Simulating emission from thin films with OghmaNano

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•Download all the software used in this talk from:

http://www.oghma-nano.com/download.php

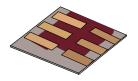
•Please report bugs to:

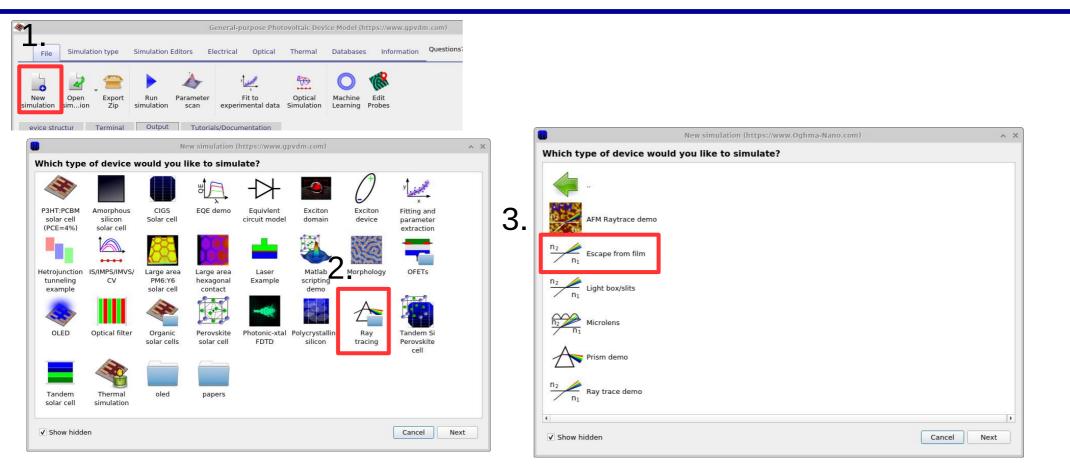
roderick.mackenzie@oghma-nano.com



- Making a new simulation
- Adjusting the dimensions of the simulation
- Optical sources
- Optical detectors
- Examining the results
- Light absorbed in each layer
- Setting the wavelength range
- Summary

Make a new simulation

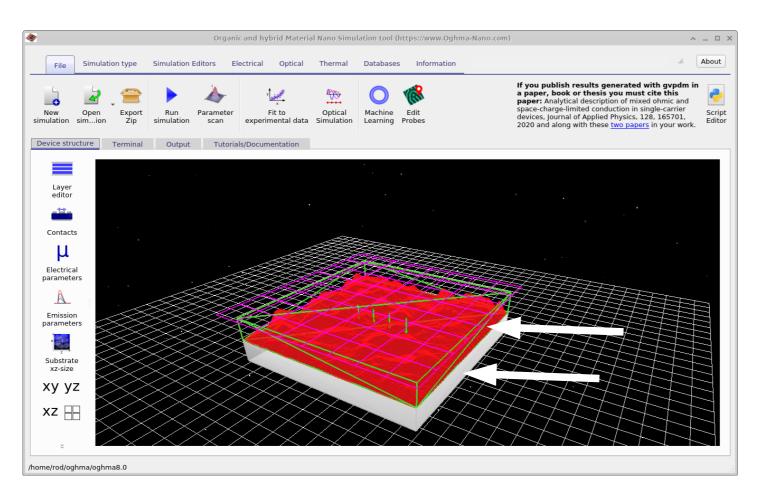




•Save this example to your home directory.

You should get a window like this





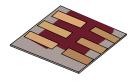
•You Can see...

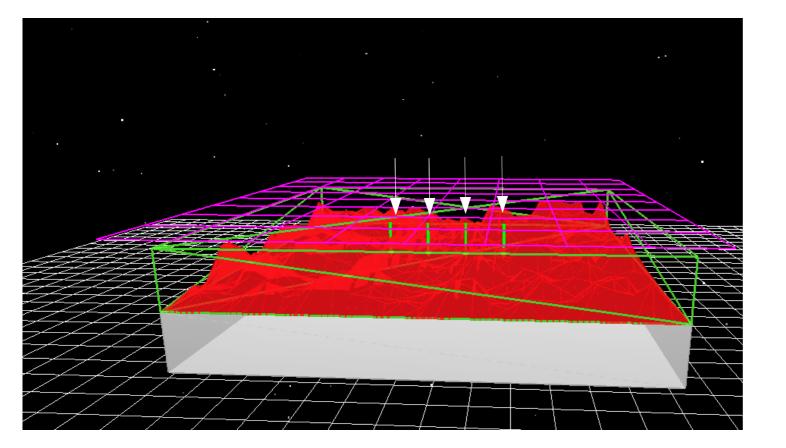
•The oxide layer in Red and gray, these are both ZnO.

•The gray box represents the substrate.

•The red region represents the substrates rough surface.

You should get a window like this

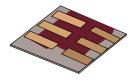


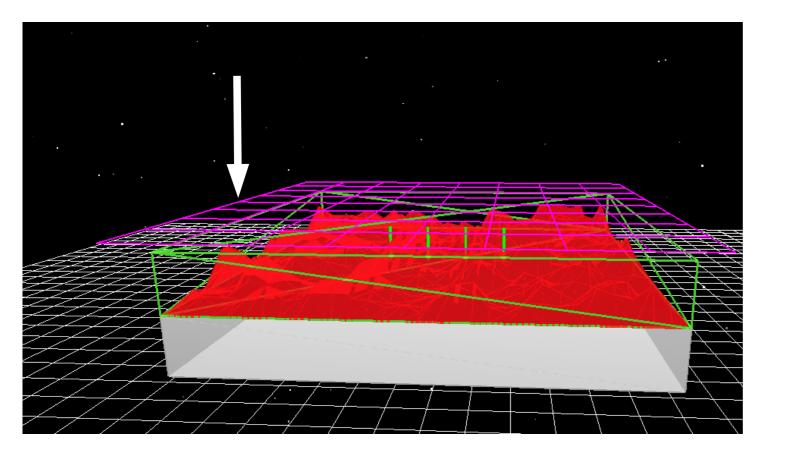


•The light sources represented by green arrows.

https://www.Oghma-Nano.com

You should get a window like this



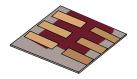


•The 'detector' is represented with a purple grid.

•This is equivalent to a CCD camera.

•The mesh represents the number of pixels. In this case 8x8.

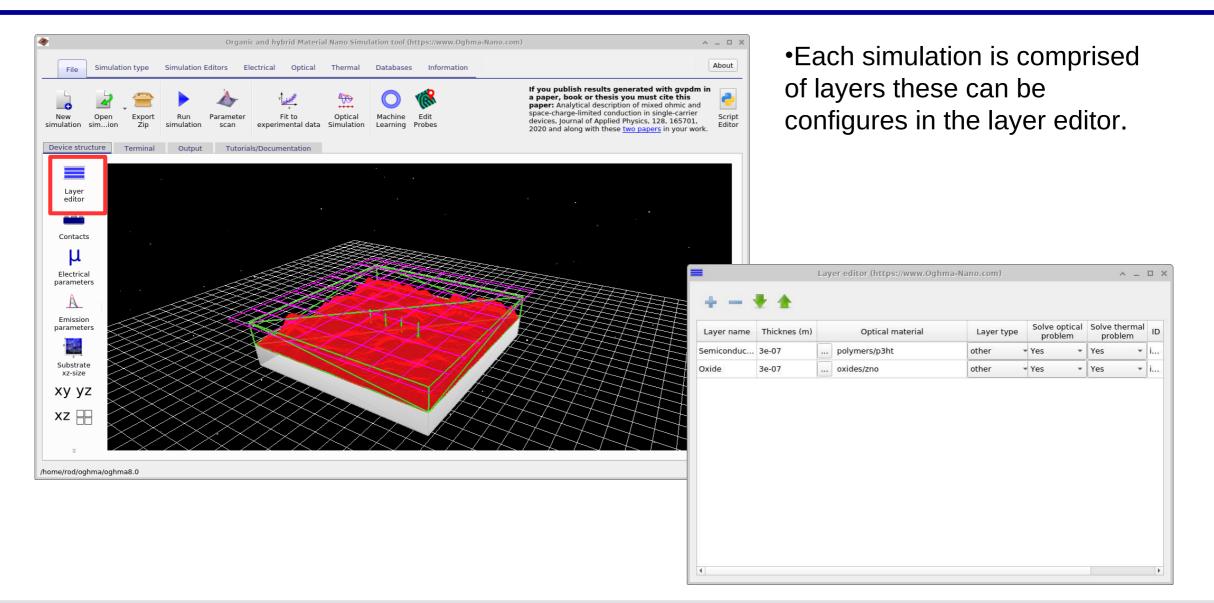
https://www.Oghma-Nano.com



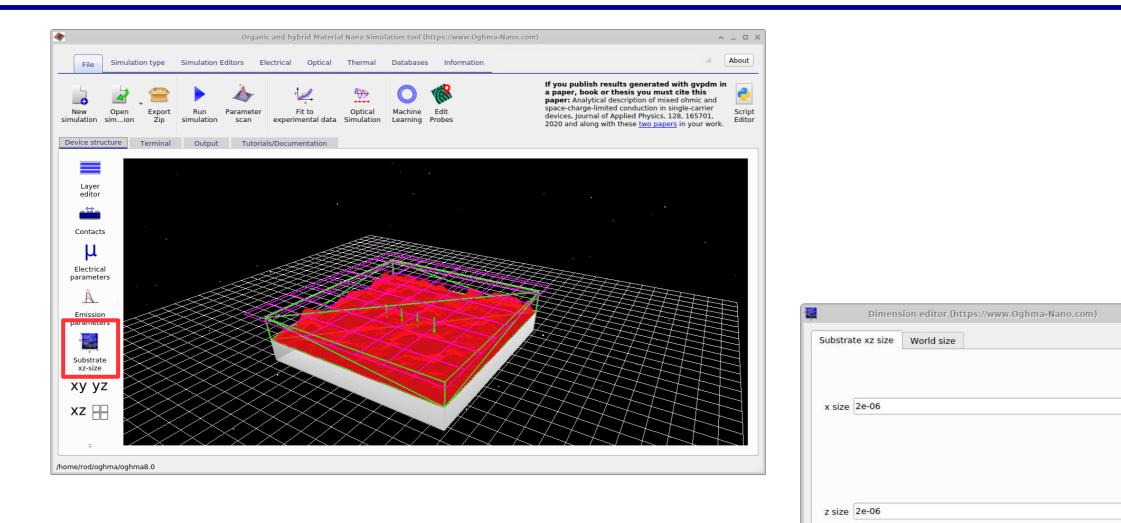
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Layer heights can be adjusted in the layer editor





The size of the substrate can be adjusted in the Substrate xz-size editor.

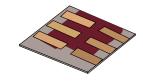


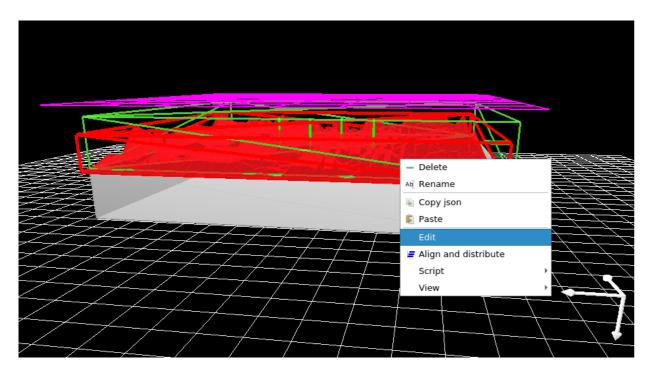
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The properties of the rough layer can be changed using the Object editor





•In each layer you can define irregular shaped objects.

•Right click on the rough layer and select edit to bring up the object editor.

•In this case the "Insert" object lives inside the top or "Semiconductor" layer

	Object editor (htt	ps://www.Og	hma-Nano.co	m)		^ _ □
New Delete F	Ab Rename object Clone object Object enable	t d				() Help
Object						
Offset	x: 0	y: 9.9e-8		z:	3e-8	m
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padding	dx: 0.0	dy: 0.0		dz:	0.0	m
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Text label	[au
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Drift diffusion	Passive					Edit
Circuit model parameters	Passive					Edit
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Inset						

The Object editor can be used to change it's physical size, position and orientation:

C.	Object editor (http	ps://v	vww.Oghma-Nano.c	om)		^ _ □
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Text label	afm_image					au
Text label Shape type	afm_image					au au
1.15						au au Edit

•Offset: The z,y,z position of the object within the layer

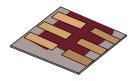


Padding: The object can be replicated multiple times in the zyx directions to form periodic
structures this gives the space between objects.

•Number of objects: Times the object is repeated in each direction.

•Rotate: rotation of the object in degrees

The Object editor can be used to change it's physical attributes



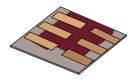
	Object editor (http	os://www.Oghma-Nano.co	m)	^ _ D
	Abí Line Object			G Help
Object				
Offset	x: 0	y: 9.9e-8	z: 3e-8	m
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adding	dx: 0.0	dy: 0.0	dz: 0.0	m
lumber of objects	x: 1	y: 1	z: 1	au
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	afm_image			au Edit
hape type Prift diffusion	afm_image			·
Fext label Shape type Drift diffusion Circuit model Darameters				Edit

•Color: Physical color of the object

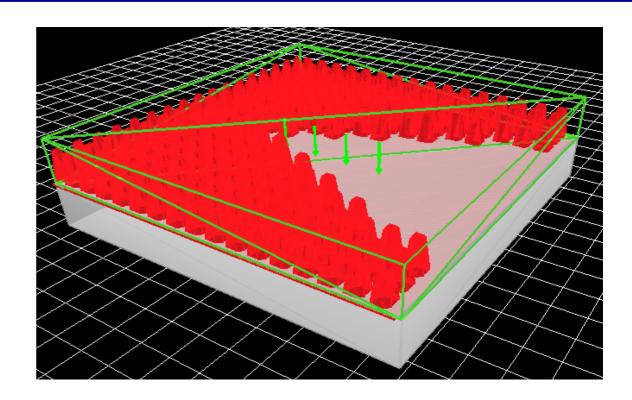
•Shape type: The 3D shape of the object selected from the shape database.

•Optical material: The objects n/k data.

The Object editor can be used to change it's physical attributes



	Object edito	r (https://	www.Oghma-Nand	o.com)		^ _ 🗆
_		Object nabled				G Help
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	y-axis: 0 255 10 14 afm_image	y:				degrees rgb au au Edit



•Try changing shape_type to photonic_xtal and see what happens to the shape of the object.

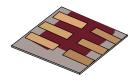


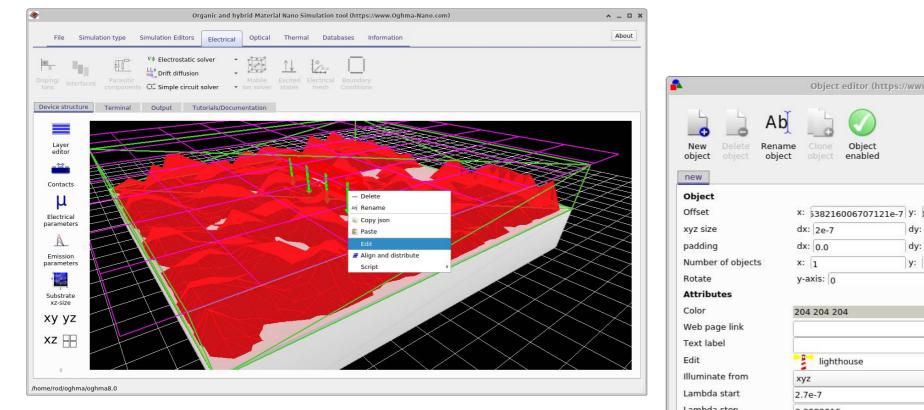
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Optical sources

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Optical sources

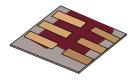




•The optical sources are the green arrows, you can edit them by right clicking on them and selecting edit.

	Object editor (https://	/www.Oghma-Nano.com)		^ _ 🗆
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badding	dx: 0.0	dy: 0.0	dz: 0.0	m
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Theta start	0			Degrees
Theta stop	360			Degrees
Phi steps	1			au
Phi start	0			Degrees
Phi stop	360			Degrees
ocal ground view factor	1.902			Degrees

Optical sources: Position



	Object editor (https:/	/www.Oghma-Nano.com)		^ _ □
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xyz size	dx: 2e-7	dy: 1e-9	dz: 2e-7	m
padding	dx: 0.0	dy: 0.0	dz: 0.0	m
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Theta start Theta stop Phi steps	0 360			Degrees
	0 360 1			Degrees

•The position of the optical source can be set here. It can also be set by dragging the arrows:

•Offset: The z,y,z position of the object within the layer

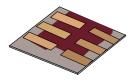
•xyz size:The size of the object

•Padding: The object can be replicated multiple times in the zyx directions to form periodic structures this gives the space between objects

•Number of objects: Times the object is repeated in each direction

•Rotate: rotation of the object in degrees

Optical sources: Emission direction



	Object editor (https:/	://www.Oghma-Nano.com)		^ _ 🗆
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Lambda stop	0.0000016			m
Theta steps	20			au
Theta start	0			Degrees
Theta stop	360			Degrees
Phi steps	1			au
Phi start	0			Degrees
Phi stop	360			Degrees
				Degrees

•The parameters in the red box control from in which direction the rays are emitted and how many rays are emitted. Options are:

•Theta steps:

•Theta start:

•Theta stop:

•Phi steps:

•Phi start:

•Phi stop:

Optical sources



*				Orga	nic and hyb	orid Material
File	Sim	ulation type	Simulati	on Editors	Electrical	Optical
and a	Ш	Light intensit	y (Suns):			۲
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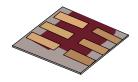
•Optical sources can also be accessed from the 'Light sources' button.

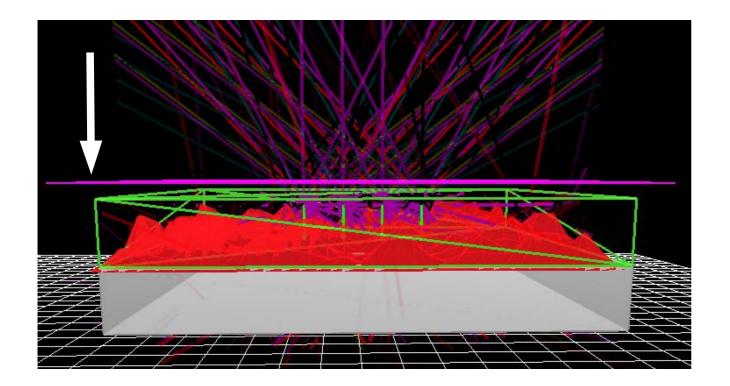
•Illuminate from: Changes where the light source is placed. For ray tracing simulations you want to choose "xyz".



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Optical detectors







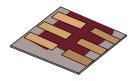
•Optical detectors are used to detect light.

•You can think of them as CCD cameras.

•They are normal objects so can be moved and rotated.

•Either right click->Edit to change their properties or access them through the optical tab.

Optical detectors



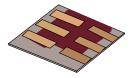
File S	imulation type	Simulation Editors	Electrical	Optical	Thermal [Databases	Information	Que
11	Light intensity	(Suns): $\frac{n_2}{n_1}$		٥	Wavelengths	: •		
Light Laser Sources (fs)	s 0.0	Ray trac editor	ing Optical	FDTD Simulation	All 👻	Optical mesh	Boundary Conditions	

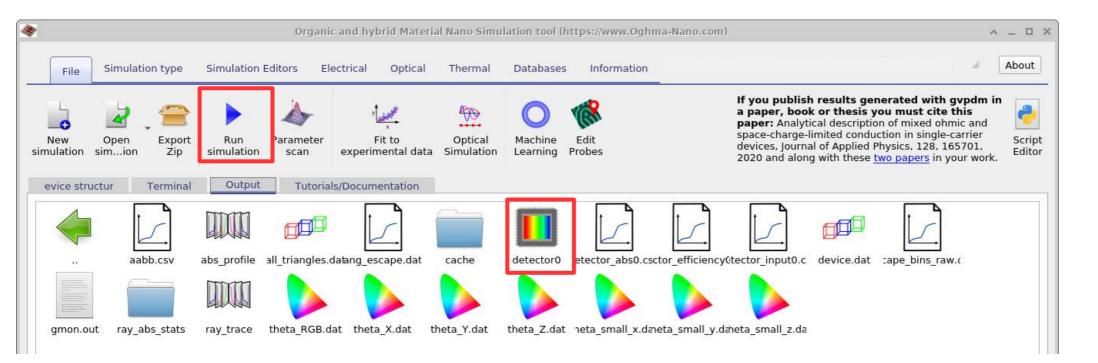
•The resolution of the detector can be set in the detector window.

	Optical detectors ed	itor (htt	ps://www.Og	hm	a-Nano.c	om)			^ _ □
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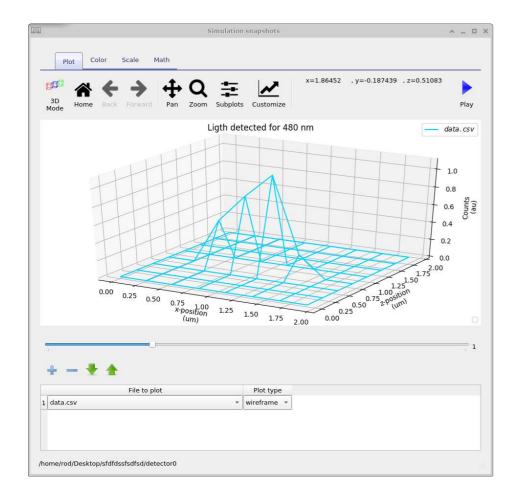
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•Detector0 contains the output from the detector, if you had more than one detector there would be detector1,2,3 etc..



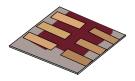


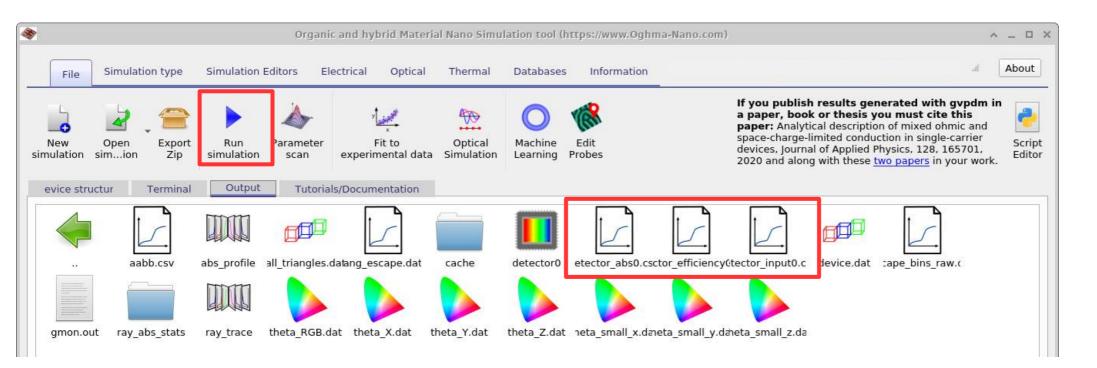
•The detector0 file contains the spatial distribution of where the light hit the detector.

•In this case it hit in the center so we get a peak in the center.

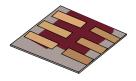
•Try playing with the values of theta and phi and see what happens

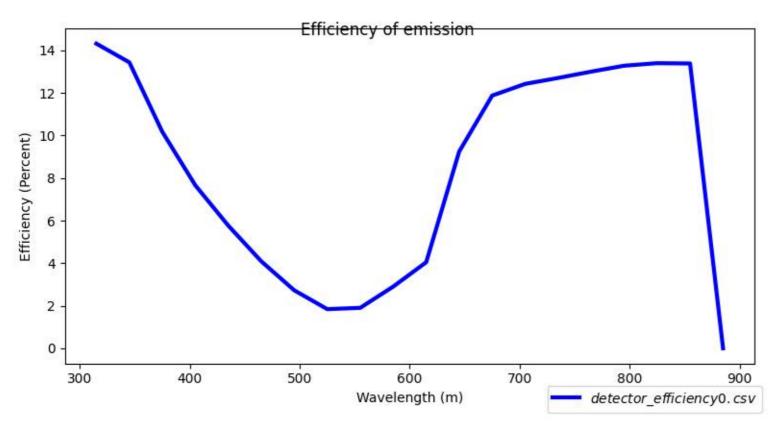
Optical detectors





- •There are also three files called:
 - detector_abs0: The number of counts detected by the detector
 - detector_efficiency0: The collection efficiency of the detector =light detected(lambda)/light emitted(lambda)





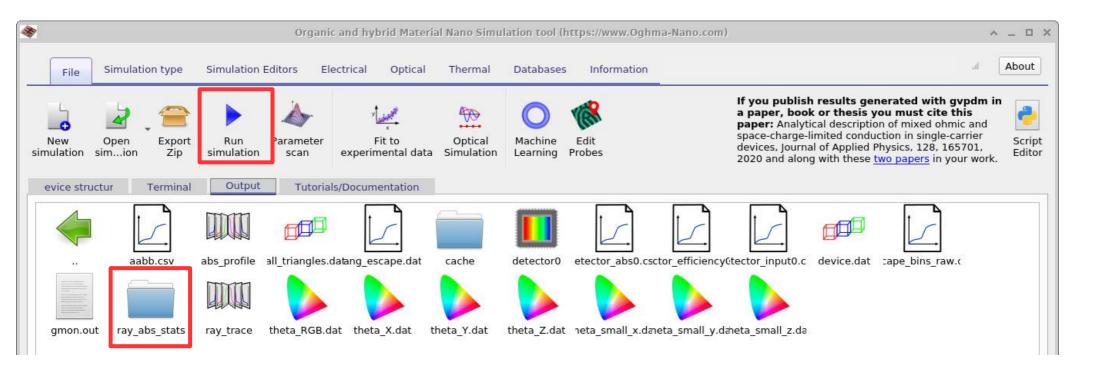
•This represents how efficiently emitted light is captured by the detector.

•Try moving the light source around and see what influence this has on the detected light.



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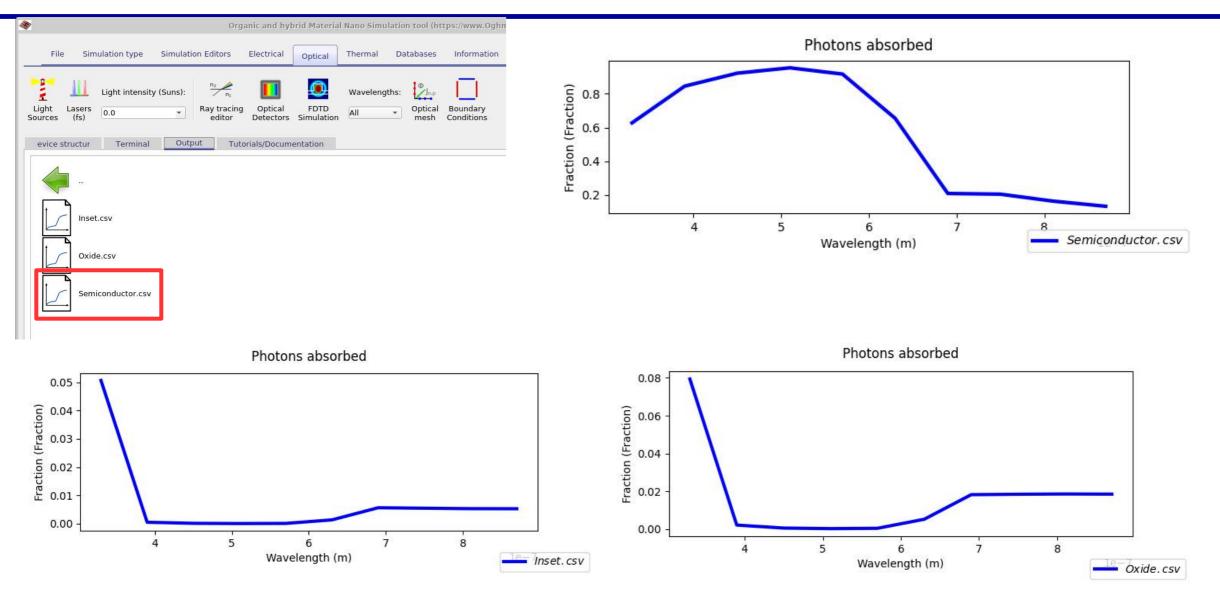




•The folder: ray_abs_stats contains statistics about what happened to the light in each layer.

Fraction of light absorbed by each layer

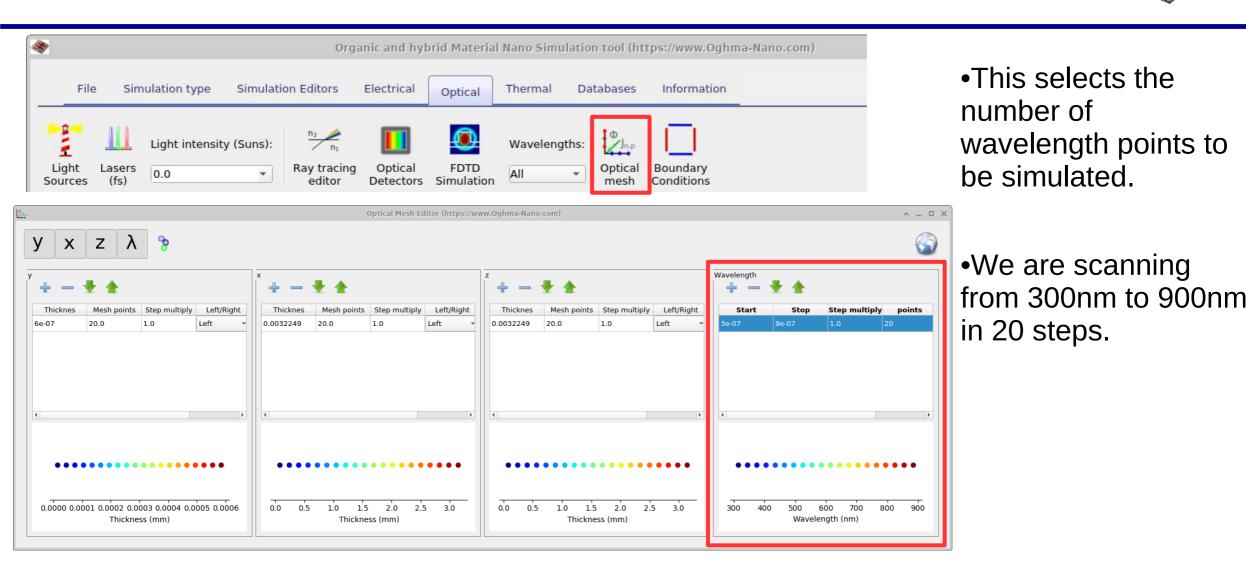






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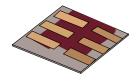
Setting up the wavelength mesh

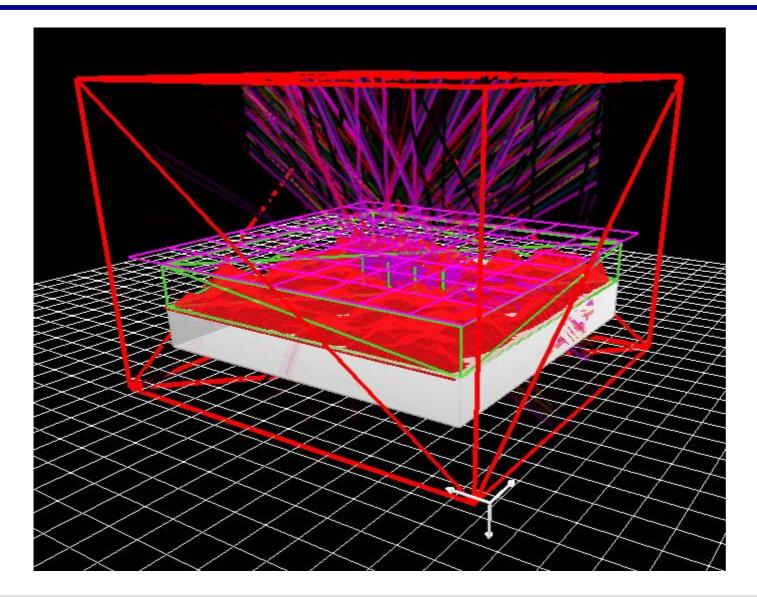




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The simulation world



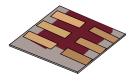


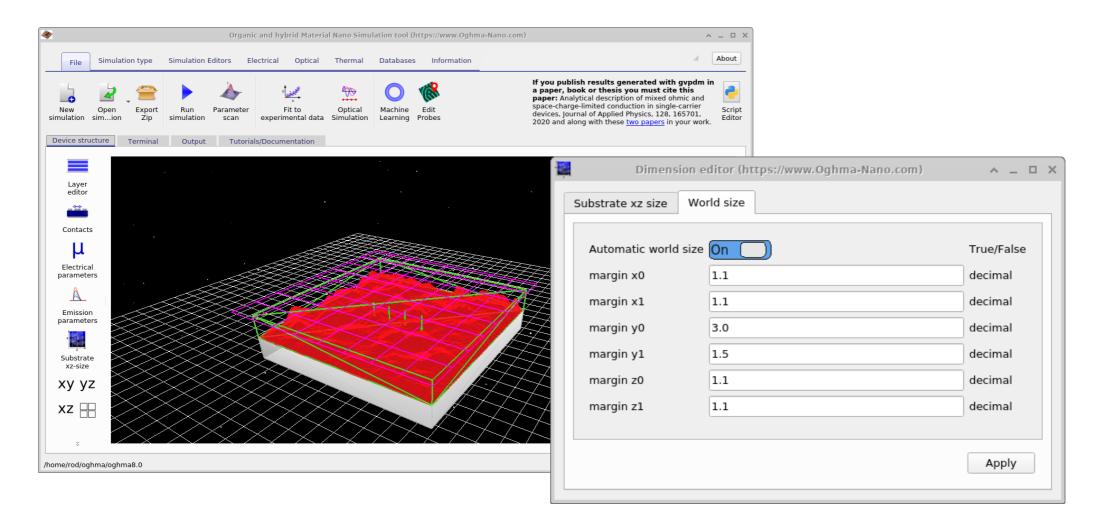
•All optical and electrical interactions must happen in the simulation world box.

•You can see the extent of the world by clicking on a black area of the simulation and selecting view \rightarrow show world box.

•If you want to change the size of the world box you can do it through the substrate size button.

Changing the size of the world box.





•Values above 1.0 increase the size of the world box.

https://www.Oghma-Nano.com



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