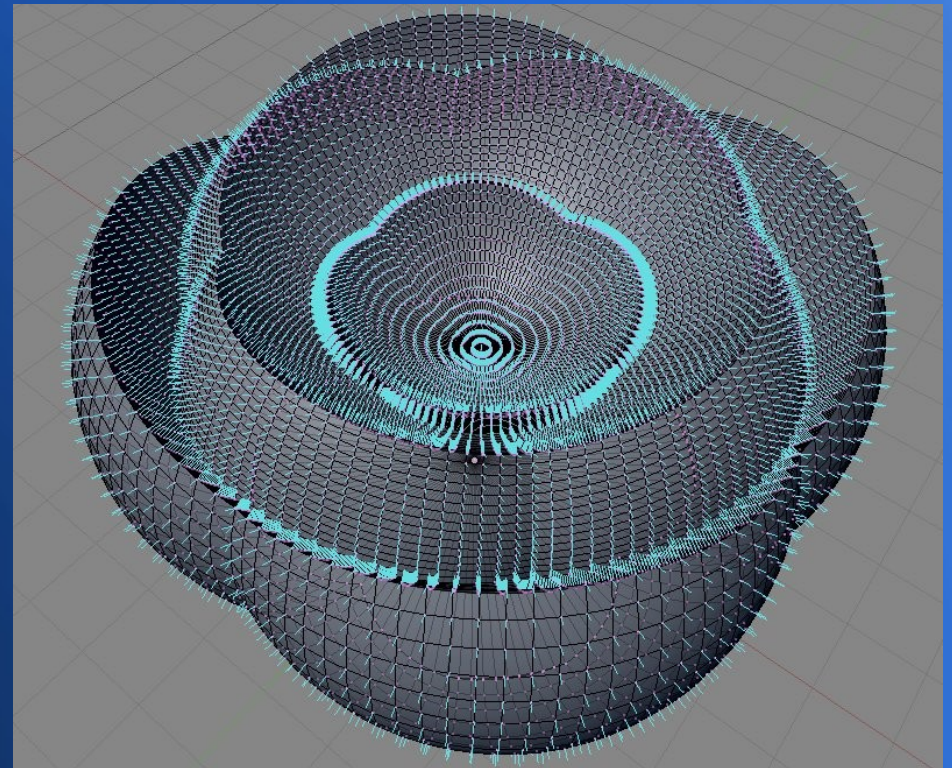
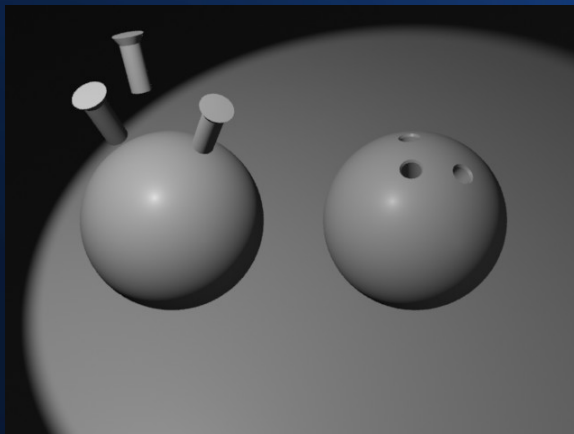
127 boxes

1189 cylinders

153 cones

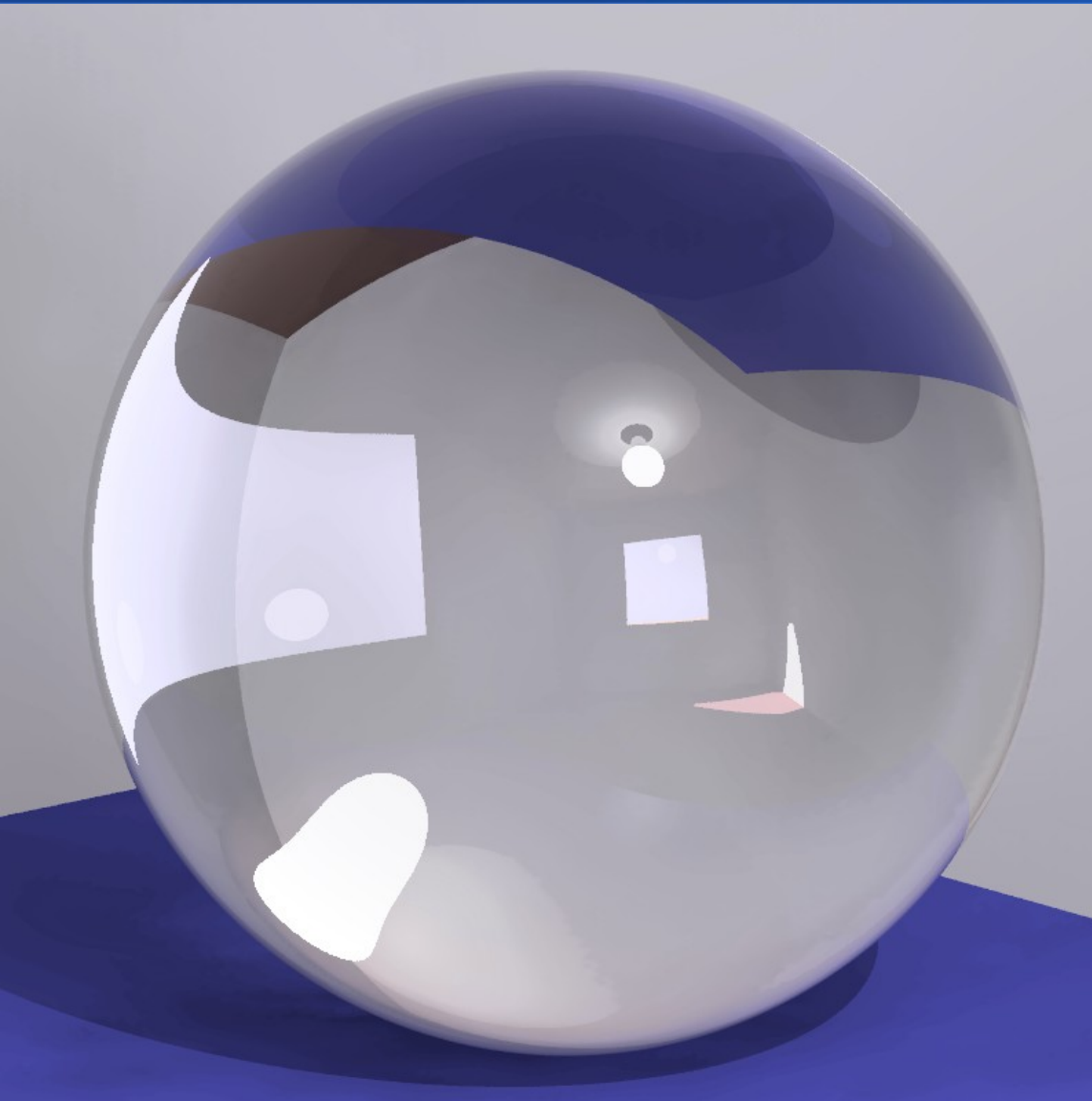
1094 spheres

50 disks



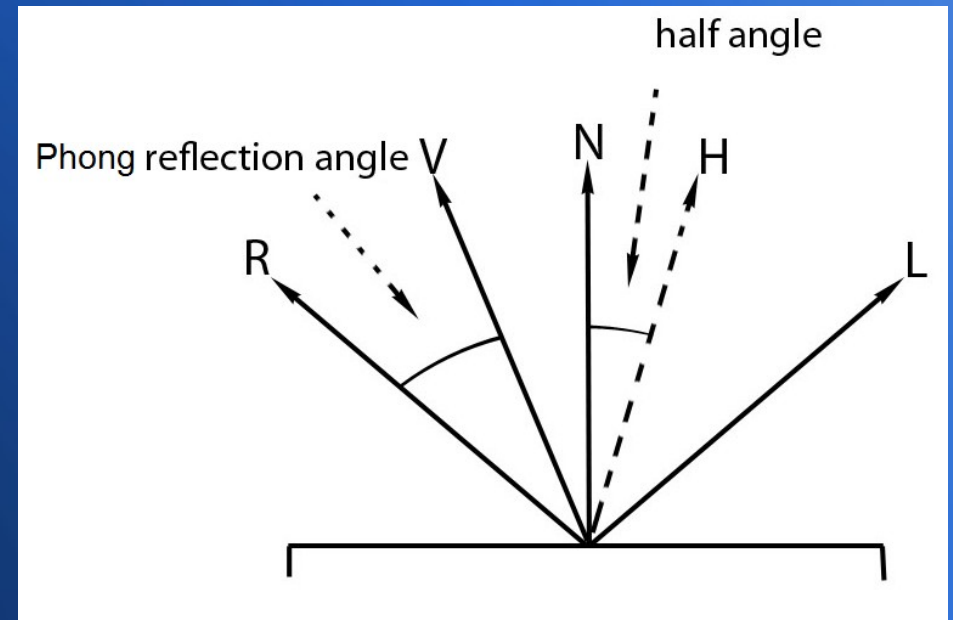
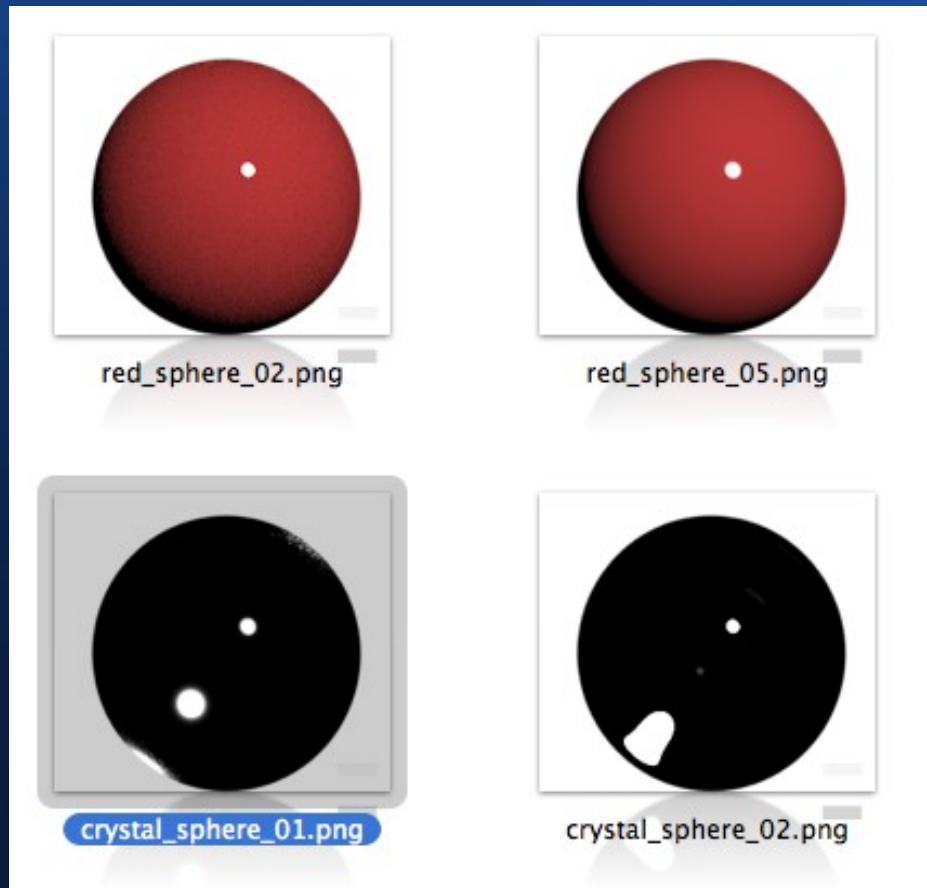
- using Constructive Solid Geometry
- vs.
- modelling intersections of e.g. spheres or cylinders

# Light Emitters



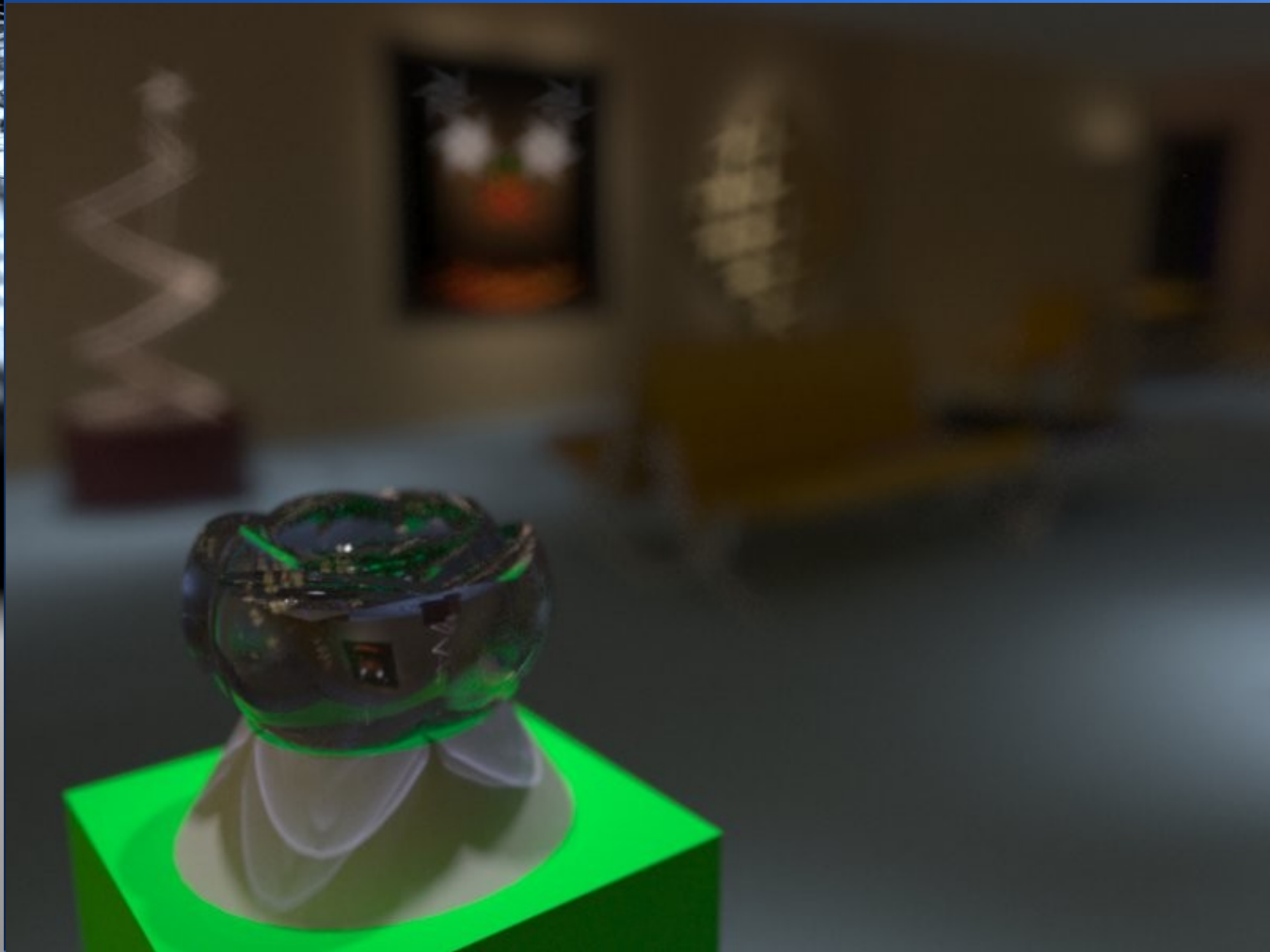
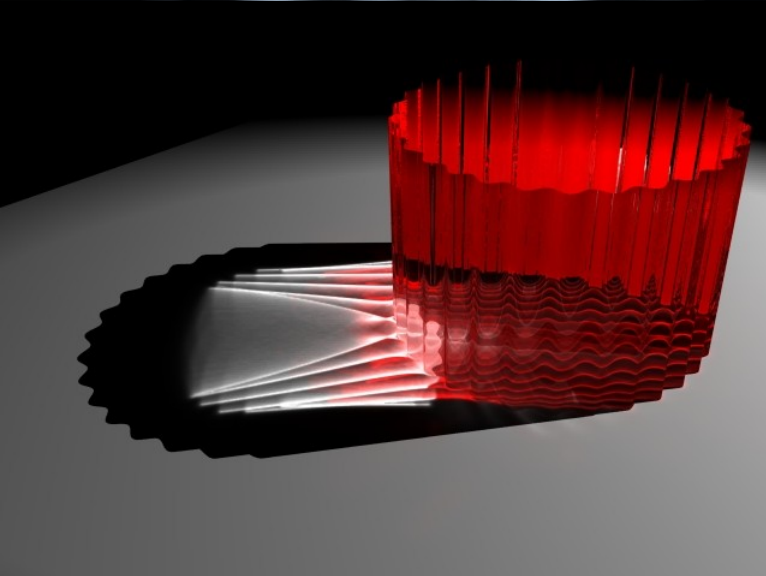
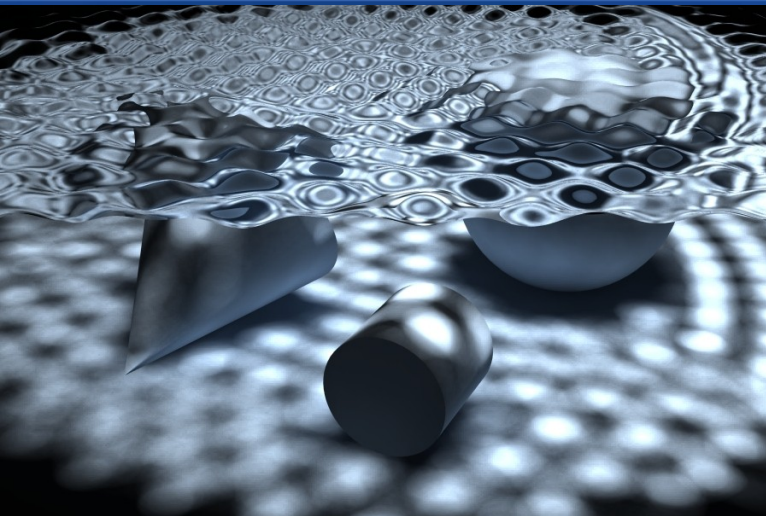
- Light emitting sphere in room
- Sun light shining onto the floor (bright spot)
- Blueish skylight
- Reflection of indoor lightbulb in window
- Caustics?

# Fake Specular vs. Refl./Refr.

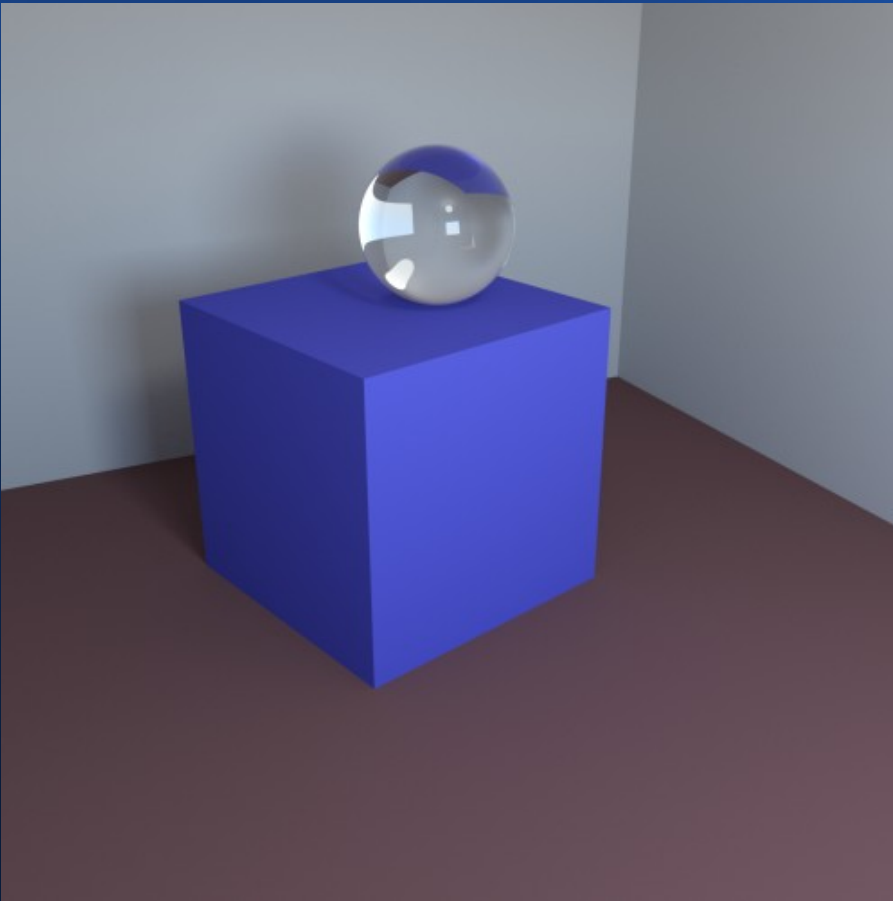


- Phong
- vs.
- Blinn-Phong

# Caustics



# Simple Scene



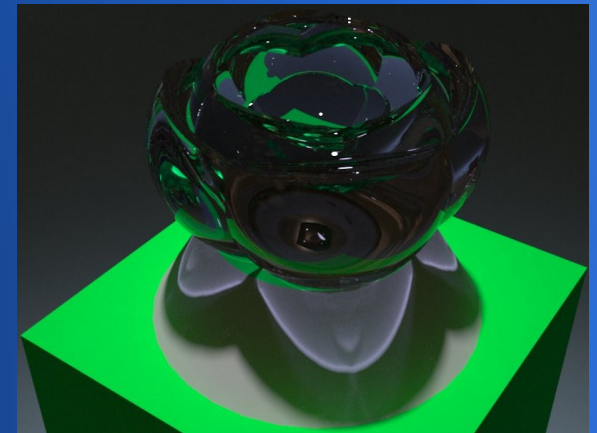
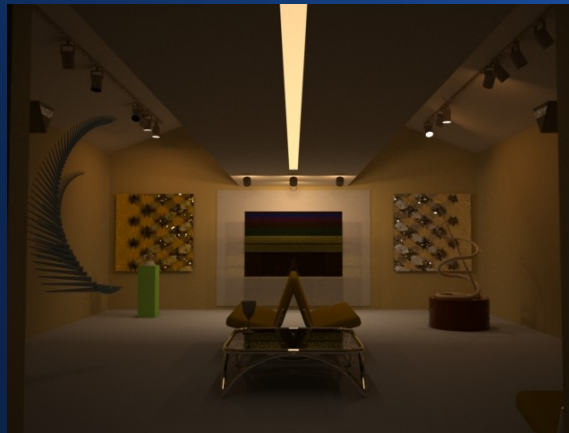
- Light emitting geo vs.
- Sun & sky / ground
- Tonemapping vs.
- Physical camera
- One button render vs.
- Faking effects *but*
- Faster render times

# Cafe Scene – Change Lights



Point (with radius) and area lights vs. light emitting geometry

# Gallery Scene



# Web Sites

- <http://janwalter.blogspot.co.uk/>
- <http://www.janwalter.com/...>
- [.../RadianceVsYouNameIt/radiance\\_vs\\_younameit.html](.../RadianceVsYouNameIt/radiance_vs_younameit.html)
- [.../Download/PDF/fmx\\_2012\\_slides.pdf](.../Download/PDF/fmx_2012_slides.pdf)
- [https://bitbucket.org/wahn/radiance\\_vs\\_younameit](https://bitbucket.org/wahn/radiance_vs_younameit)
- <https://bitbucket.org/wahn/blender-add-ons>
  - io\_scene\_rad: Radiance importer (exporter?)
  - io\_scene\_ass: Arnold exporter
  - io\_scene\_rib: RenderMan exporter