Kerkythea Material Editor

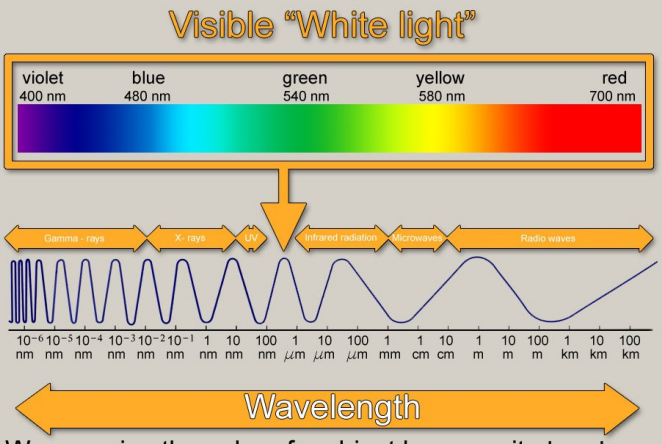
Text and Images by Patrick Nieborg (a.k.a. patricks)

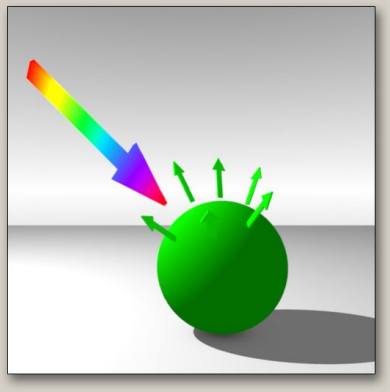
Table of Contents

1 Diffuse Color & reflected Light 3
2 Specular is reflection ! 4
3 Material & Layer selection Menu 5
4 Layered Material & Weight 6
5 Sub Layers 7
6 Layer Weight organization 8
7 3 different ways to create an apparently correct plastic material 9
8 Fresnel Reflection 10
9 Fresnel Reflection & IOR 11
10 Automatic Energy conservation 12
11 Get Material Instance 13
12 Core Feature 14
13 Ambient 14
14 Diffuse 15
15 Specular Reflection 15
16 Specular Shininess 16
17 Reflection 16
18 Refraction 17
19 Translucency 17
20 Transmittance 19
21 Transmittance Shininess 19
22 Self Luminance 20
23 Absorption 21
24 Anisotropcio reflection 21
25 Dielectric Glass 22
26 Thin Glass 22
27 Wireframe 23
28 Bitmap 24
29 Bitmap Coordinates Panel 25
30 Normal Ramp 25
31 Fresnel Ramp 26
32 Partial coverage 28
33 Diffuse/Specular Map 29
34 Mask 30
35 Metals 32
36 Sub Surface Scattering 35

Materials are a very important part of a rendered image and can make the difference between a photo realistic looking image and an artificial looking one. Kerkythea provides a powerful Material Editor System that allows an extreme control over the final aspect of the created material. Kerkythea material properties are based on physical laws and therefore are very accurate. Before we can build one we need to know some aspects of physical laws to understand better how we can create our own materials, so let's have a look at the following image.

Diffuse color & reflected Light

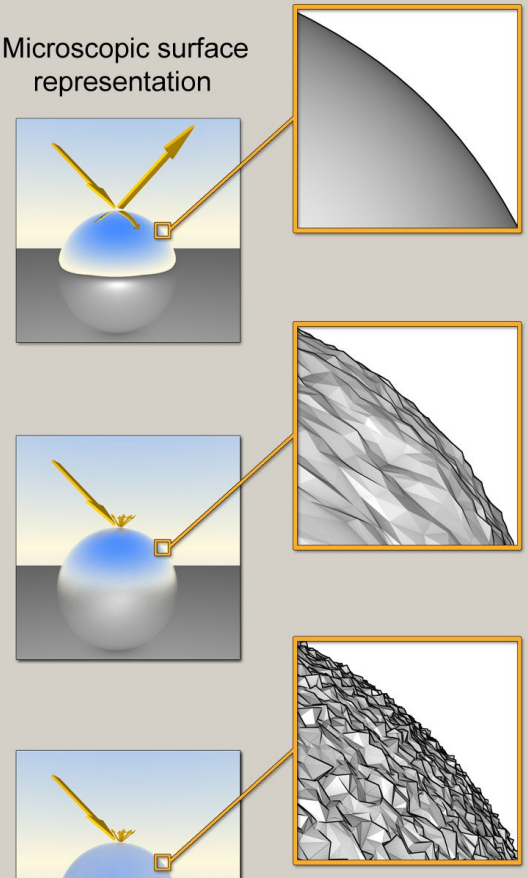




The visible light is only a small portion of the electromagnetic radiation spectrum.

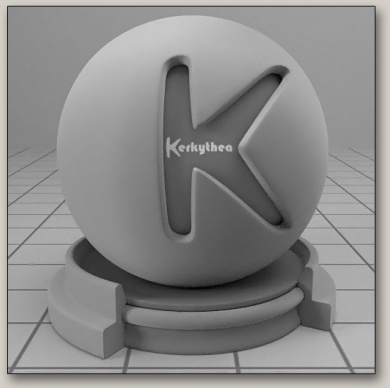
We perceive the color of a object because it absorbs some wavelength more then others and reflects those that are not absorbed. It is important to notice that all light is reflected light and that most common Materials reflect their color in a diffuse way but also reflect light in a specular way which depend on their Microscopic surface properties

Microscopic surface representation



DIFFUSE COLOR

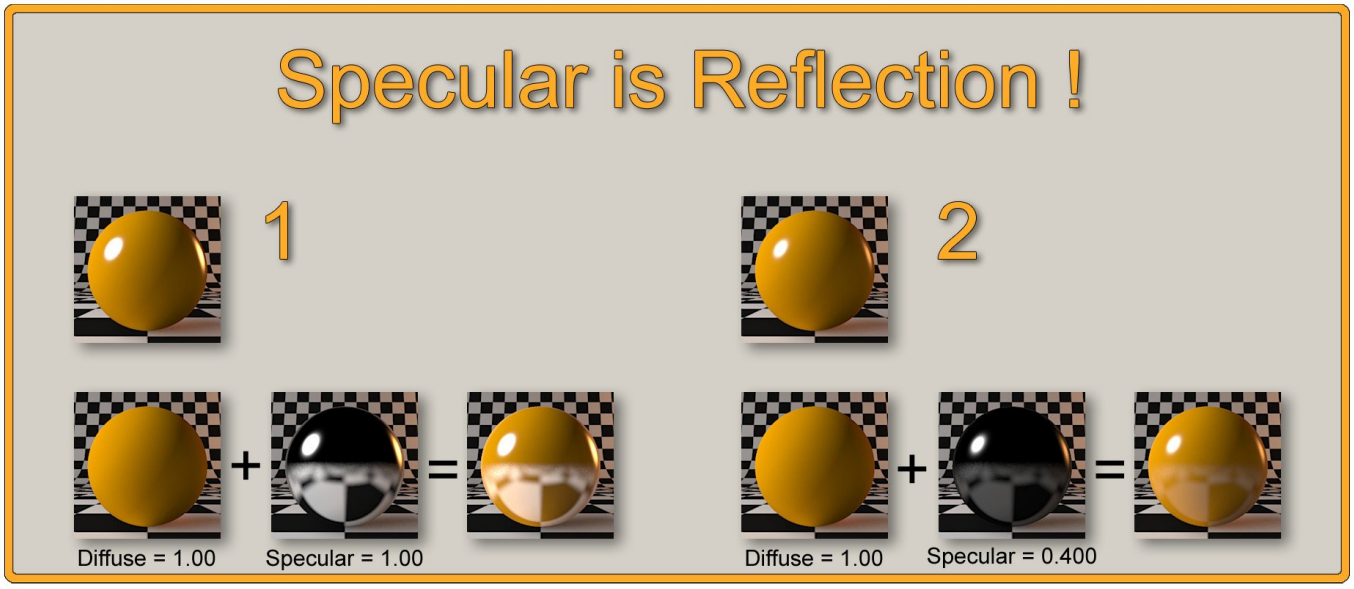
This is Kerkytheas Diffuse matt and is used to define the color of the material.



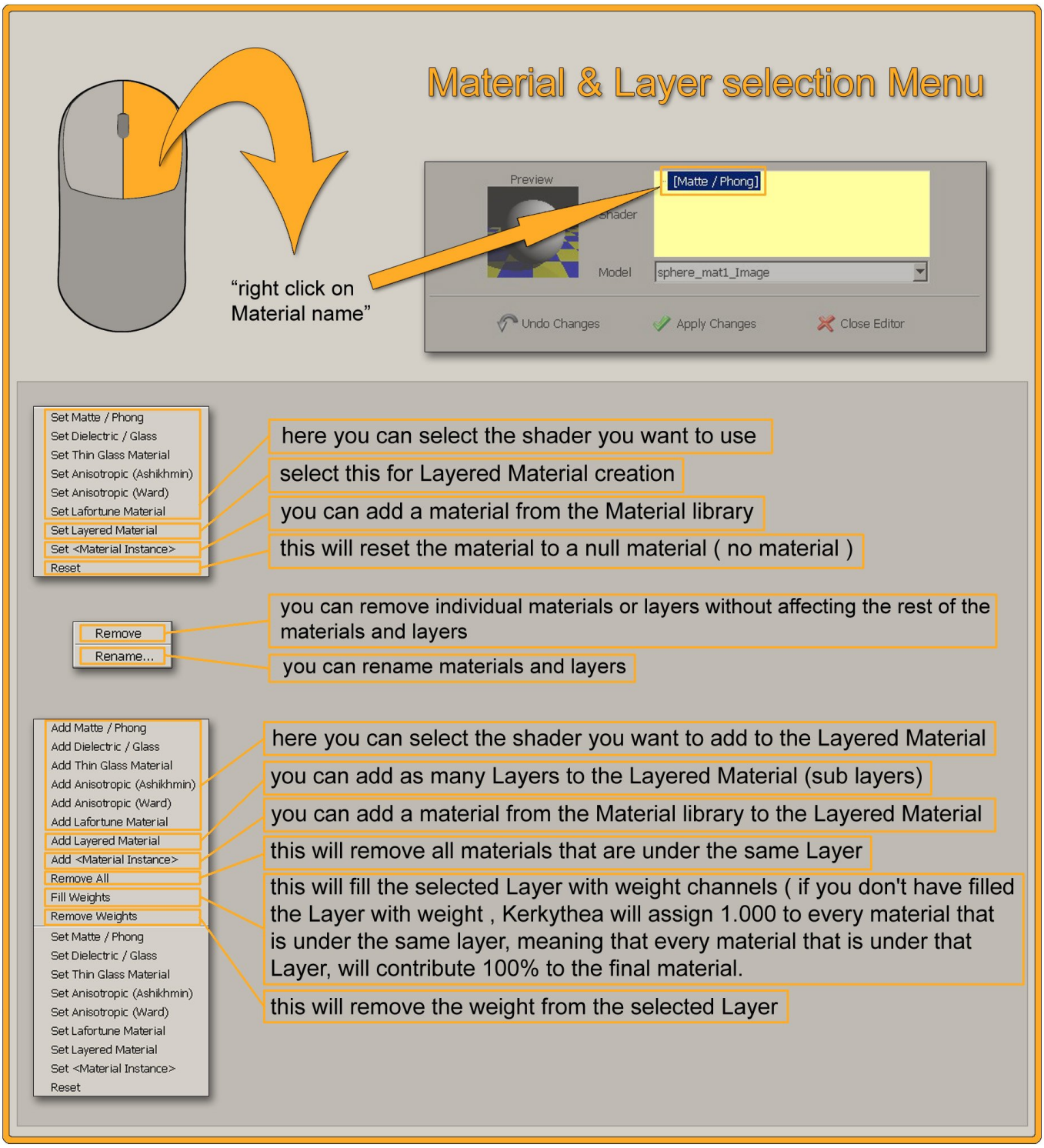
SPECULAR COLOR

reducing the shine value to 0.001 in x and y (Ashikhim anisotropic) we are changing the Microscopic surface property to a very rough surface and the light reflects in a diffuse way.

As you can see all light is absorbed and reflected light. Understanding this is a very important part to be able to create accurate materials. If you have some experience with other render engines, you will have to relearn some concepts that are widely accepted but not physically accurate at all. One common mistake is the distinction between specular and reflection. Both represent the same physical property of a material, light being reflected in a specular way. So why does this distinction between specular and reflection exist? The answer is that most 3D programs are realized for animation rendering and therefore physical accuracy are exchanged for rendering speed. One second of an animation represents at least 25 images and the cost in render time for accurate specular reflection is too high, therefore specular reflections are faked in these kind of render engines (typically a scan line render) meaning that in the best case, only the light source is being sampled. If you have a look at the next image, you can see that both spheres 1 and 2 look very similar but when you turn specular sampling on in Kerkythea, you can see the difference. So why is this important? It is important because of a physical Law called Energy Conservation. As the first image explained that all light is reflected light, this means that the diffuse color is reflected light and the specular color is also reflected light. An object can only reflect the light it receives, thereforewe have to make sure that our diffuse color and specular color don't exceed the amount of light it receives, meaning that both diffuse and specular have to be in the 1.000 intensity limit!
If not, we are creating a material that reflects more light then it receives and this is not physically accurate. The common mistake is to set the specular color to a high intensity value because you could do that in a scan line render without any problem but with Kerkythea, specular is rendered accurately as reflection and thereforeyou have to be sure to set a proper value that doesn't violate the Energy Conservation Law. The same rule has to be used with transparent or semi-transparent materials because the light that passes through an object cannot also be reflecting from it at the same time.



Kerkythea allows you to turn specular sampling on or off depending if you want to fake a material property or not. Turning specular sampling off will speed up render time but be aware that this can only be used with the Photon Map & Final Gathering render method (or any other Biased Method). Kerkythea will automatically turn specular sampling on when you choose an unbiased render method like Path tracing, Bidirectional Path tracing or Metropolis Light Transport.
There is another important physical Law called Fresnel Reflection (Fresnel effect) but I am going to talk about this later. Now it is time to learn something about the powerful Material Layer System of Kerkythea. A good way to perceive the Material system of Kerkythea is to think of it like combining different material properties to create our final
Material and in this task, the Layer system is our friend. Let's see the options we get by right clicking on the Material name…



As you can see we have a lot of options we can choose from. "Set Layered Material" and"Fill Weights" will be one of the options we are going to use most of the time besides the selection of the Material Shaders. You may wonder what "Fill Weights" is… Here is a good moment to explain that in Kerkythea there is a separation between the Material Panel where we assign the color to our material components and the Layer Panel where we assign the weight of each material component that will contribute to the final material. This means that when you give a diffuse color to your material or a specular color, the intensity of the colors don't correspond to the exact value you can read on the intensity value. For example if you give a value = 0.800 to the specular color in the Material property panel, this value does not mean that your adding 80% reflection strength to the material!
The % of each material element we have assigned to a material is controlled in the Layer panel and its called Weights. If you give an intensity of 0.800 in the Layer Panel, it will correspond to 80%. Let's create our first Layered Material and fill it with Weights.

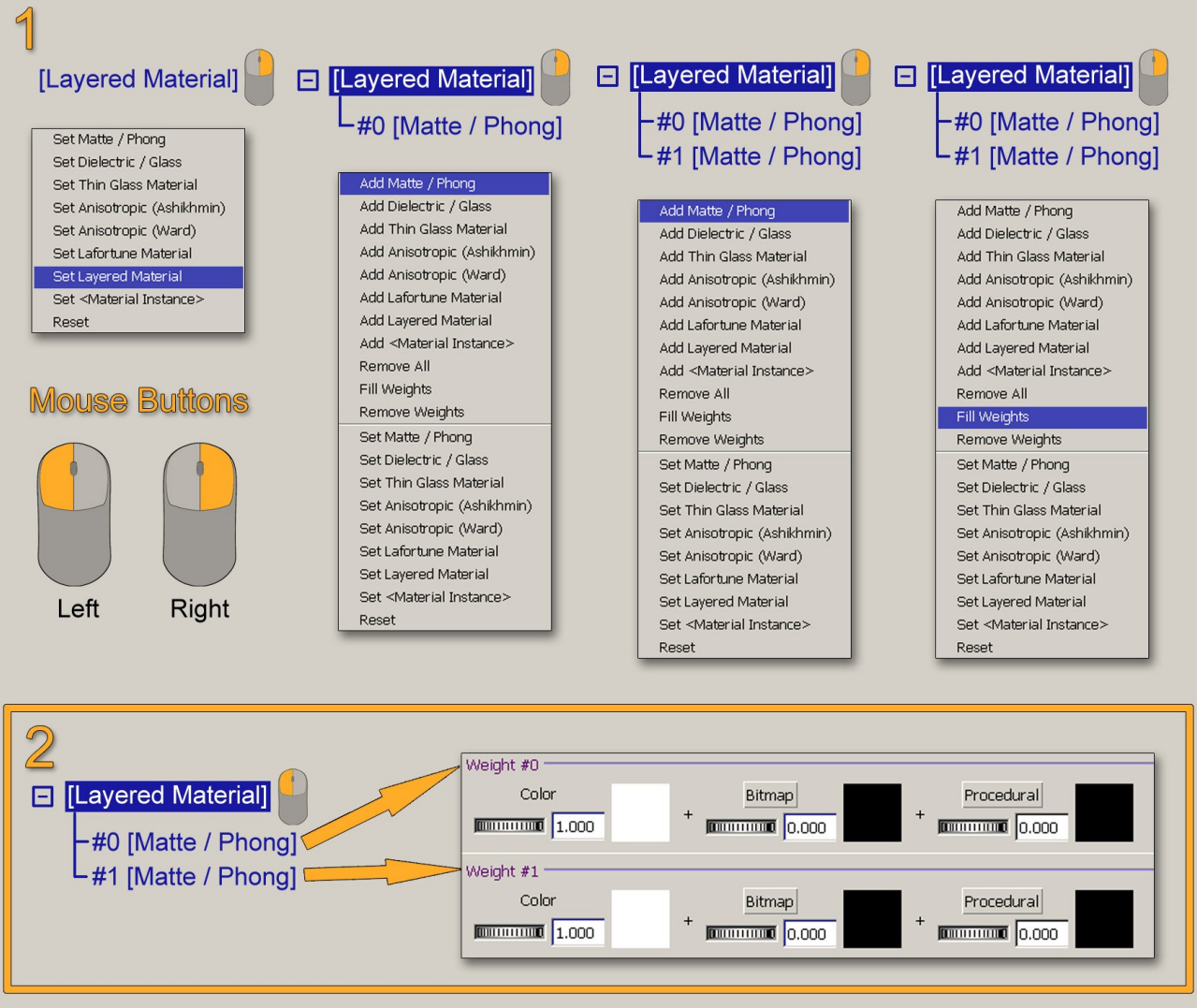
Layered Materials & Weight

⊟ this are the symbols that indicates if a Layered Material tree is open or closed , by left clicking on ⊞ ⊞ you open the Layer tree and by left clicking on ⊟ you close the Layer tree

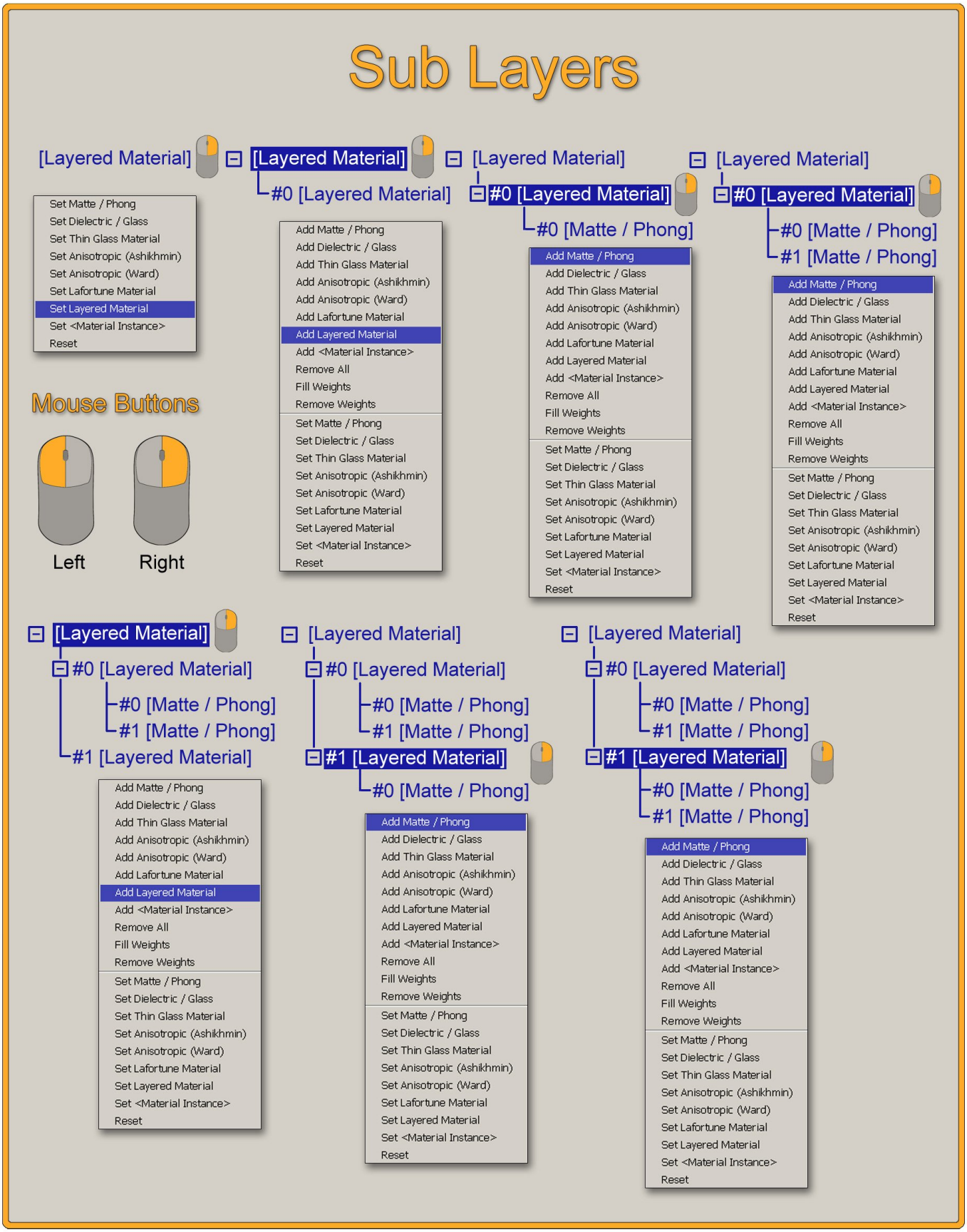
#0 When creating a layered material, for each material or sub layer you add, Kerkythea will assign a number to it. Even you can rename the materials and layers, it is good practice to leave the numbers unchanged.

[Layered Material] Kerkythea uses this name to indicate that the material is a layered material. Even you change the layer name , Kerkythea will add [Layered Material] behind the layer name.

[Matte / Phong] Kerkythea will assign the name of the shader you use behind the material name. This way you will always know which shader you have used when you combine different material properties from different shaders (Layered Material)

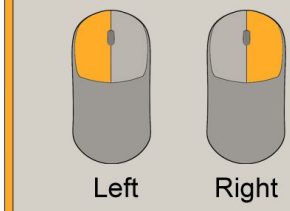


By filling the Layer with Weight, Kerkythea will assign a weight channel for each Material Component we have added. Each weight channel has a number that corresponds to the number of the Material Component. We can also build more sophisticated materials by using Sub-layers…



Now we need to know how Kerkythea handles the weight for each material component and sub Layer…

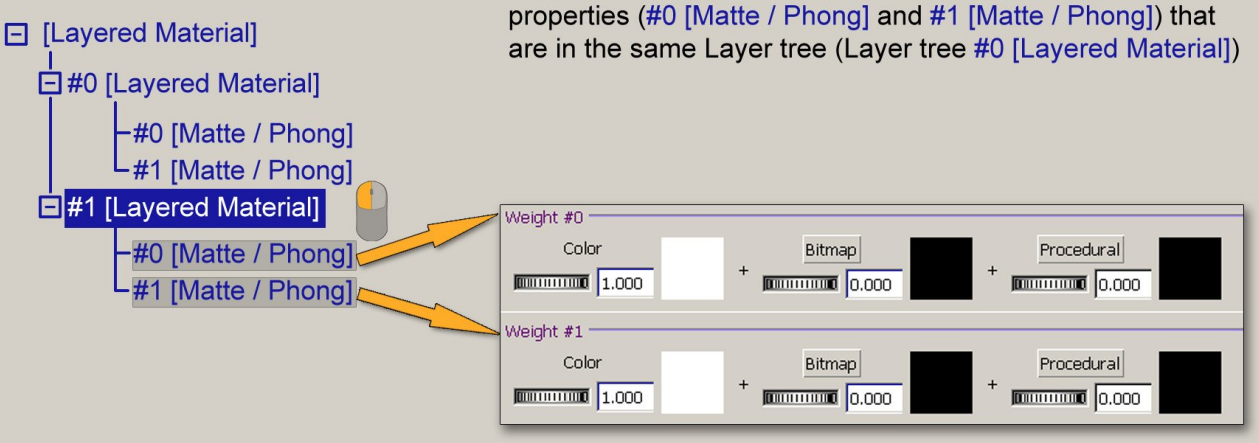
Layer Weight organization



Kerkythea Layered Material system is very powerful do to the possibility of “sub Layers” meaning that you can create very sophisticated Materials. The organization of the Layer weight is very important .Each Layer controls the weight of the Material component and/or additional Layer that is in the same Layer tree

The first Layer will control the weight of #0 [Layered Material] and #1 [Layered Material]. Notice that it will control the results and not the shader components of the “sub Layers” .

#0 [Layered Material] controls the weight of the two material properties (#0 [Matte / Phong] and #1 [Matte / Phong]) that are in the same Layer tree (Layer tree #0 [Layered Material])



#1 [Layered Material] controls the weight of the two material properties (#0 [Matte / Phong] and #1 [Matte / Phong]) that are in the same Layer tree (Layer tree #1 [Layered Material])

We are ready to create our first material. I will show you how to build a basic plastic material because plastic shares 99% of the physical behavior of most common materials, meaning that if you want to create a varnished wood material or leather, you would need to follow the same steps like you do when creating a plastic material. I will show you 3 different ways to create an apparently correct plastic material. The first two ways of creating a plastic material are very common in other render engines and maybe you are used to doing them this way. The third one uses the Procedural Fresnel shader and I will explain it in depth later.

Material 1 uses a Matte/Phong Diffuse element and the reflection from the Dielectric Glass shader with an IOR (Index of Refraction) = 3.00 and Fresnel turned on. The weights for each element are 0.800 (80%) for Diffuse and 0.200 (20%) for reflection.

Material 2 uses the same Matte / Phong Diffuse element and the reflection from the Matte/Phong shader. Here we don't use IOR and don't use Fresnel. The weights are for Diffuse = 0.900 (90%) and for Reflection = 0.100 (10%)

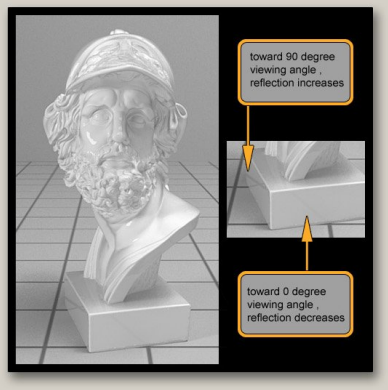
Material 3 uses the same components as Material 2 but the weight channel uses the Procedural Fresnel shader instead of the color intensity. Just follow the steps in the image and copy the values for the procedural Fresnel shader (you can access Procedural Fresnel by clicking on the Procedural thumbnail window)
Apparently all 3 Materials should give an accurate plastic material because none of them is violating the energy conservation Law. But this is not the case because of a physical Law called Fresnel effect. Let's compare these 3 Materials and see how Fresnel works...

Fresnel Reflection

Fresnel attenuation is how the reflection/refraction behave on the material ; most common materials have a Fresnel attenuation which makes the object more reflective when looking at glazing angle. The reflection strength is controlled by the IOR value, Increasing the IOR value , increases the reflectance at 0 degree viewing angle (at 90 degree viewing angle reflectance is always 100%). The reflection/specular color should be set to 1.000 white ! (the reflection strength is not controlled by the reflection/specular color intensety, it is control by the IOR and the weight in the Layer panel).

IOR 1.500 = reflectance at 0 = 4.0%
IOR 3.000 = reflectance at 0 = 25.0%
IOR 5.000 = reflectance at 0 = 44.0%
IOR 10.000 = reflectance at 0 = 67.0%
IOR 20.000 = reflectance at 0 = 82.0%
IOR 50.000 = reflectance at 0 = 92.0%
IOR 100.000 = reflectance at 0 = 96.0%
IOR 200.000 = reflectance at 0 = 98.0%
IOR 500.000 = reflectance at 0 = 99.2%
IOR 1000.000 = reflectance at 0 = 99.6%

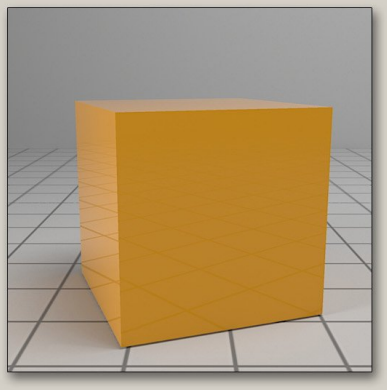
Thanks to Thomas An. for the IOR list ;-)



Fresnel Effect

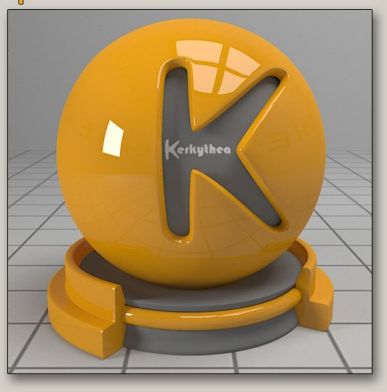
3

Diffuse weight = Procedural Fresnel
Specular weight = Procedural Fresnel
IOR = 1.460

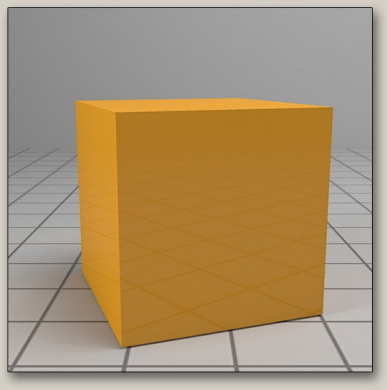


No accurate Fresnel Effect

1

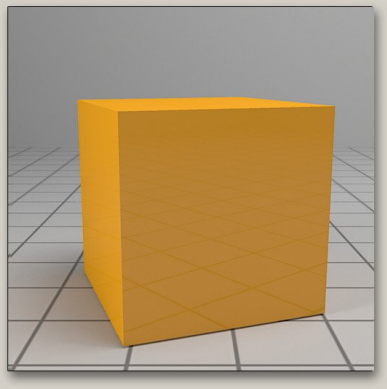


Diffuse weight = 0.800
Specular weight = 0.200
IOR = 3.000



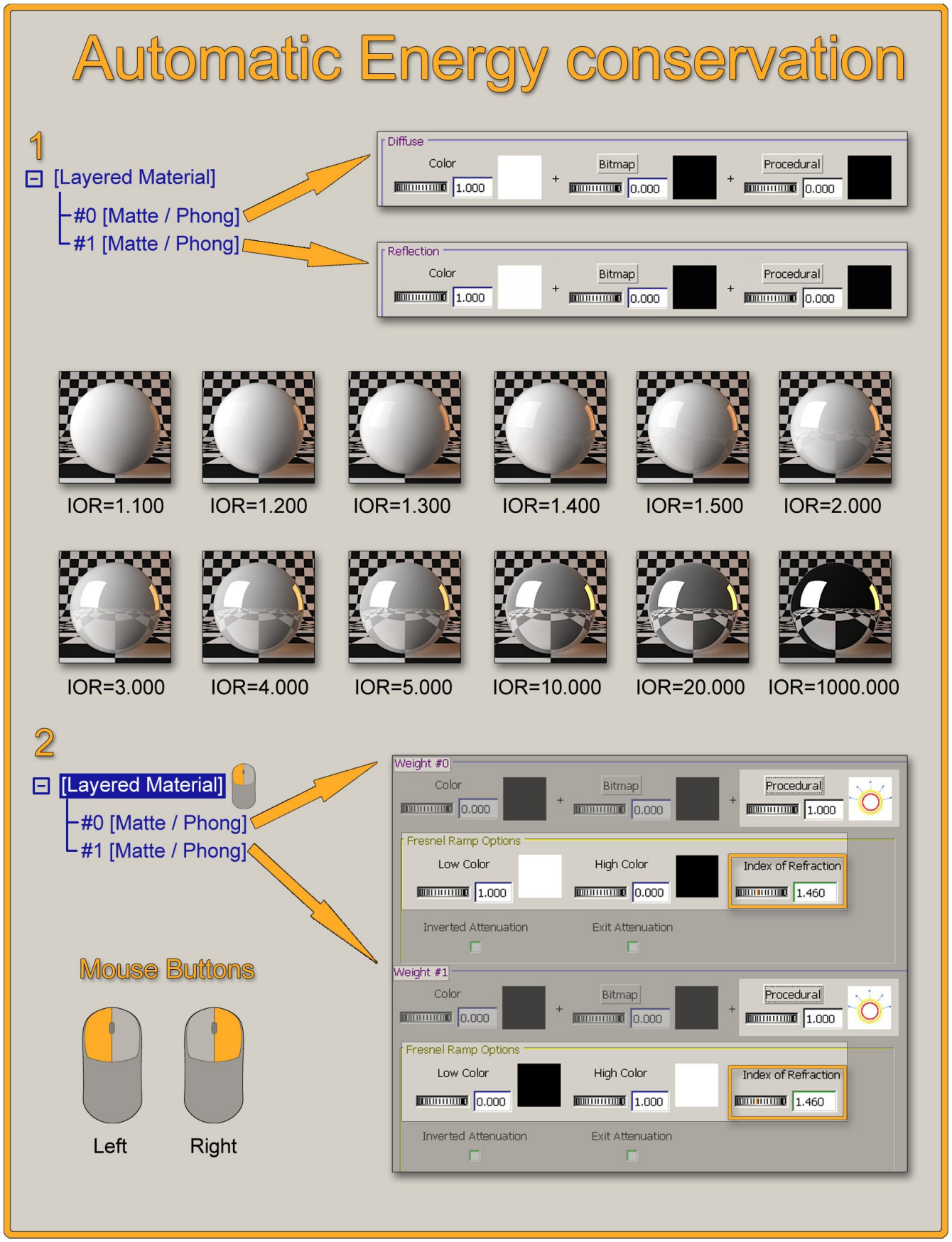
2

Diffuse weight = 0.900
Specular weight = 0.100
No Fresnel Attenuation



Looking at the materials applied on a spherical shape we don't see so much difference but applying it to a box shaped object, the difference between Material 3 and the other two (material 1 and 2) are evident. What is going on? Why does material 1 with an IOR = 3.00 AND Fresnel enabled show a different effect? The answer is because of the way Fresnel works. As I explained in the image above, Fresnel is governed by the IOR value meaning that *by increasing the IOR value, we increase the reflection at the 0 degree viewing angle and Fresnel calculates the reflection distribution on the object. At 90 degree viewing angle reflection is always 100%.* This means that the Procedural Fresnel shader is calculating a gradient from 0 degree viewing angle to 100% reflectivity at 90 degree viewing angle depending on the IOR value we have set. Every Material has its own IOR (Index of Refraction) value and you can find accurate indices for the material you want to build in Optical Reference Tables. Probably you have heard of IOR for Glass and transparent objects but these values are also for non-transparent objects. In the next Image you can see how IOR affects the reflection by increasing its value.

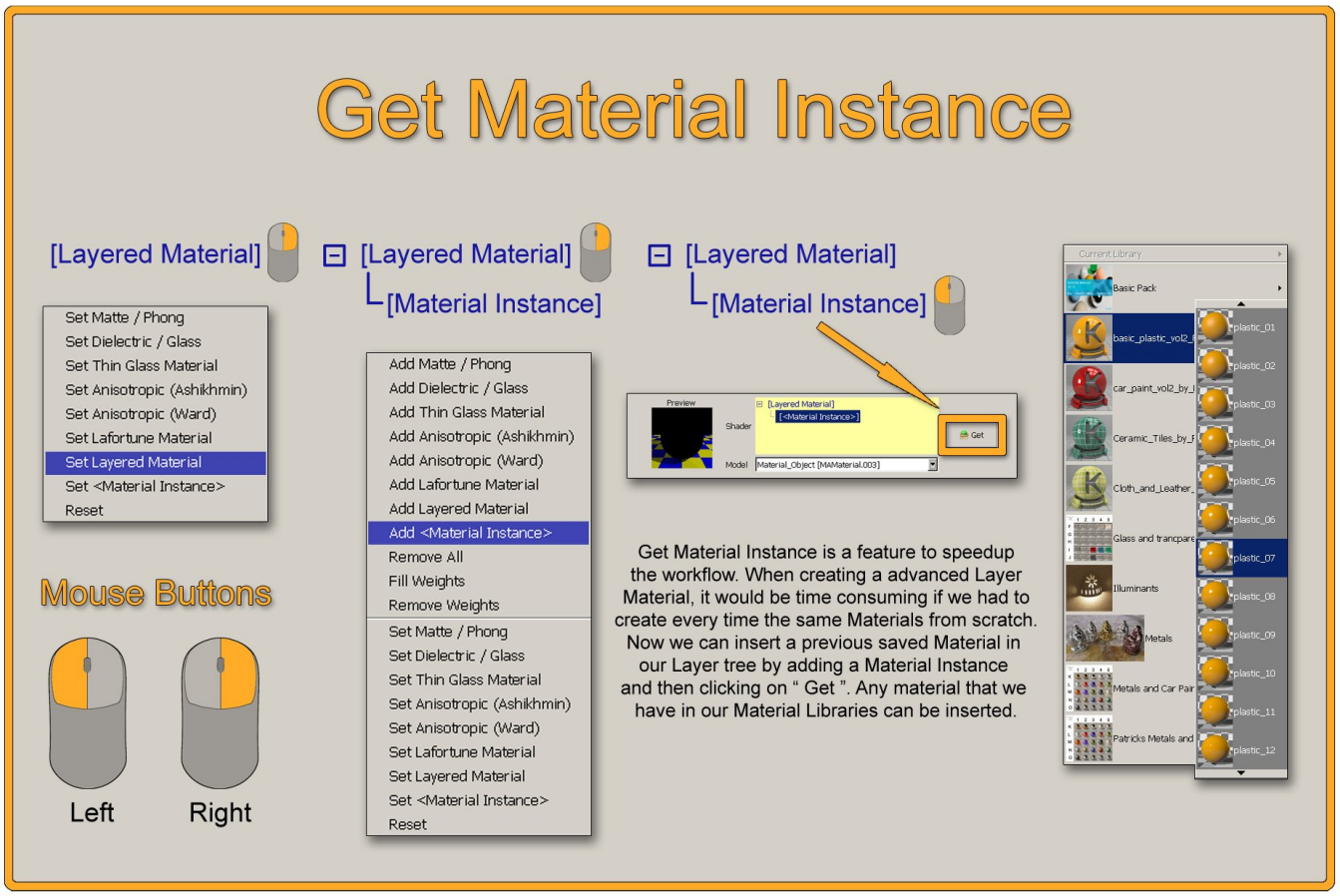
Now back again to our question, why does material 1 with an IOR of 3.00 not show the Fresnel effect. If we look at the Material components, we see that we have used the reflection of the dielectric shader with reflection intensity = 1.000. Until here everything is correct. We can look at the Fresnel & IOR image and see how the Fresnel reflection with IOR = 3.00 would look. But now we have to accomplish the energy conservation Law and so we have to give the reflection component a weight according to the weight we have given to the diffuse component. In this case I have chosen 0.800 for diffuse and 0.200 for the reflection (0.800 + 0.200 = 1.000) energy conservation is correct. But Fresnel Law says that at a 90-degree viewing angle, reflection is 100%. Our reflection component can not accomplish this Law because we have given it a weight of 0.200 to accomplish the energy conservation Law, meaning that at the end our reflection component will only reflect 20% at 90 degree viewing angle (weight = 0.200 is equal 20% reflection max). Material 2 does not use Fresnel but the problem is the same, we have given a weight = 0.100 for reflection and 0.900 for diffuse, meaning that our reflection component will only reflect 10% max. It looks like there is no way to accomplish both Laws at the same time. If we want to have accurate Fresnel reflection, we would need to set the weight to 1.000 (100%) but then we violate the energy conservation Law because any diffuse component we add to the reflection would increase the total reflection to more the 100%. The solution for our problem is the Procedural Fresnel shader that can accomplish both Laws at the same time...



Here I created a white plastic material to demonstrate the accuracy and easy use of the Procedural Fresnel solution. The Procedural Fresnel shader works exactly the same way as the Fresnel in the Material Panel but with the advantage that we can have more control over it when needed. This would be the basic plastic material setup and *the important part here is that the Procedural Fresnel for the Diffuse Color Weight has to have the Low and High Color inverted (this is very important)*. By changing the IOR

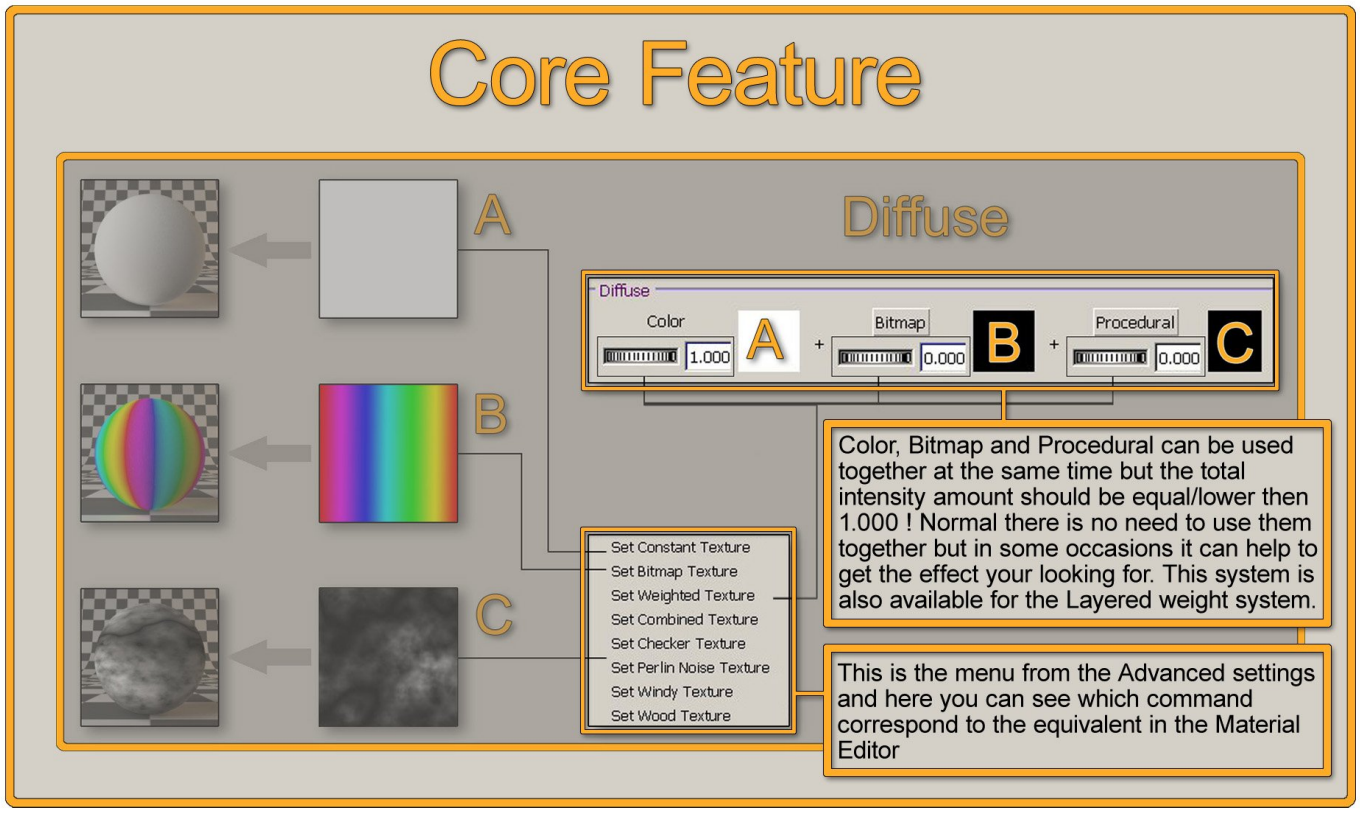
values in both weight channels we can change the reflection strength without having to make any other changes. Notice how by increasing the IOR value, the diffuse color gets less visible until it disappears completely. This is predicted by physical lLaws because the more reflective an object is, the less it shows its own diffuse color. Another advantage is that we don't have to care about our diffuse color and specular color in the Material panel, because both can be at 1.000 because the Procedural Fresnel is taking care of the energy conservation and Fresnel Law. Even more, the specular color must always be set to 1.000 intensity! Now that we have created our basic plastic material, adjusting it for our needs is very easy because we only have to give it the appropriate diffuse color and adjust the shininess value to make the reflection more blurry or more crisp, adding a bump map to it if needed and that's it. The main difference in Kerkythea is that we are creating Materials, meaning that once we create a plastic material, we don't have to do it again, it will work with any diffuse color or bitmap we give to it without having to change any IOR value or specular color strength intensity! As I mentioned before every material has its own IOR value that can be found in optical tables on the internet. Common plastic has an IOR around 1.46 (depending on the type of plastic, the IOR can change from 1.46 until 1.66 more or less) but for a ceramic material, an IOR = 1.51 would be more appropriate.

You may think that this material setup can be time consuming if you want to create a more sophisticated Layered material with Sub-layers. Not at all, in Kerkythea we have the possibility to add materials that we have saved in our Material library to our Layer tree. Have a look at the next image that explains how to do it.

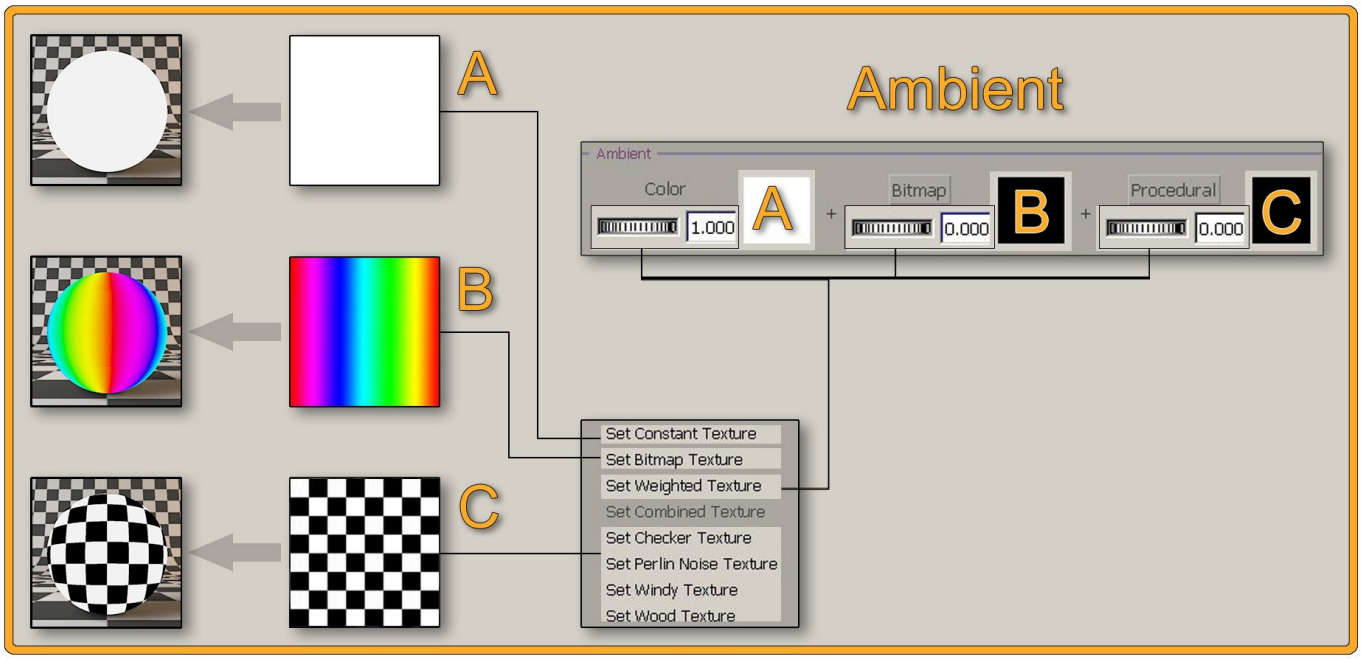


We have covered an important part of material creation and I hope you could follow all my explanations and see how important energy conservation and Fresnel reflection are.
Accurate Fresnel reflection is one of these things that will contribute to a more realistic looking material and as the Fresnel effect is more visible on Box shaped objects, you will see the difference in your renders immediately (just think of all the objects that we have around us everyday, most of them are box shaped objects …. Walls, Floors, Furniture's ….etc.). It is important that we take a close look at the objects around us and see for how the Fresnel effect shows up on those objects (reality is always our best judge!)

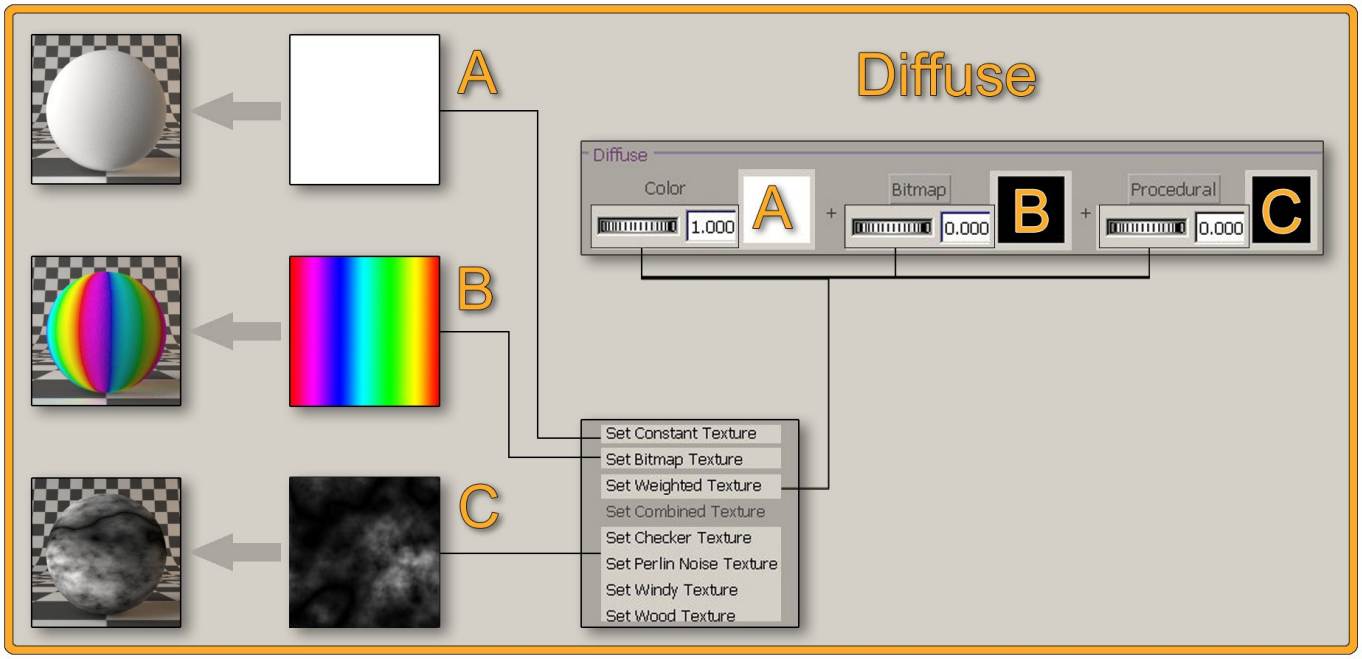
Let's have a look at the Material shaders and the components Kerkythea offers to build our materials. Before we start getting into details, I want to show one of the "Core Features" of Kerkythea…



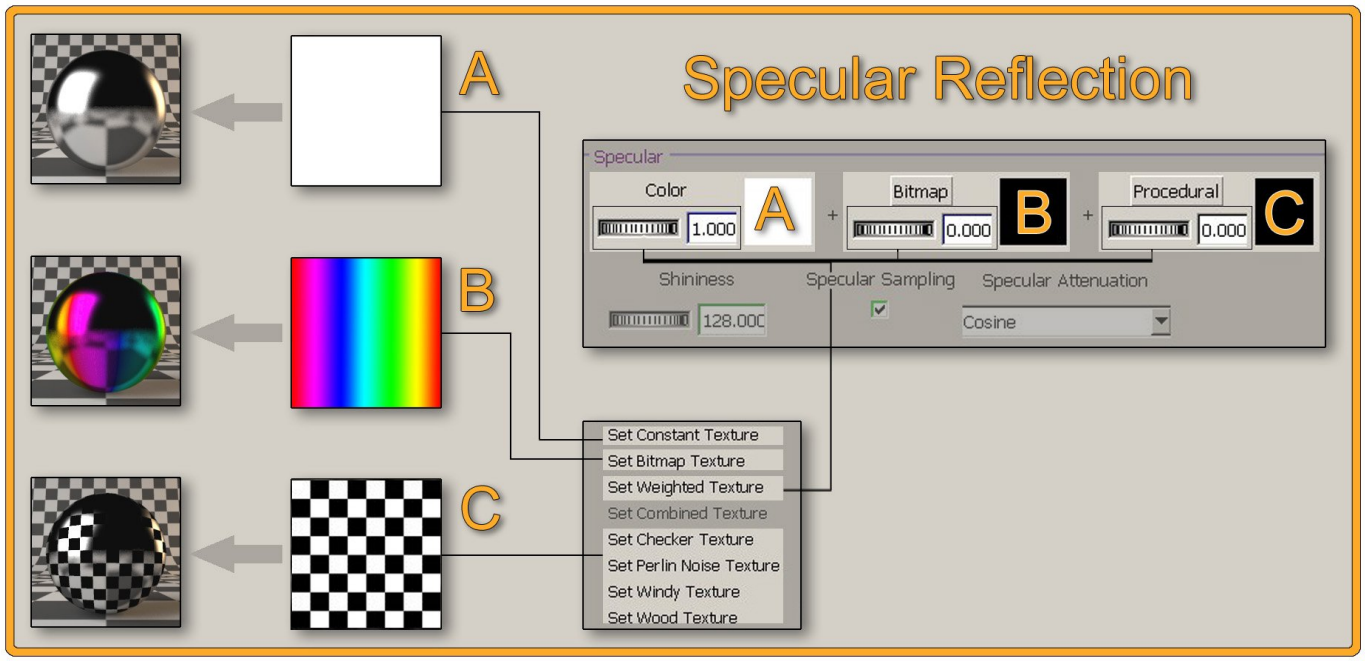
Kerkythea lets you use a Color, Bitmap or Procedural shader for nearly all shader elements and also for the Layered Weight Channels. You can even use them together at the same time but remember that they should not sum more than 1.000 together. Laterwe will see how we can use them to enhance our materials. The words "shader" and "material" are used interchangeably throughout this tutorial.



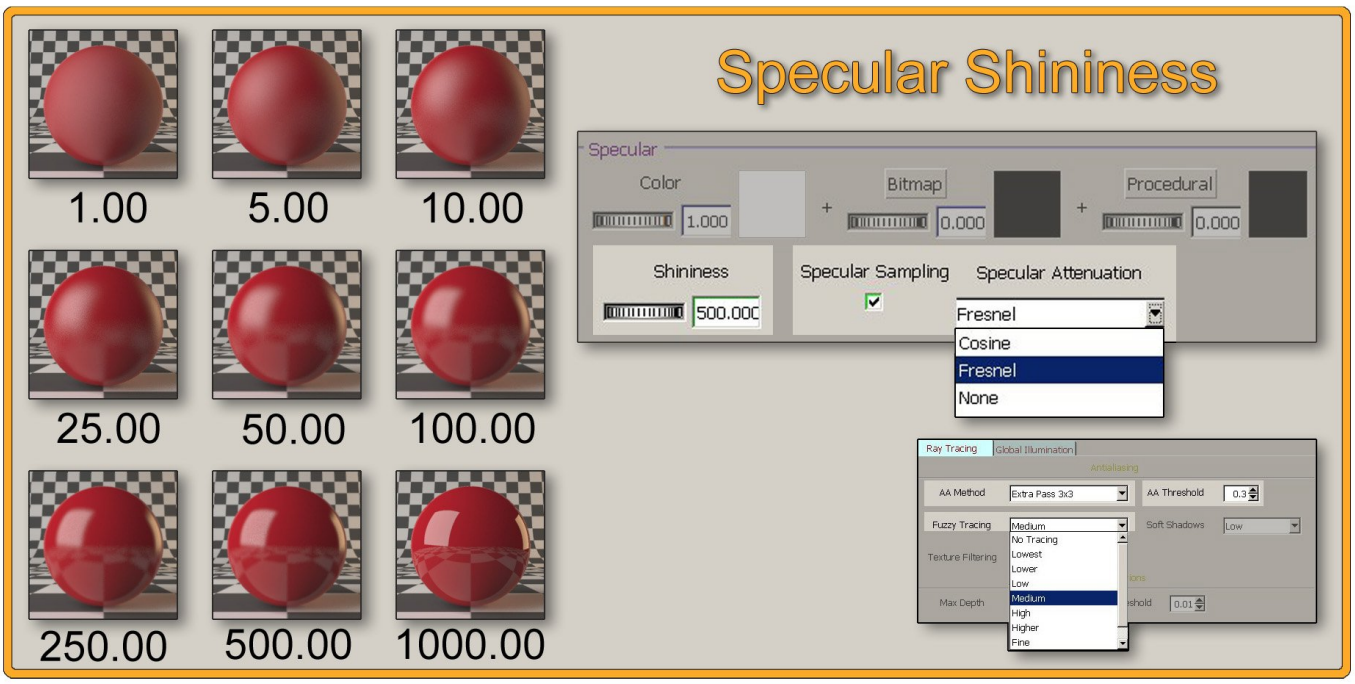
Ambient color is an "old" feature that survives from the days of scan line renders.
The original need for it was to simulate ambient light coming from the sky or indirect light in an indoor scene. With Kerkythea we don't need to fake ambient light because we have physically accurate GI render methods but for those who want to use the plain ray tracer without GI, it can come in handy. Before you can use it, you have to enable
Ambient Light from the tool bar > Settings > Scene settings > Global Settings



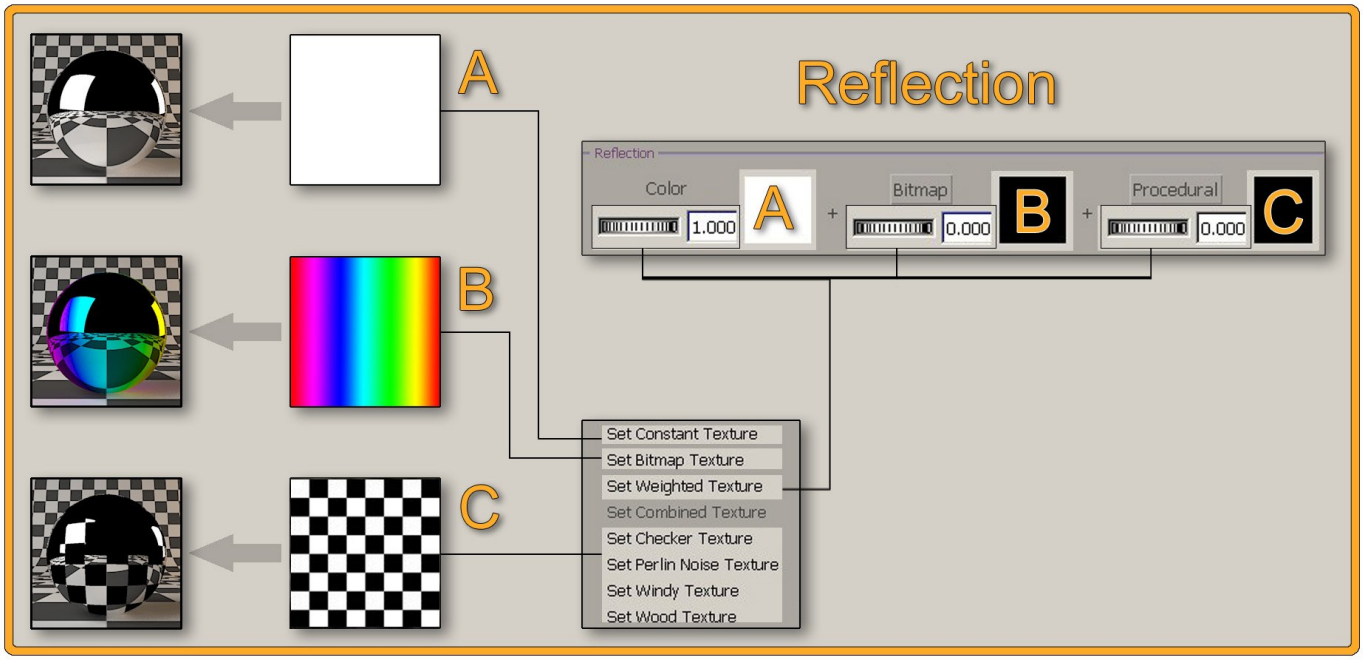
Diffuse color is the shader component that gives the color to our material. Apart from the color of the object, you can use it for very diffuse materials like walls or any material that doesn't show a specular component.



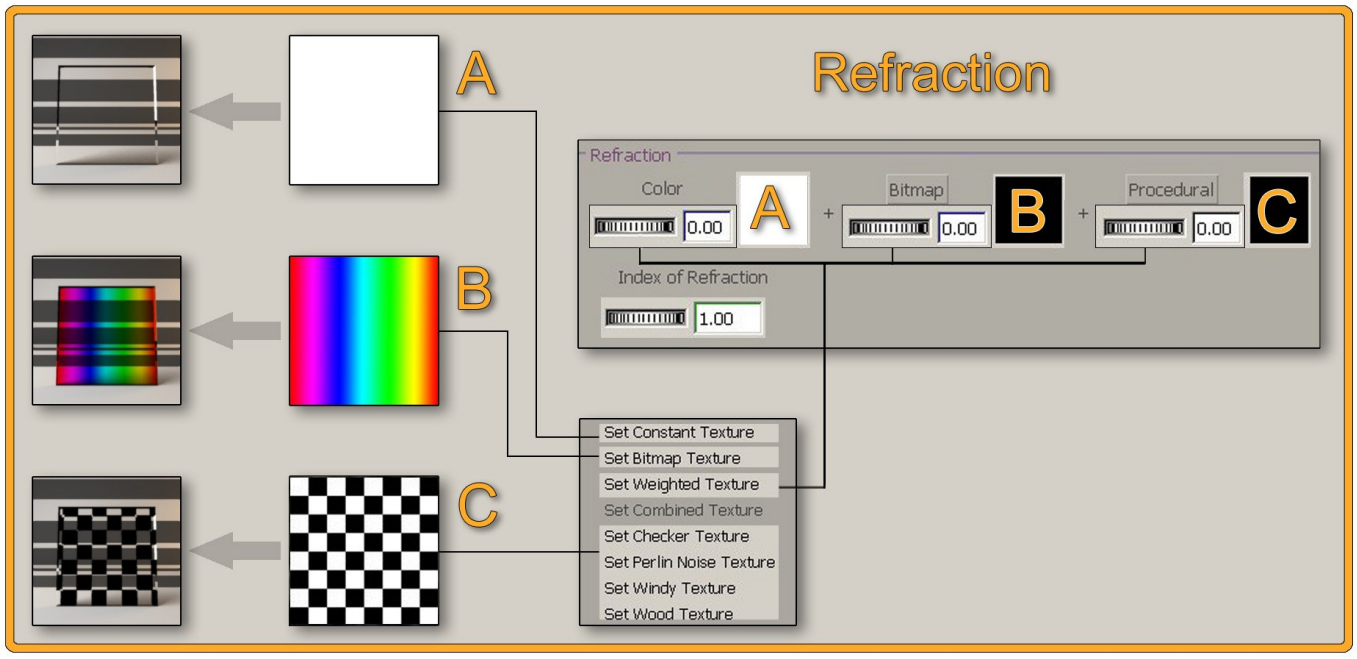
Specular color is the component that gives the specular reflection part of the material.
If you want to use it in combination with Procedural Fresnel in the Layer weight, the intensity must be set to 1.000.



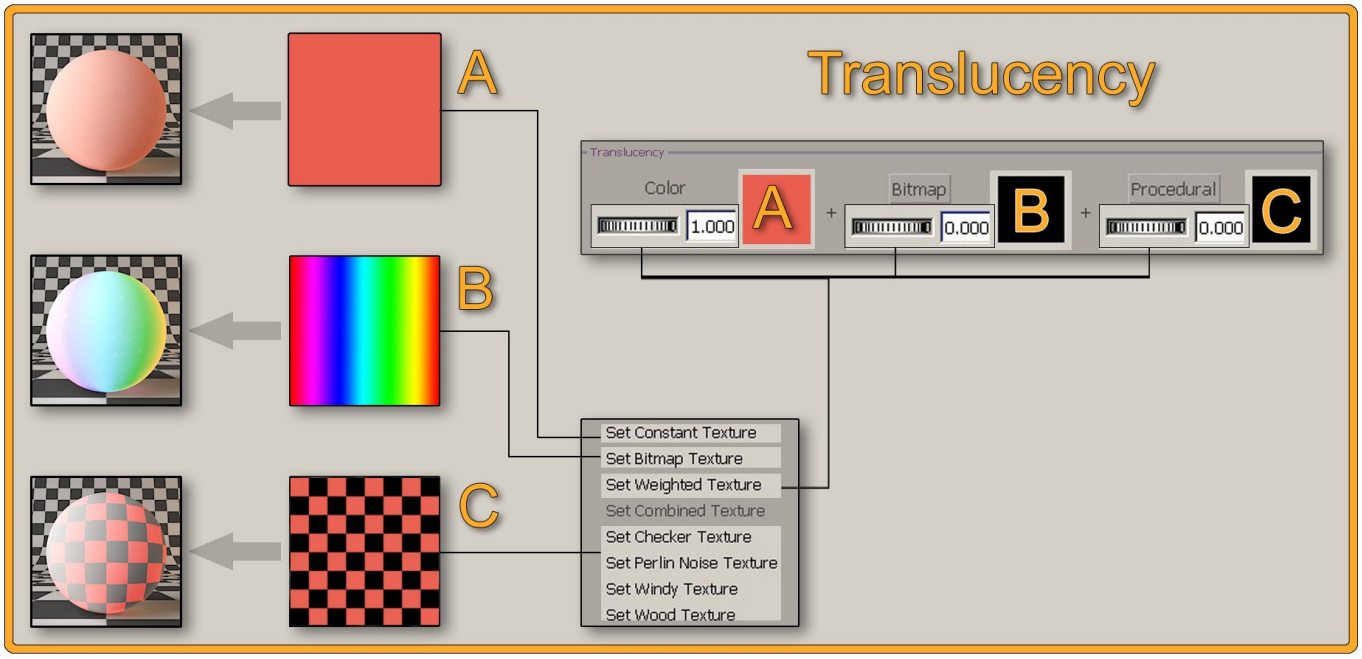
Shininess represents the microscopic surface property of the material. Increasing this value will make the material surface smoother and the reflection more sharp and mirror- like. Reducing the value will do the opposite and make the microscopic surface more rough and therefore the reflection will be more blurry. A value of 50 000.000 will produce a perfect mirror. The quality of the specular shininess sampling is controlled with the Fuzzy Tracing value located in the render panel. Medium or High will give acceptable results most of the time. You can select an attenuation like Cosine, Fresnel or None for the specular reflection. If you want to use Fresnel, the specular color has to be at 1.000 otherwise Fresnel cannot work accurately and you will have to use an IOR value greater then 1.000 to get any reflection. If you are going to use Procedural Fresnel in the Layered weight, then you have to select “none” for attenuation because Procedural Fresnel already uses Fresnel attenuation and we don’t want to use Fresnel twice.



Reflection in Kerkythea represents a perfect mirror like smooth reflection and should be used if you are looking for a very smooth surface that reflects perfectly because it renders much quicker than using the specular color with a high shininess value



Refraction is used for transparent materials and works with IOR. An IOR value = 1.000 will make the object invisible (can be used as an alternative clip map). An IOR value = 1.52 is for common glass.



Translucency is for translucent materials and represents a sub surface scattering behavior of a material. Depending on the size of the object, render time can be very long when using it with Photon Mapping and Final Gathering, therefore Kerkythea offers also a pseudo translucency alternative that renders very quickly with acceptable results. Translucency can be mapped (using Bitmap) and also work with Procedural shaders. Translucency and pseudo Translucency are turned off by default and have to be enabled in the advanced settings. For Translucency you have to go to Advanced Settings and under Ray Tracer > Standard Ray Tracer > Sample Criteria, turn on Translucency. For Pseudo Translucency you have to go to Advanced Settings > Direct Light Estimators > Refraction Enhanced and enable Pseudo Translucency. Translucency works with Diffuse color and therefore you have to use them together. You don't have to worry about energy conservation because Kerkythea handles that for you and both can be used together as one material component. Later we will see how we can create materials that present sub surf scattering behavior. Translucency can also be used on single face objects like paper or leaves, have a look at the following image…

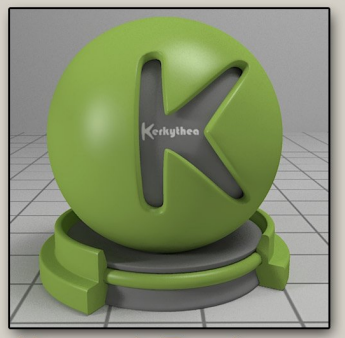
Translucency

With Translucency

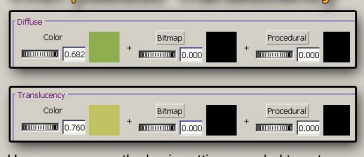
Without Translucency

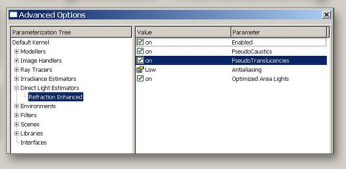
Pseudo Translucency

With pseudo Translucency

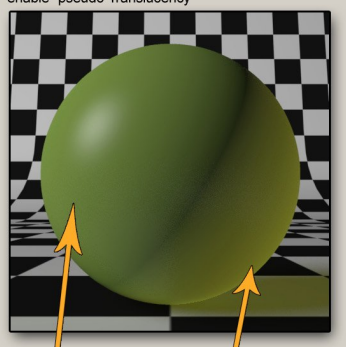


No pseudo Translucency

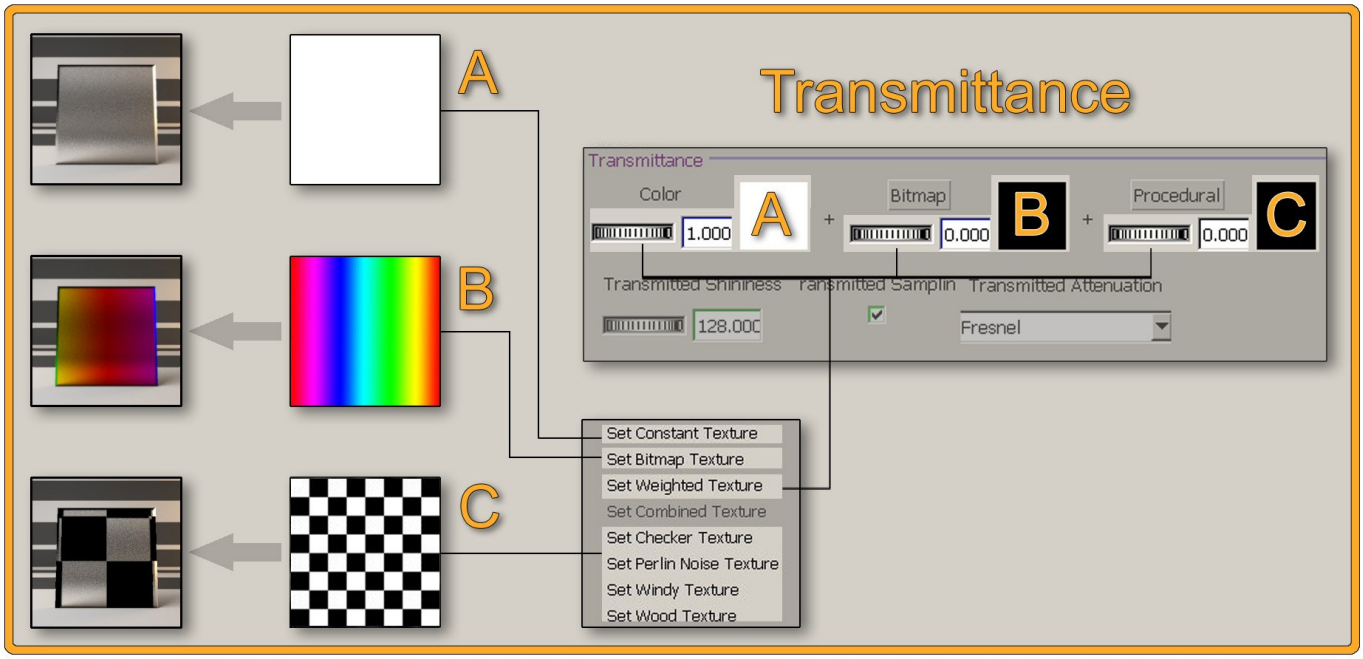




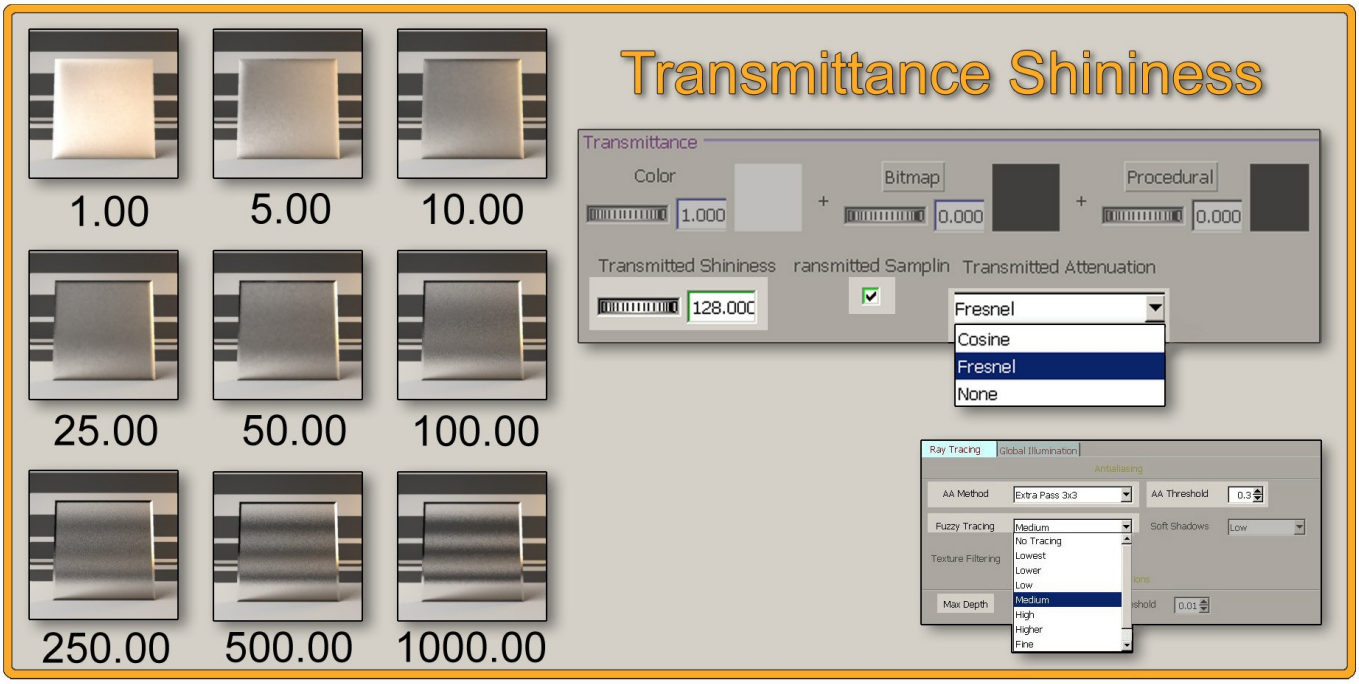
Here you can see the basic settings needed to get translucency effect (pseudo and real Translucency) whit pseudo Translucency you have to go to the Advance options and under "Direct light Estimators" enable "pseudo Translucency "



Pseudo Translucency with reflection & refraction

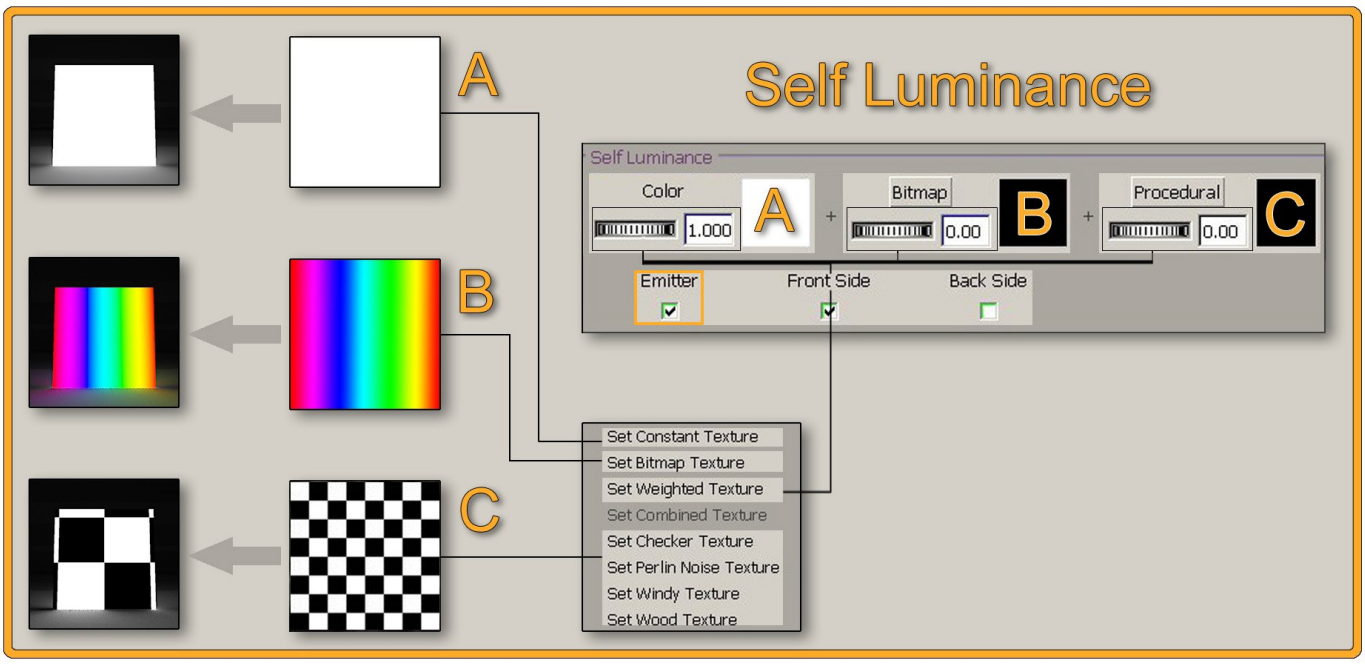


Transmittance is also for transparent objects but the difference with the refraction component, it produces blurry refraction for Frosted Glass or other blurry transparent objects. Like the refraction component, it also works with IOR values.

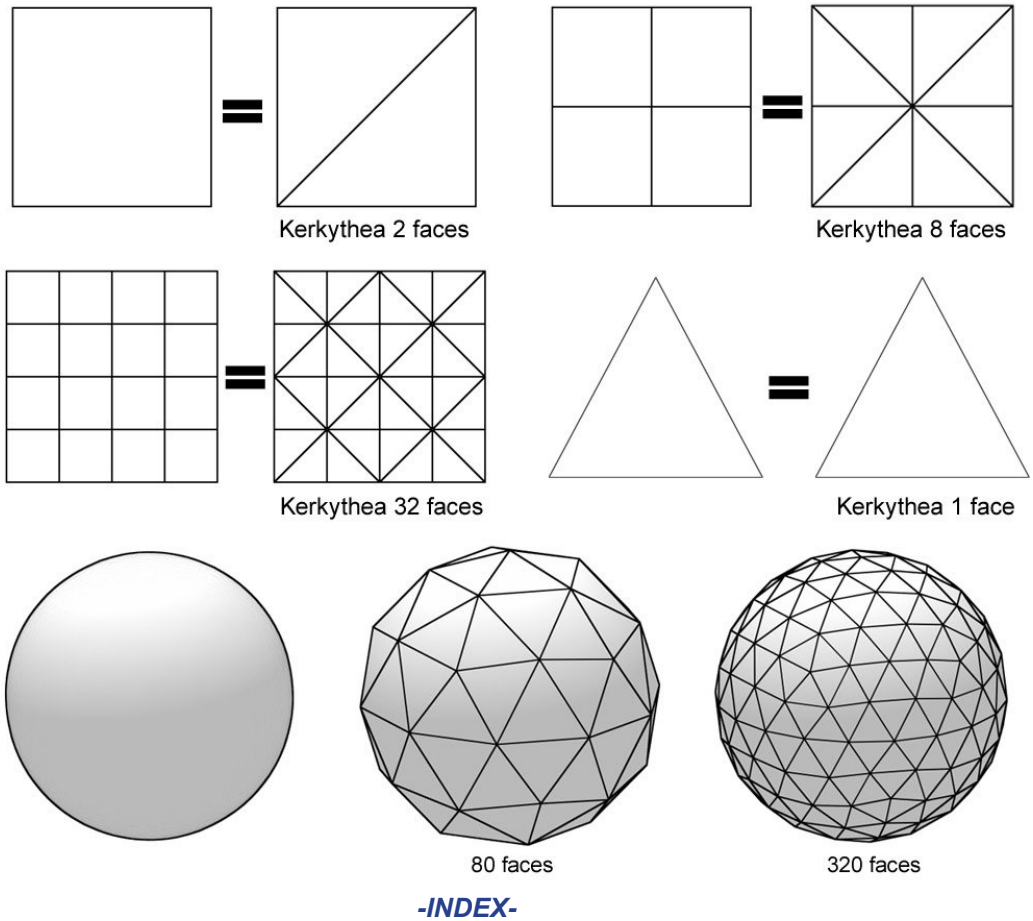


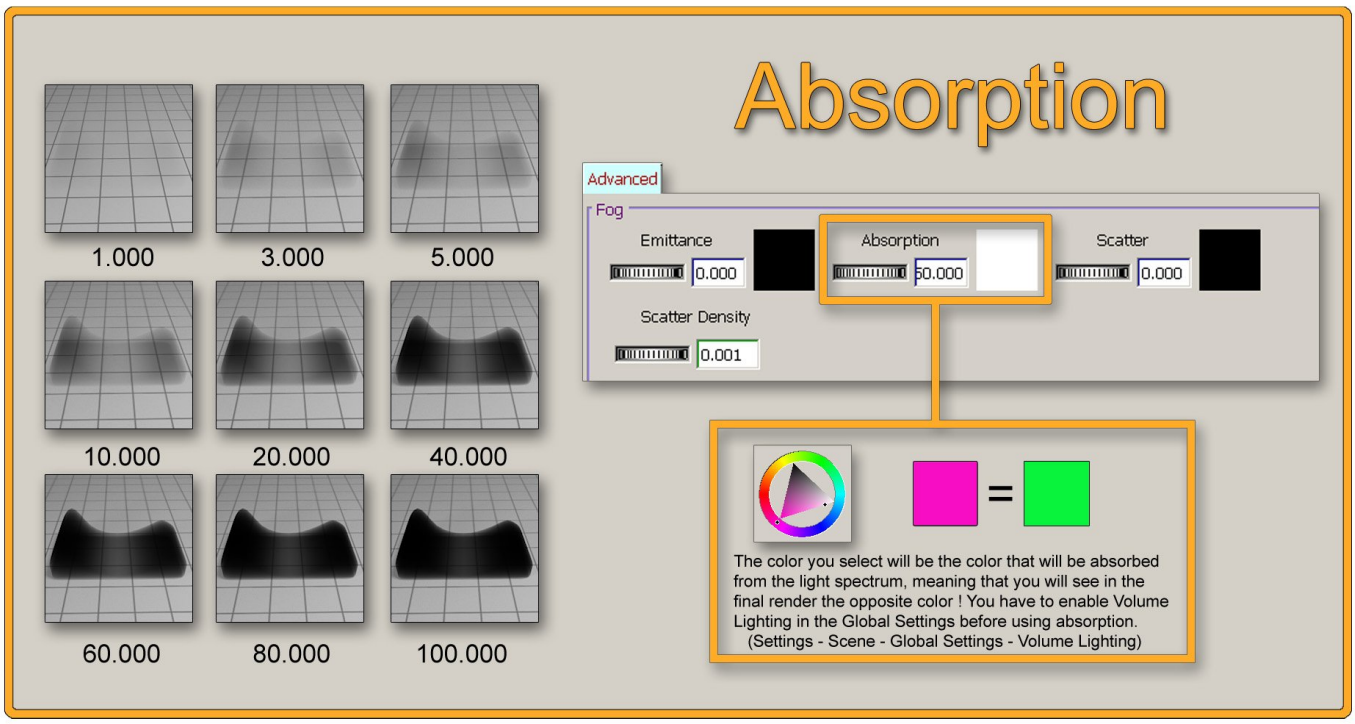
Transmittance Shininess represents the blurry amount of the Transmittance component. Lower values will make the object more blurry and higher values less blurry until it is perfectly transparent. Notice that if you set a very low value for transmittance, the material will start to scatter the light in all directions and therefore you can also use it as a scatter element for your material creation. Fresnel attenuation is the one to use for most common materials. The sampling quality is controlled with the Fuzzy tracing parameter located on the render panel.

These are all the components of the Matte / Phong shader; let's have a look at some other components located in the advanced panel of the Material Editor…

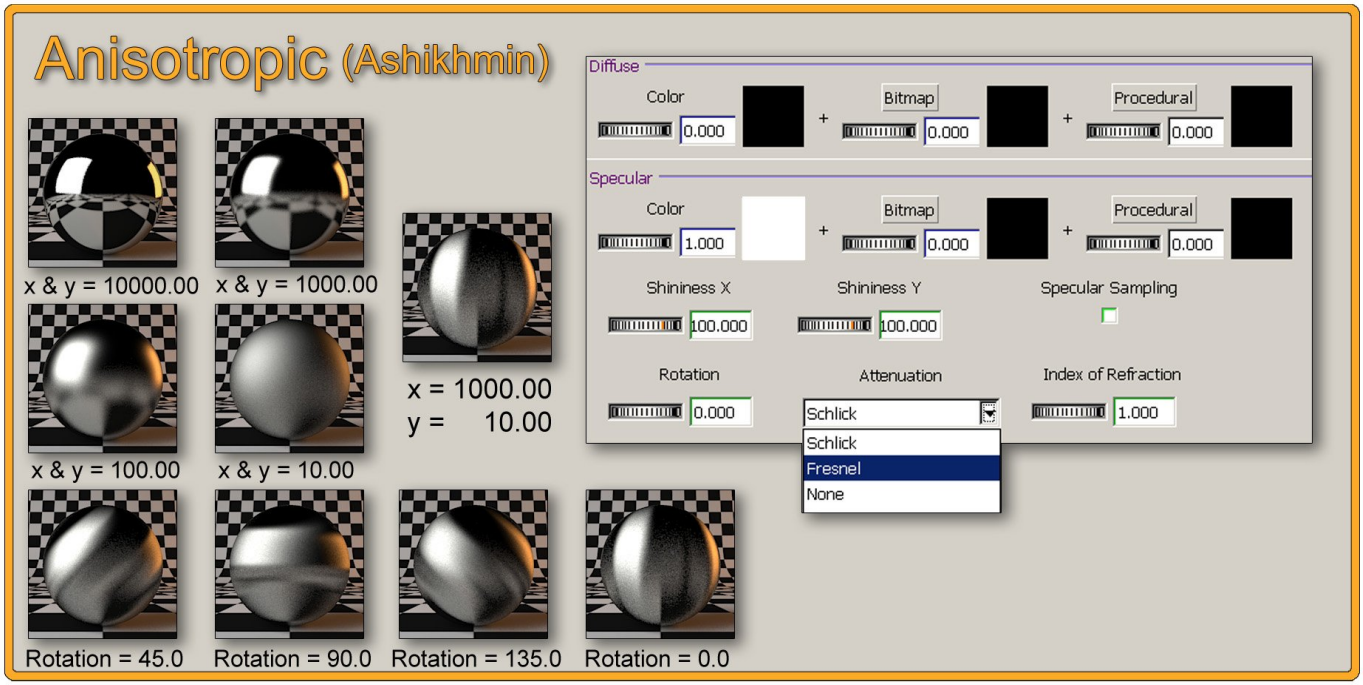


With the Self Luminance property, we can convert our object into an Emitter (light) by enabling the Emitter option and giving it a color value greater than 0.000. You can also indicate in which direction the Emitter should emit the light by enabling Front and/or Back option. To obtain a power for your emitter greater than 1, you will need to type the number in manually. If your render takes too long with Photon Map and Final Gathering renders method, one problem could be that you have given a self luminance value to a dense polygon object. Every triangle face of an Emitter object will be considered as one Light Emitter by Kerkythea, meaning that every light will shoot the amount of Photons you have set in the Global Illumination panel! If the Emitter object is a dense mesh, you could even run out of memory when rendering with Photon Map & Final Gathering render method. With unbiased render methods like Path tracing, Bidirectional Path tracing and MLT, these problems are not presented but even there it is good practice to keep the amount of polygons of your emitter objects low. Here you can see how Kerkythea handles imported geometry.



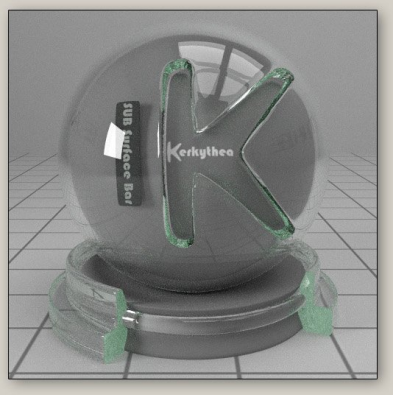


Absorption is another important feature and represents the behavior of light passing through an object. For example, if you look at water in a swimming pool you can see the bottom of the swimming pool but when you look at sea or ocean water; you may or may not see the bottom. This is because when light passes through an object, it will get absorbed and loose intensity and it depends on the object property how fast the light will loose its intensity. Notice that the color you give to absorption will be the color that will get absorbed meaning that you will actually see the opposite color in your material. You will need to use absorption for accurate colored Glass and also for sub-surface scattering (a.k.a. "sss"). A good way to look at absorption is to see it as the density parameter of an object. The difference between a transparent and a solid non-transparent object is the absorption factor.



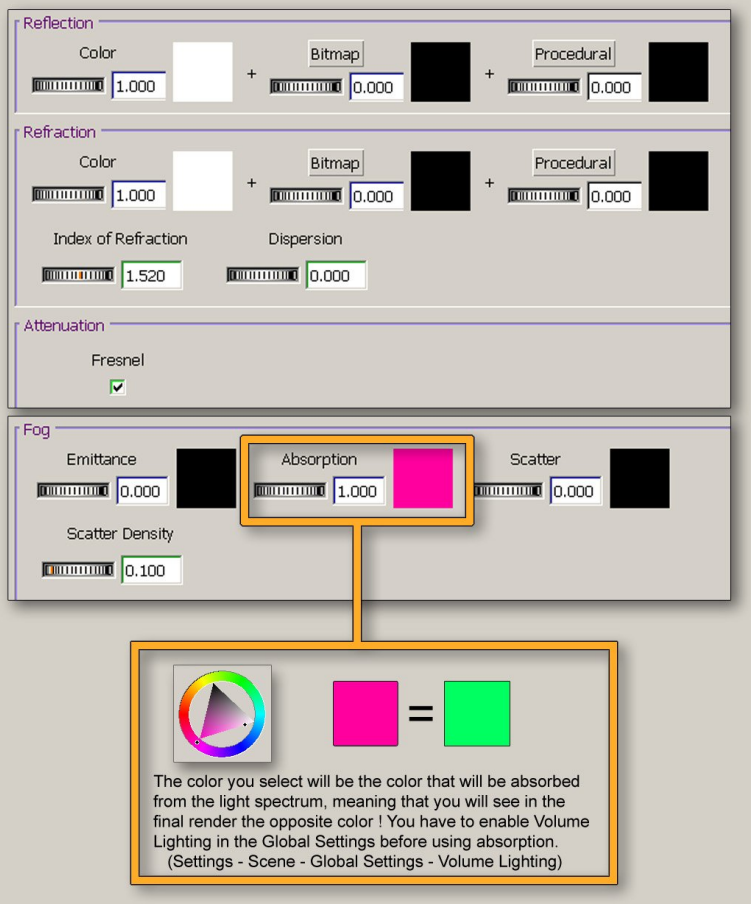
The Anisotropic (Ashikhmin) shader is very useful for metals and other material that show anisotropic reflection. The difference between the Matte / Phong specular shininess and the anisotropic shininess is that you can control the shape of the reflection in the X and Y direction. You have to enable specular sampling to get accurate specular reflection. The sample quality is controlled with the Fuzzy Tracing Variable in the render panel (be aware that this shader needs higher fuzzy tracing quality settings than the Matt / Phong shader). The shininess value for perfect reflection is 100 000.00 (the double of the Matte/Phong specular shininess) but normally a value of 10 000.000 is more realistic. *(Your model needs UV coordinates for anisotropic reflections)*

Dielectric Glass



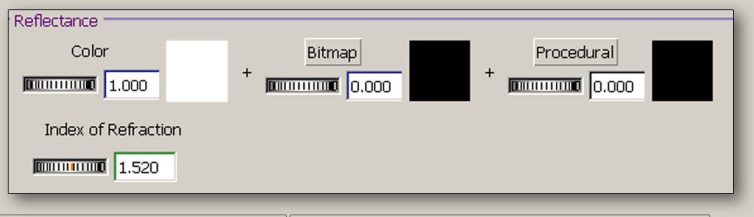
color obtained with absorption

Bitmap used for color + Bump



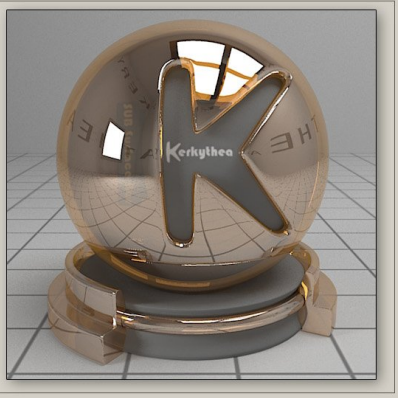
Use the Dielectric Glass shader whenever you need accurate glass or other transparent materials like water, plastic, diamand ….etc. To work accurately, your model needs to have thickness meaning that for a single face object, the dielectric Glass shader can not calculate accurate IOR values. You can find accurate dispersion values (Abe) on Optical tables.

Thin Glass

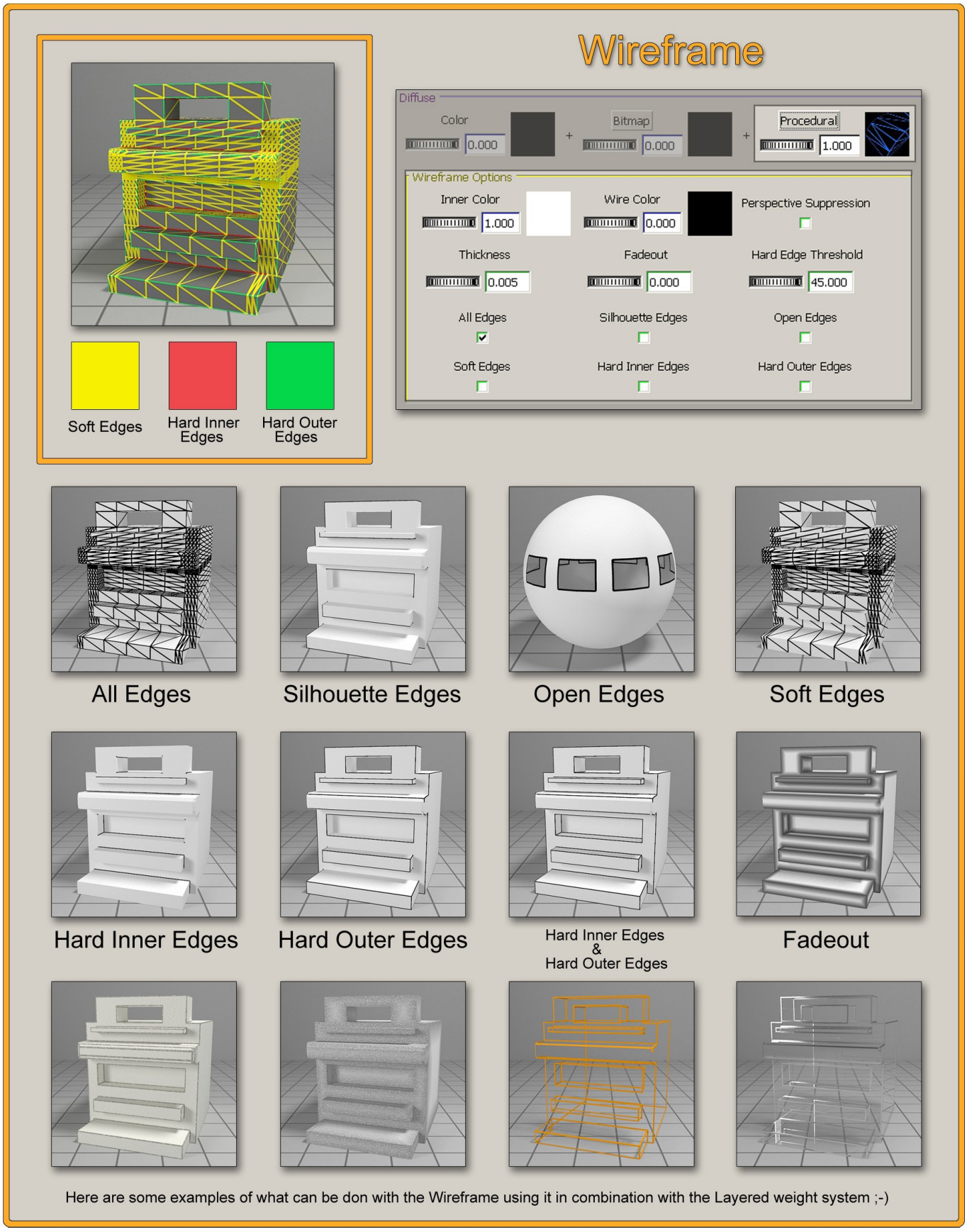


Reflectance color = white
Index of Refraction = 1.52

Reflectance color = orange
Index of Refraction = 5.00

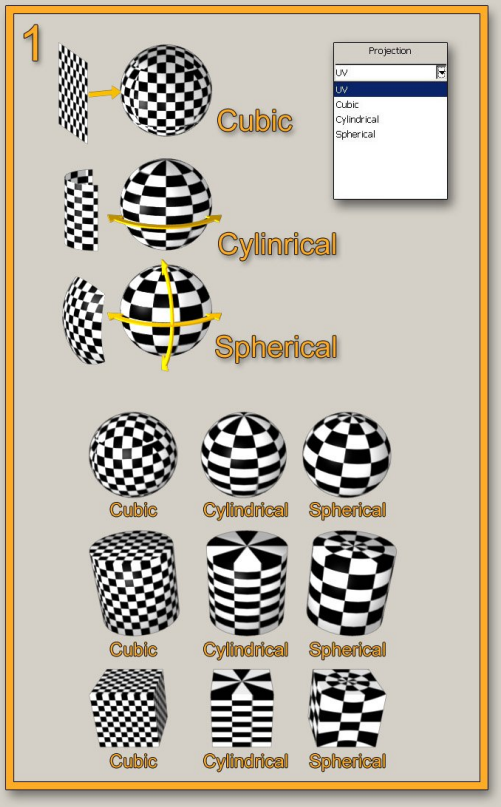


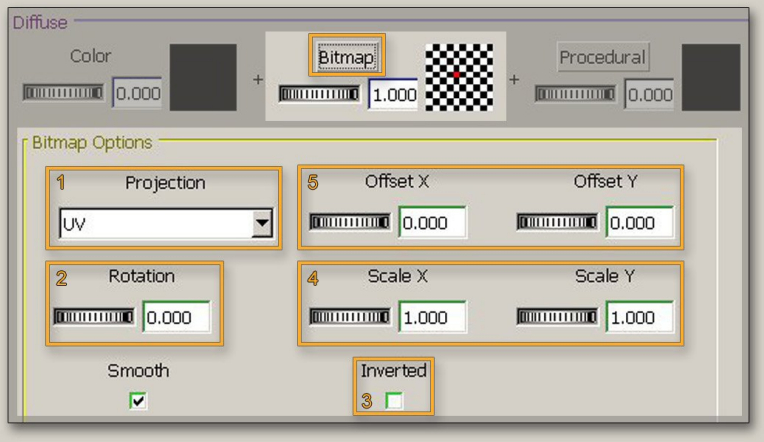
The Thin Glass shader is a special shader that represents what the name suggest “thin glass” (a.k. AGS). It dos not bend the light and therefore it will not produce caustics but render time is much faster. The IOR value will only change the reflection intensity of the glass. This shader works well on single faced objects.



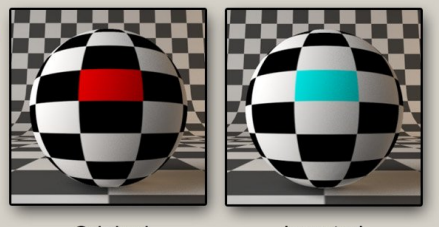
The Wireframe Procedural shader is one of the many Procedural shaders Kerkythea has to offer. Have a look at the image to see what the different settings do. The thickness of the wire is represented in metric units meaning that 1.000 = 1 meter. Enabling Perspective Suppression will render all wireframes with the same thickness (you will have to increase the thickness very much). Hard Edge Threshold lets you control the angle of the wires that will be included or excluded for rendering. This Procedural shader has two colors; you can also use it as a mask in the Layered weight.

Bitmap



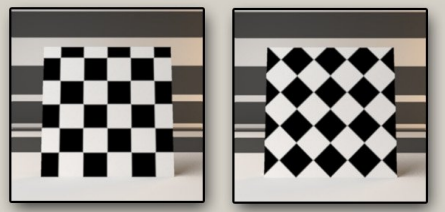


3



you can " invert " your bitmap. Very useful when blending two materials with a bitmap as a mask.

Original Inverted



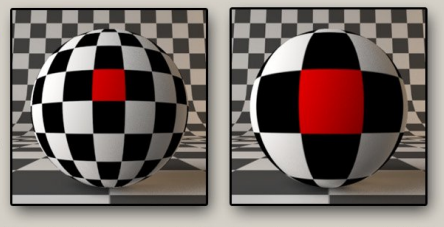
2

Rotation = 0.00 Rotation = 45.00

Bitmaps can also be rotated in Kerkythea. Be aware that if your using a normal map for bump, rotating the normal map can lead to incorrect results (use a bump map if you are planing to rotate the Texture)

4

You can scale your bitmap. Higher values will till the bitmap and make it smaller while repeating it. Smaller values will increase the size of the bitmap. You can also use it to correct unwanted "stretching" of the bitmap image.



X = 2.000 Y = 1.000 X = 1.000 Y = 0.500

5

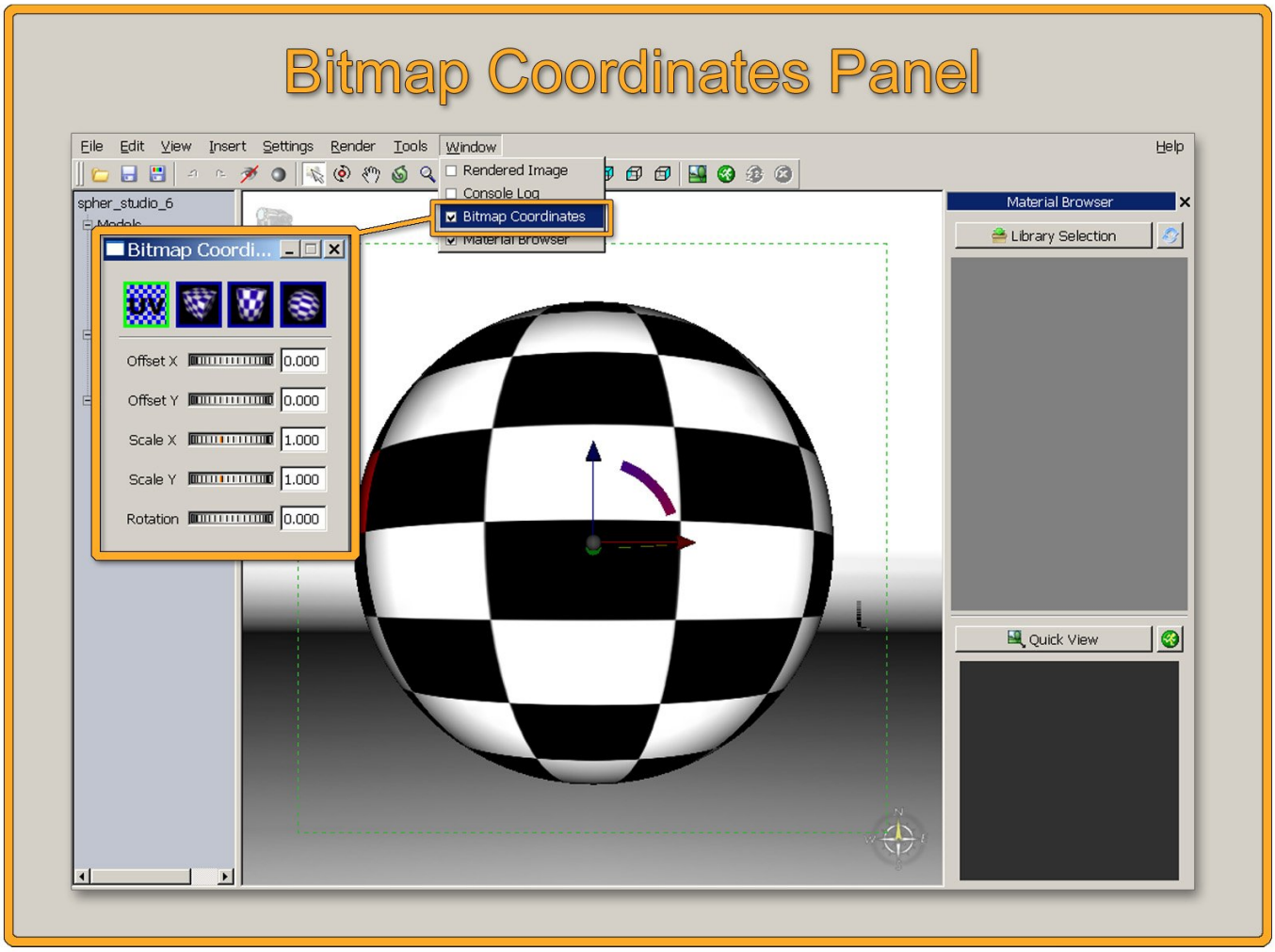
If you discover that a important feature of you bitmap is not at the right place of your model, you can use the offset feature to adjust your texture to the desired location of your model.

X = 0.000 Y = 0.000 X = 0.130 Y = 0.000 X = 0.000 Y = 0.130

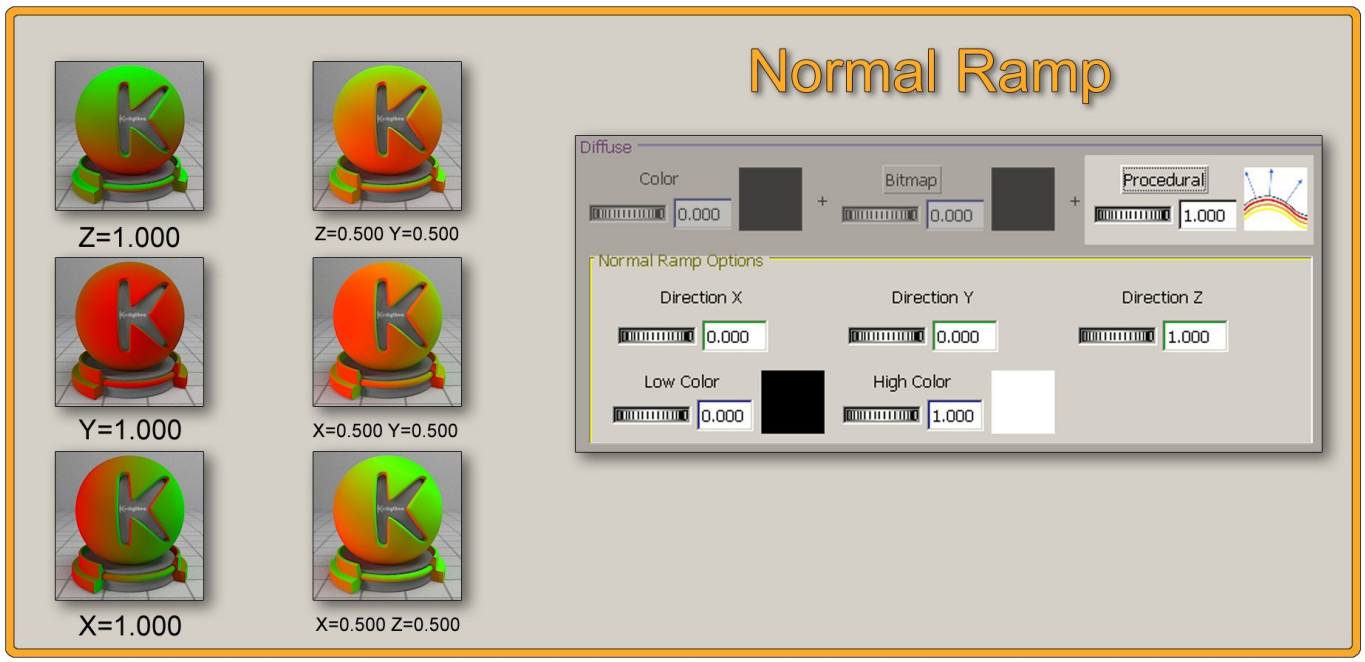
X = 1.000 Y = 1.000 X = -1.000 Y = 1.000 X = -1.000 Y = -1.000

If the bitmap is flipped horizontal or vertical (or both at the same time), you can correct this by making X Scale and/or Y Scale a negative number.

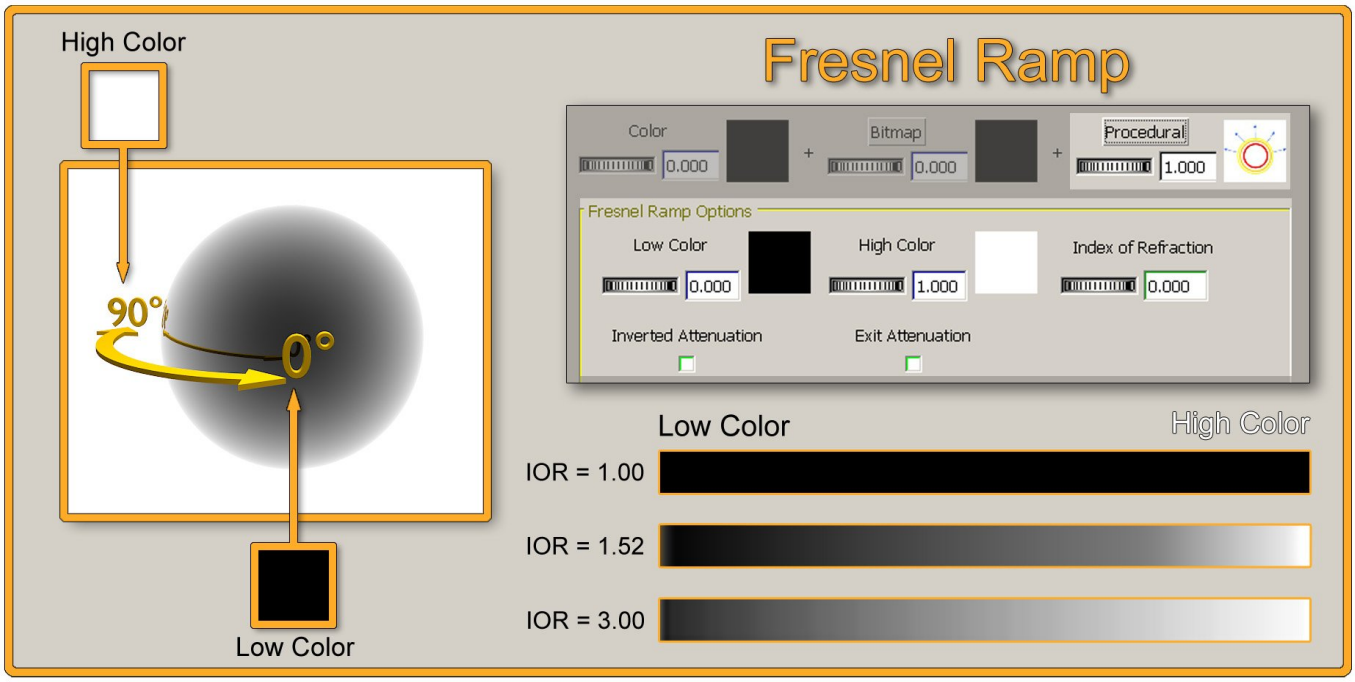
You will visit the Bitmap panel quite often, have a look at the image to see all the options it offers.



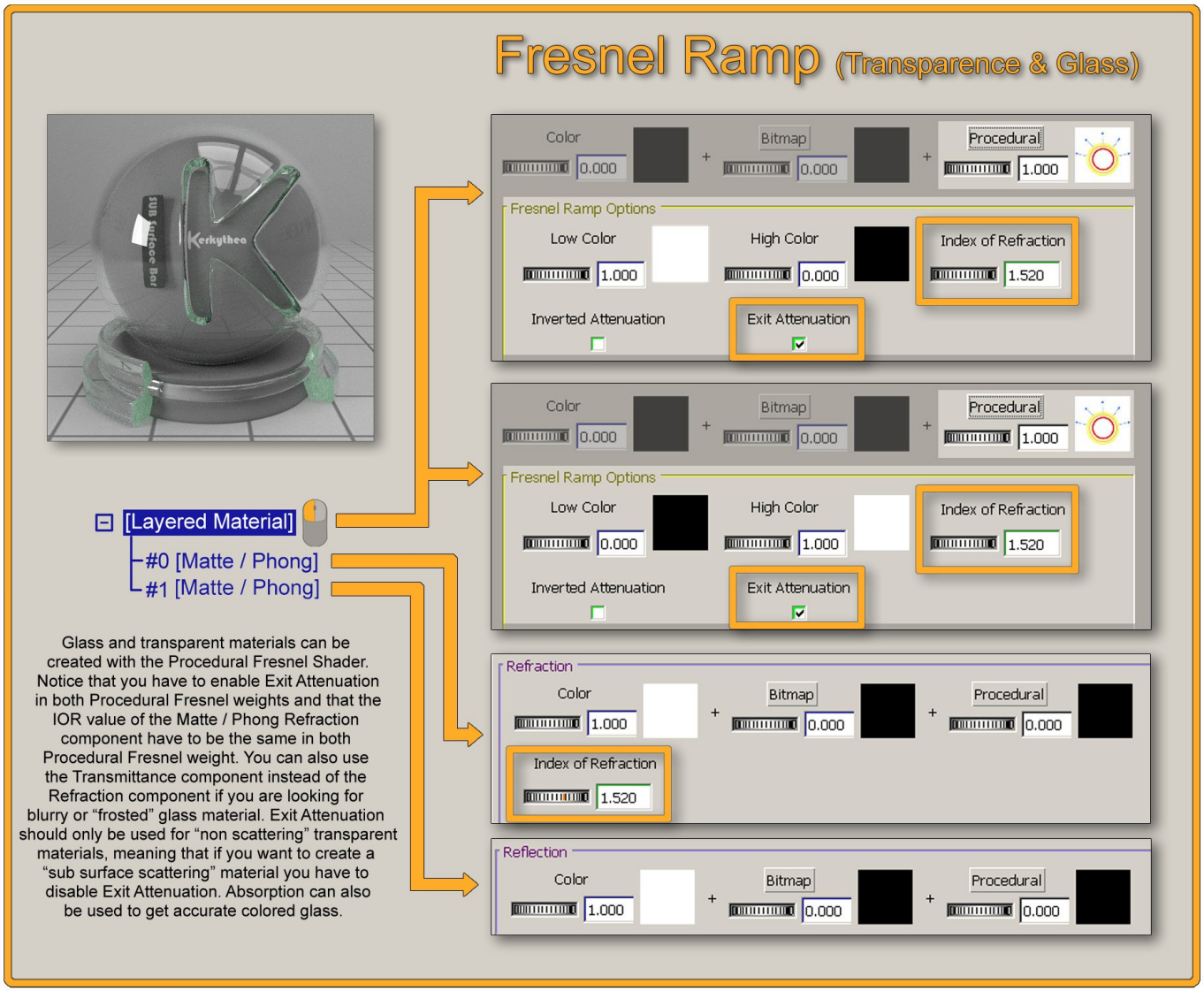
Imagine you have multiple bitmaps for one material, like different bitmaps for; the mask, the bump, and the diffuse color …etc, if you need to change the rotation or scale of your texture, it would be time consuming to change every bitmap one by one. The Bitmap Coordinate panel lets you make changes to all Bitmaps that the material uses at the same time and you can access it from the tool bar (turn solid rendering on (shortcut = "v") so you can watch the changes you are making to the object)



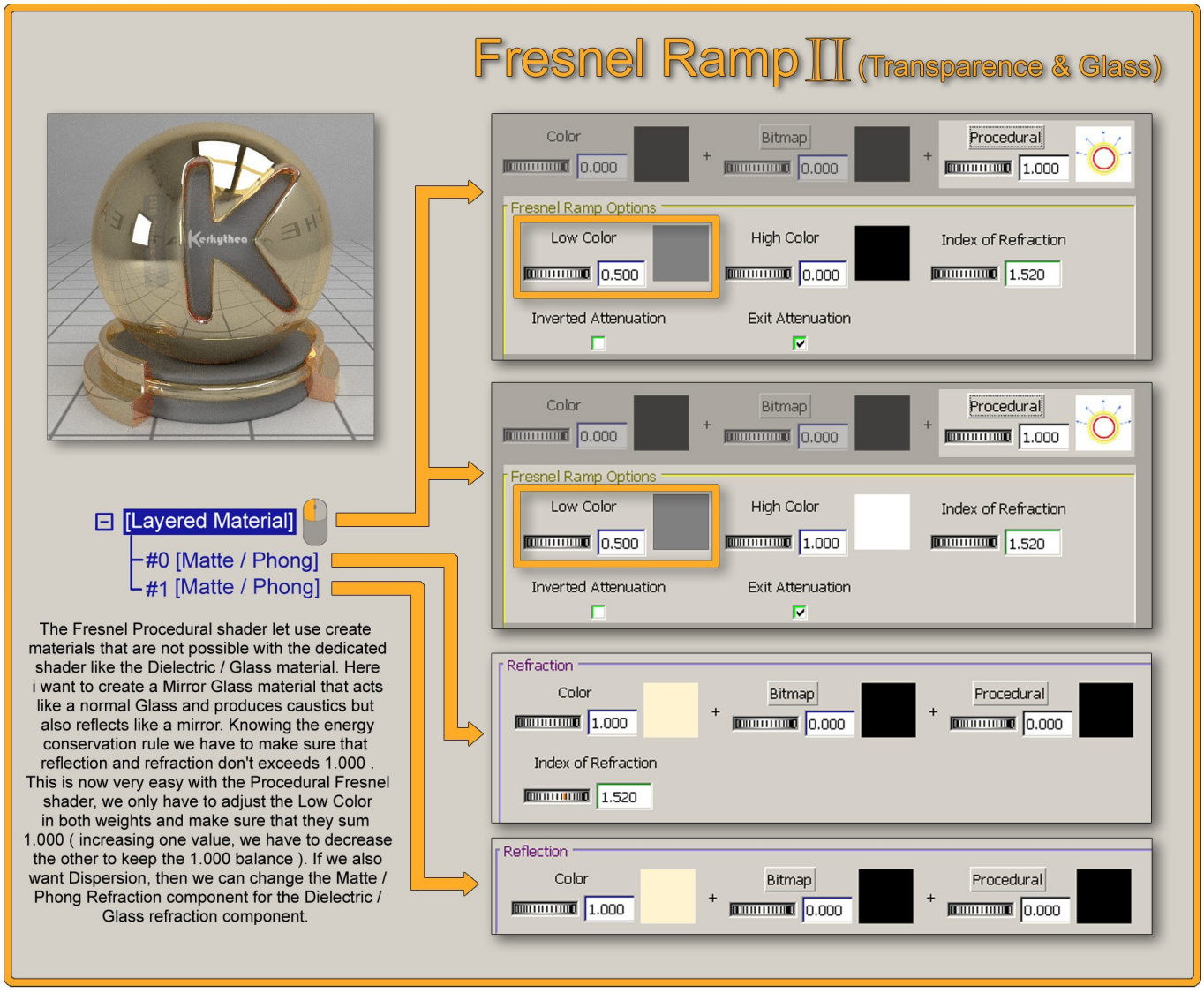
Normal Ramp is a Procedural shader that let us map the Low and High color according to the normal of the object. By changing the X, Y and Z direction, we can decide where we want the Normal Ramp to act. In the image I changed the Low and High color to red and green to make the effect more visible. This Procedural shader is another one that has two colors and therefore can be used as a mask or weight for a Layered material.



Fresnel Ramp works the same way as the Fresnel attenuation option we have in the Material component panel but with the difference that we have more control over it. By default the IOR value is 0.000 and will act like a cosine attenuation (useful for velvet and satin materials), to get accurate Fresnel attenuation we need to set IOR higher then 1.000. Depending on the IOR we set, Fresnel will calculate the according gradient between the Low Color and High Color. Have a look at the next example image…



The Material setup for transparent materials with reflection like glass is the same as we did for our basic plastic material. The Procedural Fresnel weight for the refraction component has to have the Low and High colors inverted and we can do this by changing the colors or enabling the "Invert Attenuation" option (I personally prefer to change the colors for better visual distinction between the different Fresnel weights). *Exit attenuation has to be enabled for transparent materials but only if the transparent material represents a non scattering material. For sub surface scattering materials, you need to disable "Exit Attenuation"*. Normally you don't need to create a dielectric glass material because Kerkythea already provides a dedicated shader for it but sometimes we will need to create special transparent materials that we cannot build with the Dielectric Glass shader like the material you can see in the following image…

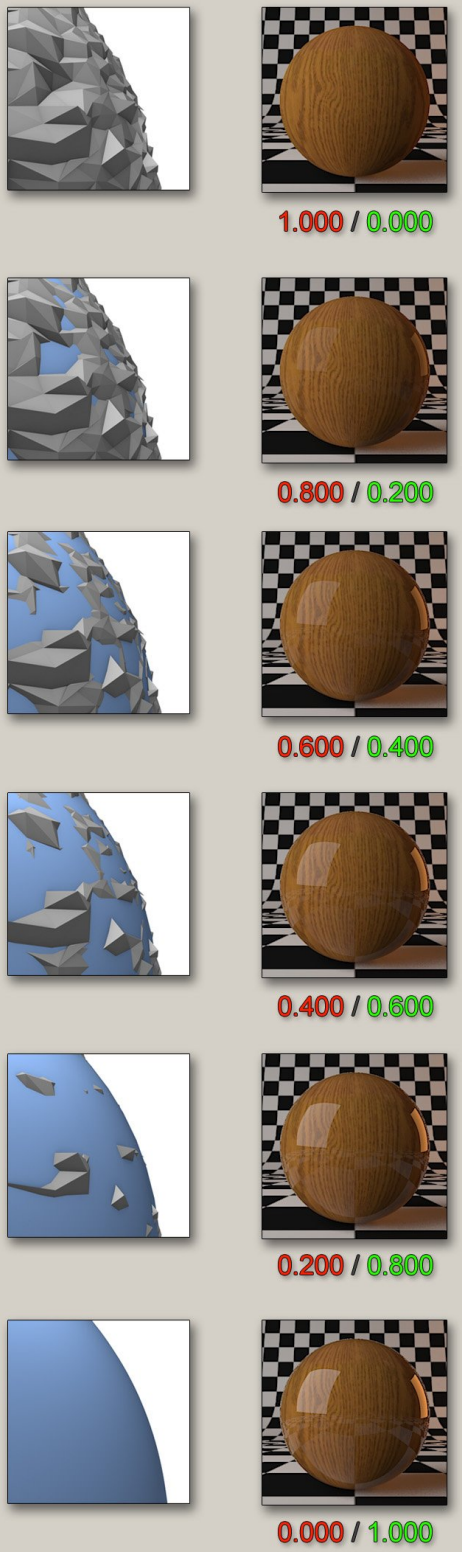


By altering the Low Color of the two Fresnel weights, we can control how the light will interact with the object and in this case I wanted to create a mirror like glass and therefore I have to increase the reflection, but by doing this, I also have to reduce the transparency of the material (remember the energies conservation Law), both Low Colors have to sum at the end 1.000. This material could not be created without the Fresnel Ramp!

But there are other situations where we only get accurate materials by using Fresnel Ramp. One case is "Partial Coverage". Varnished wood for example is a combined material and at Microscopic Surface Level the varnish dos not always cover the wood 100% (if you ever have varnished a wood table, you know that you need to give it more than one pass). This would be a case of "partial coverage". Have a look at the next image to see how it works…

Partial coverage

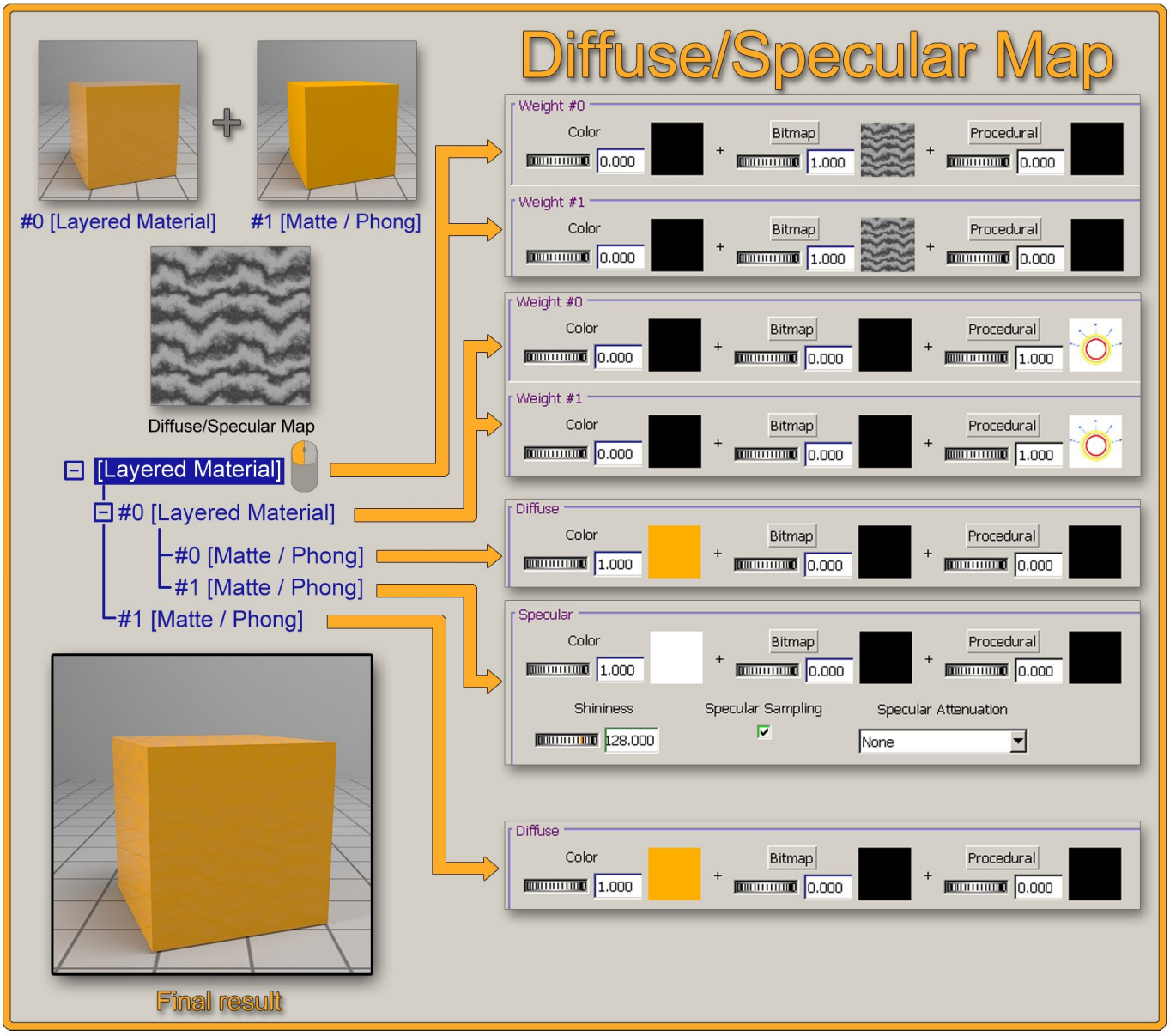
Microscopic surface representation



The High color for the diffuse and specula/reflective weight have to sum always 1.000 !
The Low color for the diffuse weight has to be always 1.000 and for the specula/reflectiv weight 0.000 !
This will guarantee correct energy conservation

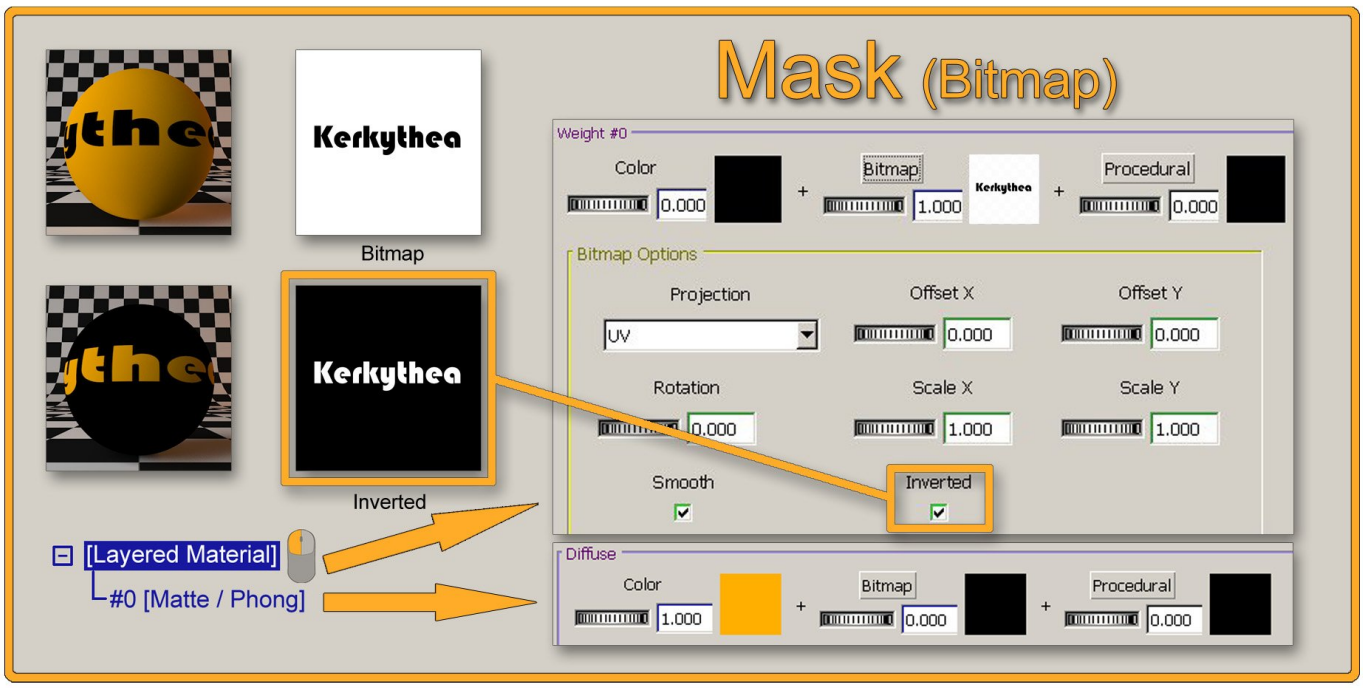
0.600 / 0.400
& Bump map

Here we have to change both High colors because we are creating a non transparent material and again we have to produce a balance between both High colors and make sure that they sum 1.000. Another way to produce partial coverage is to use a diffuse/specular map. The next image shows how to do it…

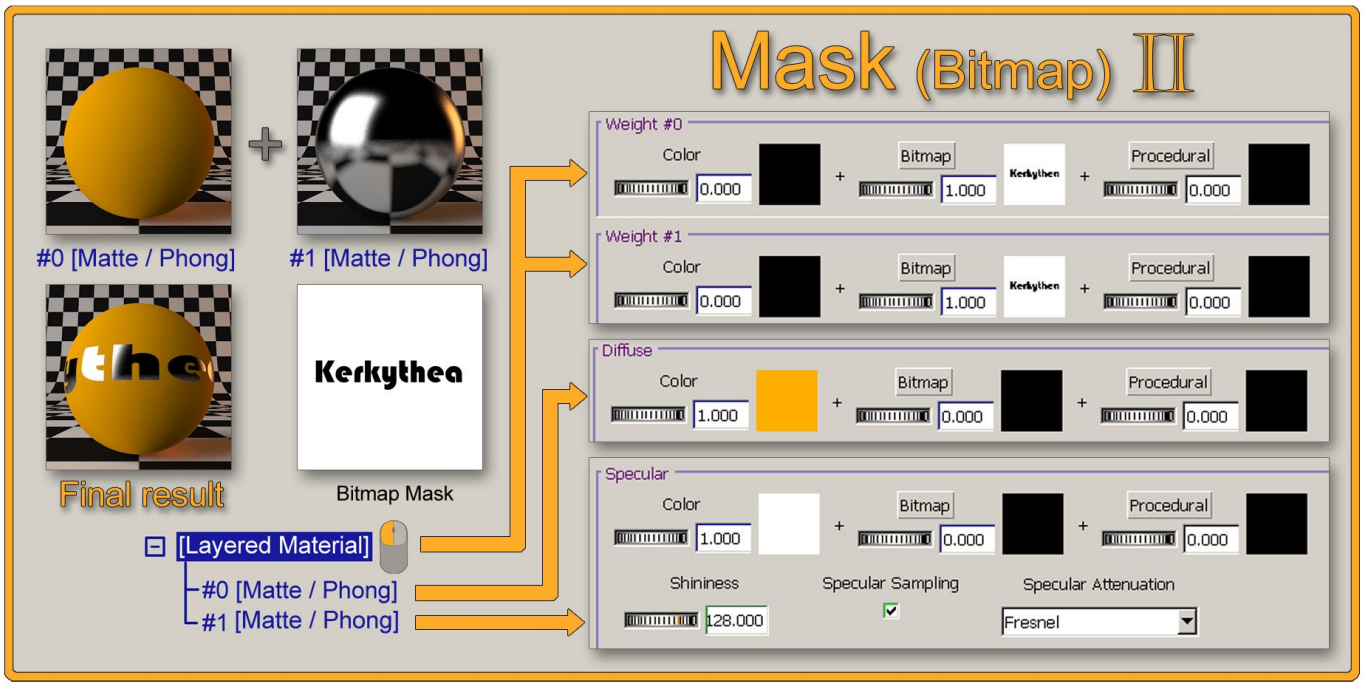


First of all we need to ask one question, "why do we need a diffuse or specular map?"
In what kind of situation a material would have uneven specular reflection? One situation would be a varnished wood that got some parts of the varnish worn away do to weathering or usage and this would be an example of partial coverage. In this case we would need to use a second diffuse component with the same wood bitmap applied as we have in the basic plastic material. A different situation would be a marble floor that has some dirt or dust on it. In that case we would need to add a "modified" marble texture that represents a dirty marble texture. Notice that we only need one texture (the diffuse map or the specular map) because we have to use the same one in both weights and one of them has to be inverted in the Bitmap panel (this will guarantee correct energy conservation and also produce correct Fresnel reflection). Maybe you are used to using two maps (diffuse and specular) and I know that there are a lot of Texture packs that provides both maps but as I demonstrated earlier, you will not get physically accurate results with the "old" method by just applying a diffuse map and a specular map to their respective channels *(Fresnel Reflection)*

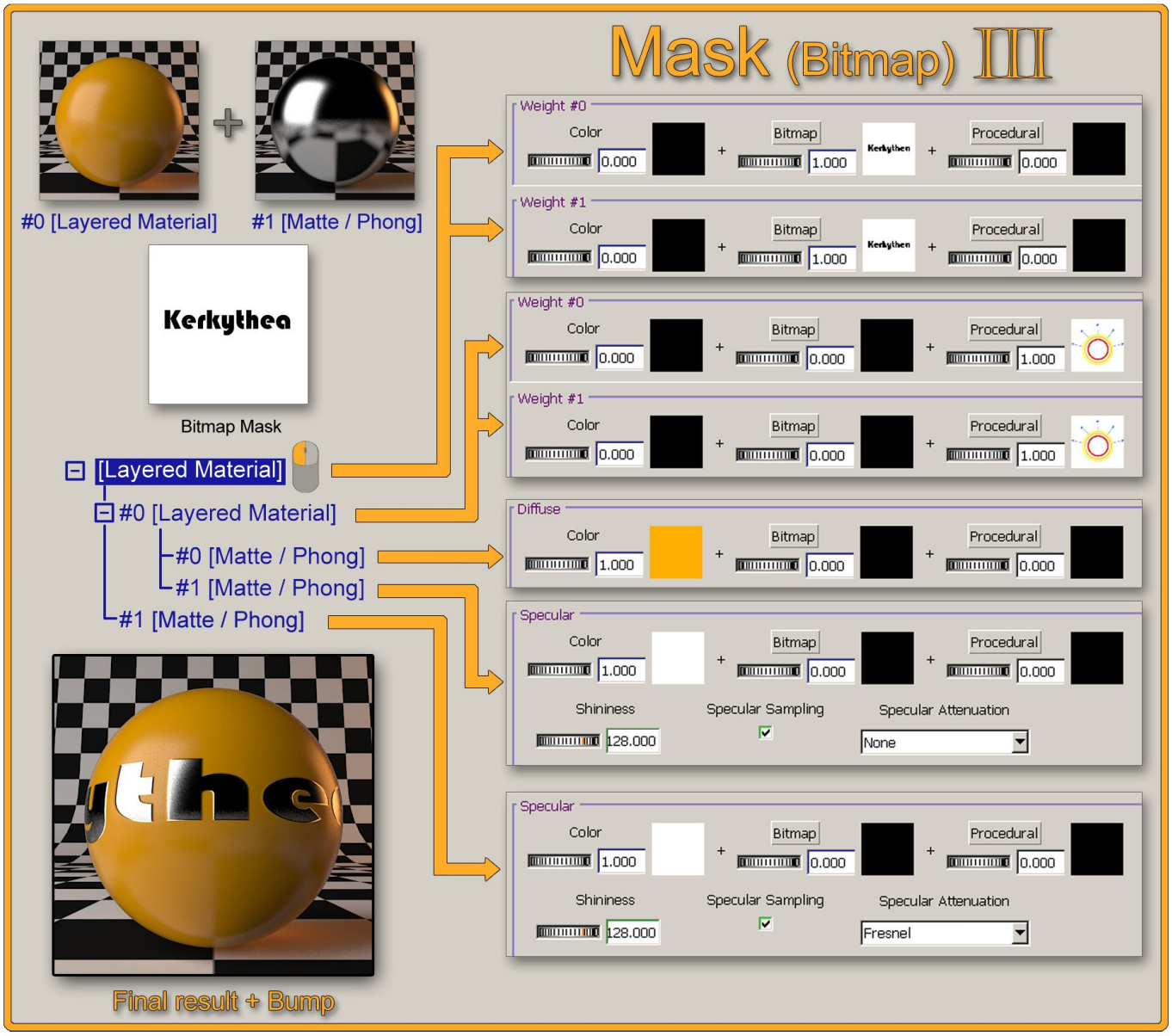
This is also an example of using a Bitmap as a Mask, lets see with more detail how Masking works….



With a mask we can separate regions of our model to add more than one material to it.
White color will let the material be visible and black will hide it completely making it possible to add another material where the black color is by inverting the mask.



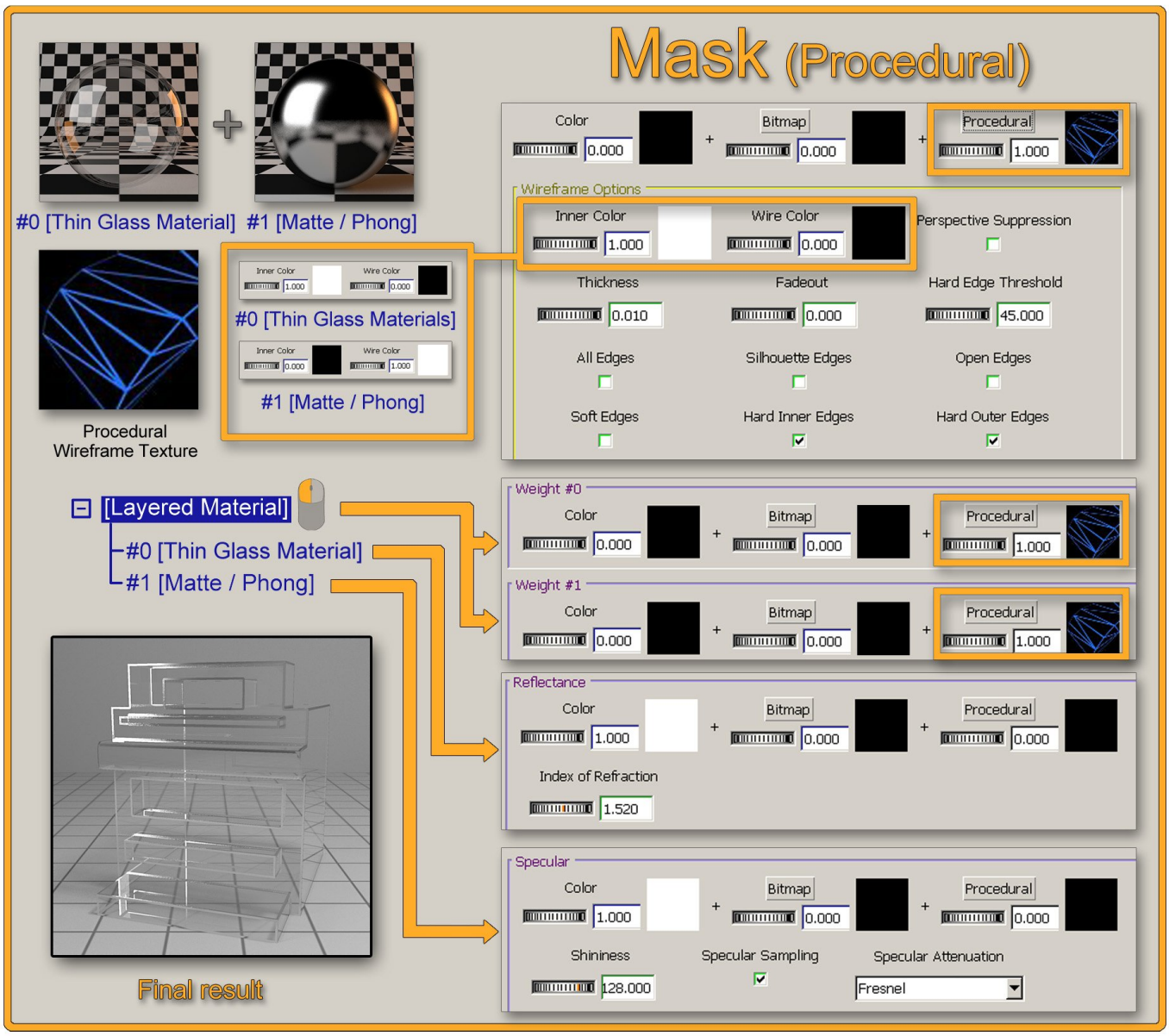
Here you can see a very basic setup, remember that we are using the same Bitmap to mask the regions and that we have to invert the bitmap in one of the Layer weights.



This would be the setup for a basic plastic material and a basic metal. The important part of using masks is that we need to be able to invert it; this is very easy with a Bitmap
but we can also use any Procedural shader that Kerkythea offers that have at least two colors. This way we can invert the results and use it as a mask. Notice that you can use any grayscale values as well which makes it possible to create materials that fade into each other. With a Procedural shader we can also control the weight of each material by adjusting the two colors in a way that they sum 1.000 at the end.
I would like to recommend two Texture generator programs that are available for free. Genetica viewer and Bricks and tiles which let you generate textures with a lot of different maps like Color maps, Bump maps, Specular maps… they work very well with Kerkythea.

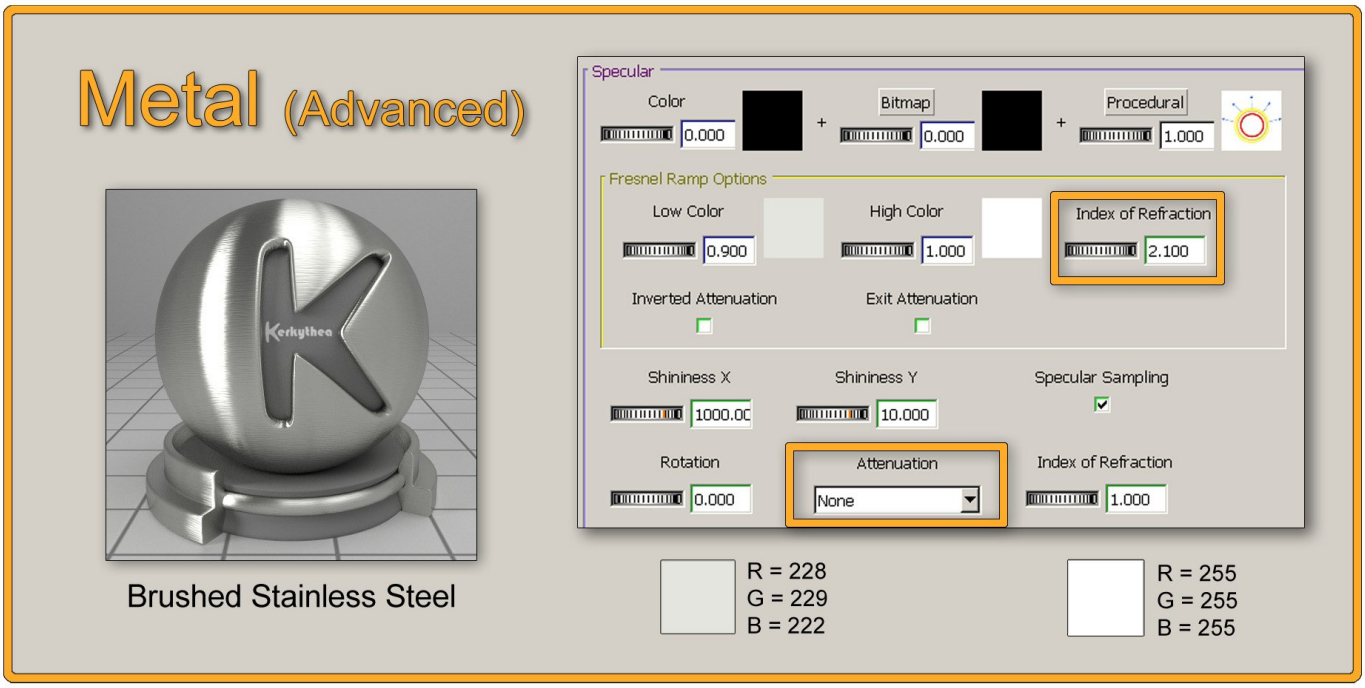
http://www.spiralgraphics.biz/

http://www.3d-rekonstruktionen.de/downloads/



Here is an example using the Procedural wireframe as a mask. Notice that the colors are inverted in one of the Layer weights.

Let's have a look on how to build a metal material. The easy way and more basic would be to use one of the specular components from the Matte/Phong or Ashikhmin shader
and give it a Fresnel attenuation with a high IOR value *(have a look at page 10 where you can see the IOR list from Thomas An.)*. Metals also have Fresnel effect and therefore the specular color must be set to 1.000 intensity otherwise Fresnel cannot do its work accurately! The color of a metal is given with the Specular Color but the intensity has to be set to 1.000. For darker metals, use a IOR value = 10.00. The reason I insist that the specular color needs an intensity = 1.000 is because Fresnel and the IOR value will calculate the reflection strength at different viewing angles and if we set the intensity to something lower then 1.000, we are "interfering" in the Fresnel calculation (remember that at 90 degree viewing angle reflection is always 100% and if we lower the specular color strength, the result at 90 degree can not be 100% reflective)



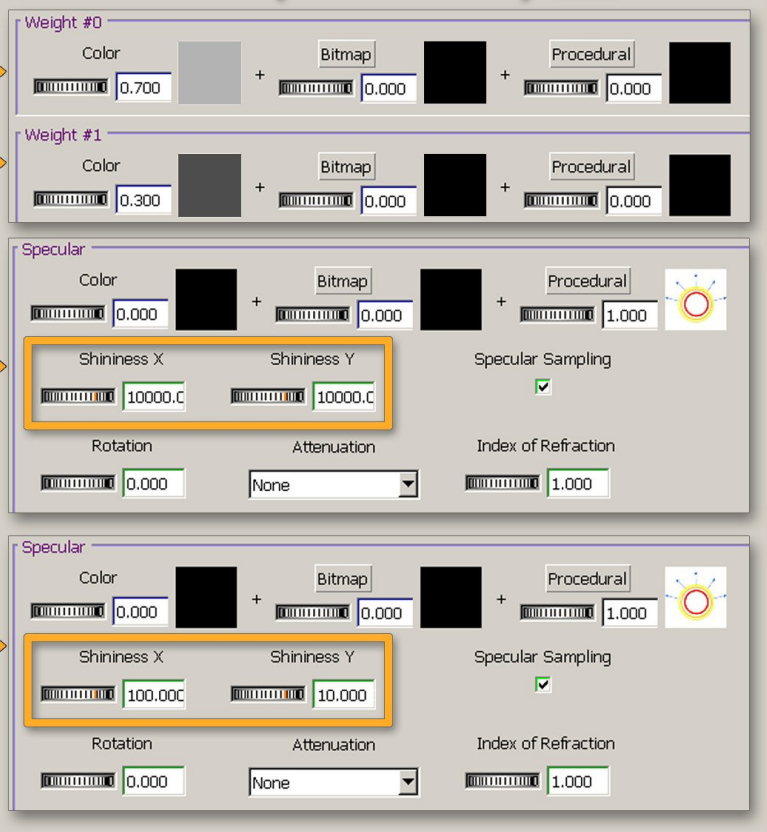
At the moment Kerkythea dos not support nk data (laboratory measured complex IOR data) but I know that it is on the "to do" list and will be available soon. Anyway nk data are not the "solution" for "everyday" materials because most of these data are measured from pure elements and the metals we use normally are alloys of different elements. For example 18k Gold is not pure Gold, it is a mixture of 75% Gold, 20% copper and 5% silver, mixing these metals with complex IOR data will not represent the correct 18k Gold because only a measured 18k Gold can give the correct complex IOR data. There are no complex IOR data available for 18k Gold or for Brass and other common metals we use everyday. Another drawback is that nk data needs much longer render times because of all the data it needs to calculate. But please don't misunderstand me, I think that nk data can be very useful.
We can get very close to accurate metals by using Procedural Fresnel and the result will be as good as using nk data because it would be very difficult to say if it is an nk data metal or not. Metals have for the High Color normally a white color but not always, for example Aluminum has a bluish color at 90 degree viewing angle (High color). We can use the simple IOR data that are available on optical tables for our metals. Another observation is that it looks like metals have two kinds of reflection, a blurry one and a relatively sharper one, both using the same colors of the metal. By changing the relative blurriness / sharpness and changing their weights, we can build a wide rang of different metals. By using the Procedural Fresnel, we can give the Low Color any intensity we want and so control the reflectance power of the metal. Adding a bump map like scratch to the metal can also increase the realism of the material (at least making a better bump I did) but it is not mandatory to use a bump map for anisotropic reflections.

Metal (Advanced) II

Stainless Steel

- [Layered Material]
  - #0 [Anisotropic (Ashikhmin)]
  - #1 [Anisotropic (Ashikhmin)]

This Metal was created with the same colors like the previous Brushed Metal example, using the Procedural Fresnel shader. This time i created a Layered Material with the same Material but giving them different weights and changing their X and Y Shininess. For the first one i created a sharp reflection and for the second a anisotropic “stretched” reflection. By altering the sharpness of the reflection and the weight of the two materials , we can create a wide rang of different Metals.

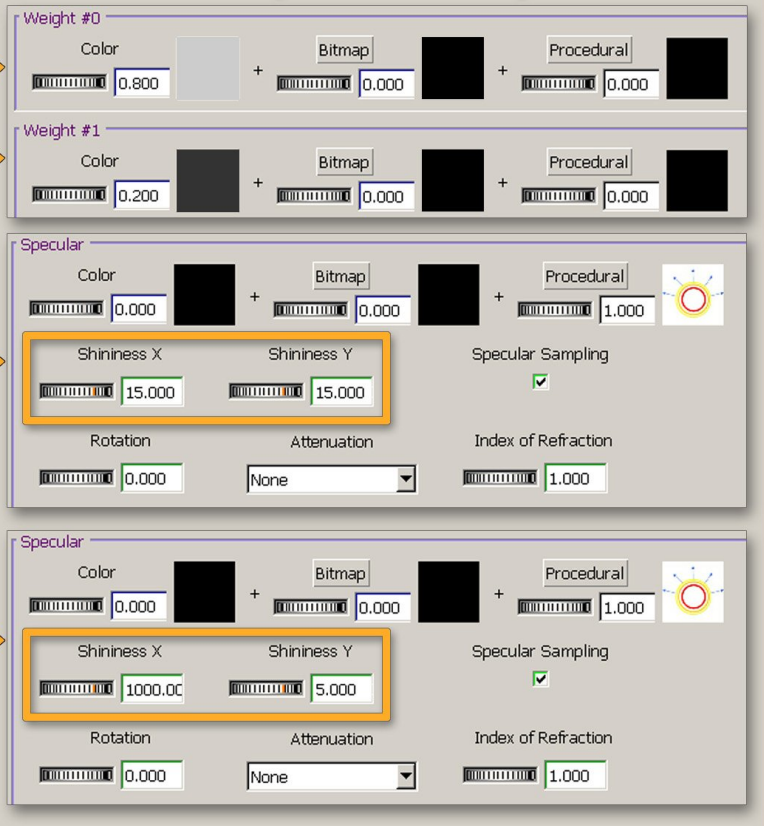


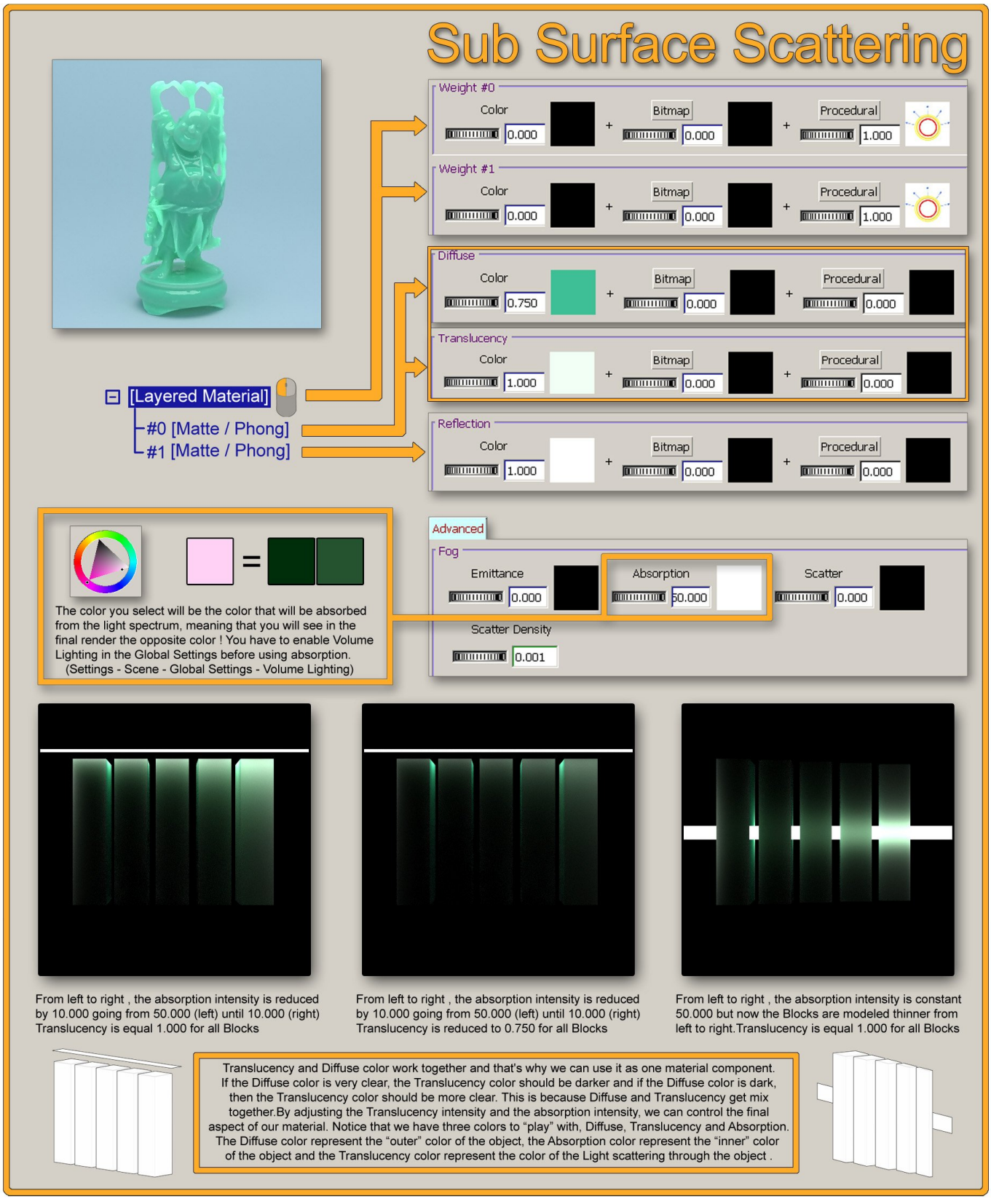
Metal (Advanced) III

Brushed Aluminium

- [Layered Material]
  - #0 [Anisotropic (Ashikhmin)]
  - #1 [Anisotropic (Ashikhmin)]

Another example of a metal with two reflections,but the important part here are the colors for the Low and High color. Some Metals like Aluminium have one color for the Low color and a bluish color for the High color. It is important that the High color intensity is always = 1.000





This example shows how to build a sub-surface scattering (sss) material. The basic plastic material is our starting point. Depending what kind of material we want to create, we have to adjust the IOR value and the shininess value of the specular component (changing the perfect reflection for the specular element if we need more blurry reflection). Instead of the translucency component, we could have used the transmittance component.
Remember that the translucency element can be mapped with a bitmap or a procedural shader which gives use more possibilities than we can explore here.

This was a basic overview of Kerkytheas Material editor, there are more things to discover and there are many things that I could not include do to lack of time but I will continue updating this Material Editor Guide. I would like to give some tricks I use when building materials. First of all it is always good to study real materials, take them in your hands and look at them from different viewing angles. To find out how rough or smooth the material is at microscopic surface level, try to find the reflection of the light source on the material, depending on the blurriness sharpness of the reflection, you can get an idea of the shininess value you have to use. Often you will not be able to find an IOR value for the material you are attempting to create, in this case I always try to imagine if the material would be more reflective if I put water on it or if the water would be more reflective (imagine a floor that has be cleaned with water and is still whet, if you can not tell that it is whet, then the IOR has to be higher then the IOR of water, if you can clearly see that the floor is wet, then the IOR has to be lower than the IOR of water.) IOR of water is 1.33 . There is also a very important thing to know about Fresnel effect and that is, that the effect get less evident the more you increase the IOR value. IOR values above 3.00 show lees Fresnel effect then values lower then 3.00 and the shinnies value (Microscopic Surface properties) also has an effect over the Fresnel effect appearance. The more rough the surface is on Microscopic Surface level, the less evident the Fresnel effect becomes (the more rough the material is , the more the light reflects in a diffuse way scatters the light uniformly in all directions) this is only a guideline to help out in some situations .

Patrick Nieborg 2007

Thanks to Giannis for providing Kerkythea and thanks to all the members of the Kerkythea Forum for their support. You can join the Kerkythea Forum at http://www.kerkythea.net