Autodesk Automotive Innovation Forum

Driving Lighting Innovation with **AUTODESK** VRED™

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Vehicle designed and built by Marc Mainville

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Agenda

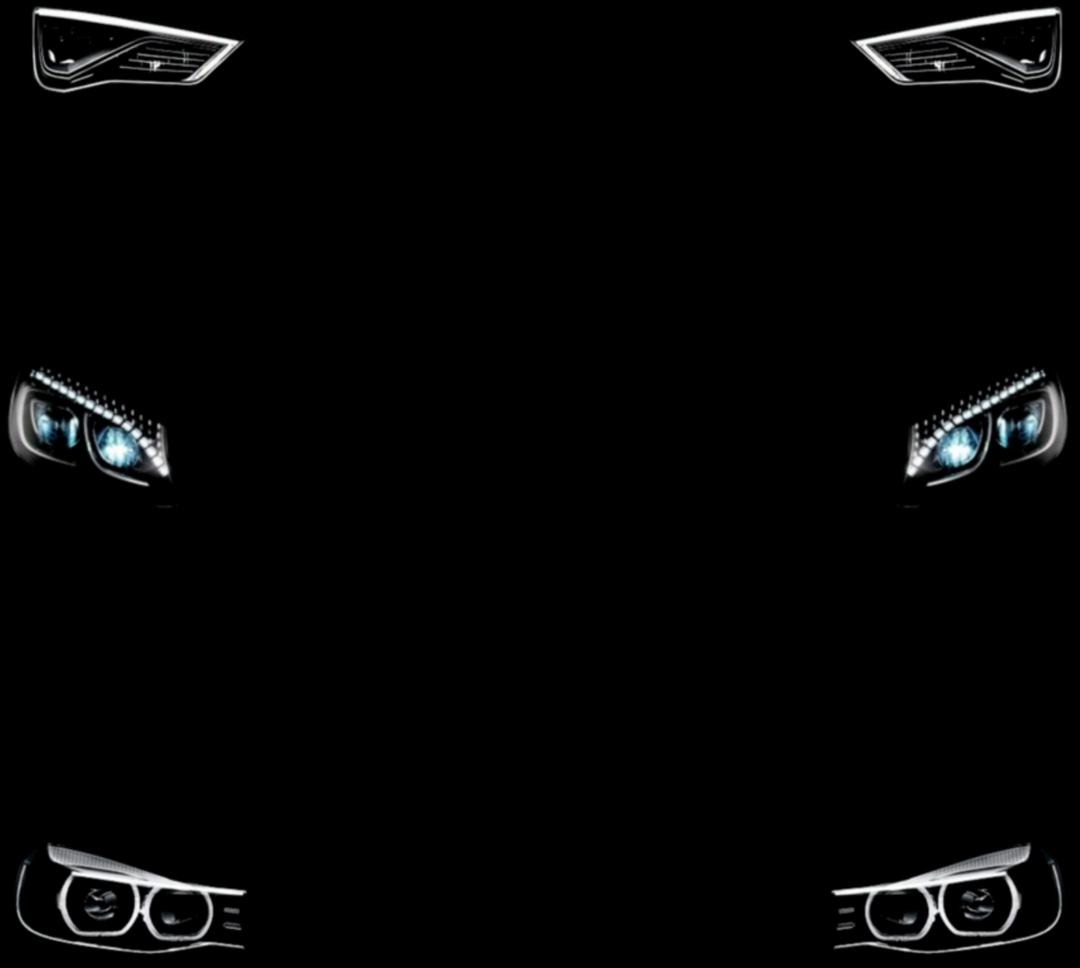
Introduction

- The Face
- Design Evolution
- Safety Aspect
- Milestone in Engineering
- Future Trends

VRED Features

- Photometric Parameter in Light and Material Editor
- Path Tracing & Photon Mapping
- Spectral Rendering, Color Spectrum & Dispersion
- IES Files
- RAY Files
- Camera Tonemapping
- Layered Material
- Nurbs Raytracing
- What you see
- Additional Features

The Face



www.netcarshow.com

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The Face

www.netcarshow.com

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Design Evolution

- Evolution of BMW 5 series
- Round Headlamps and Chrome Kidney are a significant Design Characteristic of BMW over the years

www.7-forum.com

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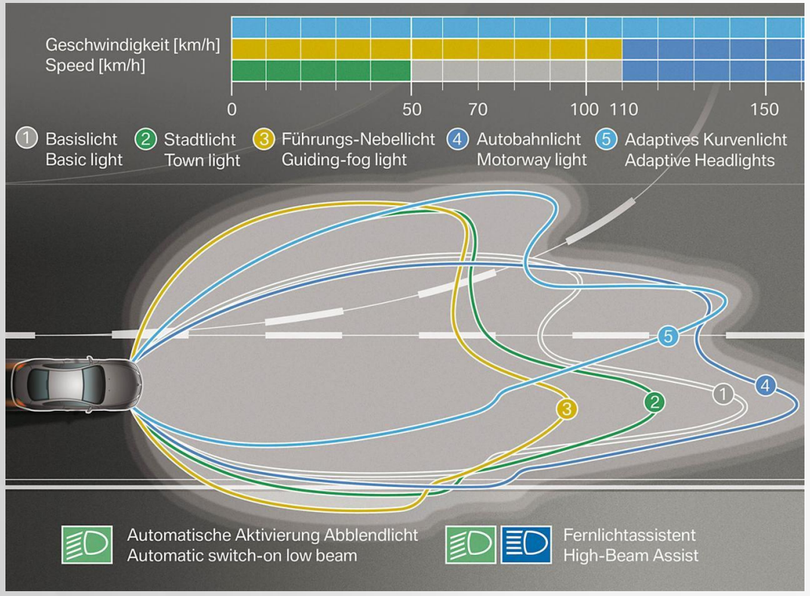
Safety Aspect

- Car lamps are first and foremost made to see and be seen at night
- Over the years, the technology and efficency of car lamps has become more and more sophisticated
- Technologies such as Adaptive Curvelight, Bi-Xenon and Laserlight have made night driving safer



www.bmwblog.com

www.xenon-vybojky.cz

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Milestones in Engineering

- Milestones in engineering at Hella over the past years
- Laserlight is the next step in Automotive Lighting

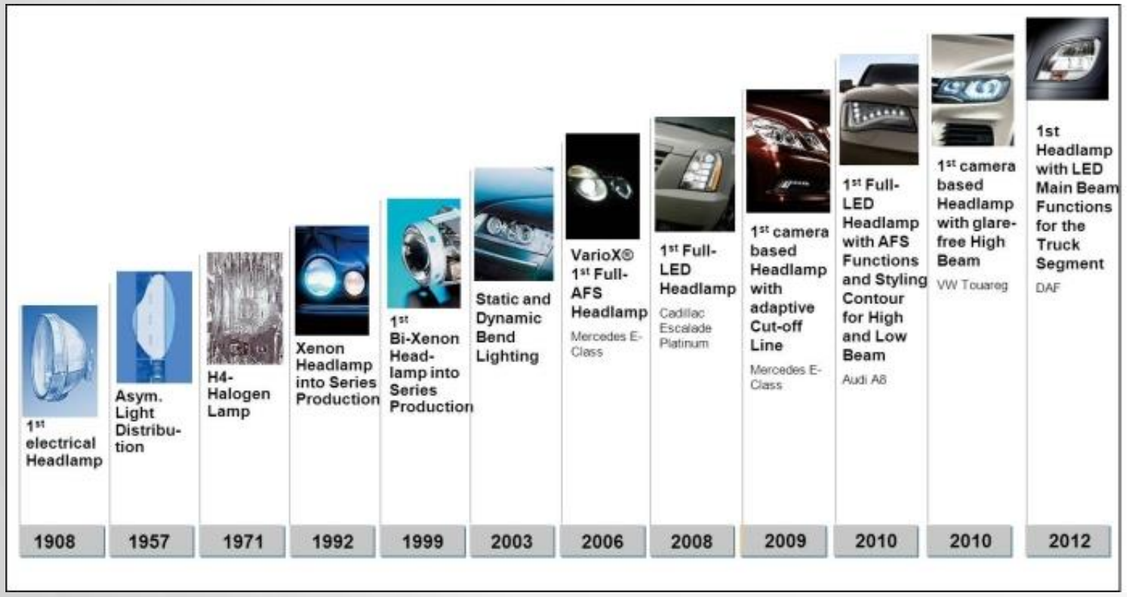
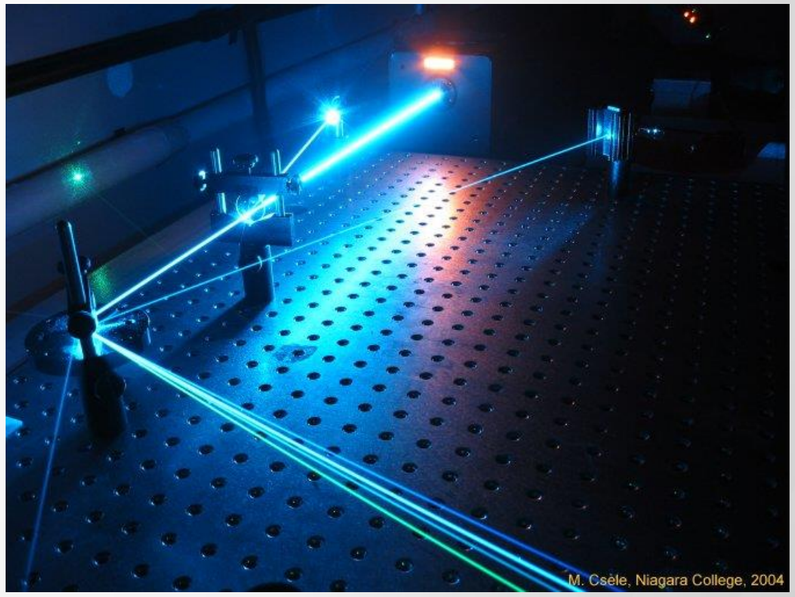


Image courtesy of Hella, www.hella.com



www.cs.virginia.edu

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Future Trends

- Integrated LED signal lights from Hella on the Porsche Macan
- Distortion-free, thick-walled PMMA body in 2K technology

Image courtesy of Porsche

Future Trends

- BMW I8 is the first mass production car with laser light high-beam headlights

Image courtesy of BMW

Image courtesy of BMW

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Future Trends

- Audi Quattro Concept- Phosphorous Converter converts blue Laser Light into roadworthy white light
- Renault Concept- parametric model of a car rearlamp

Image courtesy of Audi, www.audi.de

IAA Concept Renault, Pascal Seifert

AUTODESK VRED™ Lighting Features

Workshop

Vehicle designed and
built by Marc Mainville

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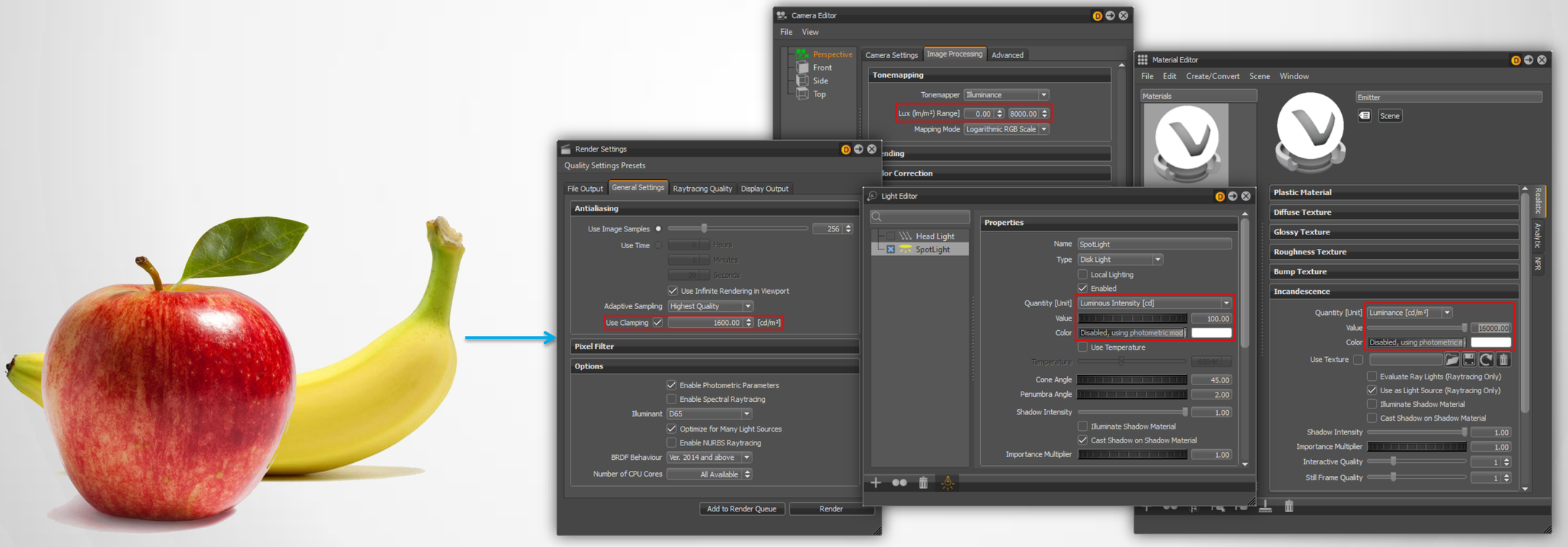
Photometric Parameters

- Input values can be changed from intensity to light specific units in the user interface



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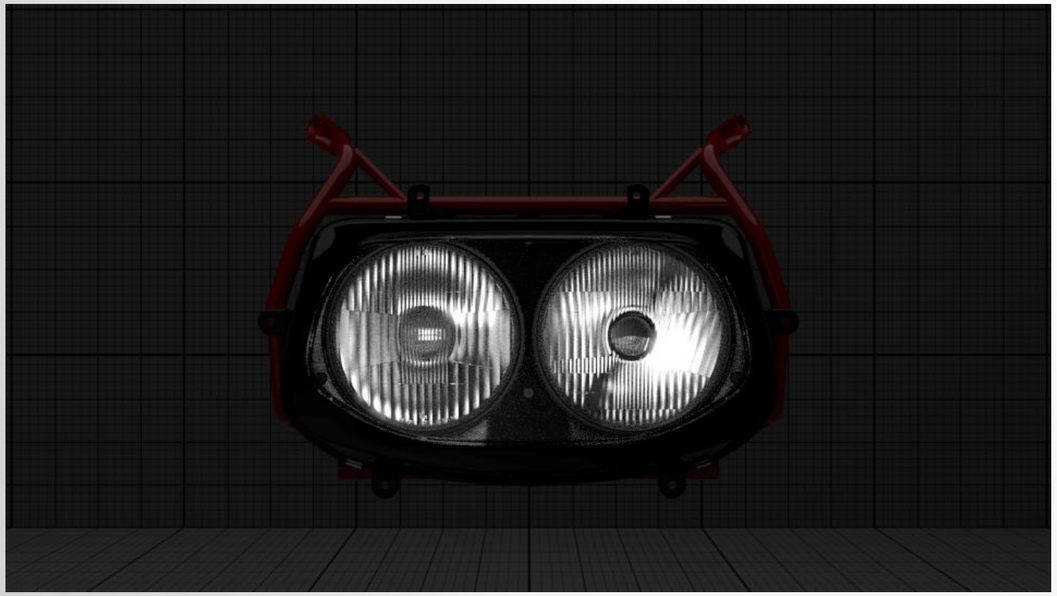
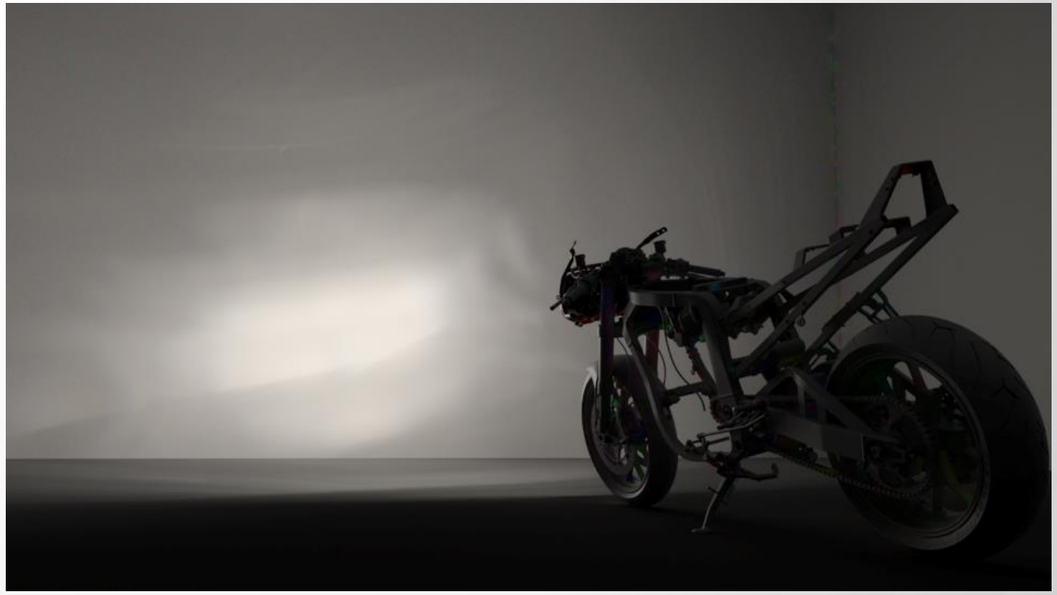
Path Tracing and Photon Mapping

- Path Tracing is recommended for looking into a light
- Photon Tracing is recommended for light distribution

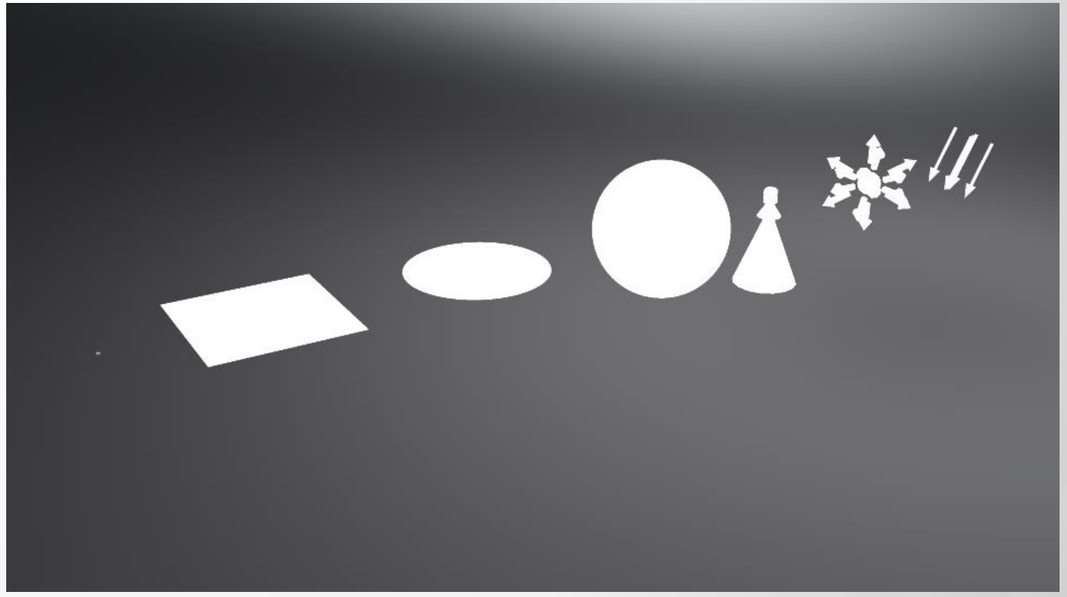


Model courtesy of madmax, www.grabcad.com



Photometric Parameters – Light Editor

- Different internal Lightsources available in VRED
- Input Units for these Lightsources are > Luminance (cd/m²), LuminousFlux (lm), Luminous Intensity (cd), Luminous Emittance (lm/m²)



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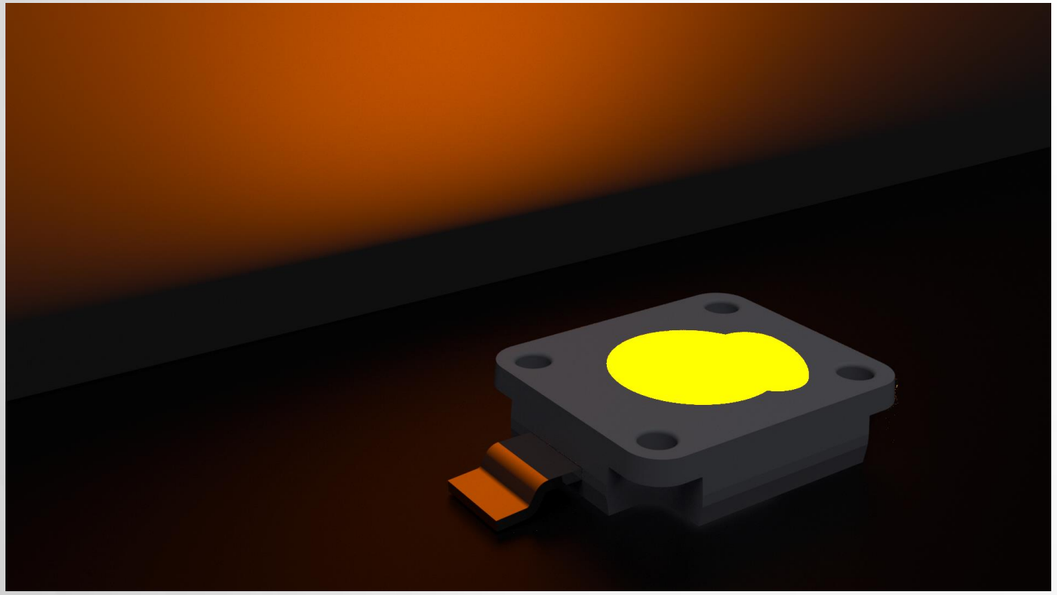
Photometric Parameters – Material Editor

- Geometry Objects can be defined as Lights with Incandesence Material
- Input Unit for Light emmiting Geometry > Luminance (cd/m²)



Model courtesy of OSRAM

www.netcarshow.com

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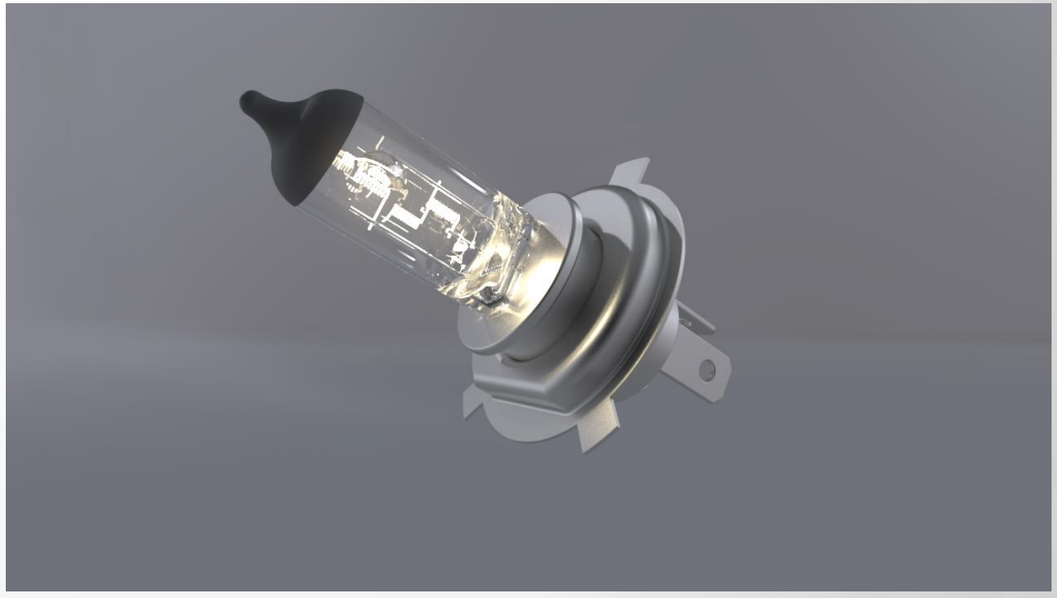
Photometric Parameters – Material Editor

- Simple plane geomety with incandesence texture
- H4 Lamp with incandesence material for the fillament

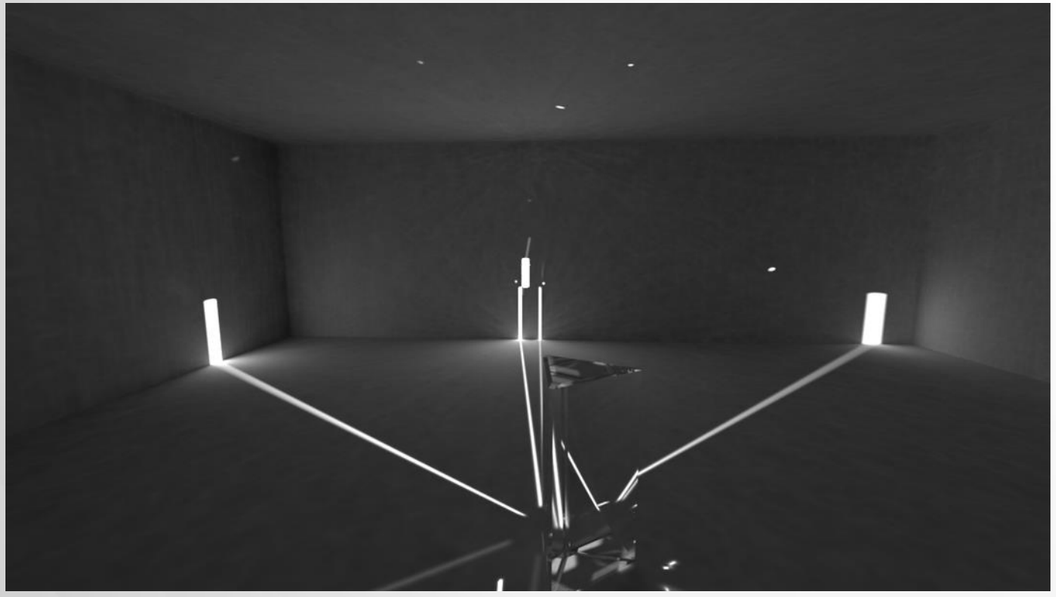
Model courtesy of chuanpin, www.grabcad.com

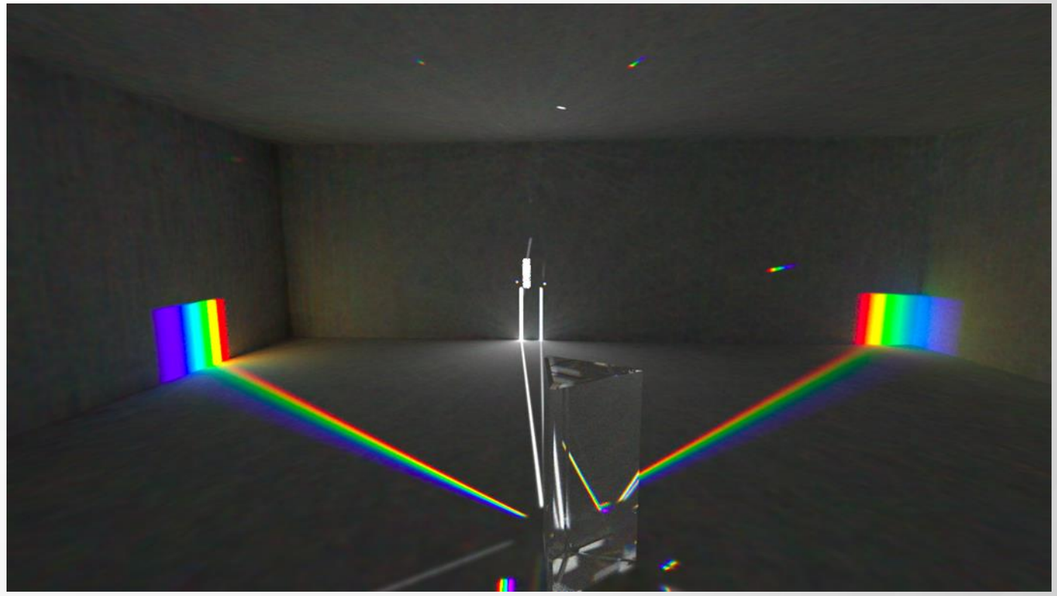


Model courtesy of Milovan Rankovic, www.grabcad.com

Spectral Rendering

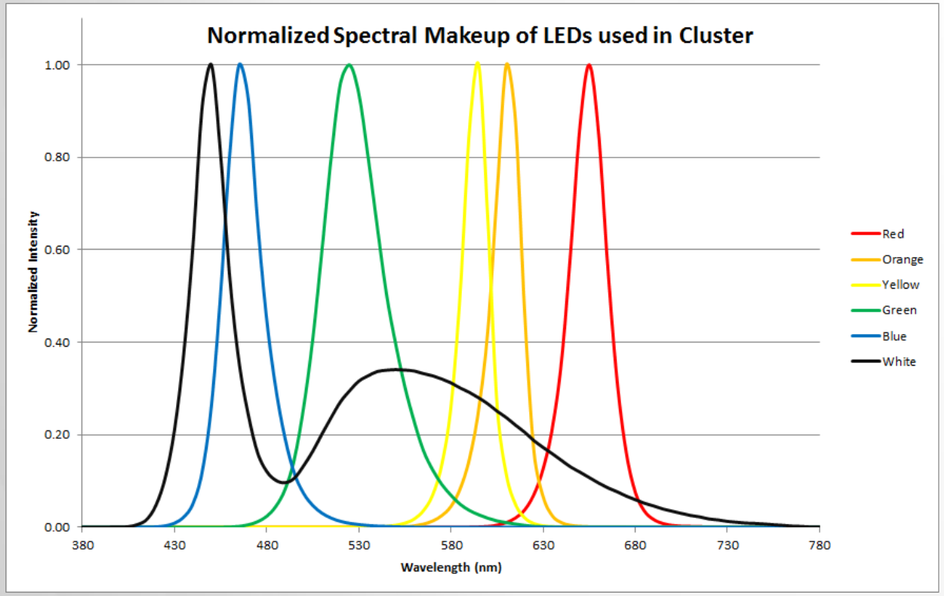
- Is where a scene's light transport is modeled with real wavelengths
- Enables dispersion effects and spectral color values

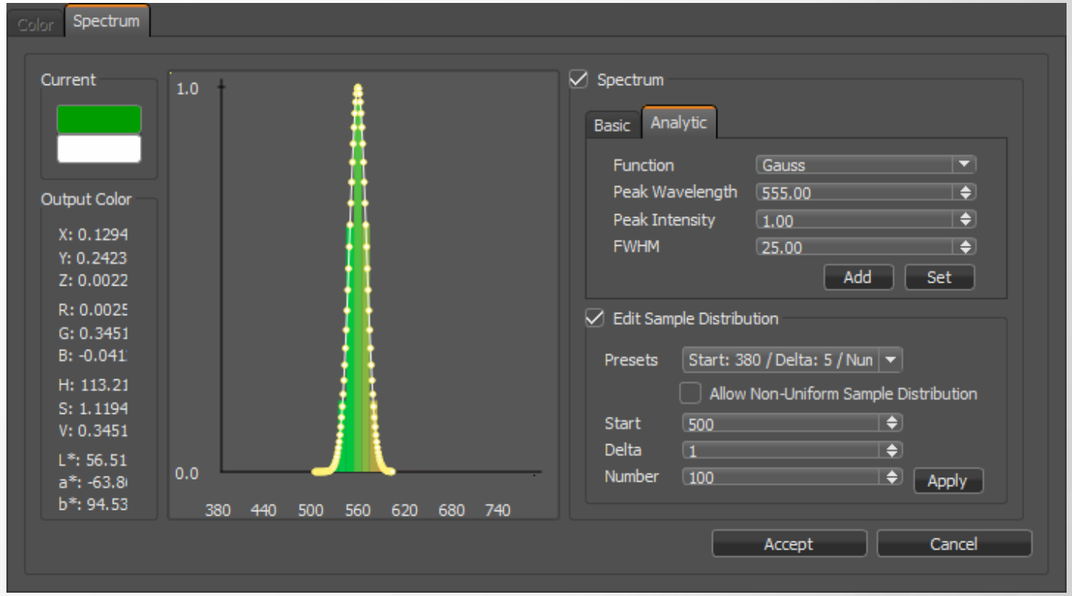




Spectral Rendering - Color Spectrum

- Realistic color spetrum for materials and lights
- **AUTODESK** VRED™ supports OSRAM spectrum files and allows drawing individual curves





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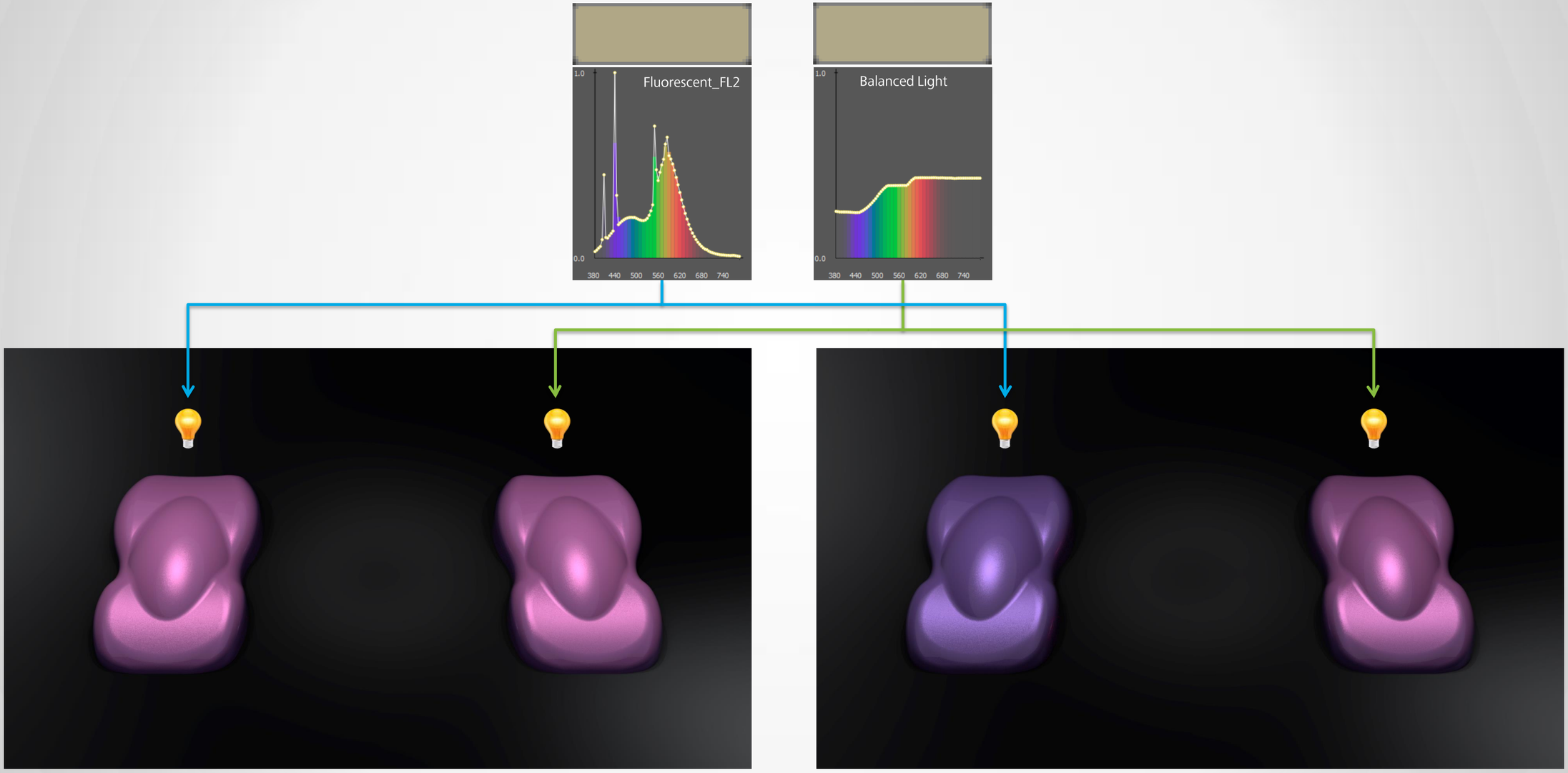
Spectral Rendering - Metamerism

- Materials match under some lighting conditions but not others
- Serious problem for manufacturers, especially those who combine various parts of different materials into one product
- Customers expect all parts of the products that they purchase to match in daylight as well as under the fluorescent lights of department stores > goal is to reduce the effects of Metamerism

Image courtesy of HunterLab, www.hunterlab.com

Spectral Rendering - Metamerism



RGB Rendering

Spectral Rendering

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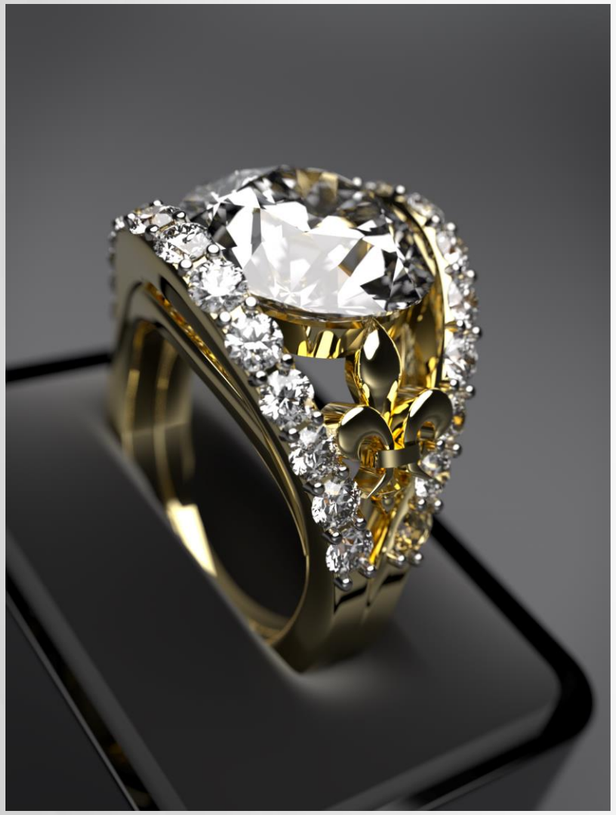
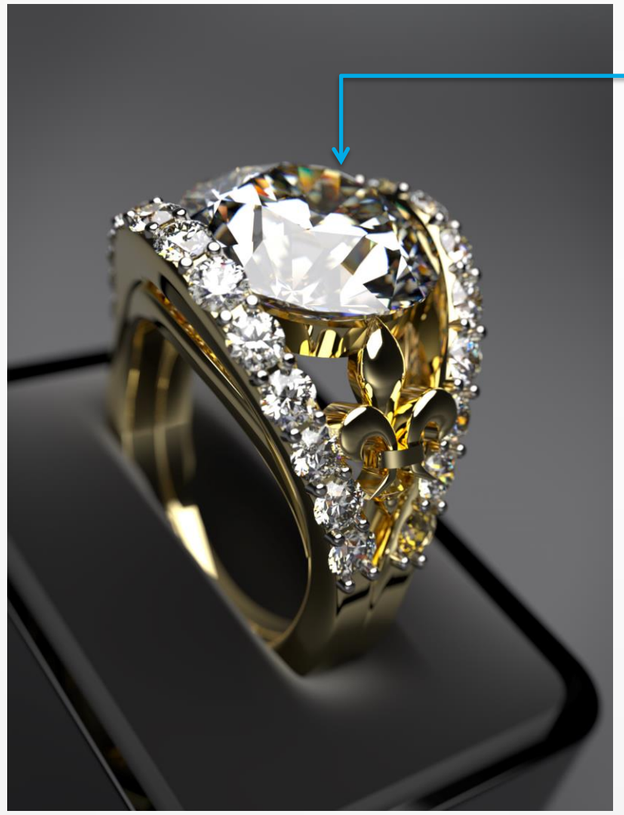
Spectral Rendering - Dispersion

- Diamonds without and with dispersion effect





Model courtesy of Robert Hilton, www.grabcad.com

Spectral Rendering - Dispersion

- The Headlights in the Mercedes S-Class Coupé (C217) are Packed with 94 Swarovski Crystals
- 17 angular Crystals for Daytime Running Lamps
- 30 round Crystals form the Turn Signal Lamps

Image courtesy of Daimler, www.auto-fokus.com

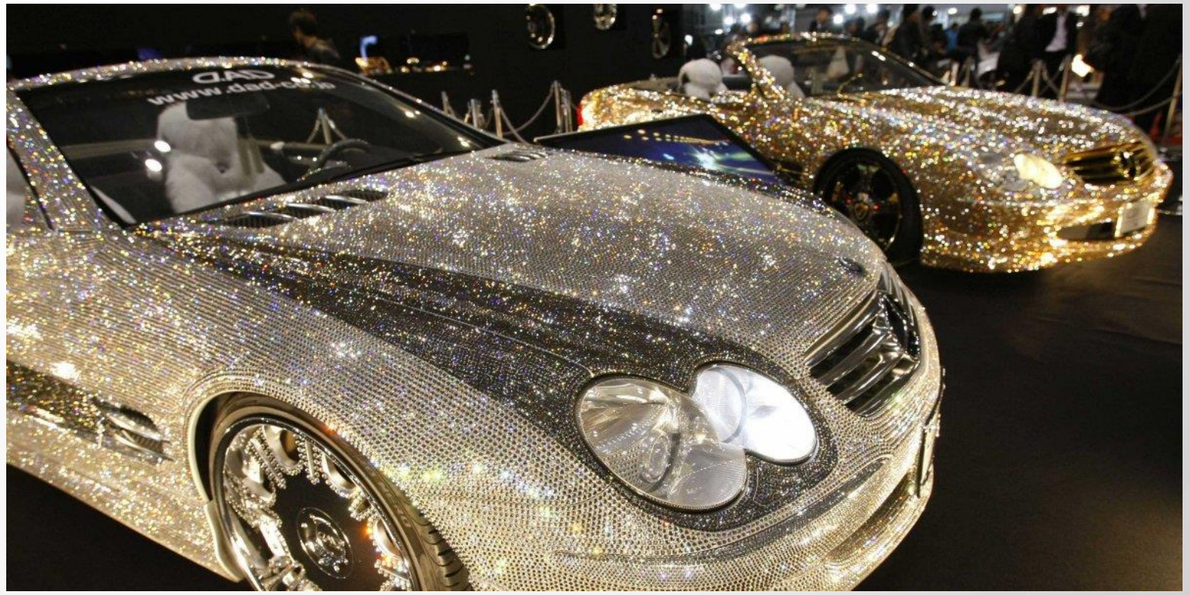
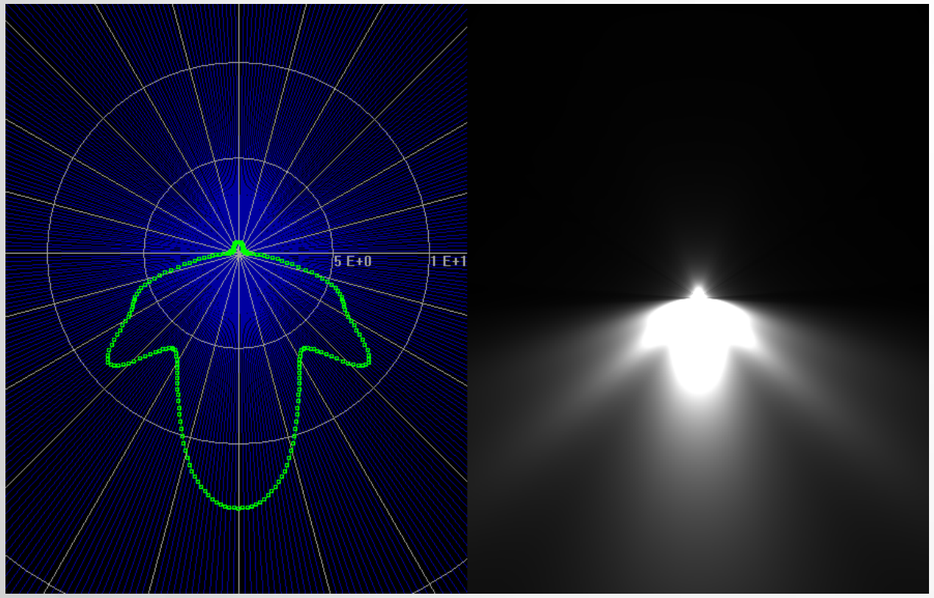


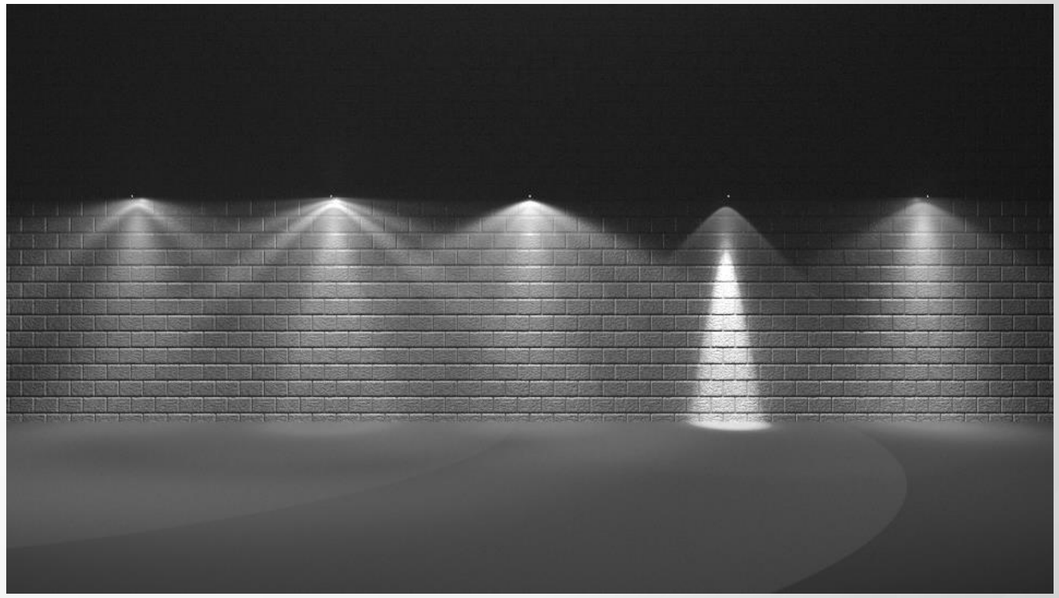
Image courtesy of Reuters, Garson/DAD Luxury Cars, www.reuters.com

IES Files

- IES is an angular based ASCII Format which stores Intensity and Shape Distribution behaviour of Light
- Approximation of Light Distribution refers to one point which does not exist in the real World



IESGen4



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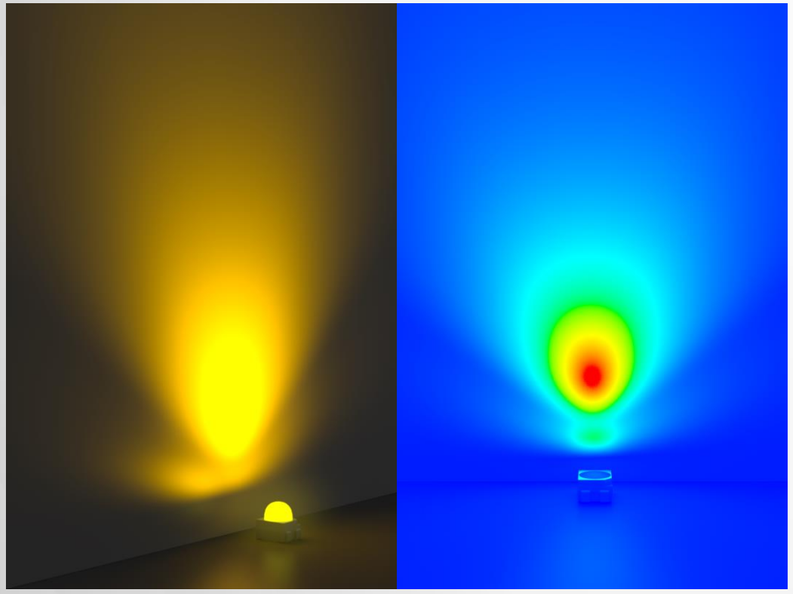
IES Files - Automotive Area

- IES File of a Osram “LY_E65F LED” Light
- IES files for headlights can be used to get an effect of light distribution on a street, for example

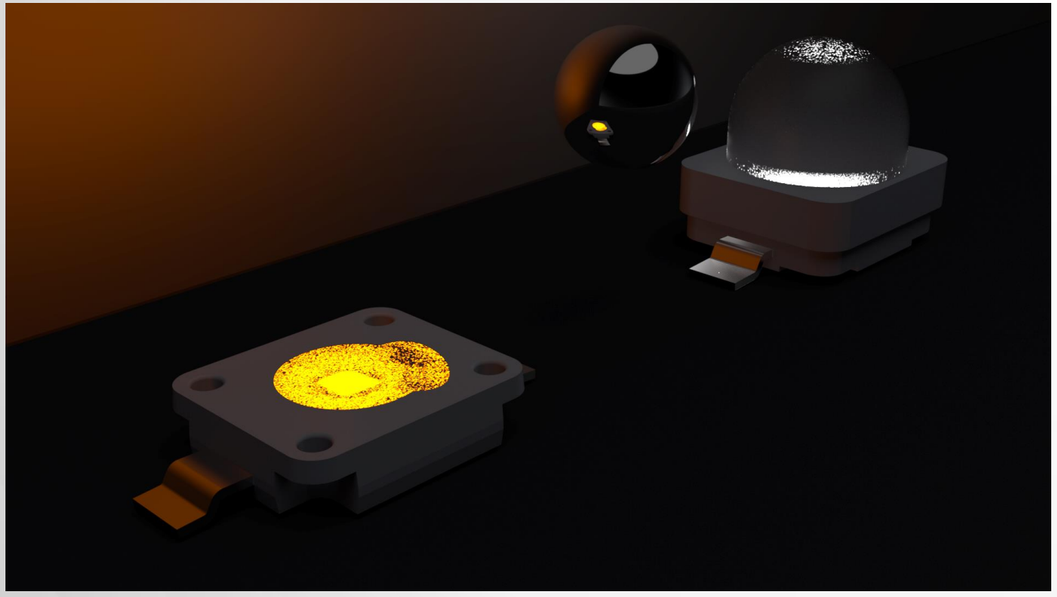


Model courtesy of OSRAM

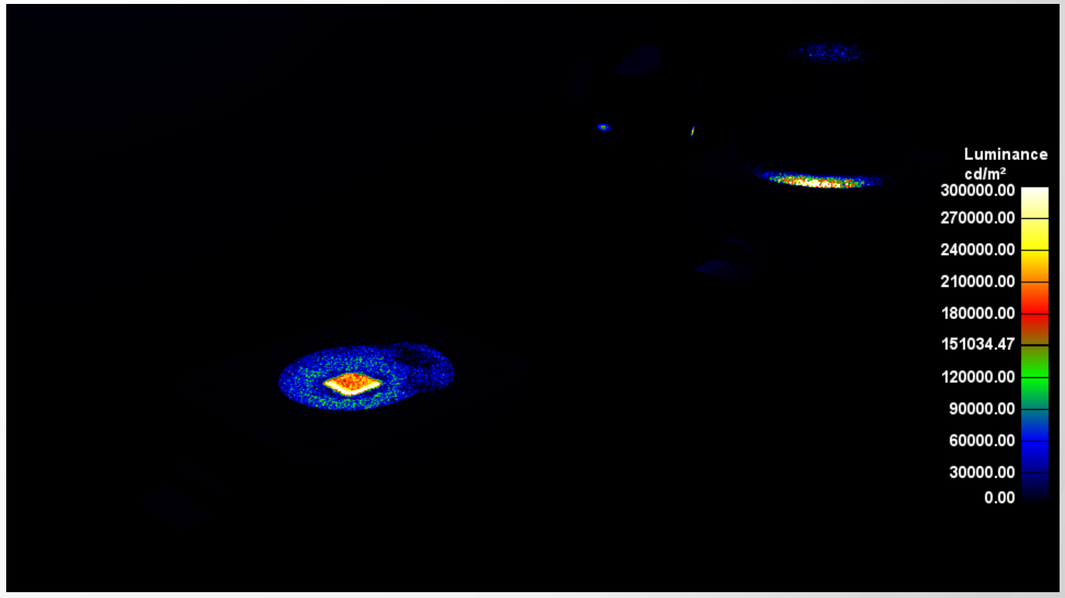
Image courtesy of SKODA

RAY Files

- Support of Lucidshape and Hella Simulation Data
- Intensity, Distribution and Emitter Surface of the Light are stored in the .ray File



Model courtesy of OSRAM



Model courtesy of OSRAM

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RAY Files

- Support of Lucidshape .ray Files works also for non- planar Surfaces

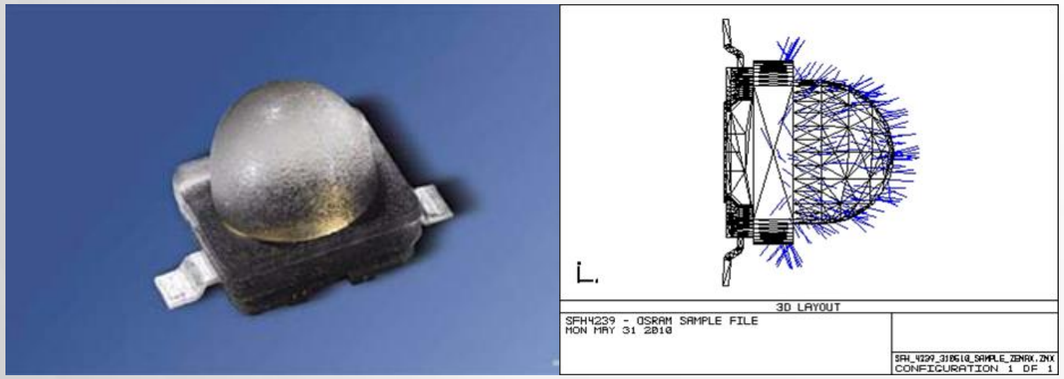
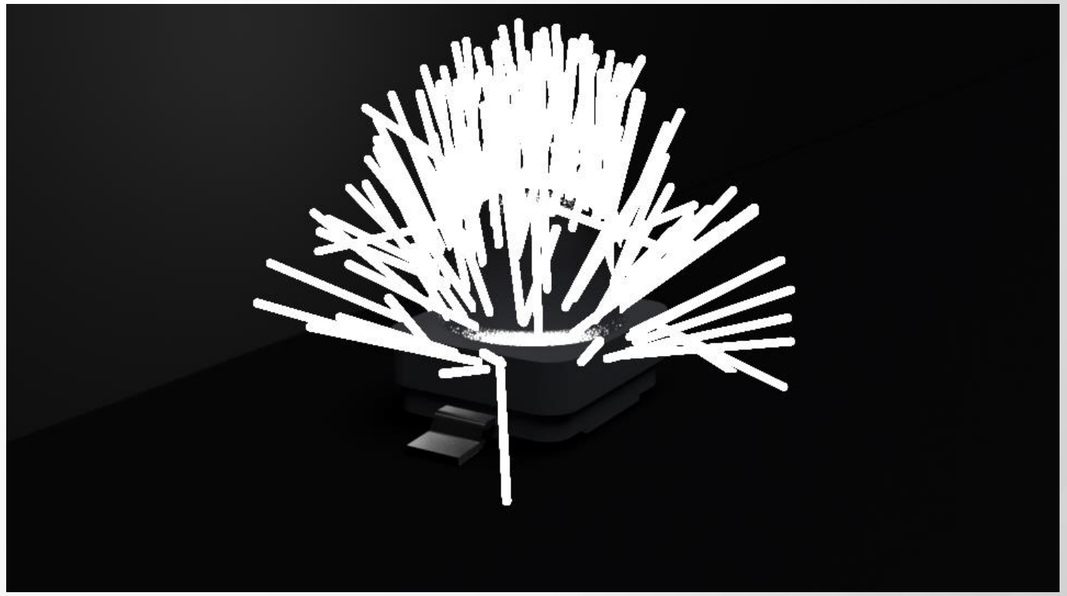


Image courtesy of OSRAM



Model courtesy of OSRAM

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RAY Files

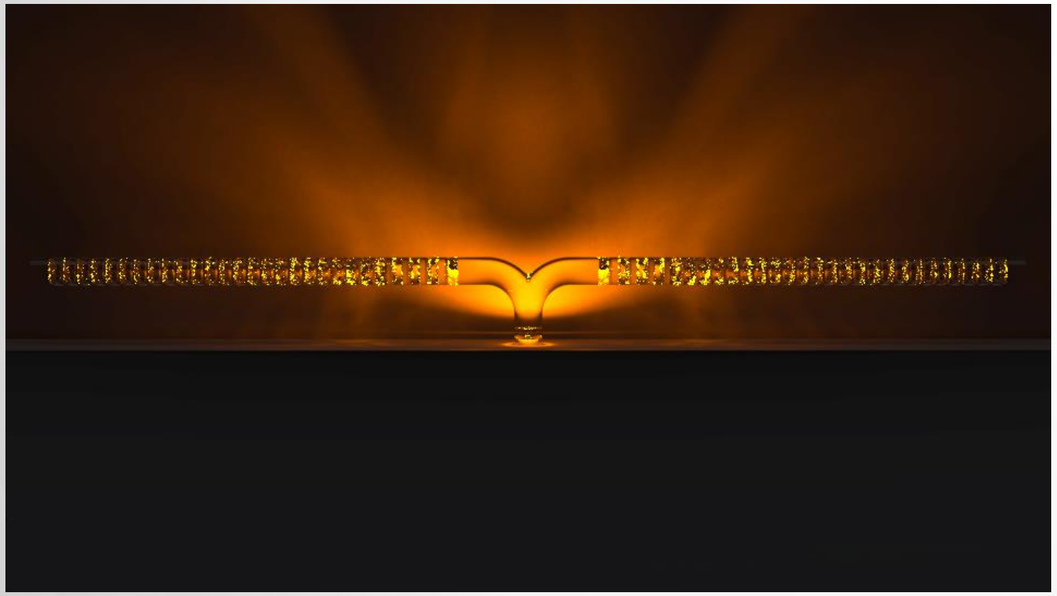
- Light Guide on Doorpanel
- Can be used for surfaces with non-linear light distribution; such as ambient lights in the door panel, or coverglass of front- and rear lights

Image courtesy of HELLA, www.hella.com

Image courtesy of HELLA, www.hella.com

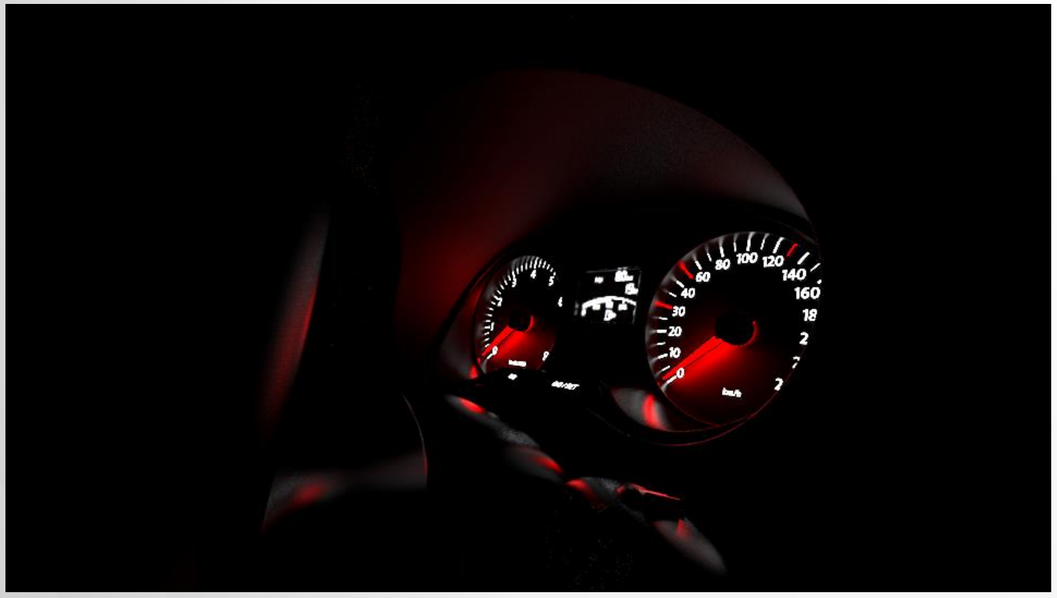
RAY Files

- Ray File is limited in the Amount of Rays it can store
- The distribution of the Optical Fiber Element is important, not the distribution of the LED!
- IES File of the LED instead of the RAY File + LED Color Spectrum + Realistic Material Properties for Glass prism

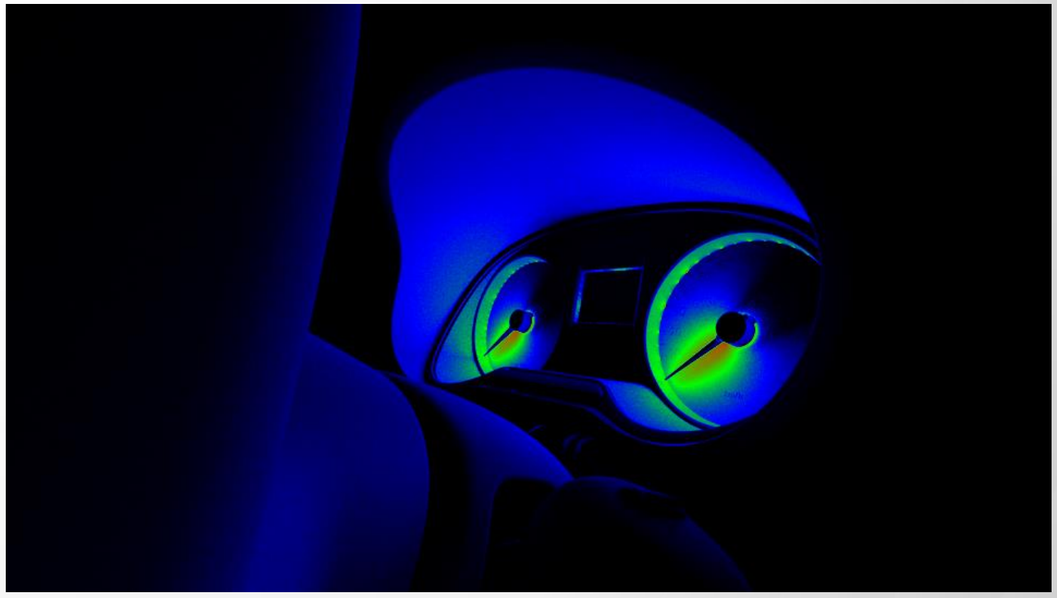


Camera Tonemapping

- Realistic Lighting helps to determine how a Car could appear in a Night design situation
- Tonemapping helps to evaluate Lightdistribution and the influence of this on the materials in a car interior



Model courtesy of VW



Model courtesy of VW

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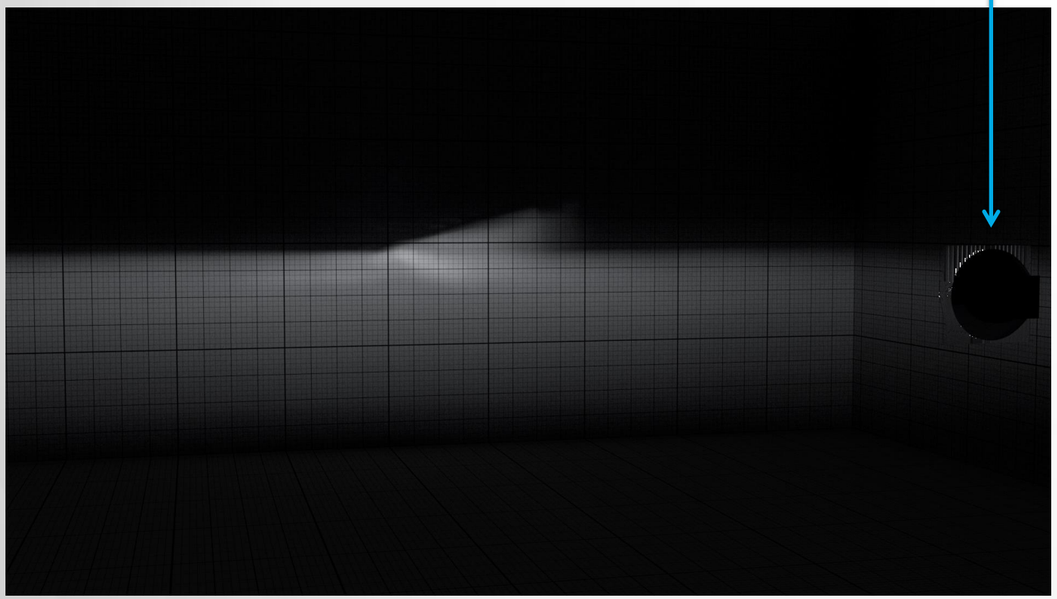
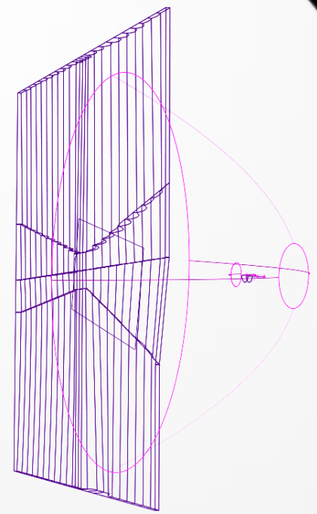
Camera Tonemapping

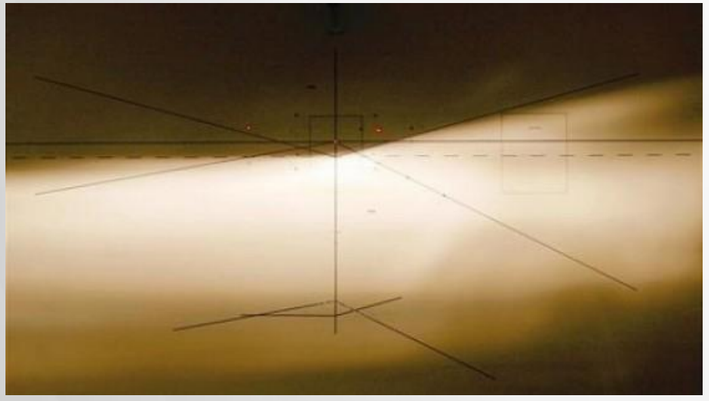
- Complex Scene shows the Light distribution calculated with Photonmapping from a filament onto a Wall



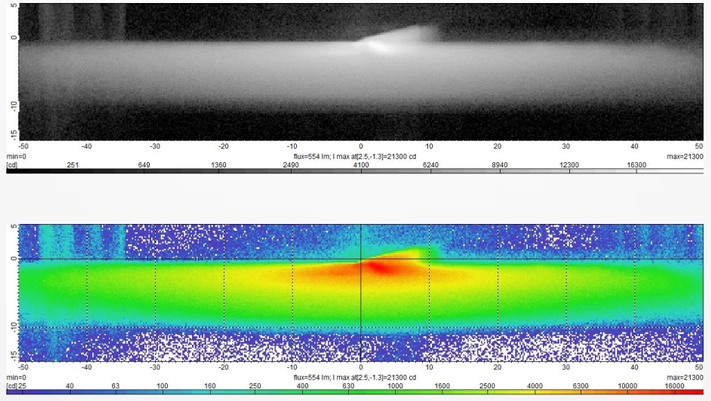


Camera Tonemapping

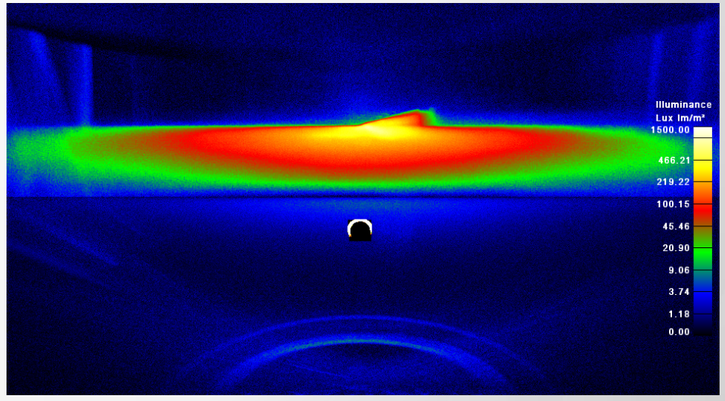
- Characteristics of a real Car Lightbeam (Img.1)
- Speos Simulation Software (Img.2)
- Autodesk VRED (Img3.)



Img.1



Img.2



Img.3

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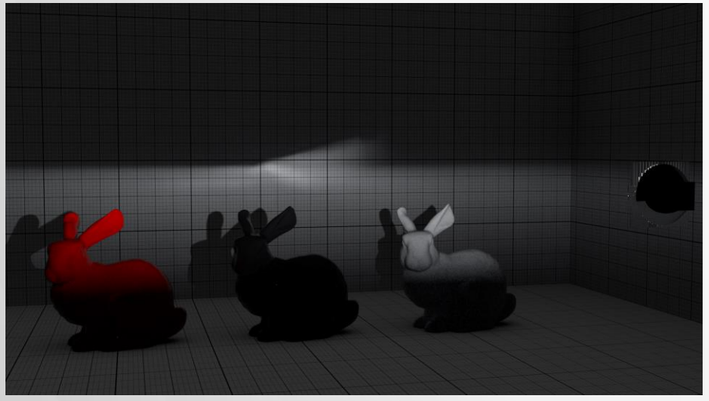
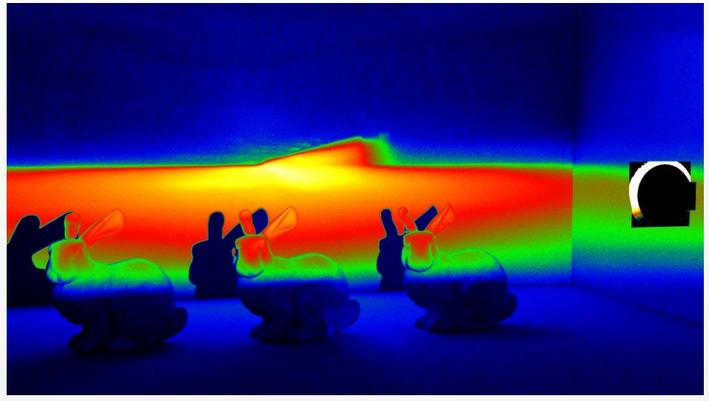
Camera Tonemapping

- Realistic Light Distribution in Scene
- Illuminace Tonemapping shows the direct light received by the Objects
- Luminance Tonemapping shows Material Properties (Color) influenced by the Light

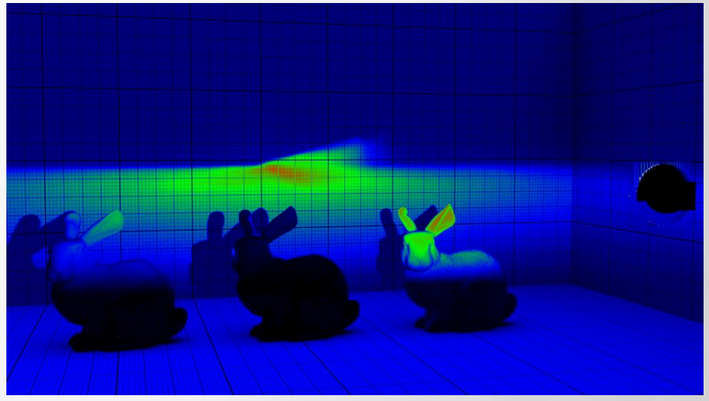
Beauty Rendering



Illuminance Tonemapper



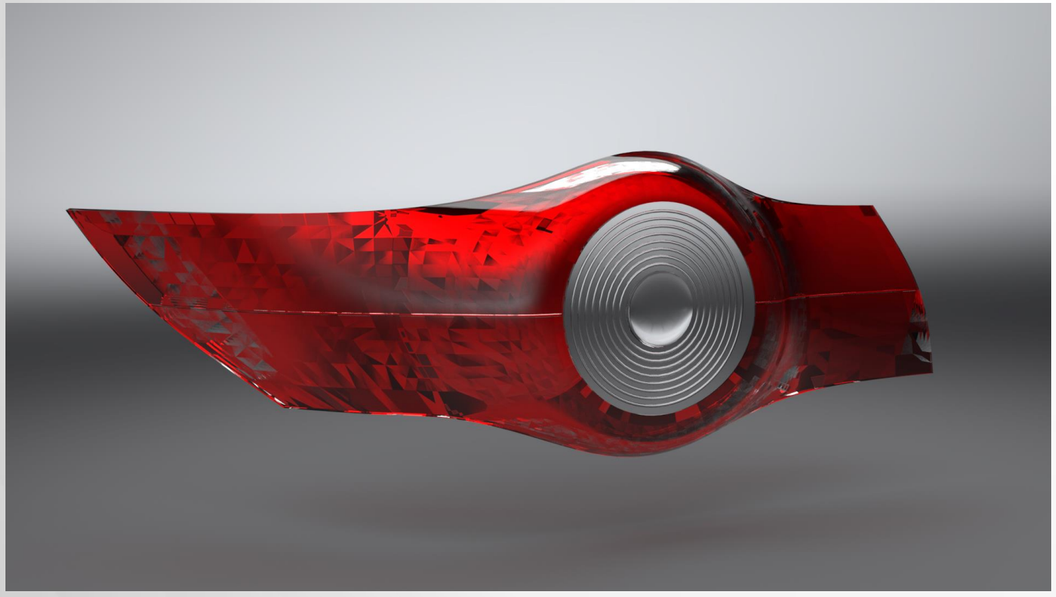
Luminance Tonemapper

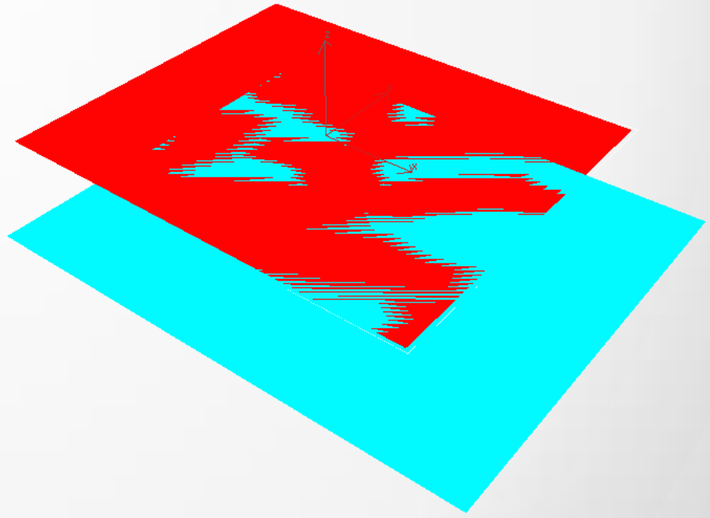


Model courtesy of Stanford Computer Graphics Lab

Layered Material

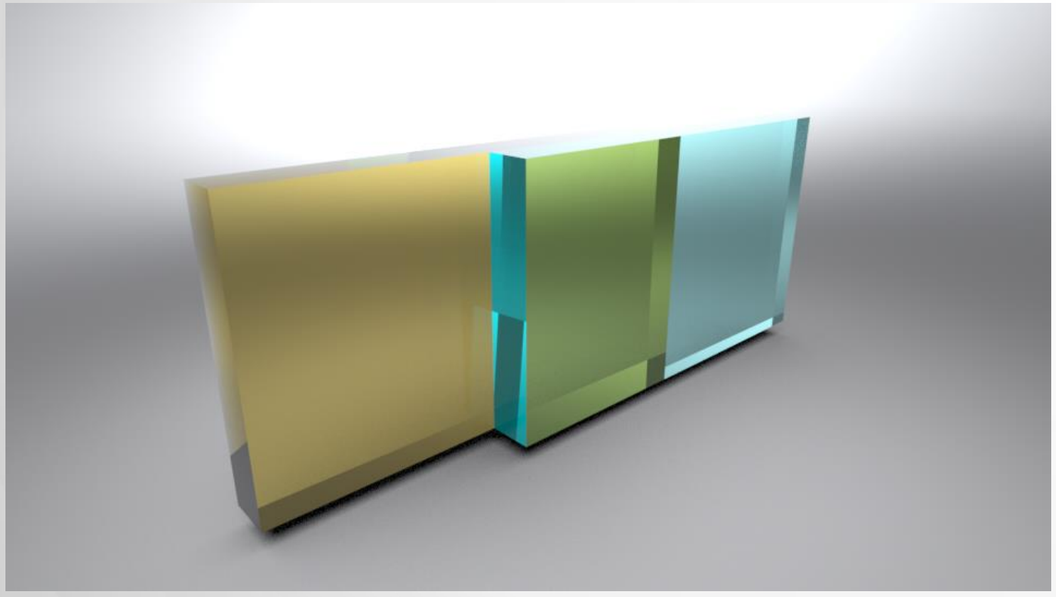
- Layered Material is used for Multi- Component Materials such as Rearlight Coverglas
- Problem with overlapping inner Surfaces from the White- and Red Glas (Z-Fighting)

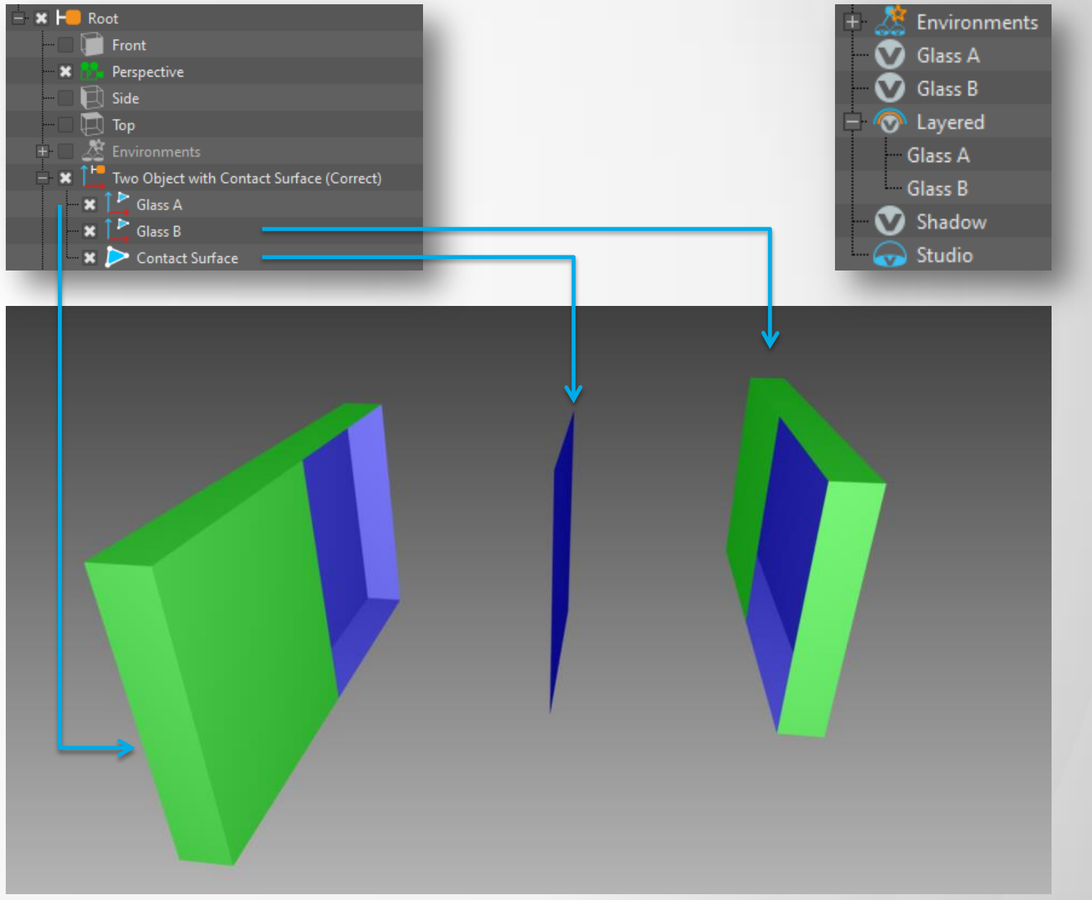




Layered Material

- Two Component Laminated Glass (Rearlight Glas)
- Layered Glass Material for Contact Surface





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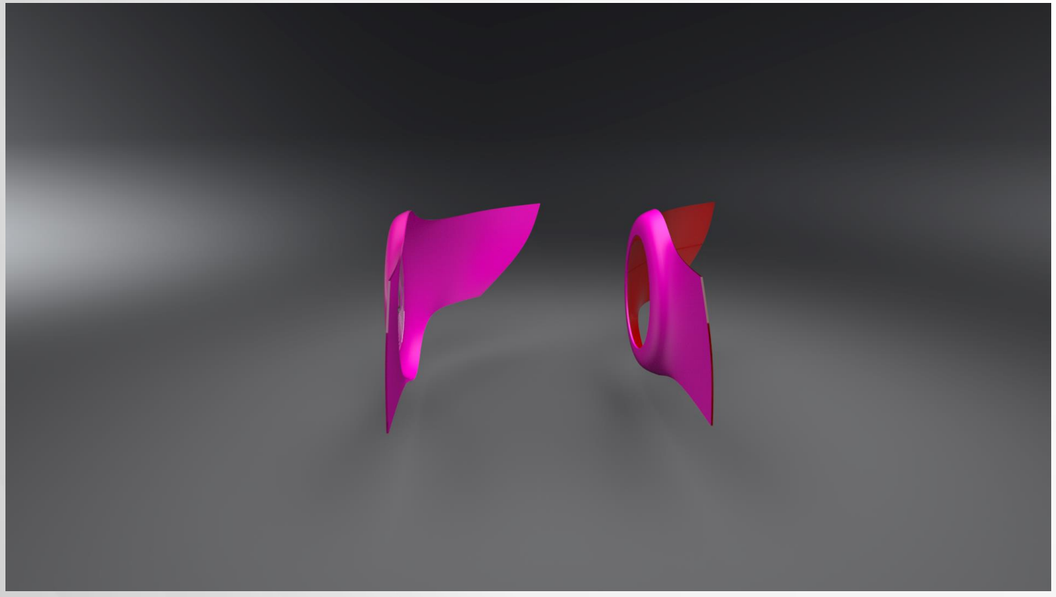
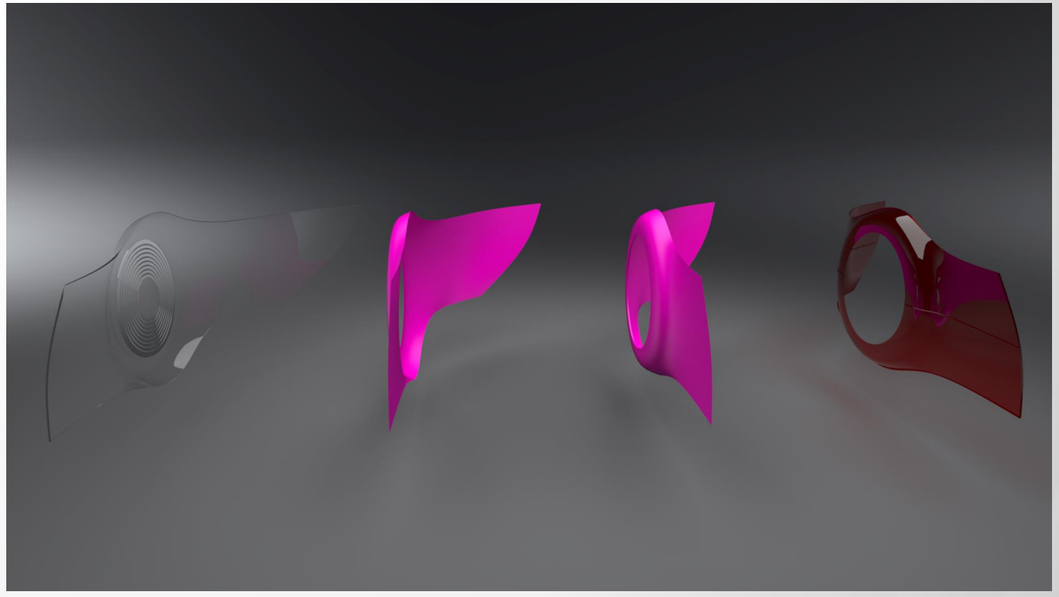
How to use

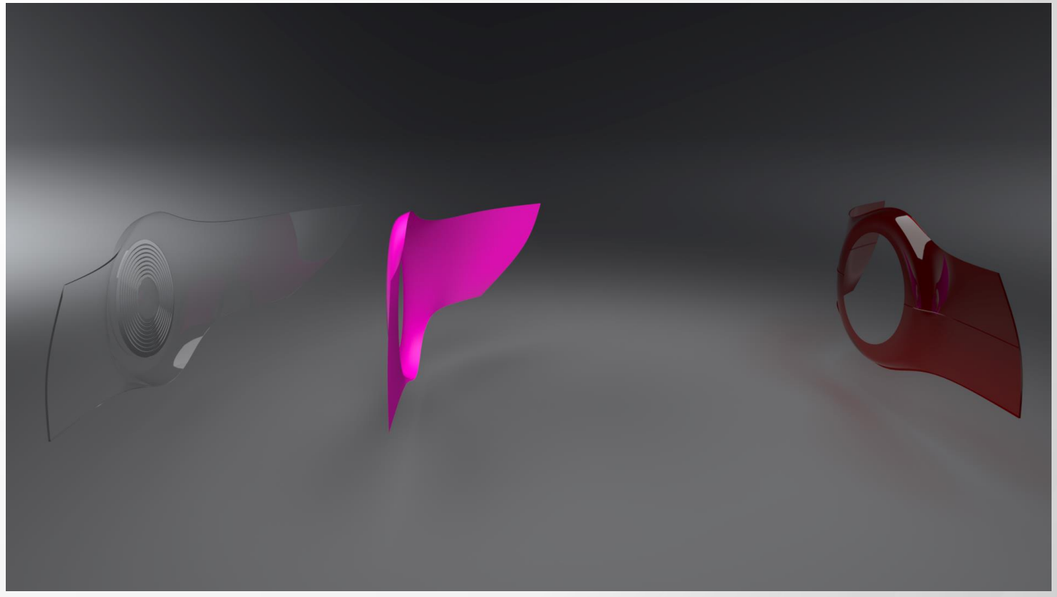
- Identify the identical inner Surface of both Glass Components
- Use „Components“ to seperate the inner Surfaces and move them into a new „Shell“





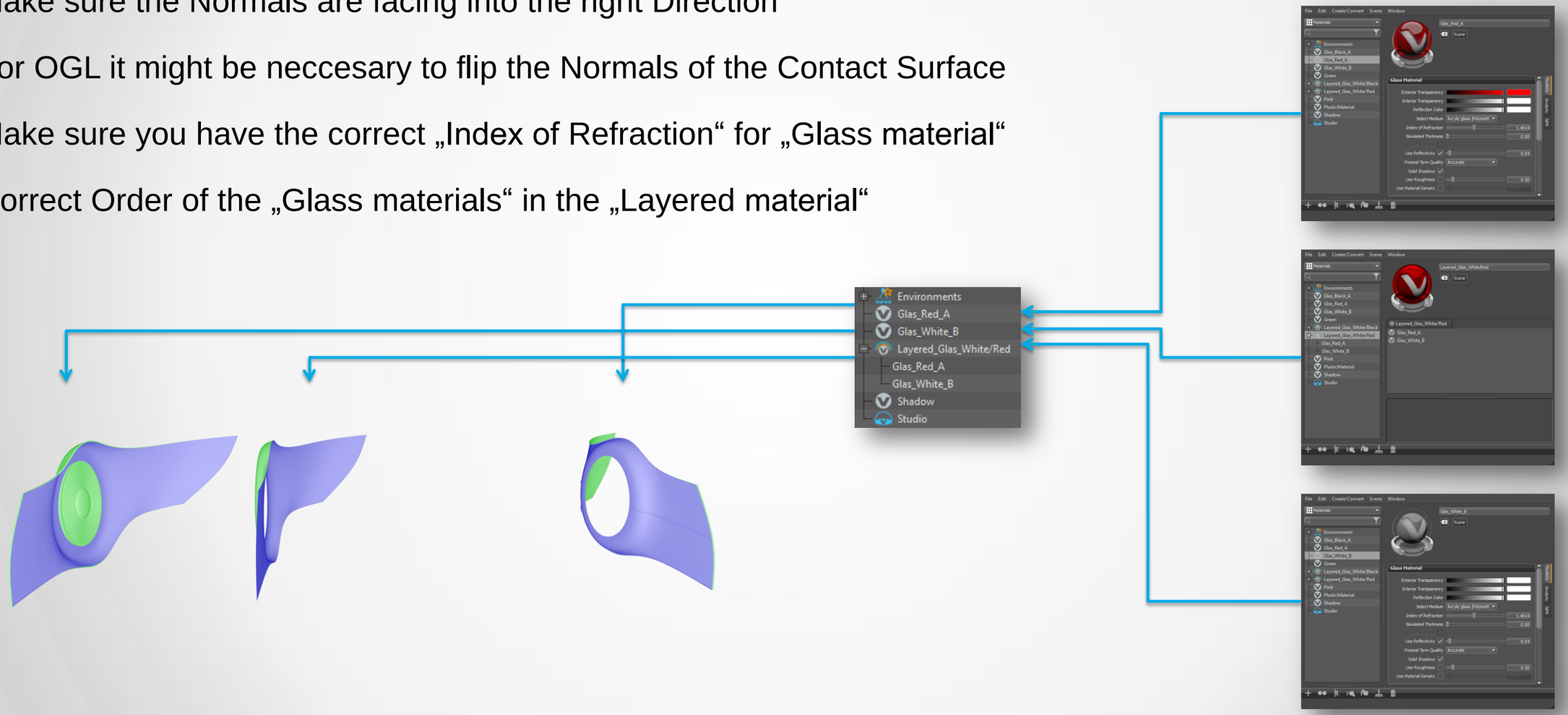
How to use

- Delete/hide the inner Surface of the Red Glass and keep only the White One
- This will be our new Contact Surface the „Layered material“ is assigned to



How to use

- Make sure the Normals are facing into the right Direction
- For OGL it might be neccesary to flip the Normals of the Contact Surface
- Make sure you have the correct „Index of Refraction“ for „Glass material“
- Correct Order of the „Glass materials“ in the „Layered material“



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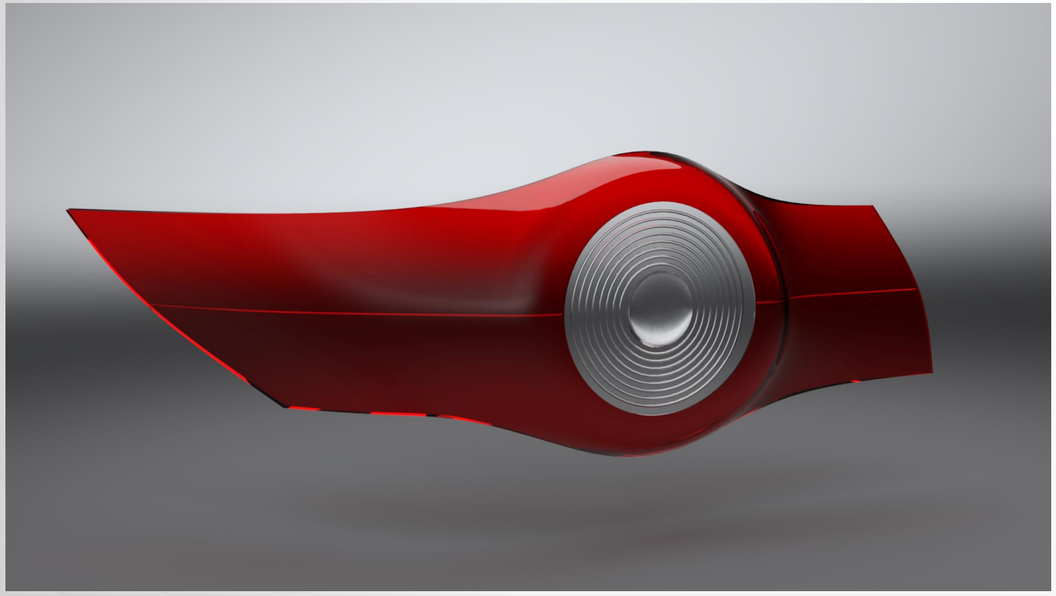
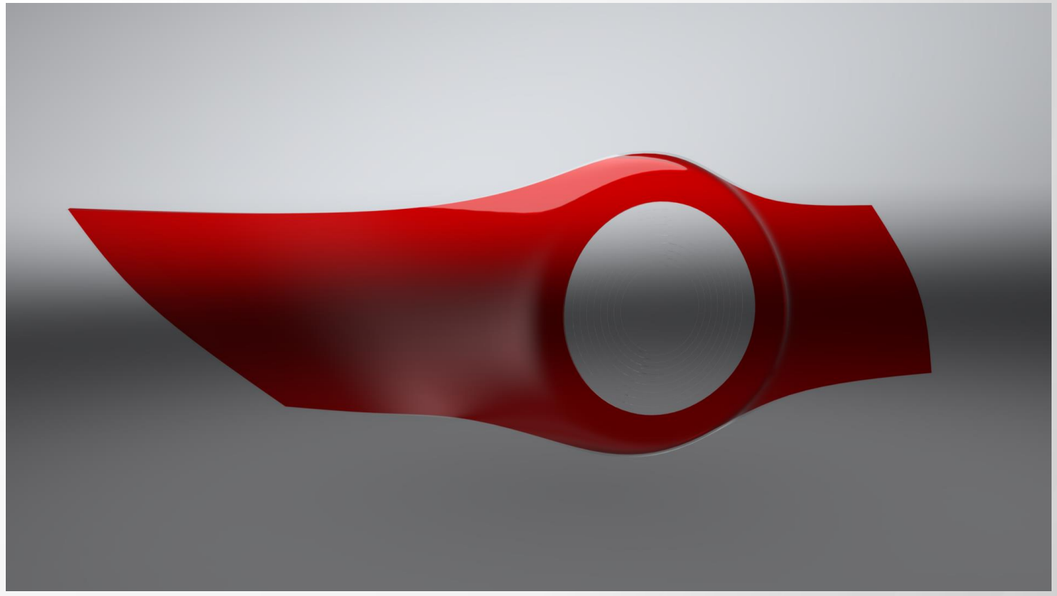
How to use

- Correct Result in Raytracing (Img.1) and OGL (Img.2)



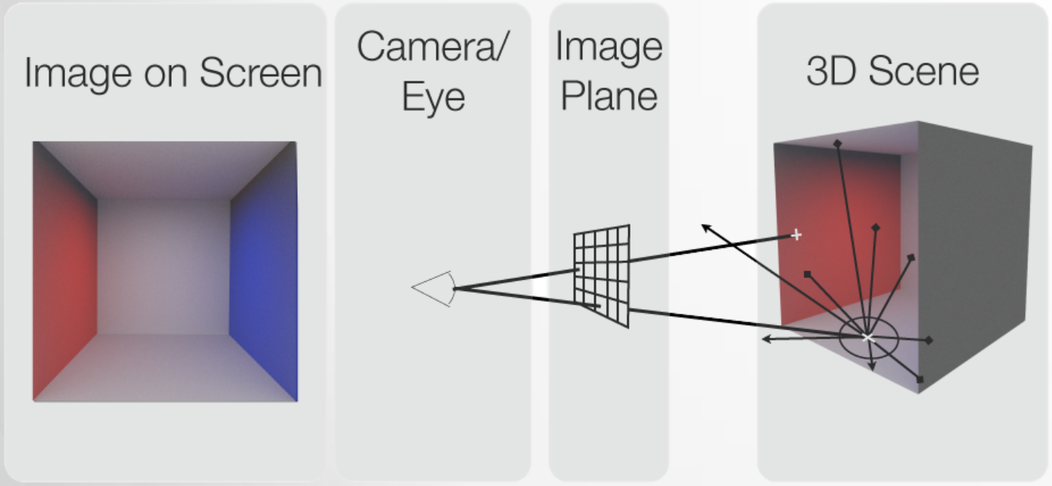
Img.1

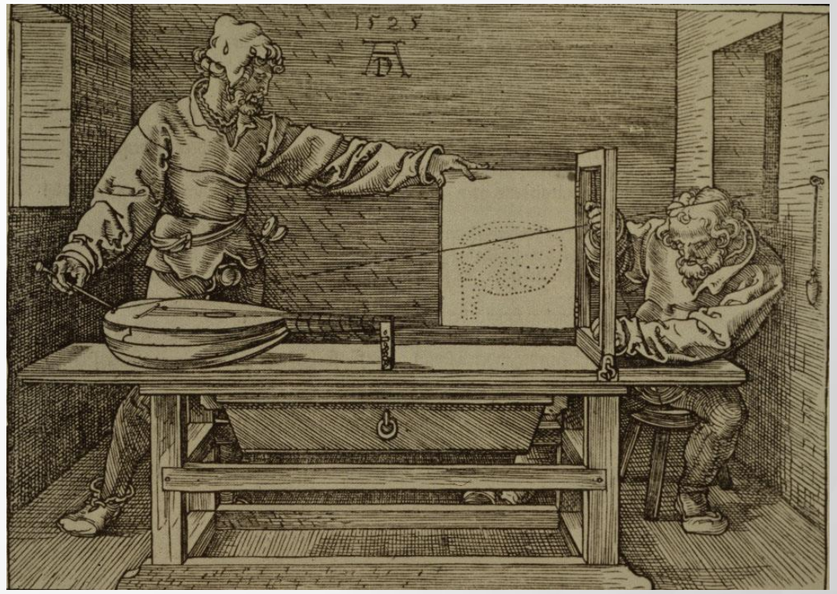


Img.2

Raytracing

- Technique for generating an Image by tracing the Path of Light through Pixels in an Image Plane and simulating the Effects of its Encounters with Virtual Objects



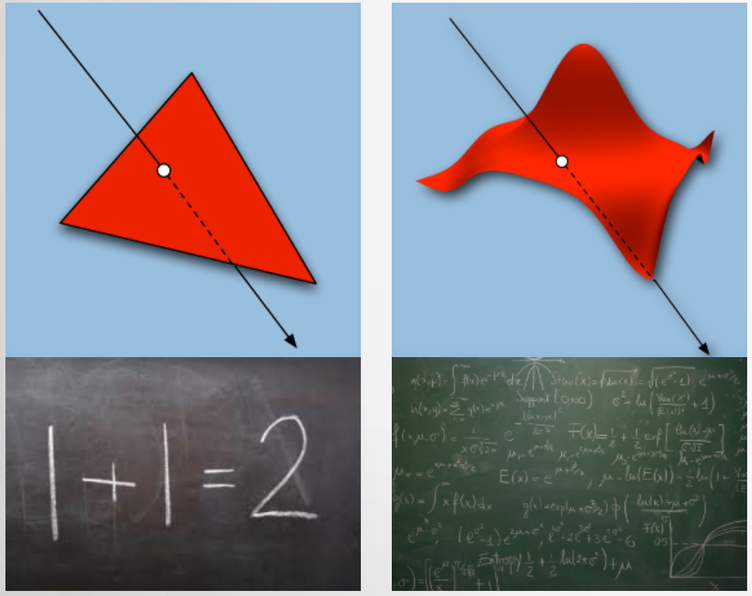


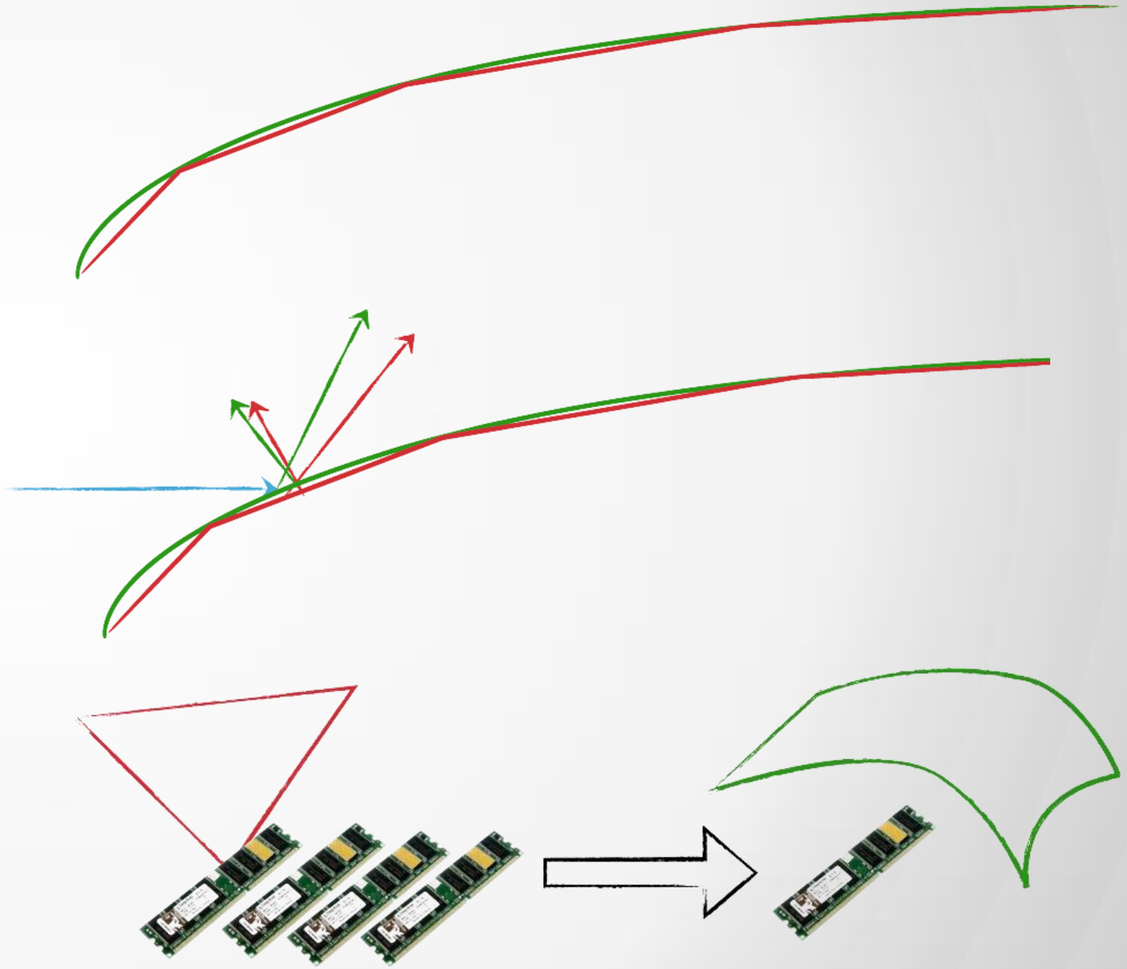
www.wikipedia.de

AUTODESK.

Nurbs Raytracing

- Perfect Sillhouette and Reflection
- Reduced Memory Consumption





Nurbs Raytracing

- What makes the Difference?
- Closer Look into a metallized Rearlight Reflector Geometry

www.netcarshow.com

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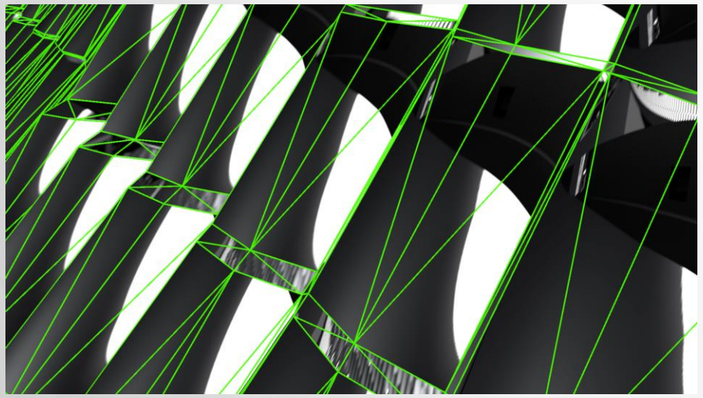
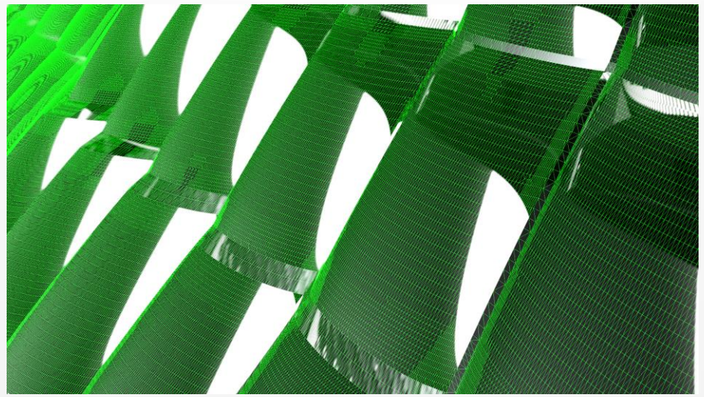
Nurbs Raytracing

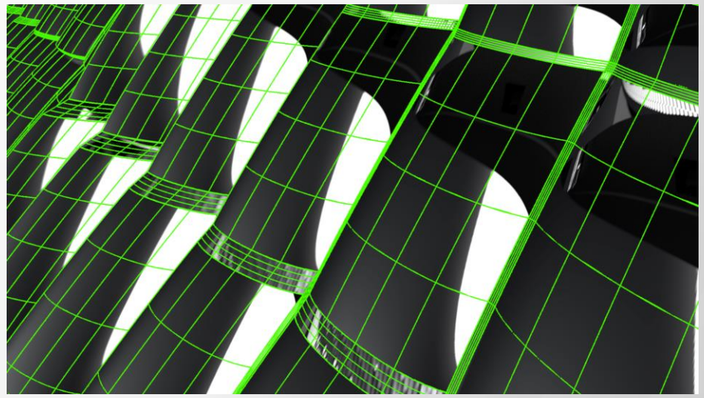
- Lower Tesselation means inaccurate Reflections but also a sober Filesize in case of Loading Time and Navigation Performance (Img.1)
- Higher Tesseletion means more accurate Reflections but also a bigger Filesize and longer Loading- and Distribution Time (Img.2)
- Nurbs Raytracing generats the most accurate Reflection Results with the Advantage of a low tesselated Geometry (Img.3)



Img.1



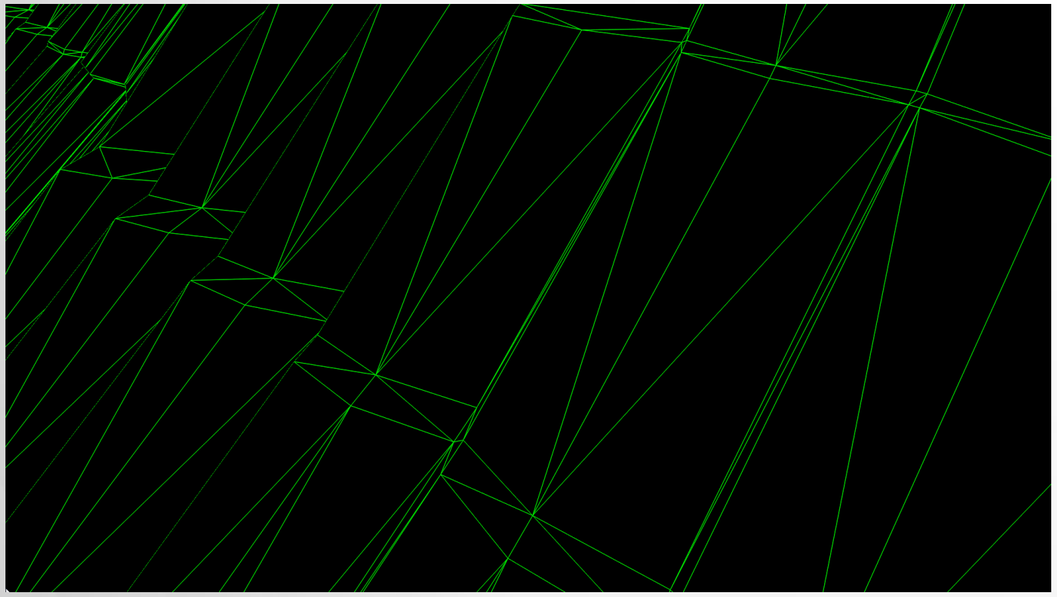
Img.2

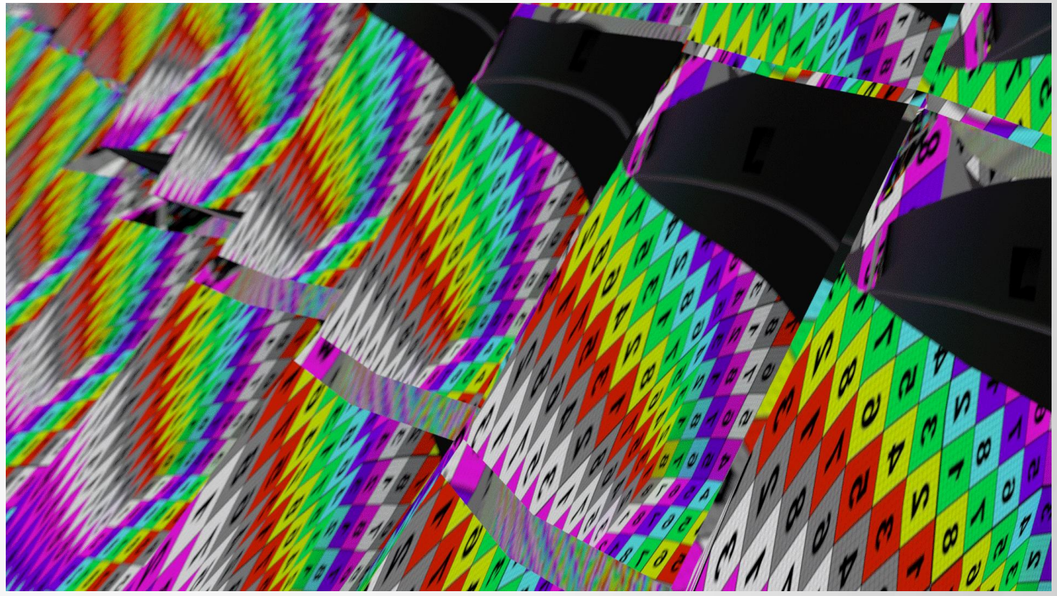


Img.3

Nurbs Raytracing

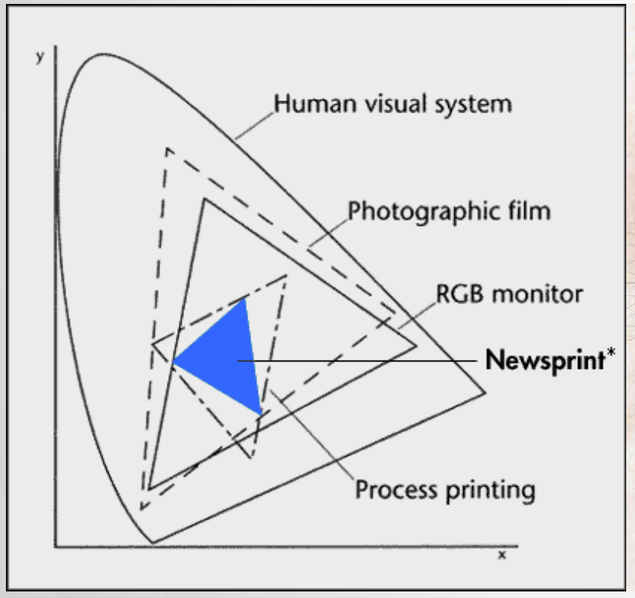
- Comparison of Polygon and Nurbs Raytracing





What you see

- VRED can Render in HDR Format
- The Color Range of the Human Eye is much bigger than what can be displayed on a RGB Monitor!
- HDR + Spectral Color Monitor would be neccesary to solve this



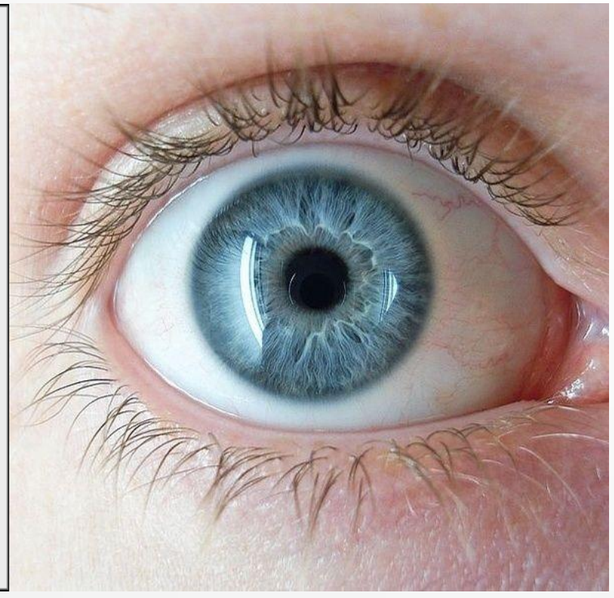


Image courtesy of Boston Globe Media

Additional Features

- Camera- Rendersettings can be stored in the image metadata
- Motionblur, Depth of Field
- Clipping-/Cutplanes
- HDR, EXR and TIFF
- Variants sets (Light On/Off, Environment, Geometry, eg.)
- Batchrendering , Renderque & Sequenzer
- Linear CPU Raytrace clustering
- True Nurbs allows retesselation at any time

Model courtesy of nagym, www.grabcad.com