G.007 Coated Slanted Grating

A coated slanted grating is generated with the Programmable Medium of VirtualLab™. The reflectance of this grating is then analyzed in the Parameter Run for different orientations of the grating.

Keywords: Grating, Coating, Slanted Grating, Programmable Medium, Parameter Run

Required Toolboxes: Grating Toolbox

Related Application Scenarios: G.014

Related Tutorials: G.001a

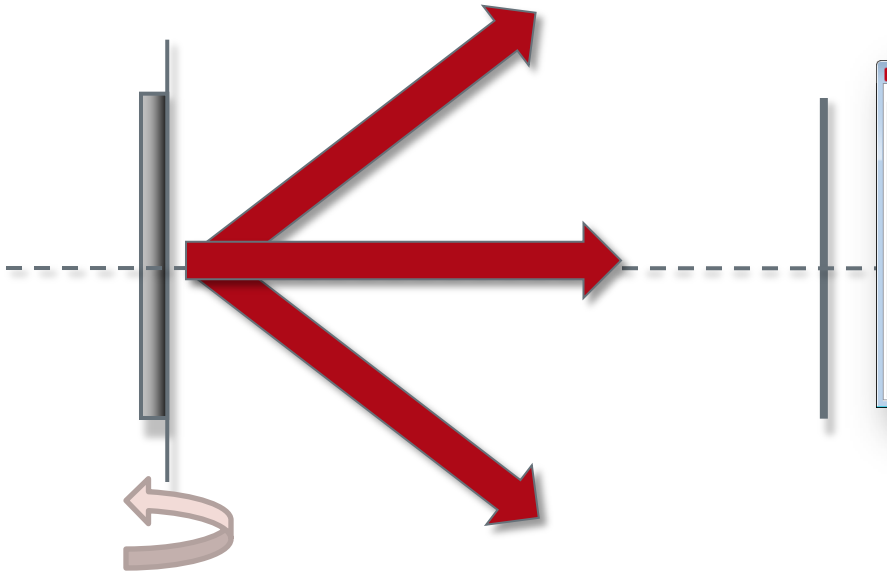
LightTrans

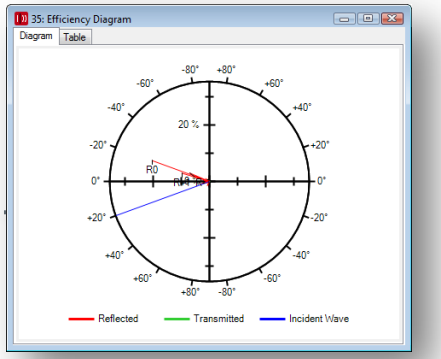
Modeling Task

Coated Slanted Grating
Period 10 µm:
Thickness: 10 µm
Slant Angle: 20°

Target
Plane

Ideal Plane Wave
Illumination





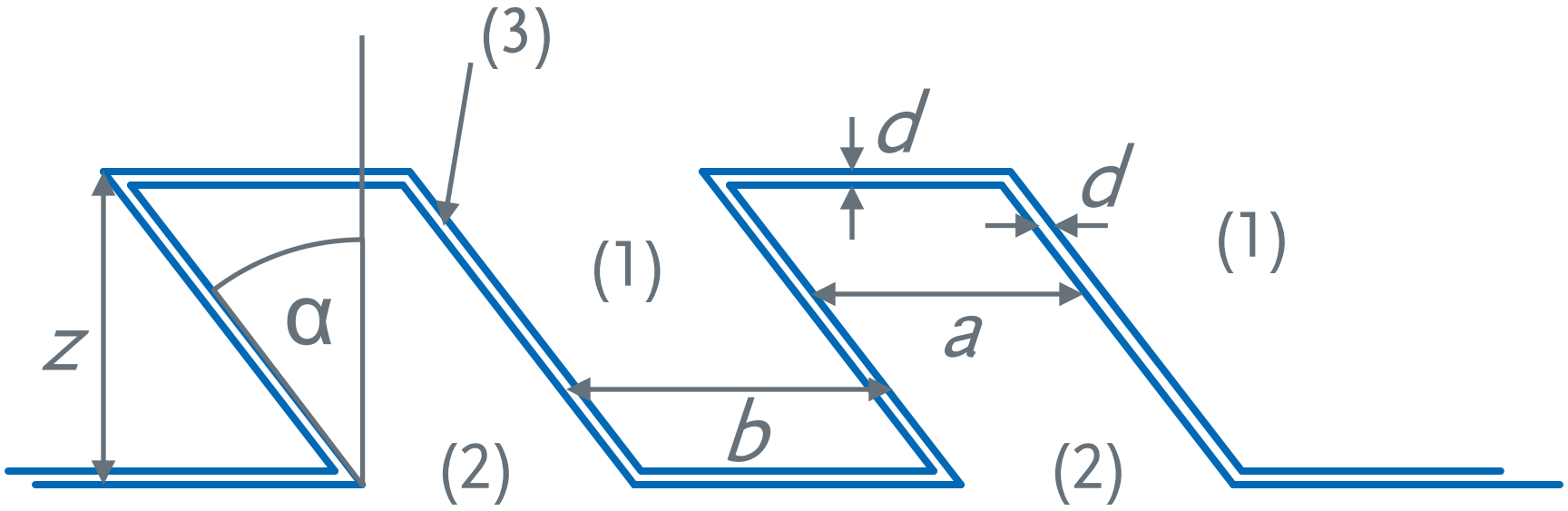
Diffraction Pattern

Rotate about y-Axis

Parameters of a Slanted Coated Grating

α	– Slant angle
a/b	– Fill factor
d	– Thickness of coating
z	– Z-extension of grating
a+b	– Period of grating

1 – Embedding Material
2 – Base Material
3 – Coating Material

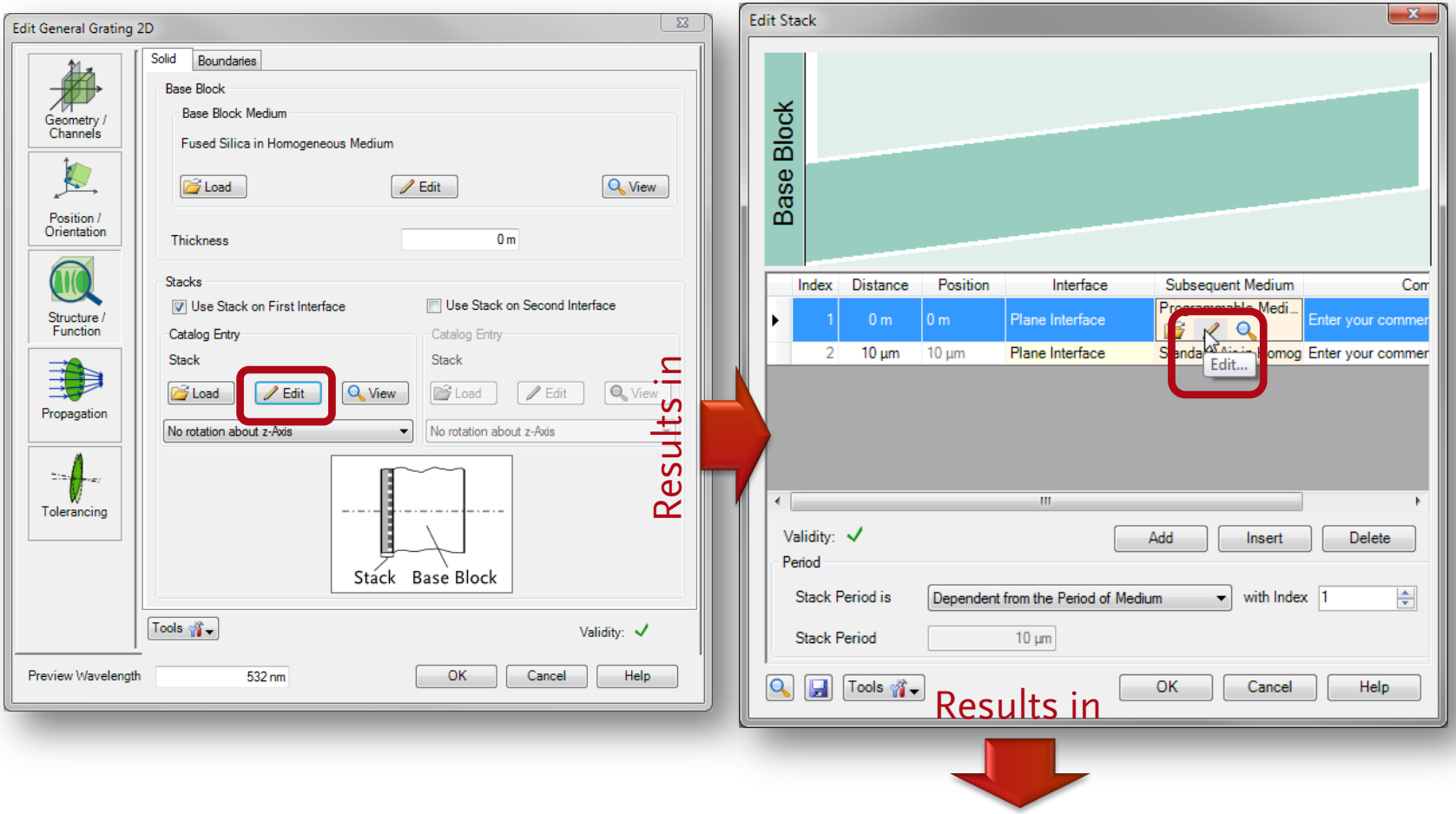


Modeling in VirtualLab™

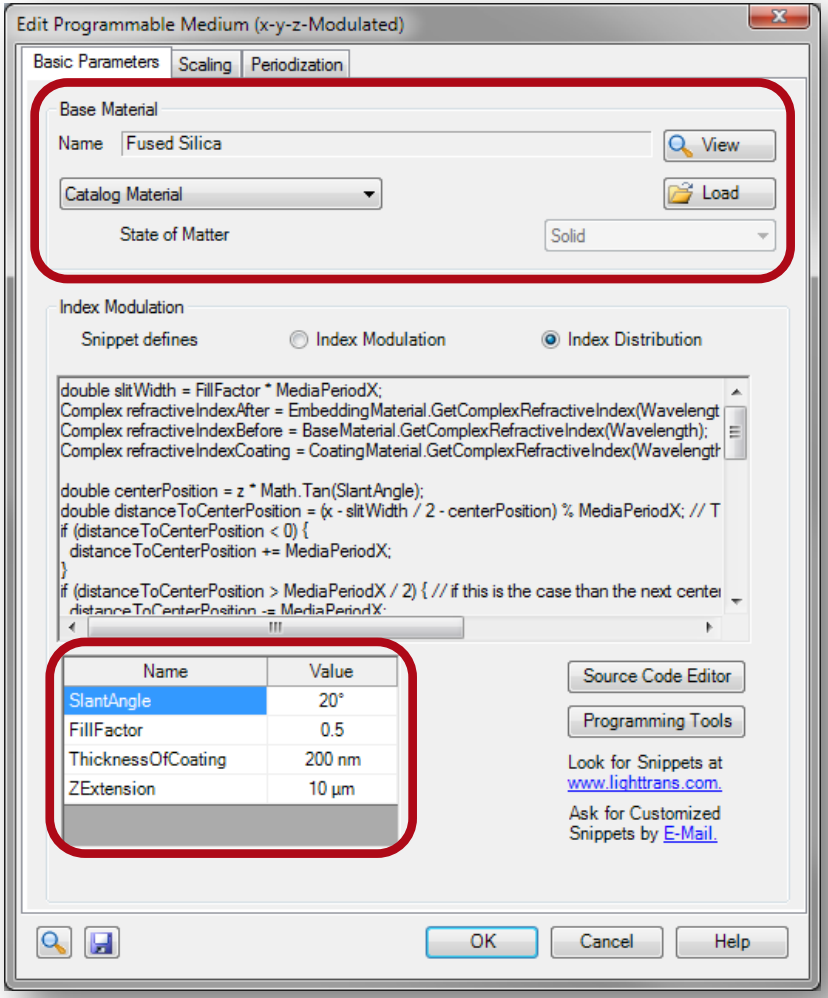
- As a coated slanted grating cannot be described as $h(x)$, it must be modeled as Programmable Medium.
- The snippet G.007_Completely_Coated_Slanted _Grating.snp is used to model the surface profile and the coating of the grating. The snippet allows the specification of the grating parameters.
- A further snippet G.007_Partly_Coated_Slanted _Grating.snp specifies a slanted grating where the sides of the “ridges” are not coated.
- To analyze this medium rigorously with the Grating Toolbox, it is placed in the first stack of a grating component.

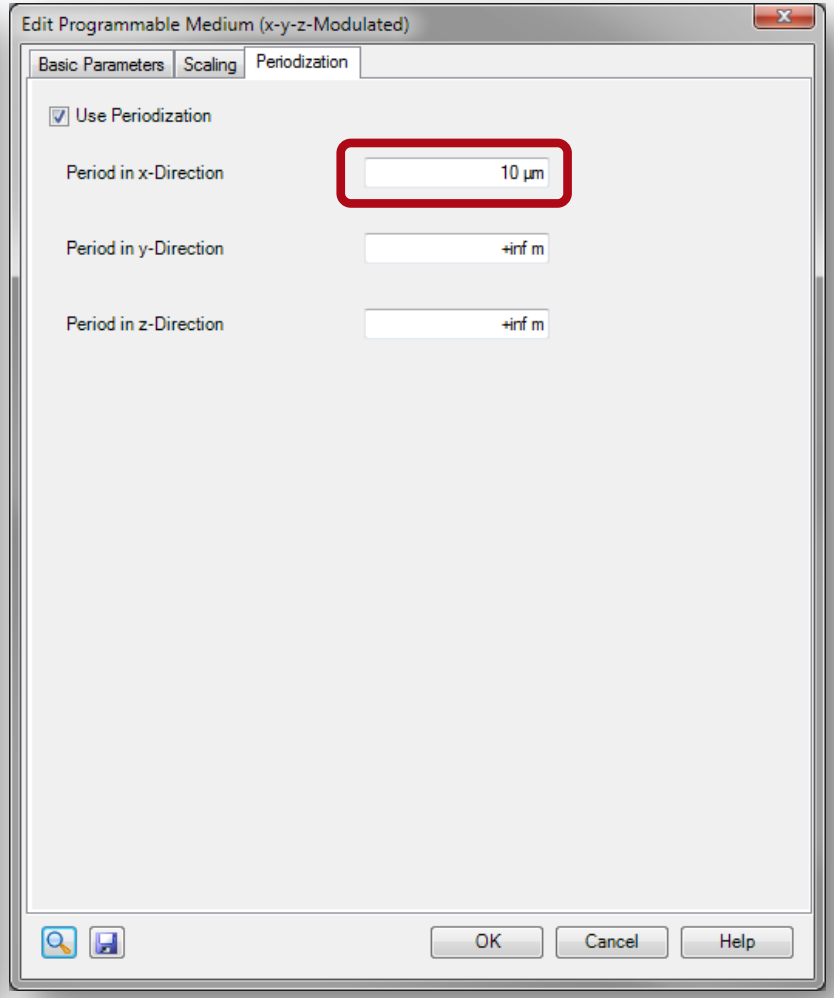
Changing the Parameters of the Grating

The parameters of the grating can be adjusted in the edit dialog of the programmable medium

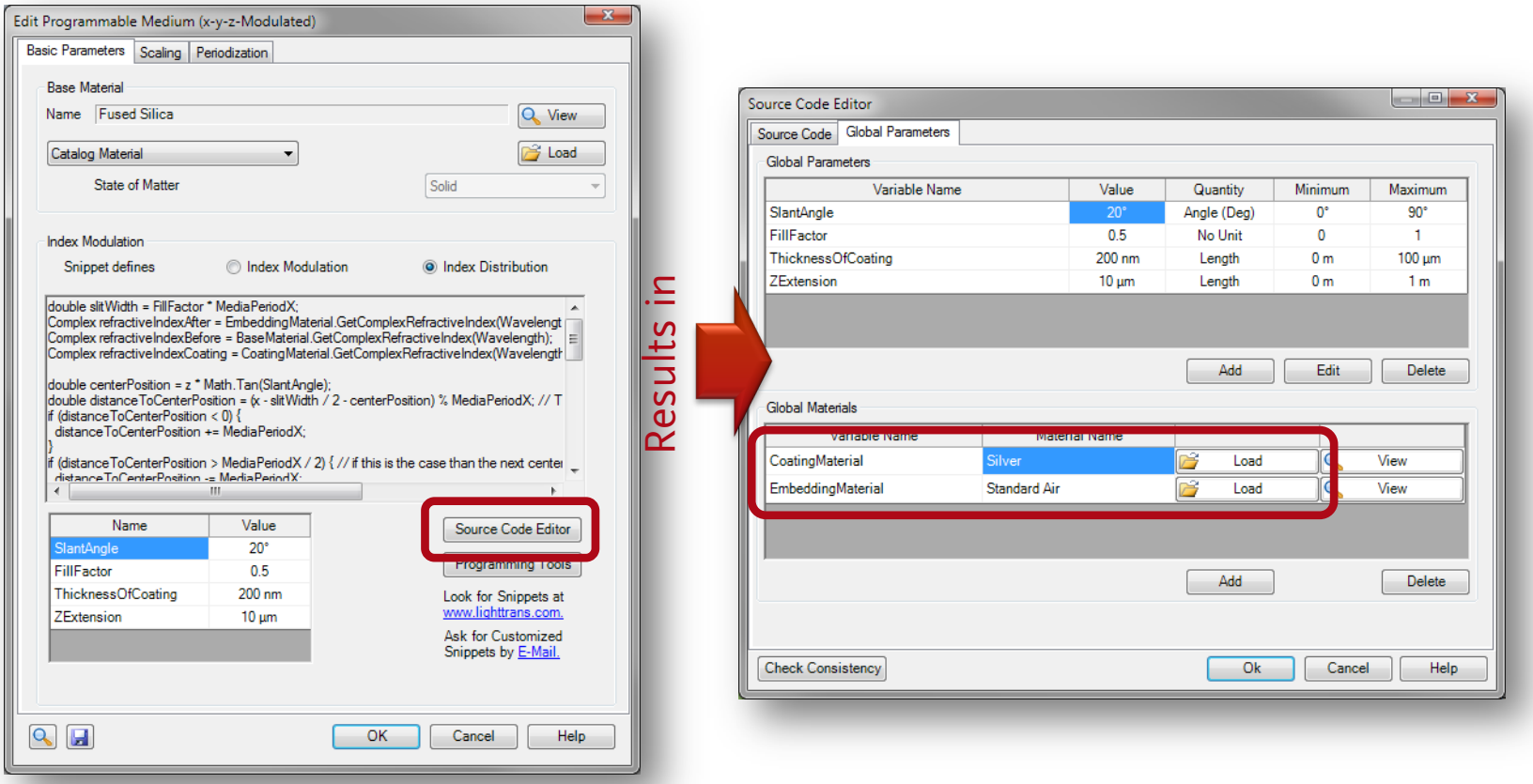


Changing the Parameters of the Grating

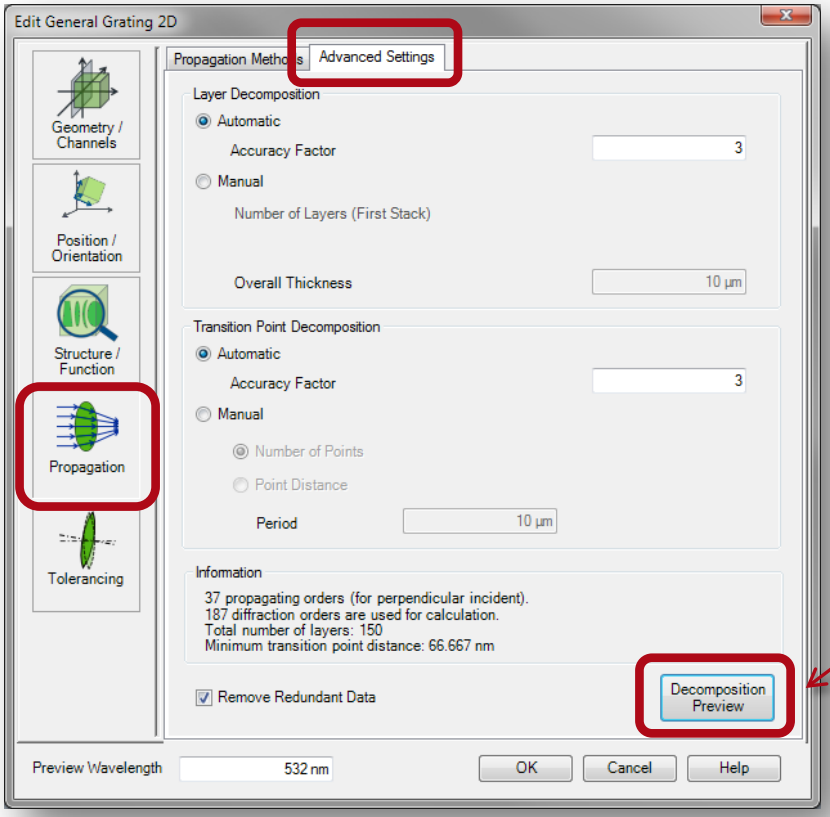




Changing the Parameters of the Grating

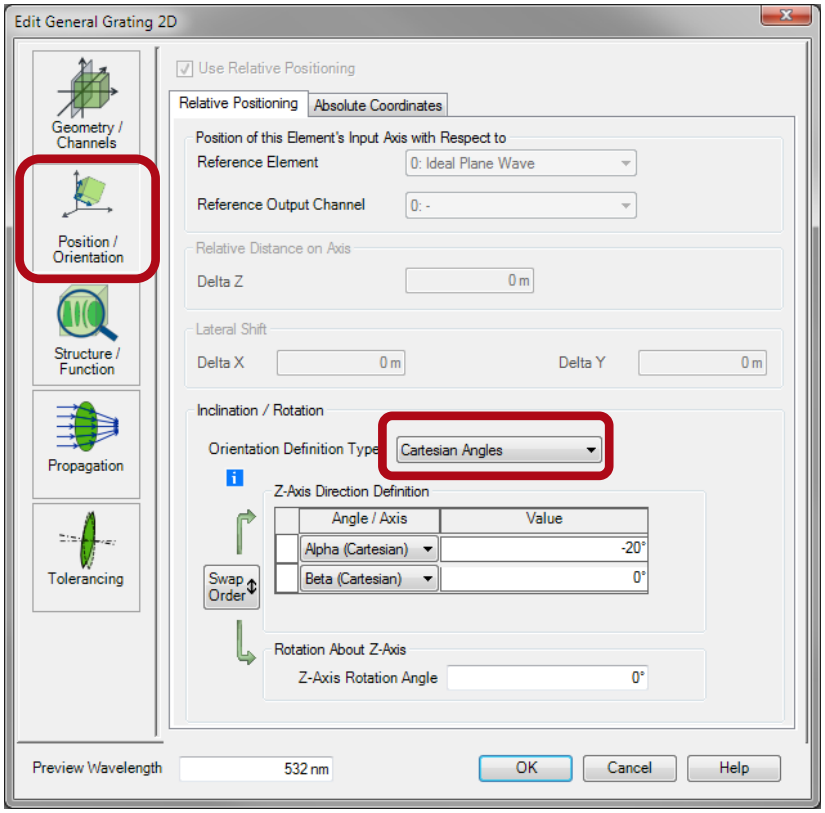


Adjusting Number of Layers and Transition Points



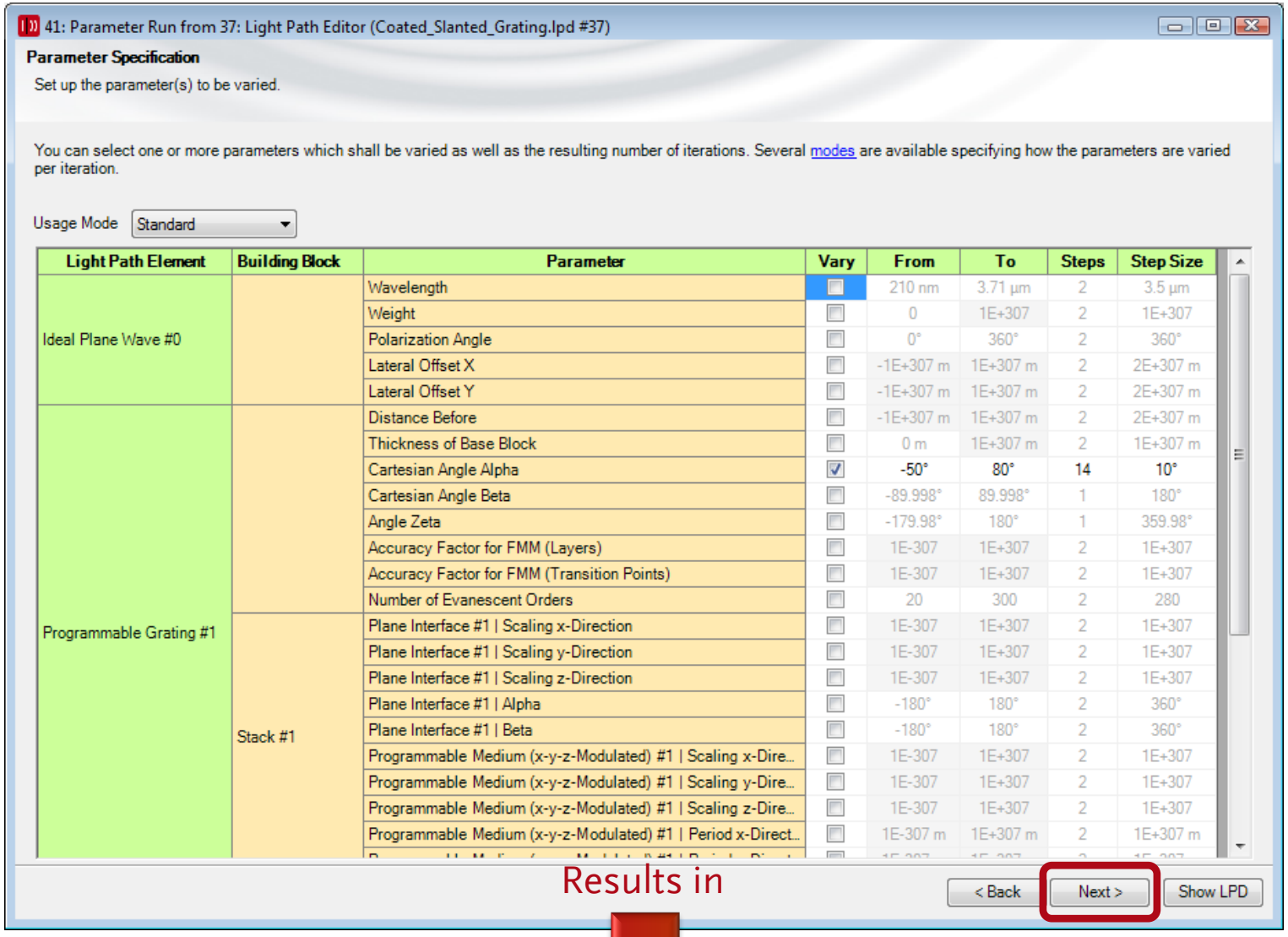
- Set the number of layers and transition points so that the coating is resolved.
- You may check this with the Decomposition Preview

Varying Cartesian Angles

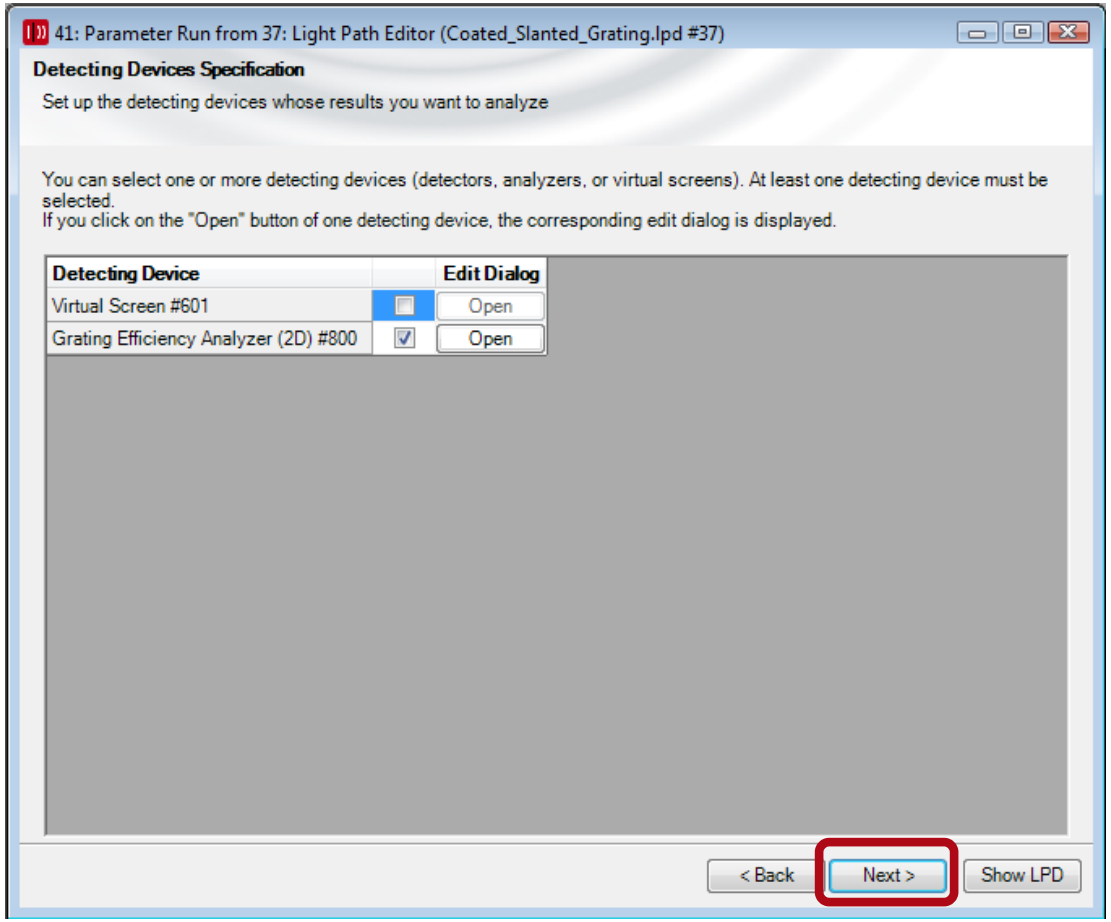


- On the *Position / Orientation* tab of the component dialog, you can specify that the *Cartesian Angles* shall be varied
- Changing the Cartesian angle α means a rotation about the y-axis.

Parameter Run (Variation of α)

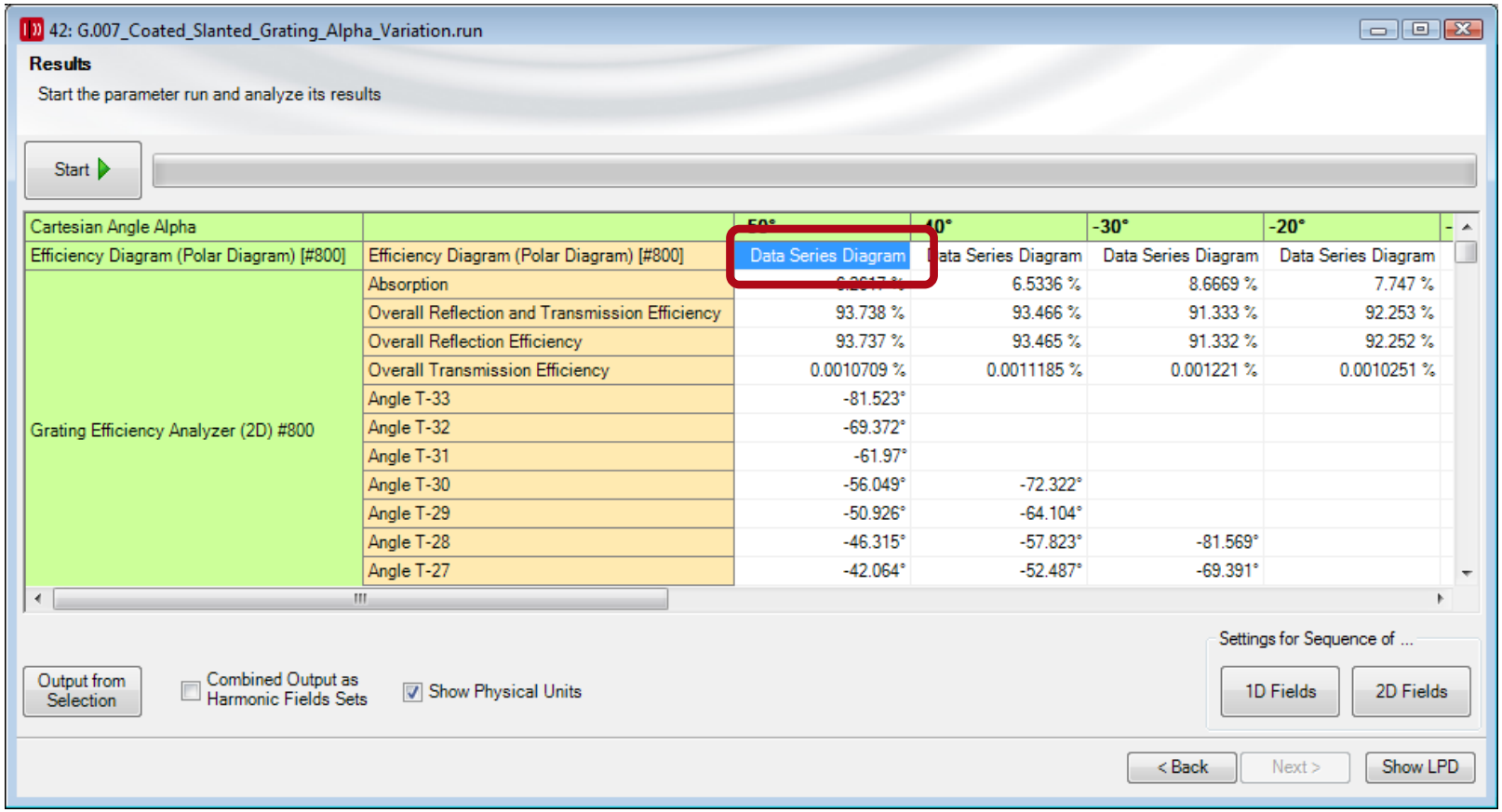


Parameter Run (Variation of α)



Results in

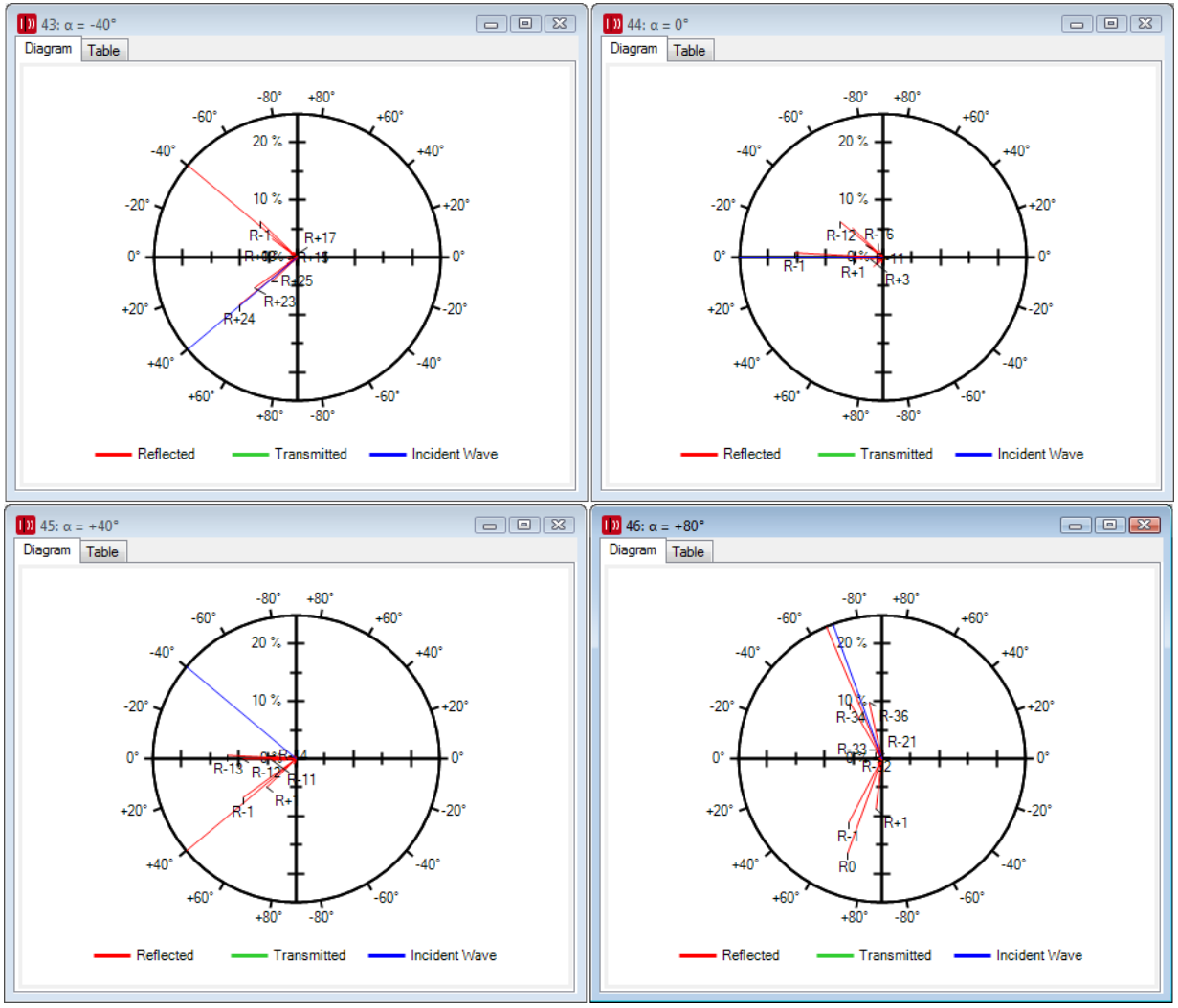
Parameter Run (Variation of α)



Double Click on a Data Series Diagram

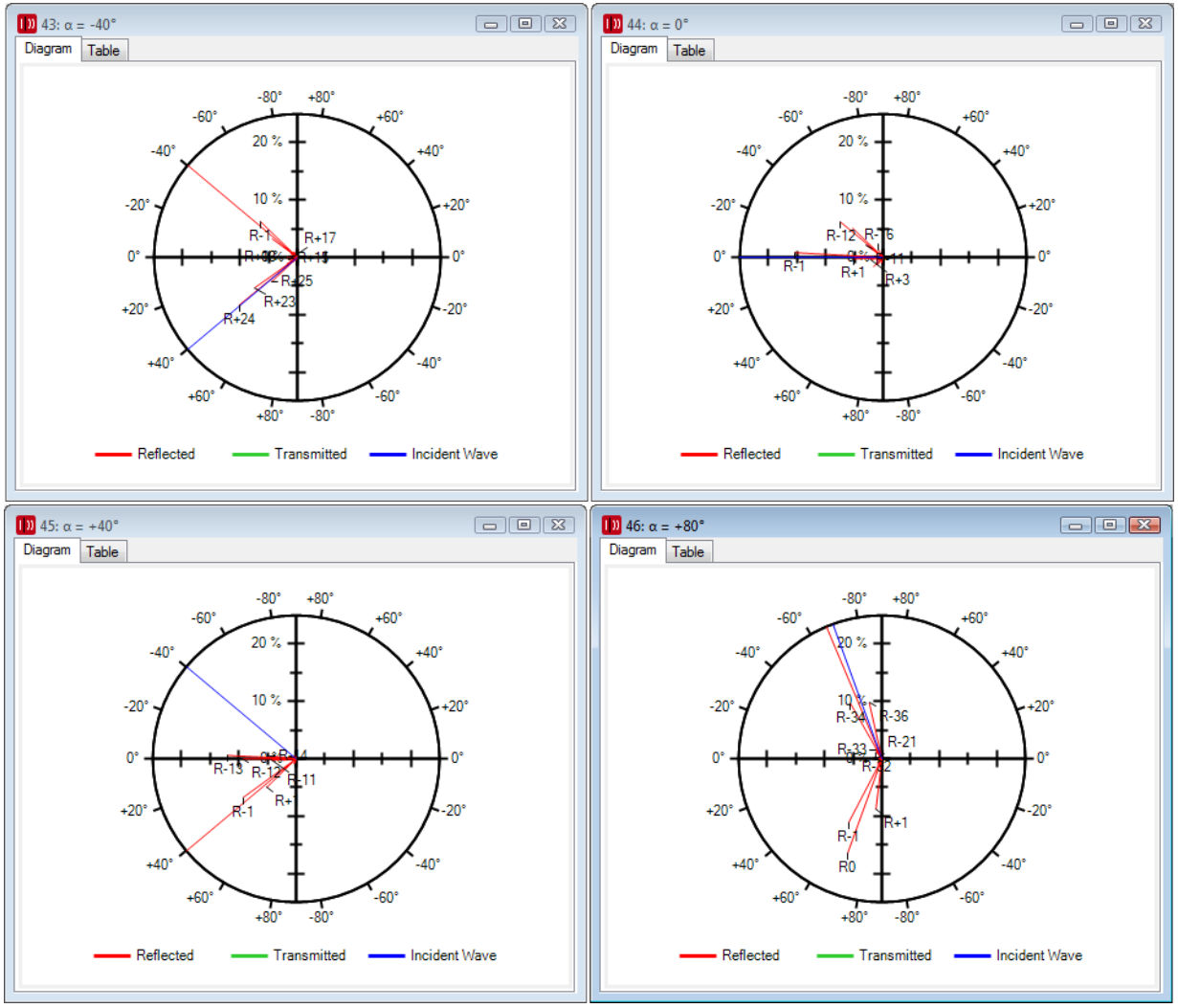
Results in

Sample Results



- You can see the direction of the incident wave as well as direction and efficiencies of the reflected orders for different incident angles.

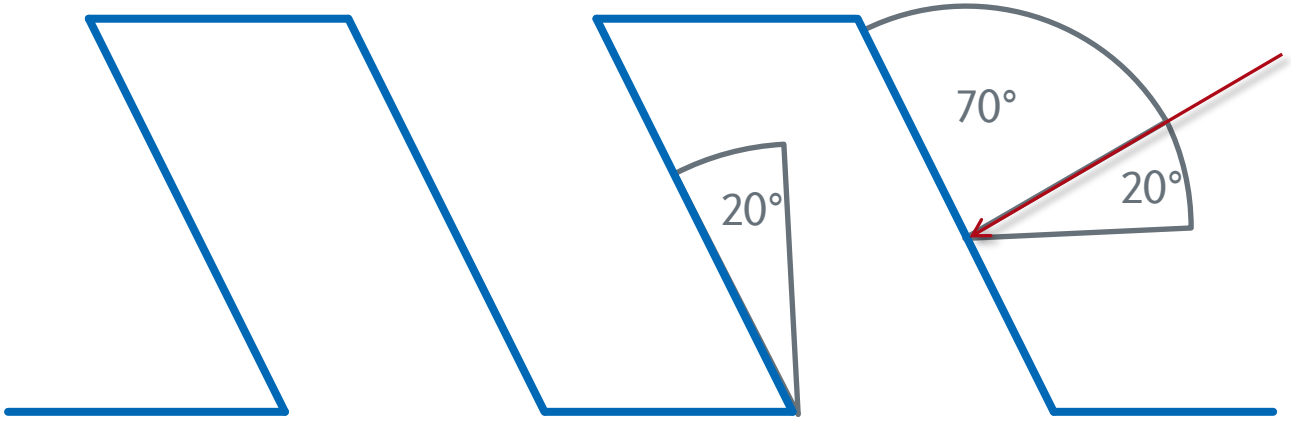
Sample Results



- Due to the coating, the transmitted orders can be neglected.
- The angle α specifies the orientation of the grating relative to the incident wave. Thus the angle of the incident wave relative to the grating has the opposite angle than α.

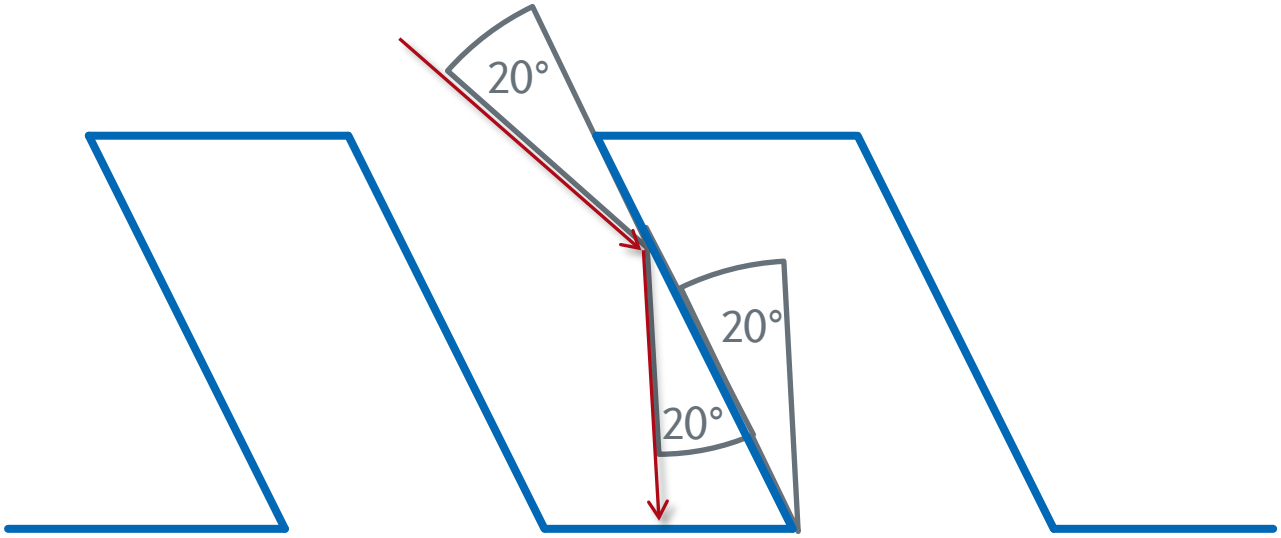
Back reflection for α = + 70°

- One can clearly see that for an angle α of +70° there is quite a strong reflection back into the direction of the incident beam as in this case the light propagates perpendicular to the side walls of the grating.



Back reflection for α = - 40°

- One can clearly see that for an angle α of -40° there is quite a strong reflection back into the direction of the incident beam as in this case the light reflected on the side walls of the grating propagates perpendicular to the base of the grating.



Conclusion

- VirtualLab™ enables the rigorous simulation of light diffraction at user defined gratings.
- User defined surface and index modulations can be modeled by the Programmable Interface and the Programmable Medium, respectively.
- The Programmable Medium allows the definition of global parameters that can be varied in the Parameter Run.