



Projection Study Guide

This guide will show you how to:

- Create a virtual representation of the stage and its screens;
- Add virtual video projectors;
- Adjust the virtual video projectors parameters;
- Create a heat map for projection surfaces;
- Export the projection study data.

Description

Determining the correct quantity and placement of video projectors is one of the most important task in the early design stages of a production. Luckily PHOTON features Projection Study tools that will help designers and integrators previsualize how video projectors will behave in the venue.

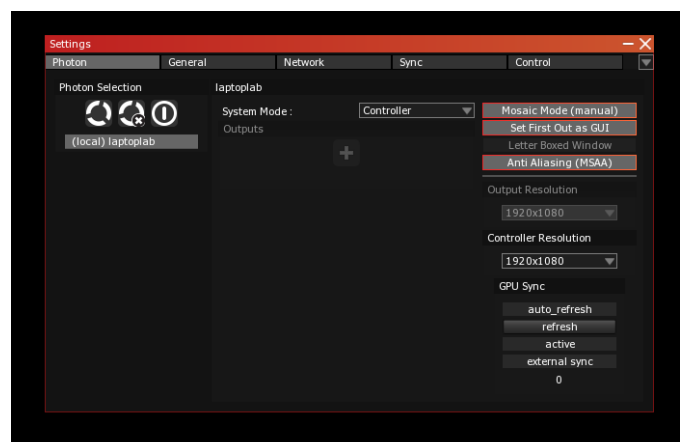
Completing the steps listed above will allow you to use PHOTON to build a full video projection simulation and export its data in standard file formats such as .CSV and .PNG so you can share your video design with your production team and integrators.

1. Initial Server Configuration

You will need only one server running PHOTON acting as a Controller to perform a Projection Study. Follow these steps to switch your server to the Controller System Mode:

1. Start PHOTON on the selected server.
2. Select {System > Settings} or press [Alt+S] to open the Settings module.
3. Select your server by clicking on its entry in the Photon Selection list.
4. Select the {Controller} option from the System Mode dropdown menu. A Confirmation Box will open.
5. Click on the [OK] button to validate your choice and close the Confirmation Box.

The server now operates as a Controller.



2. Virtual Stage Construction

It is possible to build a virtual representation of the production's stage in PHOTON. You can add 3D models of sets, props and architectural features of the venue to build a realistic previsualization. While these can help you create a beautiful virtual stage, they are not essential (see section 5.2 Decorative Stage Elements).

The only crucial set elements of a Projection Study are the Screens. The main objective of a Projection Study is to determine if the quantity and placement of video projectors provide sufficient coverage. Therefore, projections surfaces should be your prior concern.

Screens

PHOTON features built-in basic 3D Primitives such as Planes, Spheres or Cubes that can be used to represent Screens. You can also import custom-made 3D models that match your production's screens. Please refer to the PHOTON manual for detailed instructions on how to import these 3D models in your project (see section 2.1 Importing 3D Objects in Chapter 3 Importing Content).

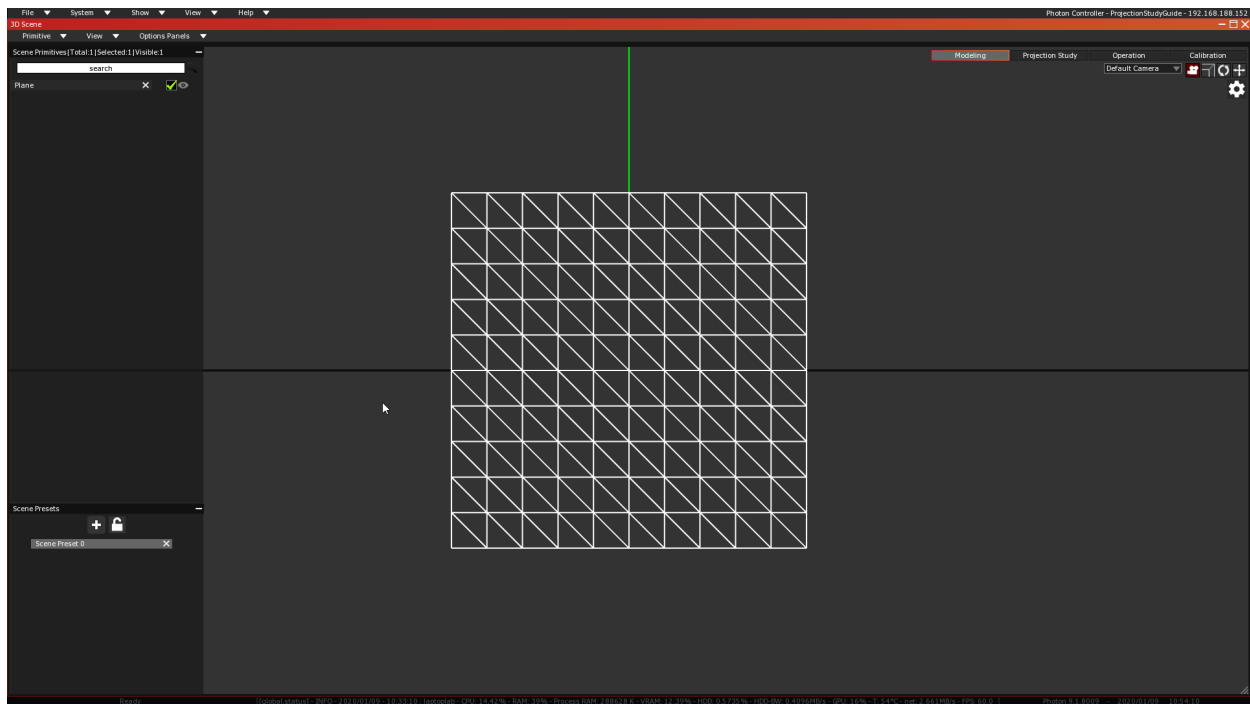
Note: PHOTON uses the metric system. All measures in the 3D Scene are in meters. Before starting to build the virtual 3D representation of your stage, make sure you have access to its measurement in the metric system.

2.1. Add a Screen

As stated before, it is possible to use built-in Primitives or custom-made shapes when creating Screens. Both methods are shown below. The Plane has been selected for the built-in model example.

1. Select {System > 3D Scene} or press [Alt+C] to open the 3D Scene module.
2. Select {Primitive > Default Objects > Plane} from the 3D Scene menu to add a Plane in the 3D Scene.



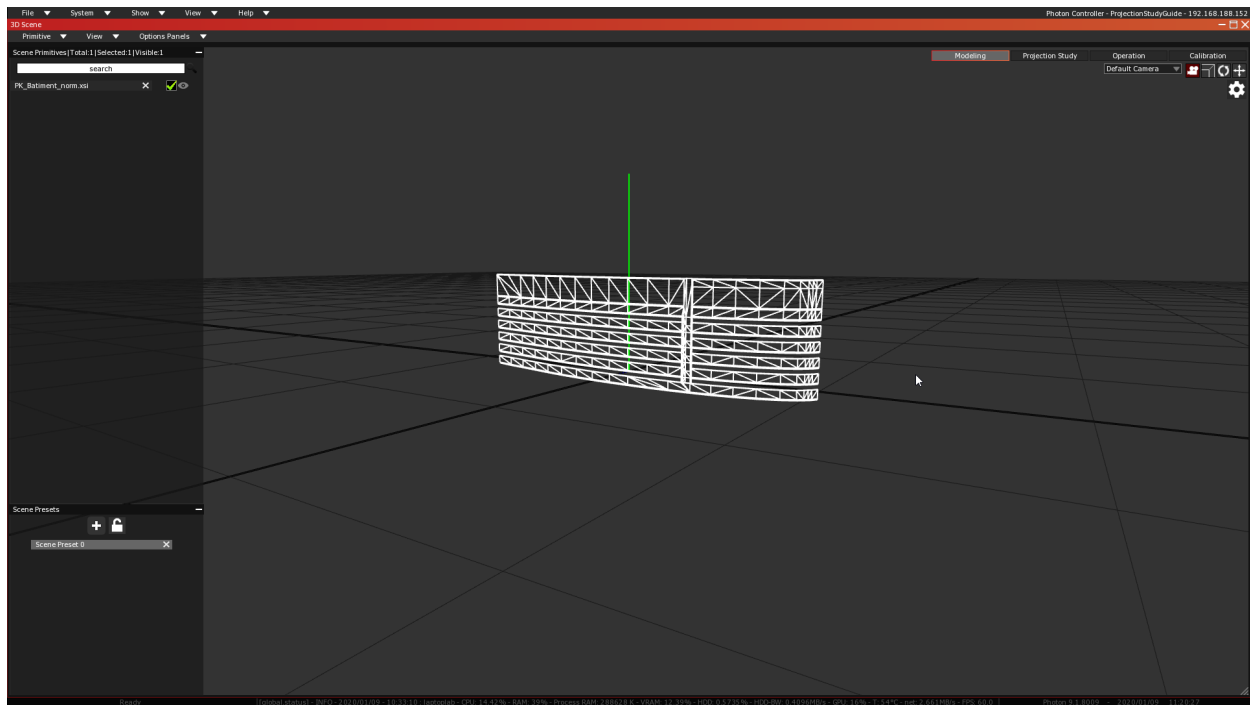


OR

1. Select {System > 3D Scene} or press [Alt+C] to open the 3D Scene module.
2. Select {Primitive > OBJ > *customModelName.obj*} from the 3D Scene menu to add a custom model in the 3D Scene.

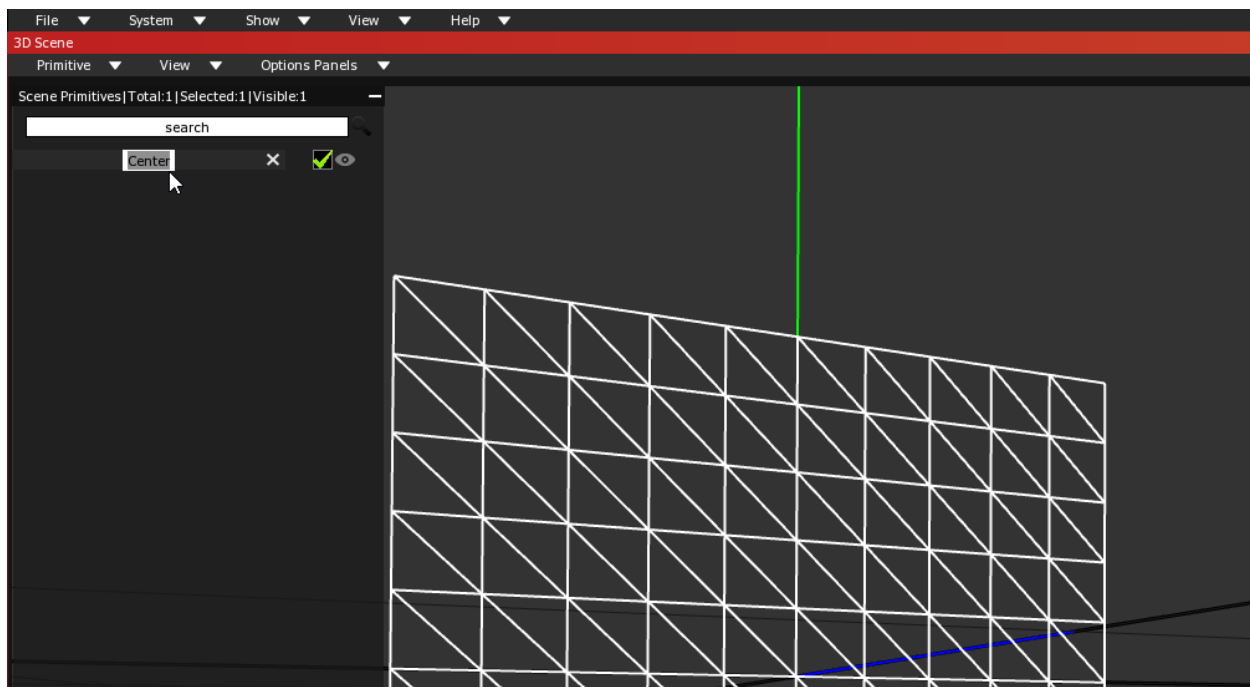
OR

1. Select {System > 3D Scene} or press [Alt+C] to open the 3D Scene module.
2. Select {Show > File Manager} or press [Alt+F] to open the File Manager module.
3. Activate the 3D Object filter by clicking on its entry in the Filters list.
4. Locate the 3D model you want to import to the 3D Scene from the filtered list
5. [Click+Drag+Drop] the 3D model from the File Manager module to the 3D Scene module.



2.2. Rename the Screen

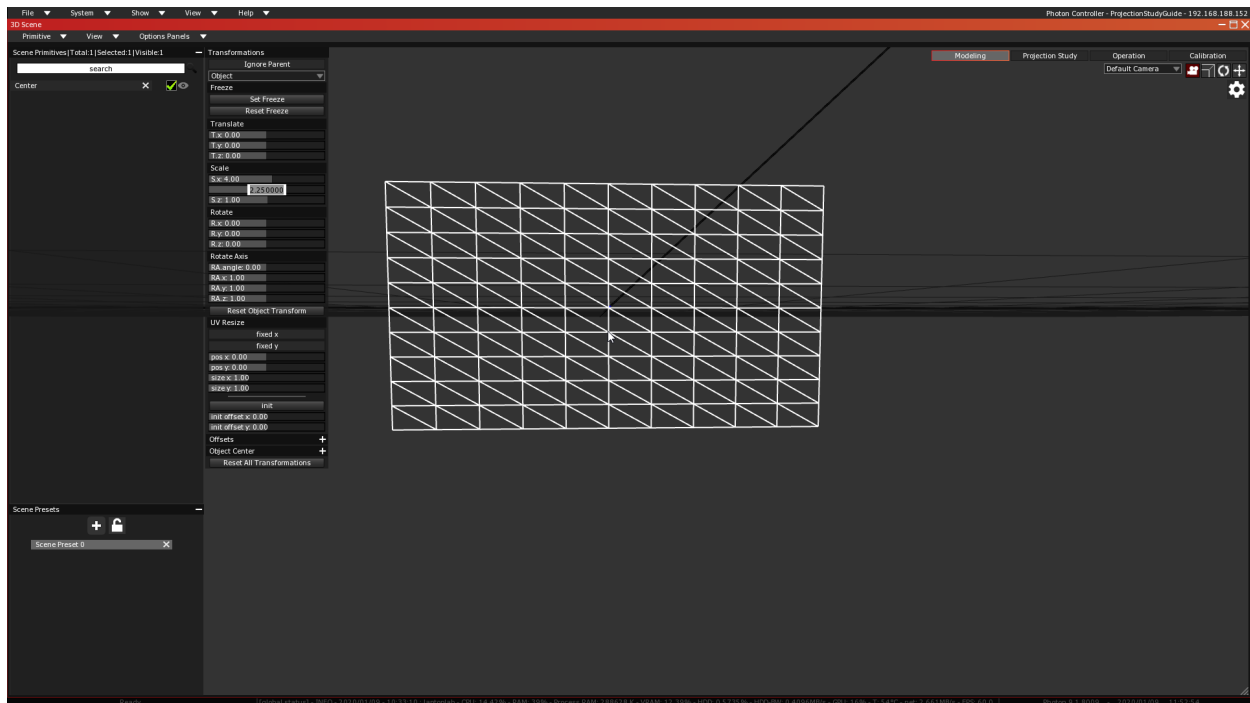
1. Double-click the 3D Object's entry in the Scene Primitives to open a text-field.
2. Write the name of the Screen then press [Enter].



2.3. Scale the Screen

You might want to adjust the Scale properties of the Screen so they match the proportions of the physical Screen.

1. Select {Option Panels > Transformations} from the 3D Scene menu or press [T] to open the Transformations panel.
2. Modify any of the X, Y or Z Scale slider value by either manipulating it directly with the mouse or by [Double-clicking] in it to open a text field where you can enter a numerical value.



Note: It is also possible to change the Scale values of a 3D object through direct mouse manipulations. To do so:

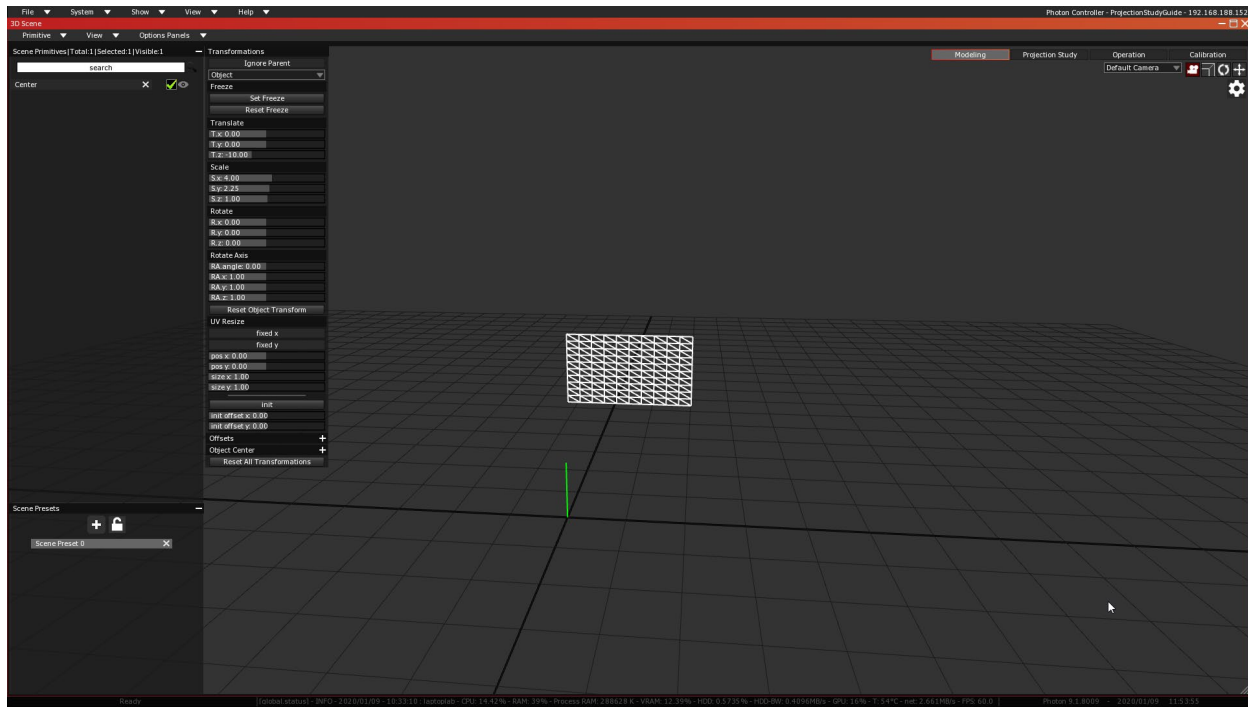
- Press [X] or click on the [Scale] button located in the top right corner of the 3D Scene window to enable Scaling transformations.
- Select the Screen you want to scale by clicking on its entry in the Scene Primitives list.
- [Drag-click] any of the 3 colored handles located on the selected object to change its scale.

2.4. Position the Screen

You have to position the Screen in the 3D Scene as it will be on the real-life stage.

1. Make sure the Transformations panel is still open and the Screen still selected.

2. Modify any of the X, Y or Z Position Slider value by either manipulating it directly with the mouse or by [Double-clicking] in it to open a text field where you can enter a numerical value.



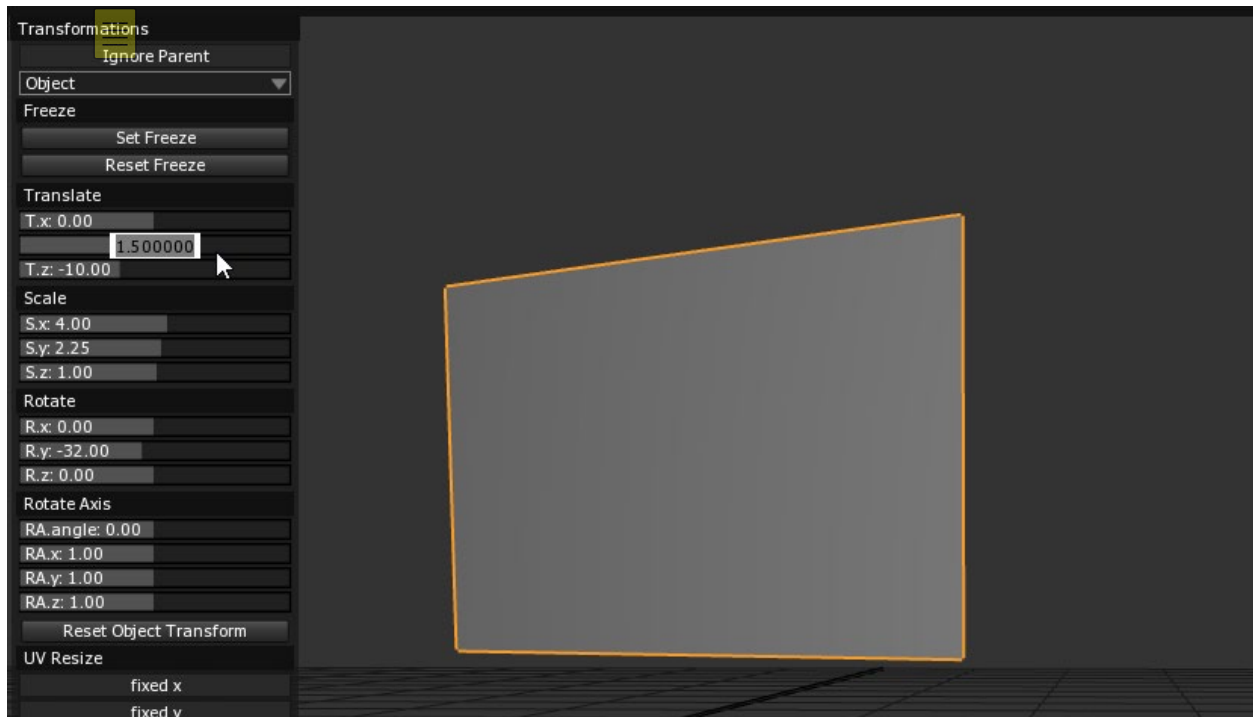
Note: It is also possible to change the position values of a 3D object through direct mouse manipulations. To do so:

1. Click on the [Position] button located in the top right corner of the 3D Scene window or press [V] to enable position transformations.
2. Select the Screen you want to scale by clicking on its entry in the Scene Primitives list.
3. [Drag-click] any of the 3 colored handles located on the selected object to change its position.

2.5. Rotate the Screen

You have to orient the Screen in the 3D Scene as it will be on the real-life stage.

1. Make sure the Transformations panel is still open and the Screen still selected.
2. Modify any of the X, Y or Z Rotate sliders values by either manipulating them directly with the mouse or by [Double-clicking] in it to open a text field where you can enter a numerical value.



Note: It is also possible to change the rotation values of a 3D object through direct mouse manipulations. To do so:

1. Click on the [Position] button located in the top right corner of the 3D Scene window or press [C] to enable rotation transformations.
2. Select the Screen you want to rotate by clicking on its entry in the Scene Primitives list.
3. [Drag-click] any of the 3 colored handles located on the selected object to rotate it.

2.6. Create Additional Screens

- Repeat steps 2.1 to 2.4 for each Screen you need to add to the 3D Scene.

Note: It is possible to duplicate 3D Objects. If you happen to have many identical Screens, you can make copies that you will rename and position later on. To duplicate a Screen:

1. Right-click on the Screen's entry in the Scene Primitives list to open a contextual menu. Select {Duplicate}.

OR

1. Select the Screen you want to duplicate by clicking on its entry in the Scene Primitives list.
2. Press [Ctrl+D].

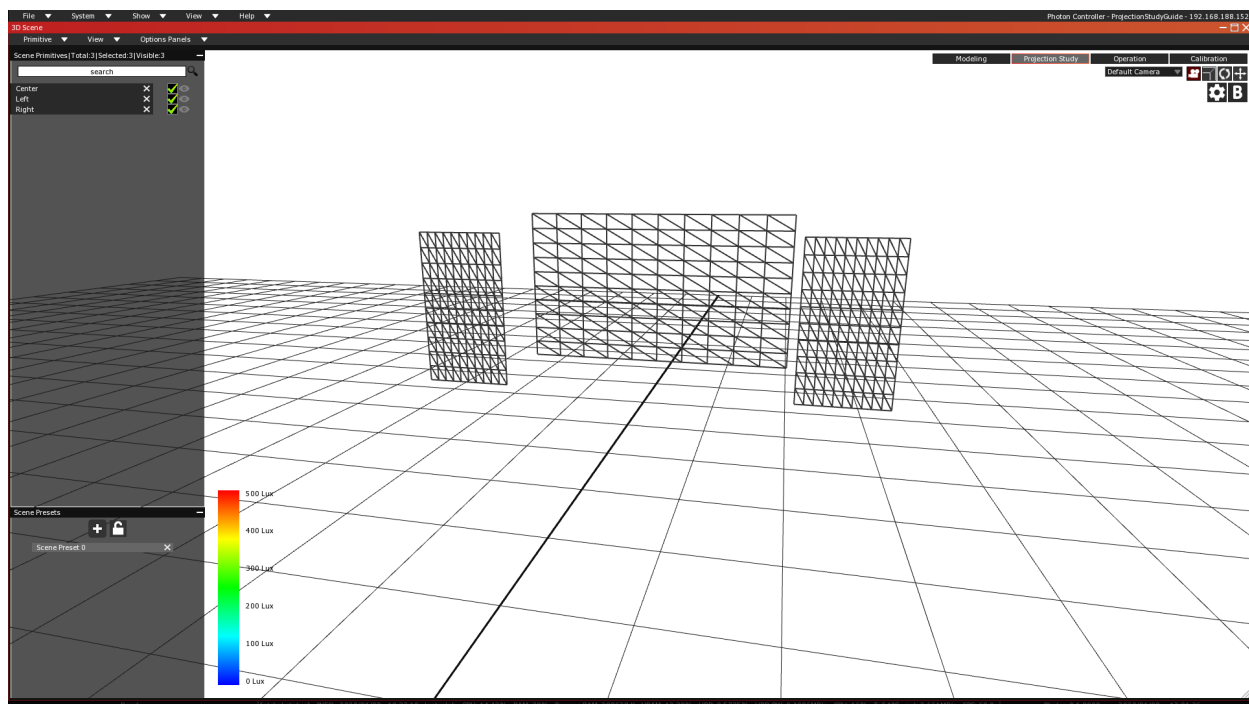
3. 3D Scene Mode, Rendering Type and Projection Study Settings

The 3D Scene is a module that allows users to perform many different tasks. You will need to change the 3D Scene's operation mode to the Projection Study mode to access the appropriate set of functionalities for the current task.

3.1. Projection Study Mode Selection

- Click on the [Projection Study] button to select this operation mode.

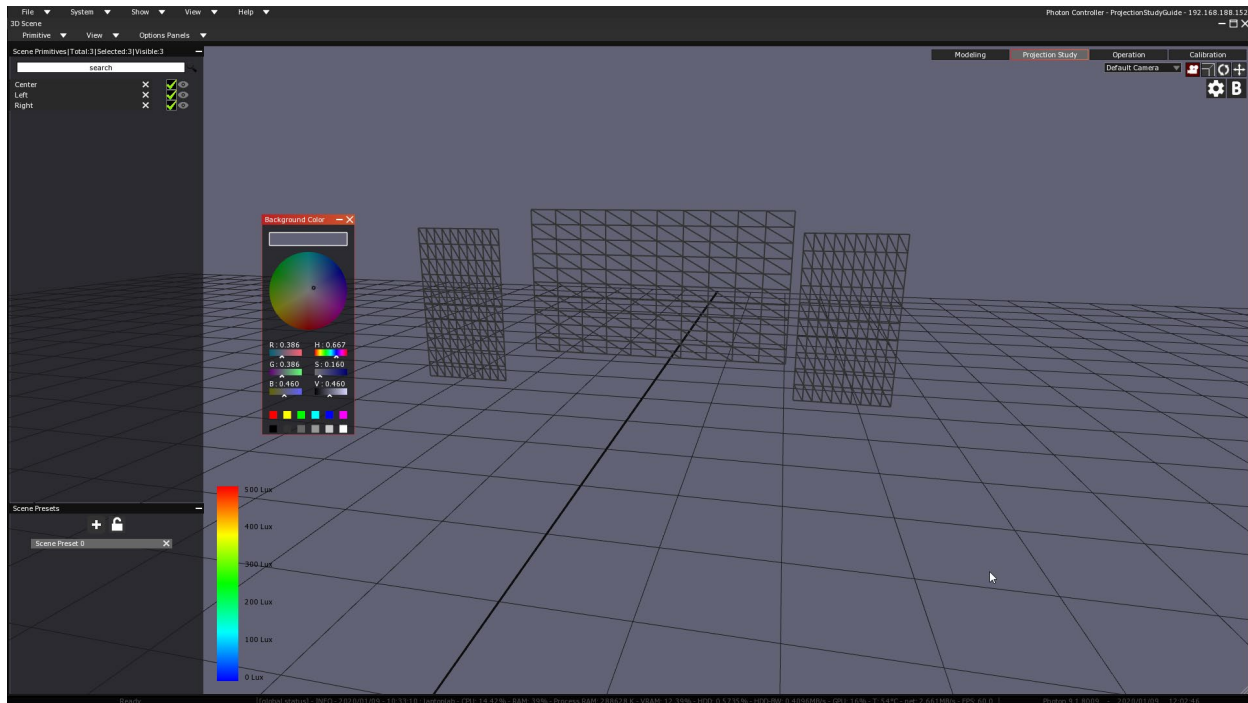
Once the 3D Scene switches to the Projection Study mode, the background turns white.



Background Color Adjustment

This step is optional. If you wish to continue your work on a dark grey background do the following:

1. Select {View > Background Color} from the 3D Scene menu to open the Background Color window.
2. Use the sliders or buttons in the window to select the desired background color.



Do the following if you wish to return to the default background color:

- Select {View > Reset Background Color} from the 3D Scene menu.

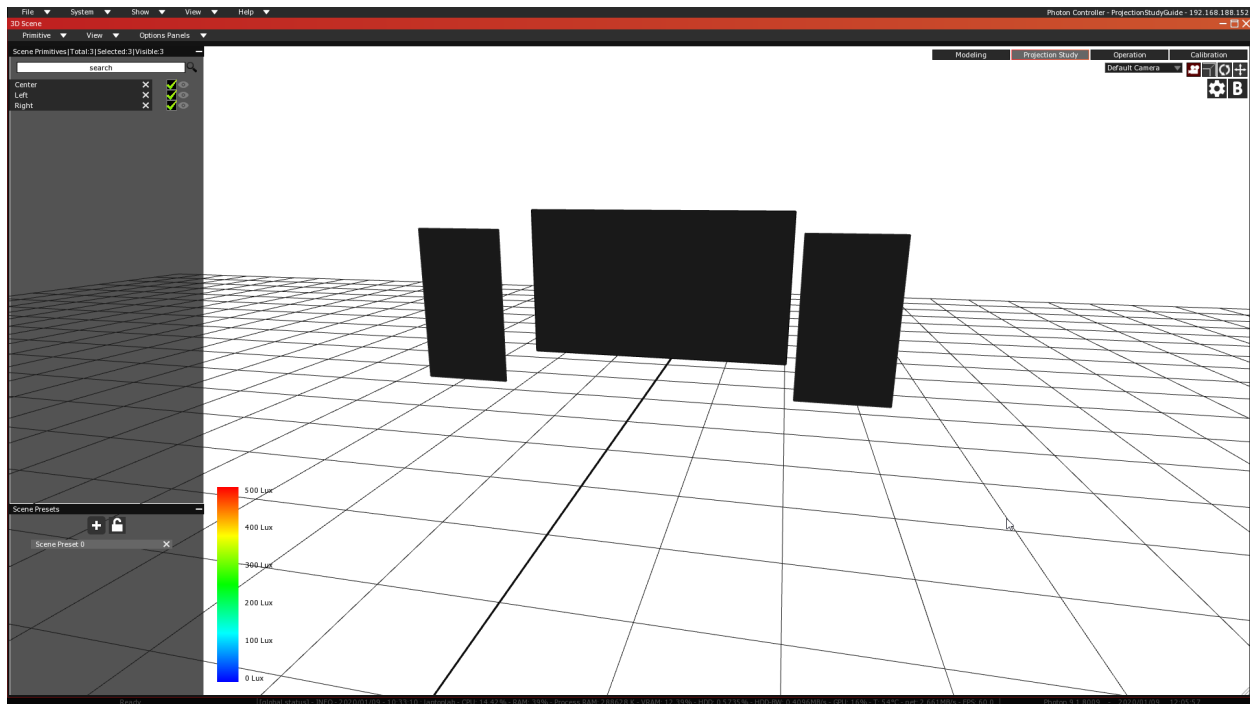
3.2. Rendering Mode

PHOTON uses wireframe rendering by default. In order to complete a Projection Study, you will need to either switch the rendering mode to Projection Rendering or Shadows Rendering.

Shadows Rendering will render light and video projected onto Screens including shadows that can be casted by a 3D object. This is the preferred Rendering mode for a projection study since it will show problems created by shadows. It is however more demanding in terms of computer performance.

Projection Rendering will render light and video but not shadows casted by objects. This mode is less computationally intensive.

- Select {View > Shadows Rendering OR Projection Rendering} from the 3D Scene menu. (You can also cycle through the Rendering modes by pressing [W] until you select Projection or Shadows Rendering.)

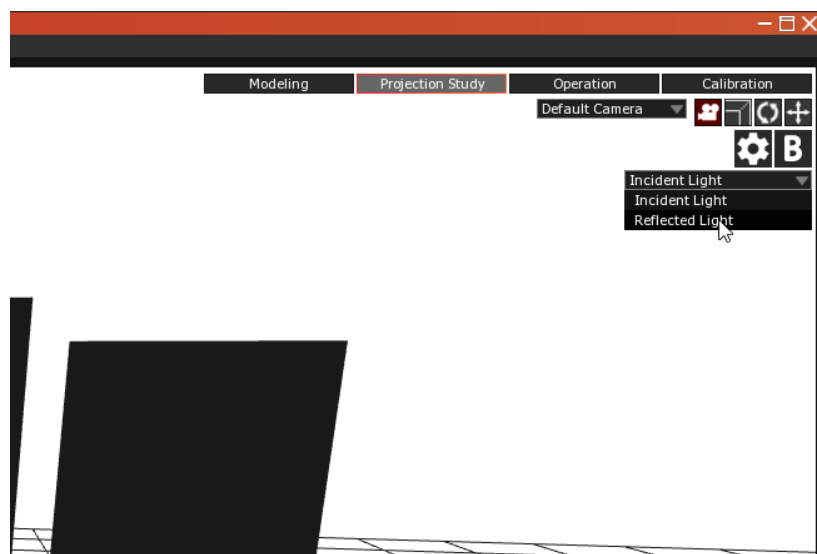


The appearance of the Screens in the 3D Scene rendering should have changed. Screens should now be solid grey and feature an orange outline when selected.

3.3. Projection Study Settings

In order to specify to PHOTON to take into account the angles of the Screens and the Projectors when calculating illumination, you will need to change a light type setting.

1. Click on the Settings button (the sprocketed wheel) located in the top right corner of the 3D Scene window.
2. Select {Reflected Light} from the dropdown menu located at the top of the Settings panel.



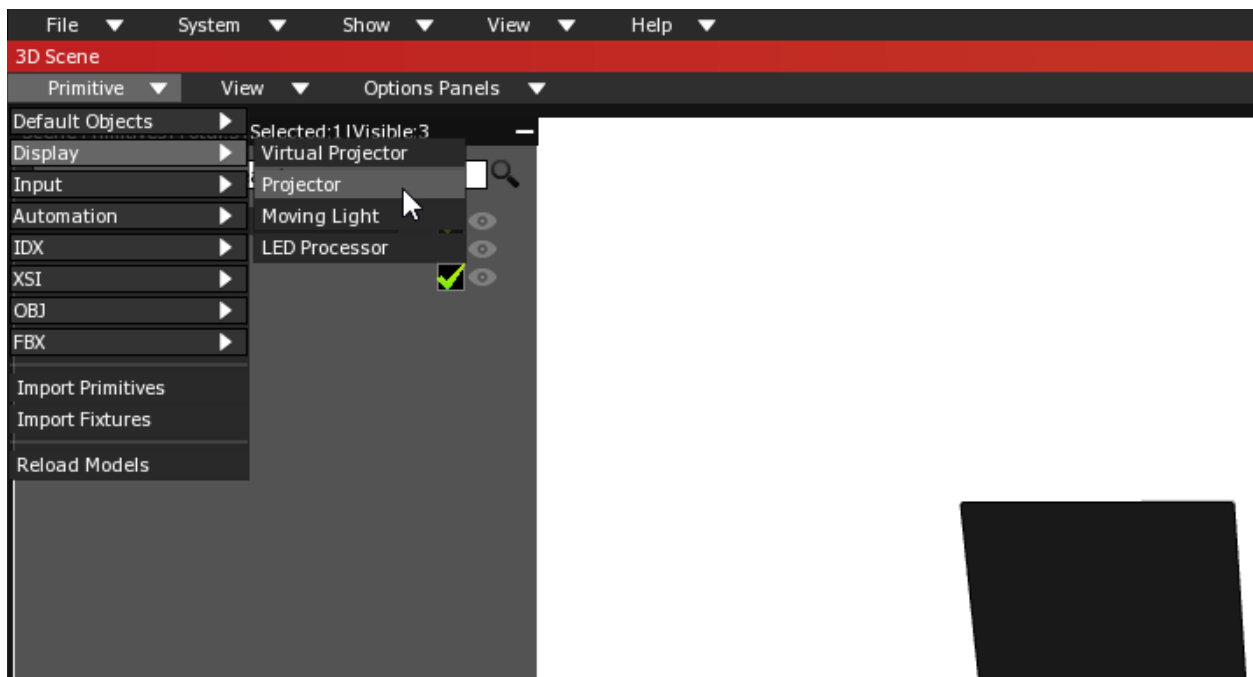
Note: The angle at which a beam emitted by a Projector hits a surface has a tremendous impact on the amount of light that will be reflected. Extreme angles will greatly diminish the amount of lux measured on a Screen. You can verify this by switching the light type setting.

4. Video Projectors Placement and Adjustments

Now that the Screens are in place, you will need to create virtual instances of your Projectors in the 3D Scene.

4.1. Add a Video Projector

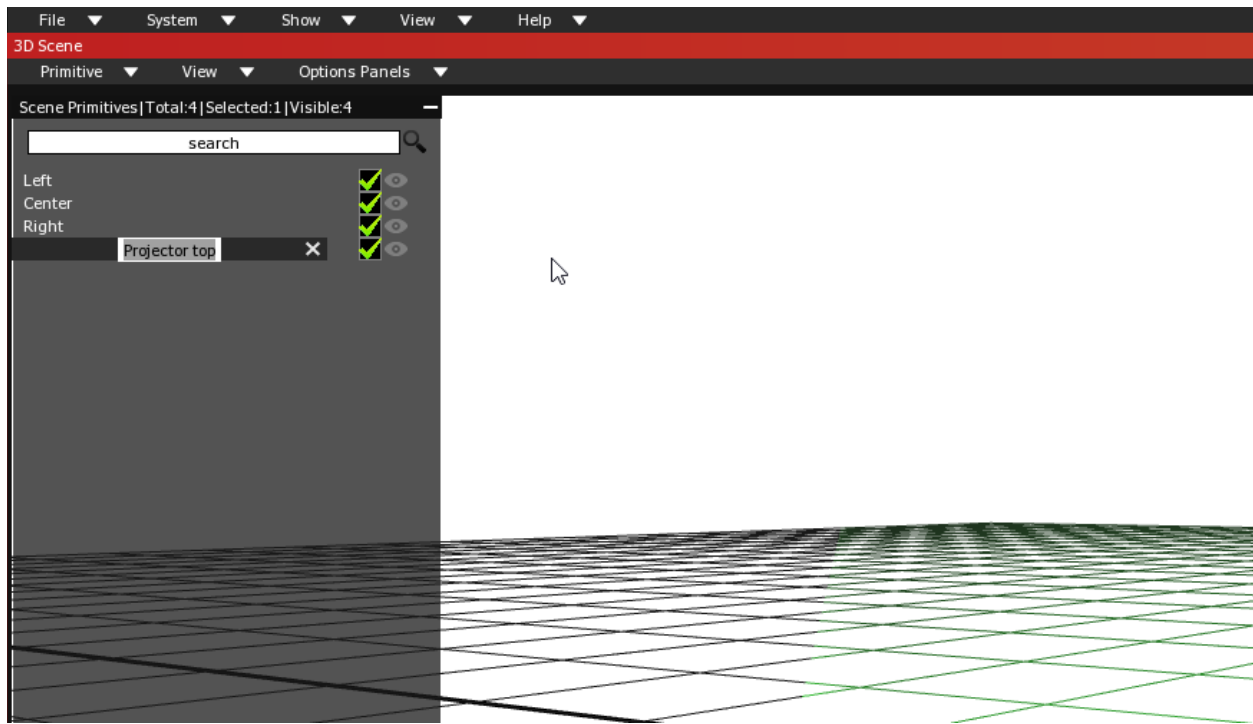
- Select {Primitive > Display > Projector} from the 3D Scene menu to add a Projector in the 3D Scene.



4.2. Rename the Projector

It is preferable to individually name Projectors, especially in large projects. This might help you identify problematic or inefficient Projectors in your design. Do the following to rename the Projector:

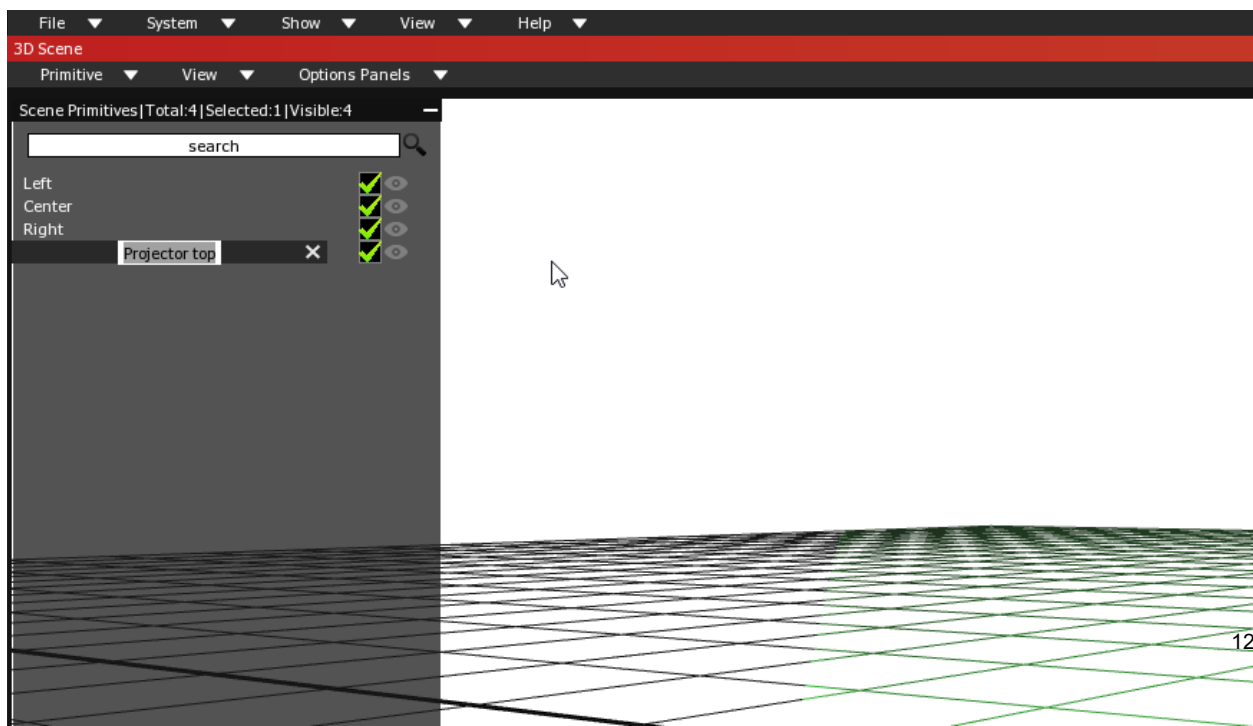
1. Double-click the Projector's entry in the Scene Primitives to open a text-field.
2. Write the name of the Projector then press [Enter].



4.3. Adjust the Projector's Properties

You will need to use the physical video projector and lens technical specifications in order to set the 3D Scene's Projector's parameters. Most of its parameters can be set in the Properties panel. Follow these steps to access the Projector's properties panel:

1. Make sure the Projector is currently selected by clicking on its entry in the Scene Primitives list.
2. Select {Options Panels > Properties} from the 3D Scene menu or press [P] to open the Projector's Properties panel.



FOVY

Field Of View Y-axis or fovy, corresponds to the vertical angle of the Projector's lens expressed in degrees. Since manufacturers rarely provide information about their product's fovy in technical documents, you will have to work with the lens' throw ratio, which should be readily available.

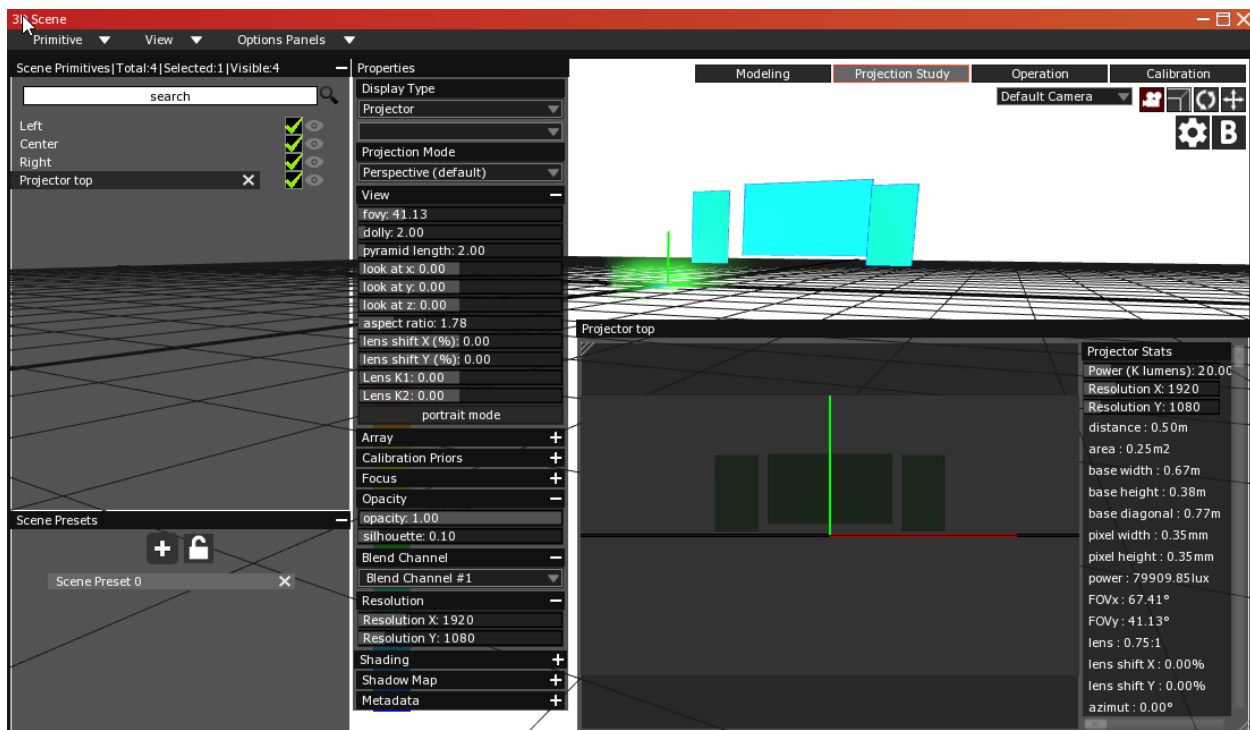
To determine your Projector's fovy, you need to change the value of the fovy parameter while watching the lens parameter located in the viewport. The lens parameter will change as you input new values in the fovy slider. The lens parameter value should match your lens' throw ratio.

Follow these steps to set the 3D Scene's Projector fovy:

- Click-drag the fovy slider in the Properties panel to set the Projector's fovy. Modify the fovy parameter's value until the lens parameter value located in the viewport matches the lens' throw ratio.

OR

- Double-click the fovy slider in the Properties panel to open a numeric field.
- Type the fovy value in the field then press [Enter]. Make sure the lens parameter value located in the viewport matches the lens' throw ratio.

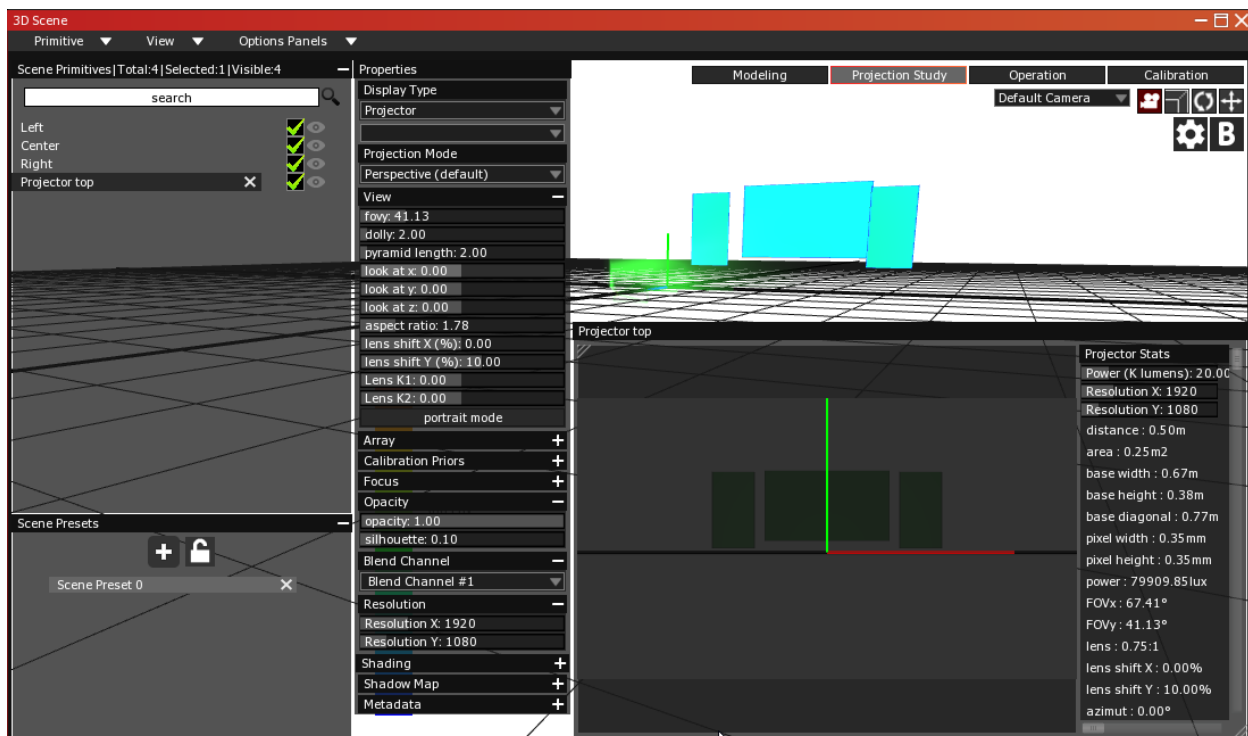


The Projector's beam is represented by a square-based pyramid. You should notice that the shape of the pyramid changes when you modify the Projector's fovy property.

Lens Shift

Projectors feature a lens shift x and lens shift y parameters that are accessible through the Properties panel. If you are planning to apply lens shift to the physical projectors, their virtual counterpart's properties should represent it. The percentage of horizontal and vertical lens shifts of the physical projectors have to be entered in the properties panel.

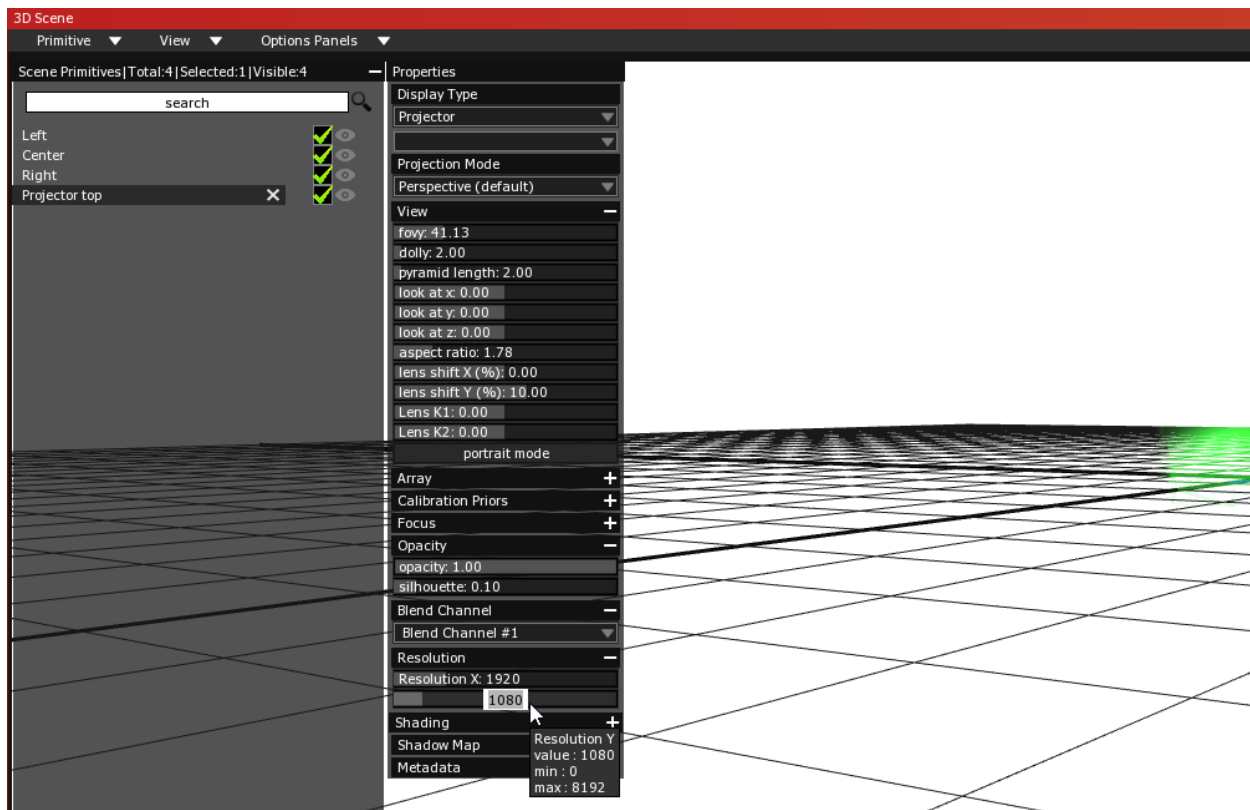
1. Make sure the Projector is selected and that the Properties panel is open.
2. Modify the lens shift x and lens shift y sliders values by either manipulating them directly with the mouse or by [Double-clicking] on them to open a text field where you can enter numerical values.



Resolution

You have to match the physical projector's native resolution with the one you created in the 3D Scene. Inputting the 3D Scene's Projectors resolution is important since the Projection Study features pixel pitch information about the various Screens.

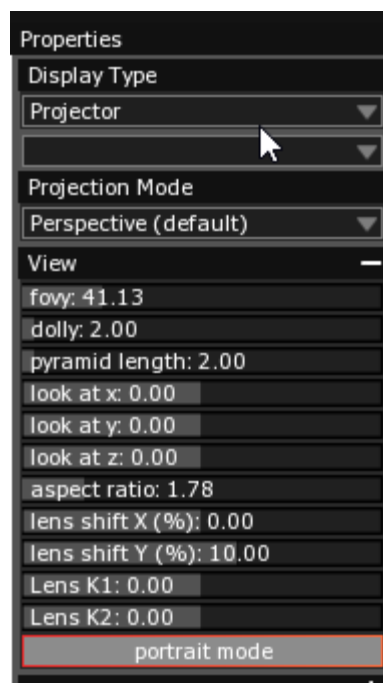
1. Make sure the Projector is still selected and that the Properties panel is open.
2. Locate the Resolution section of the panel. You might have to unfold it by double-clicking on the section's title.
3. Modify the Resolution X and Resolution Y sliders values by either manipulating them directly with the mouse or by [Double-clicking] on them to open a text field where you can enter numerical values corresponding to the specification of the physical projector.



Portrait mode

If the physical projector is rotated on the Z axis by 90 degrees to achieve a portrait image ratio, you will need to represent this in the 3D Scene. Do the following to activate the Projector's portrait mode:

1. Make sure the Projector is still selected and that the Properties panel is open.
2. Click on the [portrait mode] toggle in the Properties panel to enable the Projector's portrait mode.



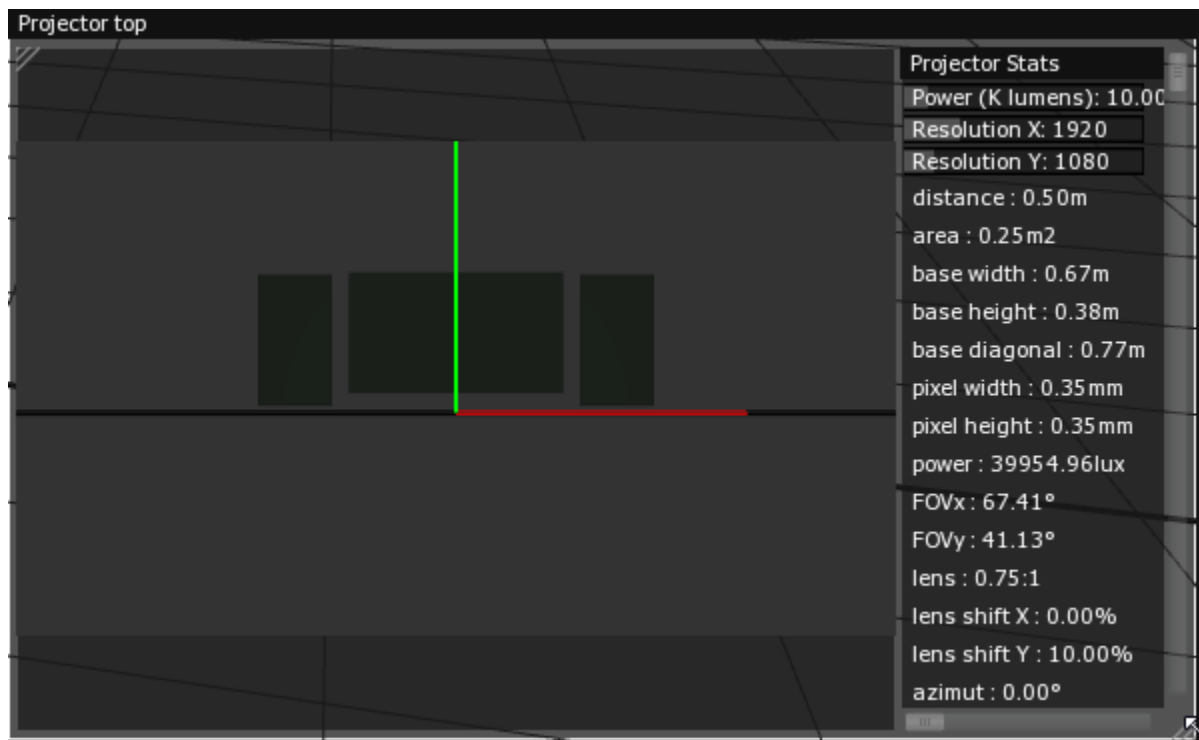
Note: Before taking the decision to rotate or flip the 3D Scene Projectors, make sure that such actions can be done with the physical projectors. Manufacturers provide information about safe projector rotation angles in their technical specification documents.

Note: You can also rotate the Projector at 90 degrees on the Z-axis to achieve a result similar to the activation of the Portrait Mode. The Rotate Z slider can be found in the Transformations panel.

Power

The Projector's power corresponds to its output in lumens. This value is expressed in thousands (K) in PHOTON's UI. This parameter is included in the viewport located in the lower right corner of the 3D Scene window. Do the following to set the Power parameter for the Projector:

1. Make sure the Projector is still selected. The viewport's name should be the same as the Projector. You should be able to see a slider named Power in the Projector Stats window section.
2. Modify the Power slider value by either manipulating it directly with the mouse or by [Double-clicking] in it to open a text field where you can enter a numerical value.



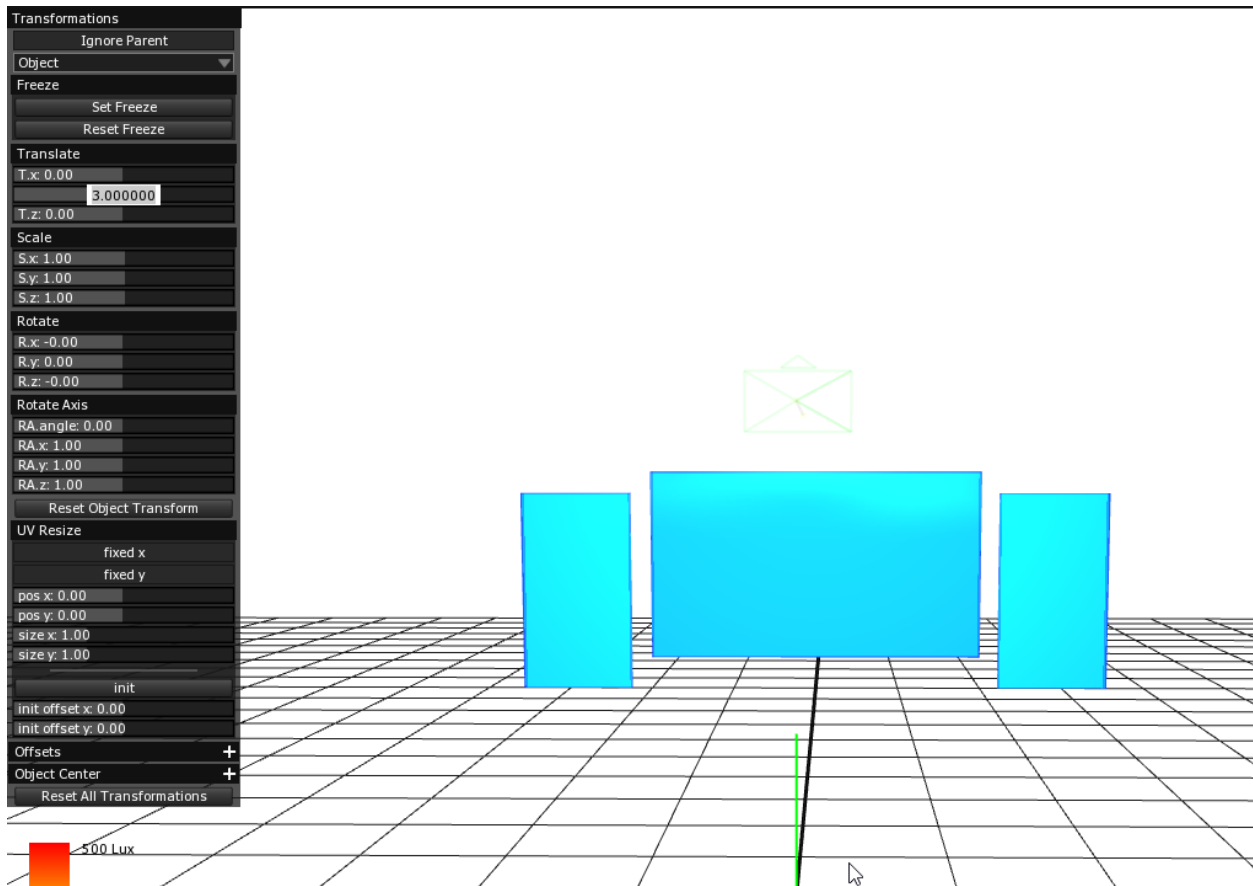
Note: If you are building a Projection Study for a project that involves a large amount of Projectors, you might want to create easily identifiable groups of them. You can change the

color of the Projectors' beams by modifying the Projection Red, Green and Blue parameters located in the Properties panel.

4.4. Position the Projector

You have to position the Projectors in the 3D Scene as it will be on the real-life stage. You should first use the same method that was presented in section 2.4 (Position the Screen) to roughly place the Projector in the 3D space.

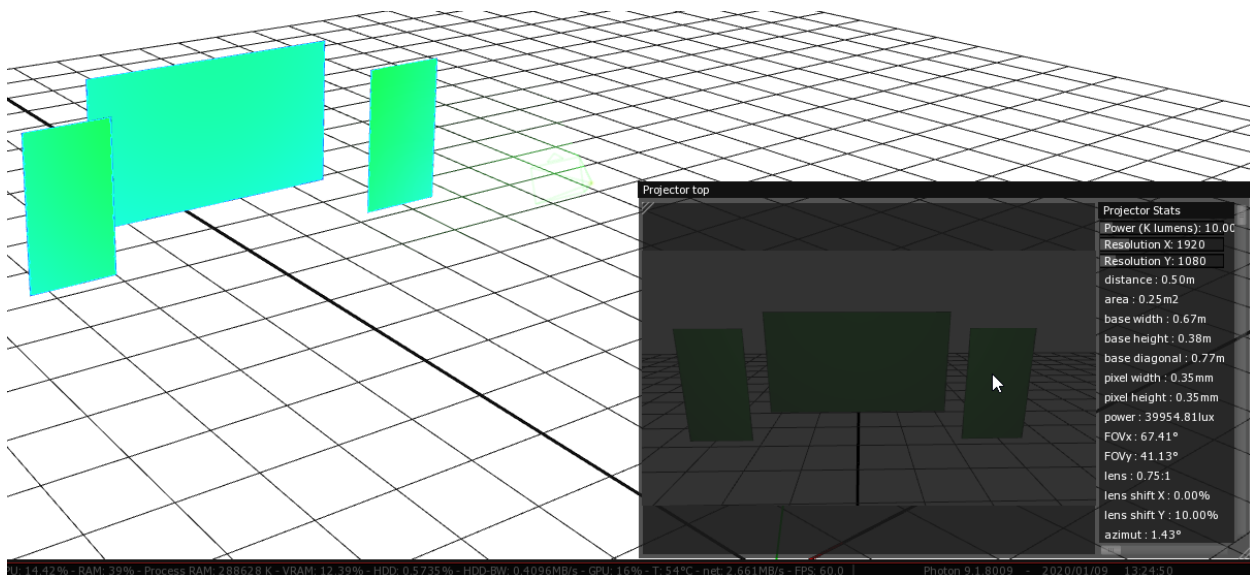
1. Make sure the Transformations panel is still open and the Screen still selected.
2. Modify any of the X, Y or Z Position Slider value by either manipulating it directly with the mouse or by [Double-clicking] in it to open a text field where you can enter a numerical value.



1. Click on the [Position] button located in the top right corner of the 3D Scene window or press [V] to select the 3D Scene's position transformations tool.
2. Drag-click] any of the 3 colored handles located on the selected Projector to change its position.

Then, you should refine the Projector's position and orientation using the viewport.

3. Make sure the Projector is still selected. The viewport's name should be the same as the Projector.
4. You can now use the mouse to interact with Projector's POV show in the viewport:
 - [Left-click-drag] to change Projector's "look at" parameter. (Doing so will change its orientation)
 - [Right-click-drag] to change Projector's position on the X and Y axis
 - [Mousewheel] to change Projector's position on the Z axis.
 - [Ctrl+left-click-drag] if you wish to modify the Projector's position and orientation without changing its target.



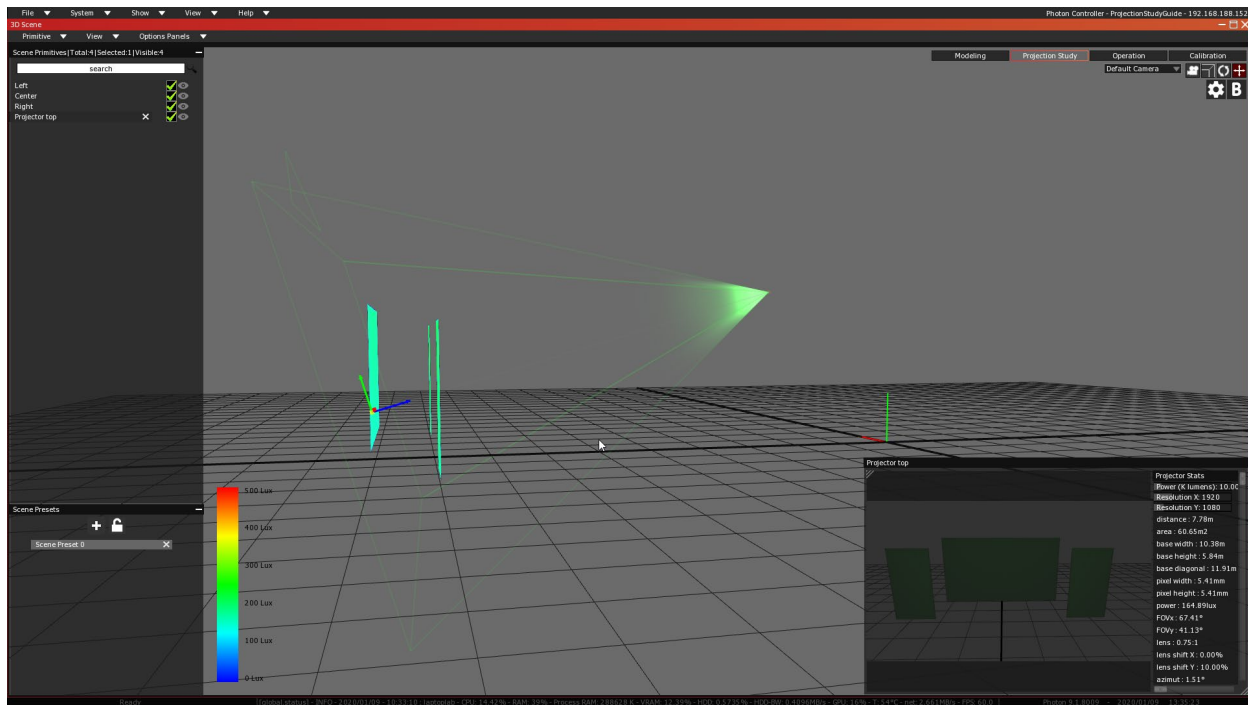
4.5. Set the Projector's Target

You will have to extend the 3D Scene Projector's beam (represented by a pyramid) until it reaches the surface of the Screen it is intended to light up. This will allow PHOTON to determine how much light reaches the surface.

1. Make sure the Projector is still selected and that its orientation and position are set.
2. Then you can either:
 - Select {Options Panels > Properties} from the 3D Scene menu or press [P] to open the 3D model's Properties panel. Change the pyramid length slider value by either manipulating it directly with the mouse or by [Double-clicking] in it to open a text field where you can enter a numerical value.

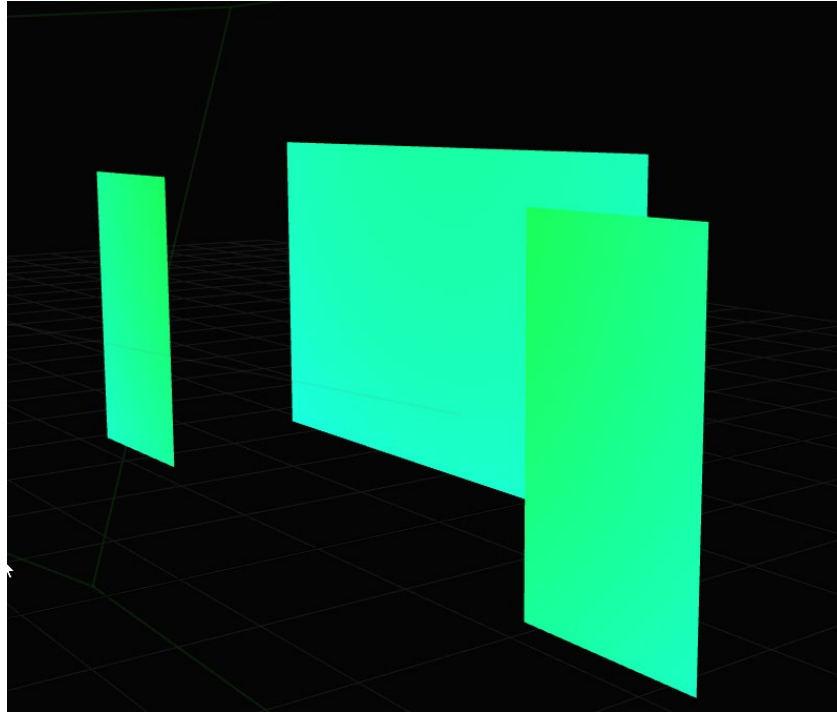
OR

- Press [V] once to enable the 3D Scene's position transformations. Three arrows corresponding to the X Y and Z axis (red, green and blue) should appear at the summit of the pyramid representing the Projector. Press [V] a second time to select the Projector's target located at the base of the pyramid. The arrows representing the 3 axis should now appear at the base of the pyramid. [Click+drag] the yellow cube representing the intersection of the axis to extend and re-orient the bases of the pyramid.



OR

- Press [Shift+E] to extend the pyramid's target onto the Screen facing the Projector.
3. The pyramid should be extended until it reaches the Screen. You verify this by making sure the pyramid's target (a line terminated with a point at the center of the beam) touches the Screen.



4.6. Create Additional Projectors

- Repeat steps 4.1 to 4.5 for each Projector you need to add to the 3D Scene.

Note: It is possible to duplicate 3D Objects. If you happen to have many identical Projectors, you can make copies that you will rename and position later on. To duplicate a Projector:

- Right-click on the Projector's entry in the Scene Primitives list to open a contextual menu. Select {Duplicate}.

OR

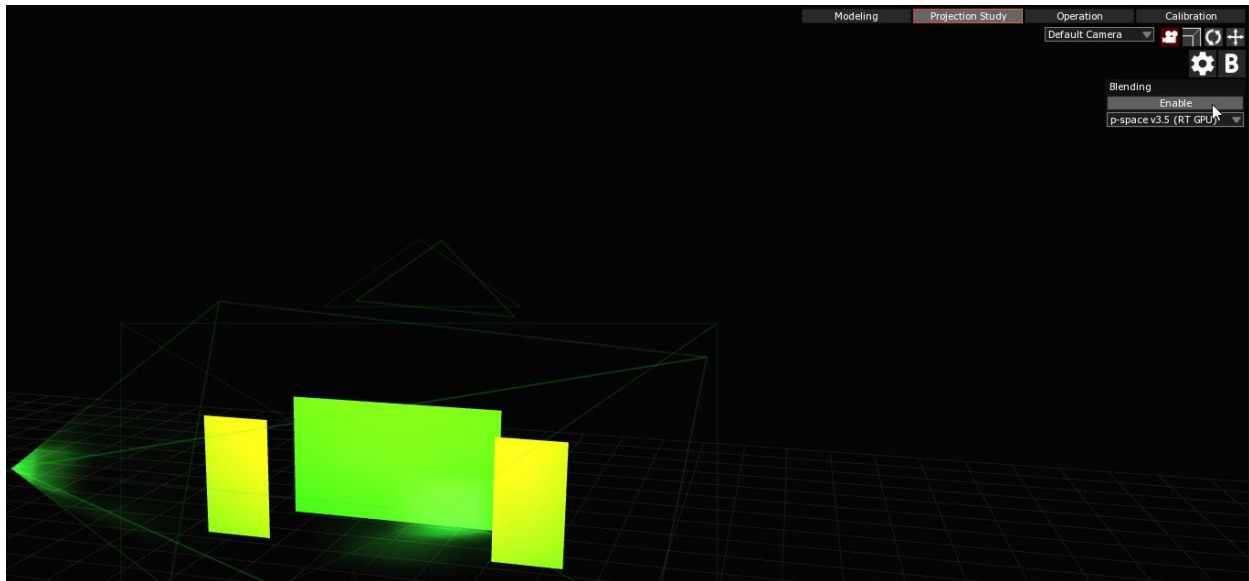
1. Select the Projector you want to duplicate by clicking on its entry in the Scene Primitives list.
2. Press [Ctrl+D].

5. Blending

Projection blending is enabled by default in PHOTON. You should keep it enabled when you build the previsualization in order to make sure that there is no blending problem. It is however preferable to submit a second version of the Projection Study where projection blending is disabled in order to show explicitly the overlapping zones for surfaces and Projectors. There will be no visible overlaps if Blending is enabled. DO the following to disable blending:

1. Click on the [B] button located to open the Blending panel.

2. Click on the [Enable] toggle in the Blending panel to disable the blending in the 3D Scene.



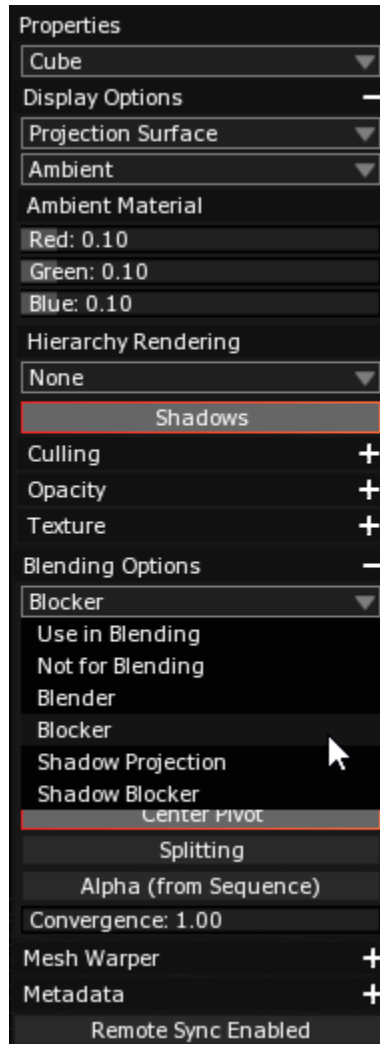
6. Shadows

Projector placement can be tricky. An actor or a mobile set element might at one point break a projection beam and create an unwanted shadow. The Projection Study is the perfect context to identify in advance potential occlusions.

Once your Projectors and Screens are set in the 3D Scene, you have to add 3D objects that will reproduce potential occlusions. These objects will represent actors or moving sets. Identify a section of the show that might produce such type of problem so you can try to re-create the situation in the previsualization.

1. Select {View > Shadows Rendering} from the 3D Scene menu.
2. Select {Primitive > OBJ > *objectofyourchoice.OBJ*} from the 3D Scene menu to add a custom model that will create occlusions.
3. Select {Options Panels > Properties} from the 3D Scene menu or press [P] to open the Projectors Properties panel.
4. Make sure that Shadows are enabled for this model by clicking on the [Shadows] toggle in the Properties panel.

5. Select {Options Panels > Transformations} from the 3D Scene menu or press [T] to open the Transformations panel.



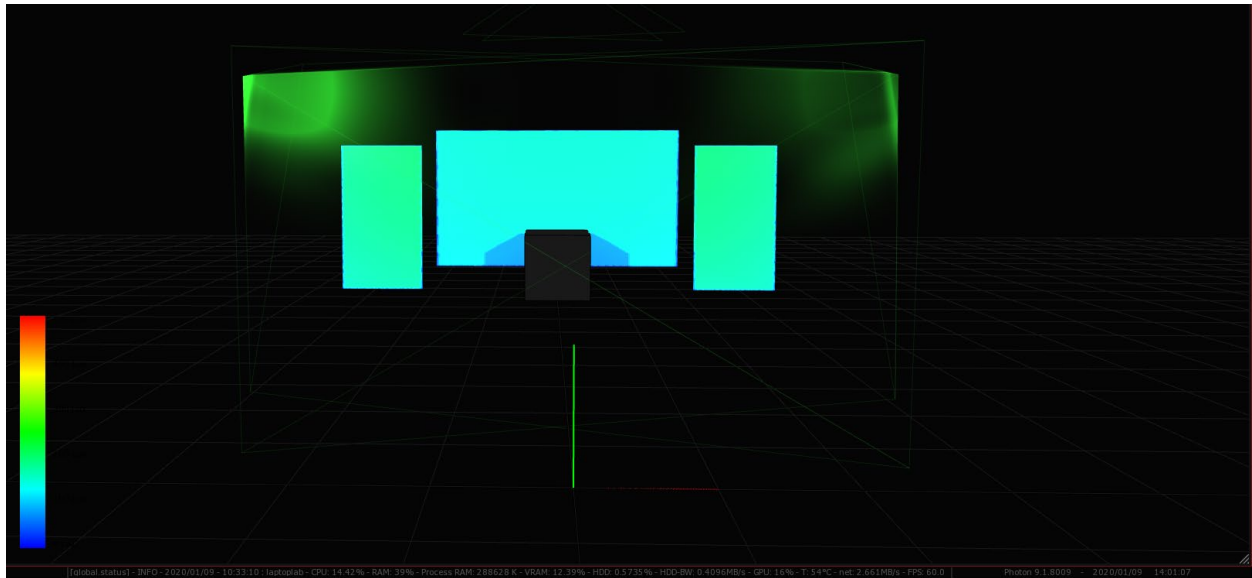
6. Move the model where it is intended to be using the Translate X, Y and Z sliders.
7. Observe the effect the model has on the projection surfaces.

7. Understanding the Results

The Projection Study should now be complete. Here follows a few indications about some of the readings featured in the Projection Study.

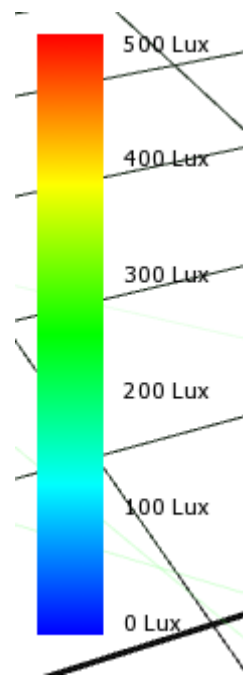
7.1. Heatmaps

You should notice that Screens now feature a color hue ranging from blue to red, indicating the amount of light they reflect.



Lux

The scale is expressed in lux, which is an illuminance measurement unit corresponding to the amount of light reaching a point from all directions (1 lux = 1 lumen / square meter).



How Much?

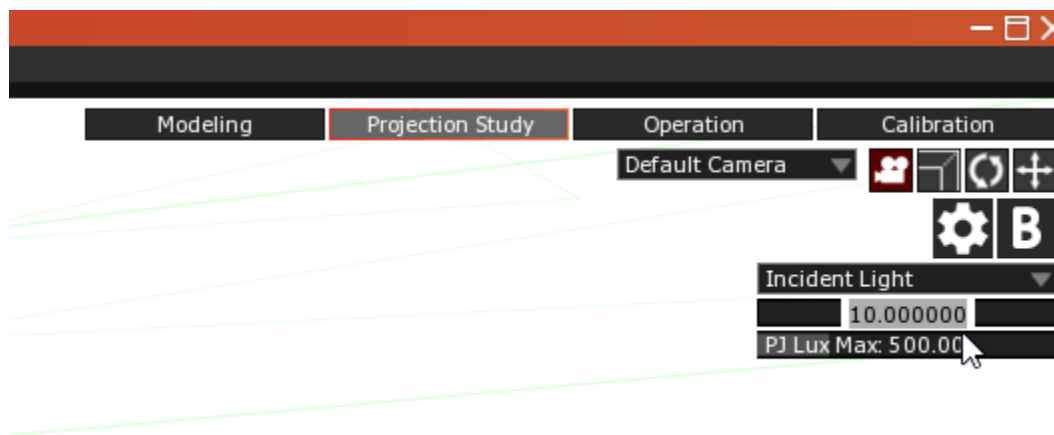
It is very difficult to come up with a blanket statement about the amount of light needed since conditions vary a lot from one show to the other. Without having prior knowledge of the context in which you are planning to project, it is impossible to give a determine how much light is needed. However, experience has shown us that in most cases (tours and large scale events), you should aim for a minimum of 300 lux reflected by projection surfaces. We suggest a

minimum of 100 lux for surfaces in architectural video projection contexts (video projected on buildings at night).

Color Scale Modification

The amount of lux expressed by the color scale can be modified to help visualize potential illumination problems. The PJ Lux Min and PJ Lux Max parameters control how the scale expresses lux. Do the following to modify these parameters:

1. Click on the Settings button (the sprocketed wheel) located in the top right corner of the 3D Scene window.
2. Modify the PJ Lux Min and PJ Lux Max sliders values by either manipulating them directly with the mouse or by [Double-clicking] in them to open text fields where you can enter numerical values.



7.2. Lumens per Projector

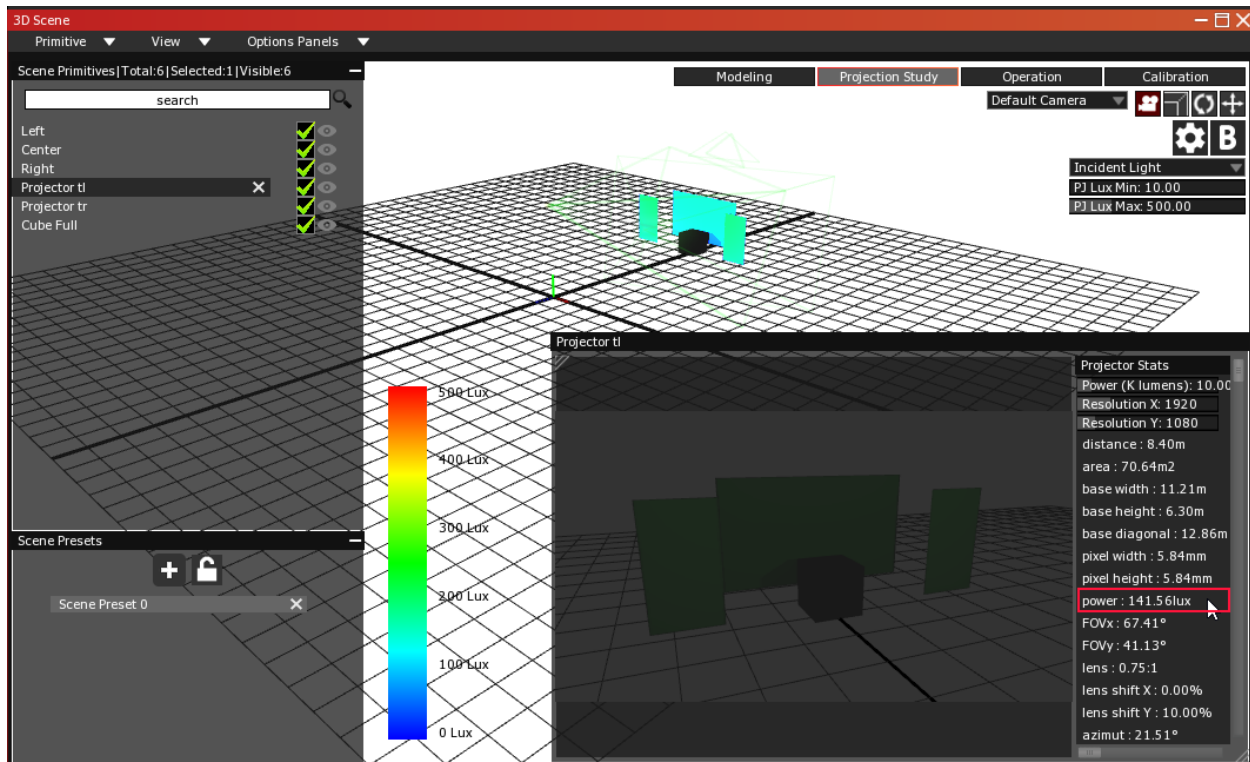
Besides the amount of light globally reflected by the Screens, you should consider having a look at the data on a per Projector basis in order to determine if you get the most out of your set-up.

Once a Projector is selected, have a look at the power parameter in the viewport. There will be a measure expressed in lux that corresponds to the amount of light the Projector throws on the surfaces. The information provided might help you reconsider the Projector's position or orientation.

Do the following in order to access the amount of incident light beamed by the Projector at the distance expressed by its pyramid's length:



1. Make sure the Projector is selected by clicking on its entry in the Scene Primitives list. The viewport's name should be the same as the Projector.
2. Have a look at the value expressed in lux listed besides *power*.

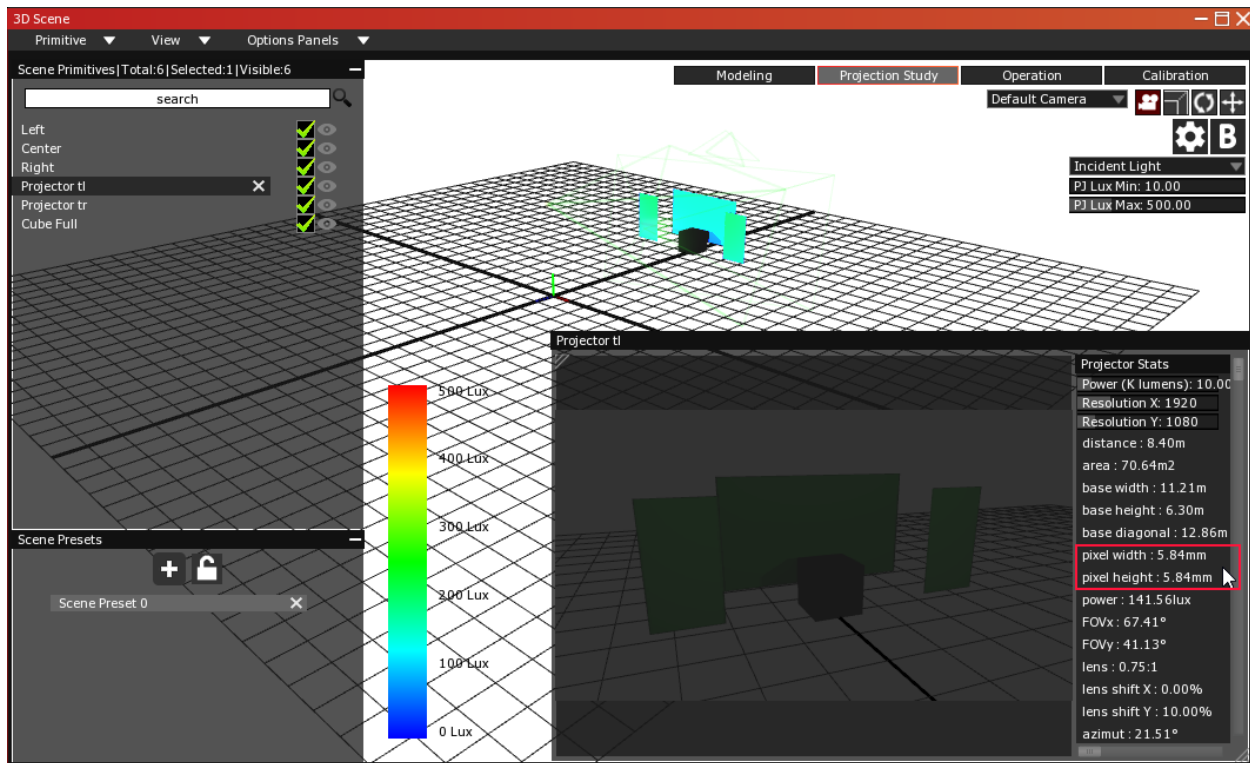


7.3. Pixel Pitch

Another important piece of information you should monitor on a per Projector basis is the size of the pixels once they reach a surface. The resolution of a Projector and the distance until its light reaches a Screen determines the size of pixels. Large pixels might be a problem for audience sitting to a Screen.

Do the following in order to have information about a Projector's Pixel Pitch:

1. Make sure the Projector is selected by clicking on its entry in the Scene Primitives list. The viewport's name should be the same as the Projector.
2. Have a look at the values expressed in millimeters besides pixel width and pixel height,



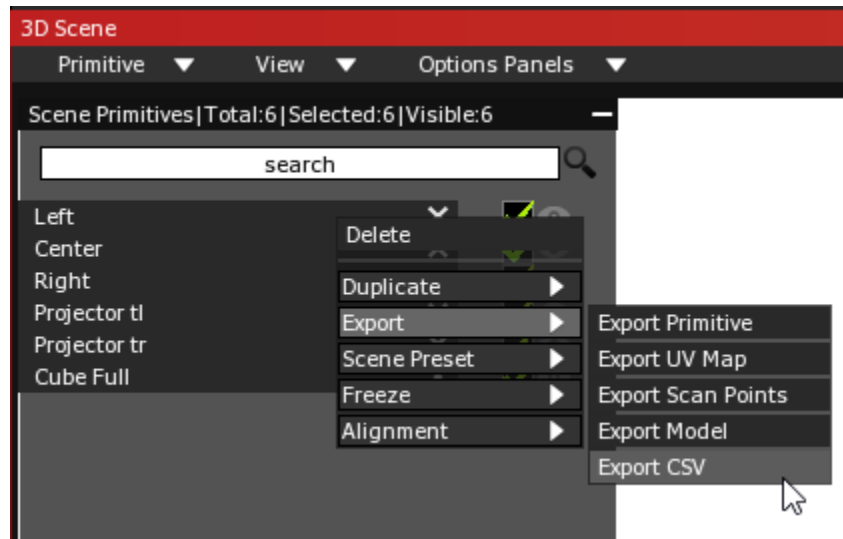
8. Projection Study Documents

Once you have completed the construction of your virtual and placed the Projectors in their optimal position, you will have to communicate with other specialists and technicians that might not use PHOTON. To do so, you will export a .CSV file and make .PNG screen captures of your project.

8.1. Data Export

Do the following to output a .CSV file that will contain all the relevant information concerning the Screens and the Projectors:

1. [Shift-click] on all the Projectors and Screens entries located in the Scene Primitives list to perform a group selection.
2. [Right-click] on one of the selected items to open a contextual menu.
3. Select {Export > Export CSV} from the contextual menu. A Save As window will open.



4. Navigate to the location where you want te file to be saved, write a file name and press the [Save] button.

8.2. Screen Capture

Do the following to make .PNG screen captures of the 3D Scene:

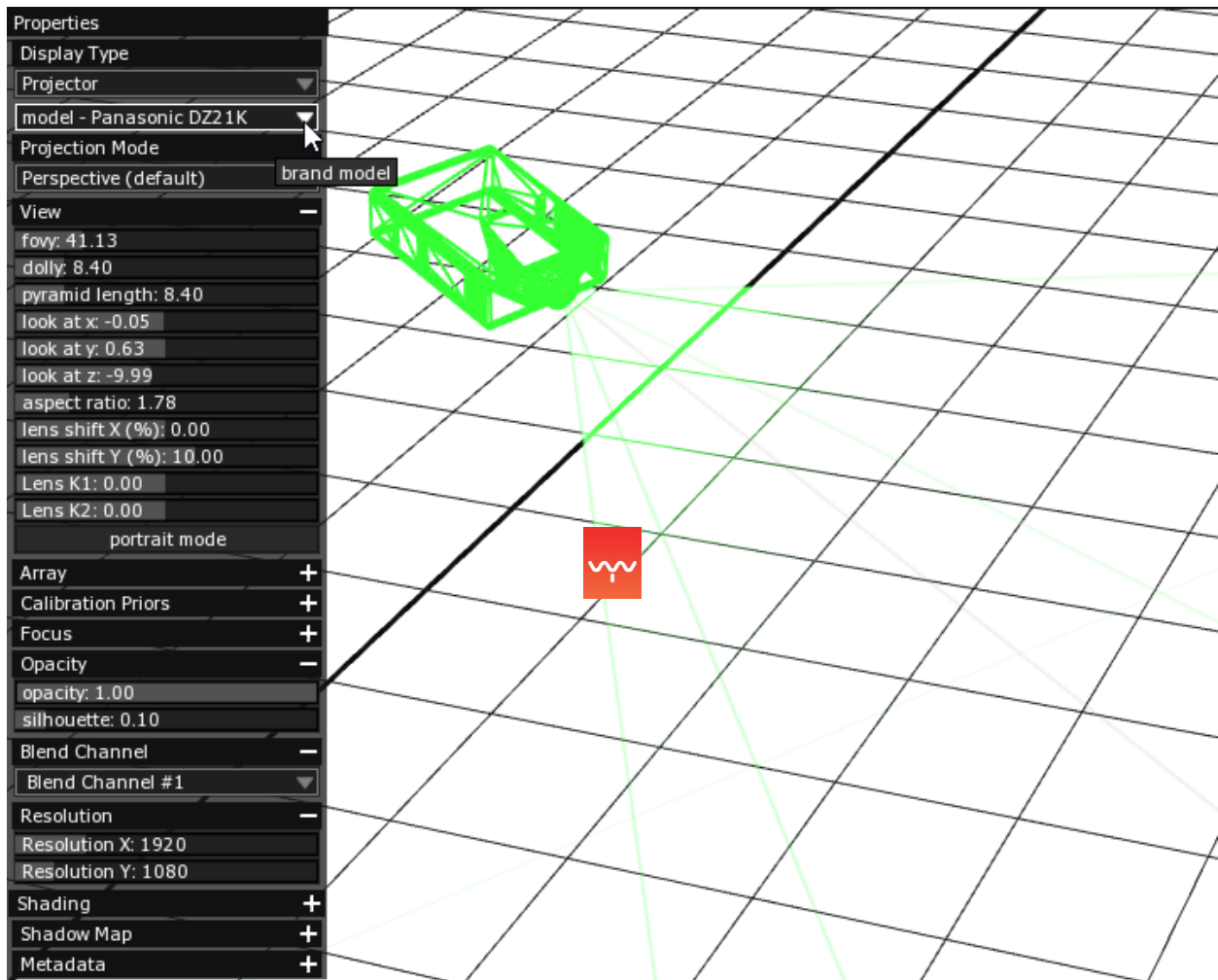
1. Use the Default Camera of the 3D Scene Press to frame a section of the virtual stage.
2. Press [Ctrl+P]. A Save As window will open.
3. Navigate to the location where you want the file to be saved, write a file name and press the [Save] button.

9. Additional Topics

9.1. Built-in Video Projector 3D Models

It is possible to load a 3D model that represent a specific Projector model in the 3D Scene. This can help technical integrators visualize the position and the volume taken by the devices. Do the following to add a model of the physical projector in the 3D Scene:

1. Select a Projector by clicking on its entry in the Scene Primitives list.
2. Select {Options Panels > Properties} from the 3D Scene menu or press [P] to open the Projectors Properties panel.
3. Select one of the available options in the brand model dropdown menu. This menu is the second starting from the top.



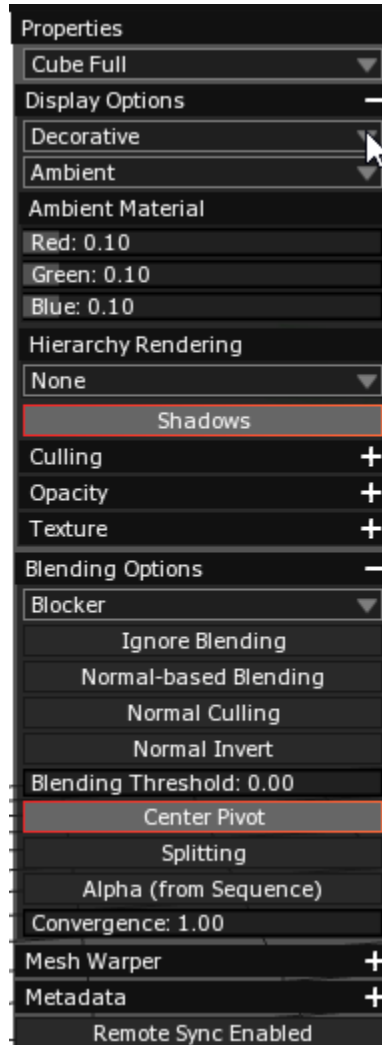
PHOTON currently features two Projector built-in models: the Panasonic DZ21K and the Barco FLM HD20.

9.2. Decorative Stage Elements

It is possible to add models in the 3D Scene that do not behave as Screens. For example, you might want to add architectural and technical features of the venue that will enhance the previsualizations.

If you wish to include such objects, you should modify their Surface type in the Display Options section of the Properties panel. Once declared as Decorative surfaces, PHOTON will not include these objects in its illumination calculations and will not create corresponding Screen containers in the Timeline module.

1. Select the 3D model you wish to declare as Decorative by clicking on its entry in the Scene Primitives list.
2. Select {Options Panels > Properties} from the 3D Scene menu or press [P] to open the 3D model's Properties panel.
3. Unfold the Display options section of the Properties panel and select the {Decorative} option from the Surface type dropdown menu. (The {Projection Surface} option is selected by default for newly created 3D objects.)



9.3. LED Screens

Some of the Screens in the 3D scene might use LED's and therefore not be dedicated to projection. It is important to declare LED Screens as such while building a Projection Study. Otherwise, they will be taken into account by PHOTON in the illumination calculations.

1. Select the 3D model you wish to declare as a LED Surface by clicking on its entry in the Scene Primitives list.
2. Select {Options Panels > Properties} from the 3D Scene menu or press [P] to open the 3D model's Properties panel.
3. Unfold the Display options section of the Properties panel and select the {LED Surface} option from the Surface type dropdown menu. (The {Projection Surface} option is selected by default for newly created 3D objects.)

