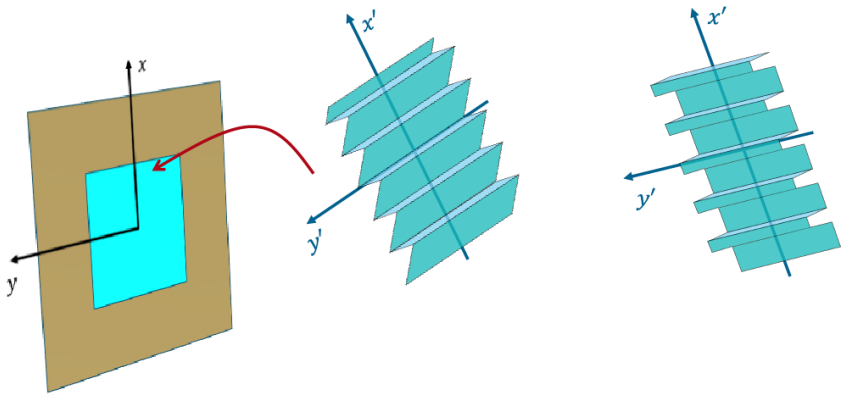
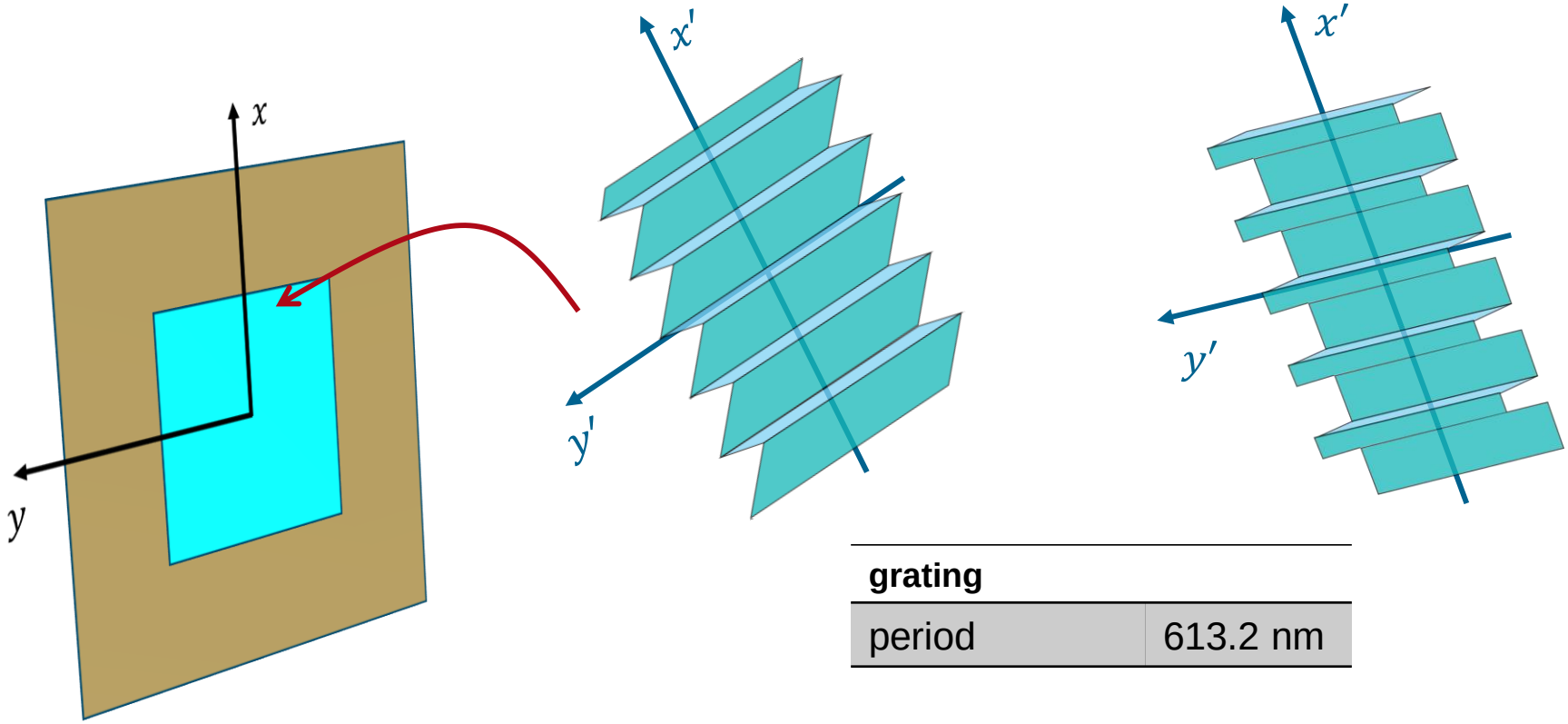
Orientation of Gratings within a Grating Region

Abstract



In VirtualLab Fusion, users can define arbitrary regions on an optical surface. Within a region, grating interface /stack can be added on. To conveniently define the orientation of the grating within the region, two angles can be used, i.e., “Orientation (Rotation about z-Axis)” and “Rotation about y-Axis by 180°”. This use case shows how to set these two angles to control the orientation of a grating in one region. The configuration of grating regions is currently only supported in the Waveguide toolbox.

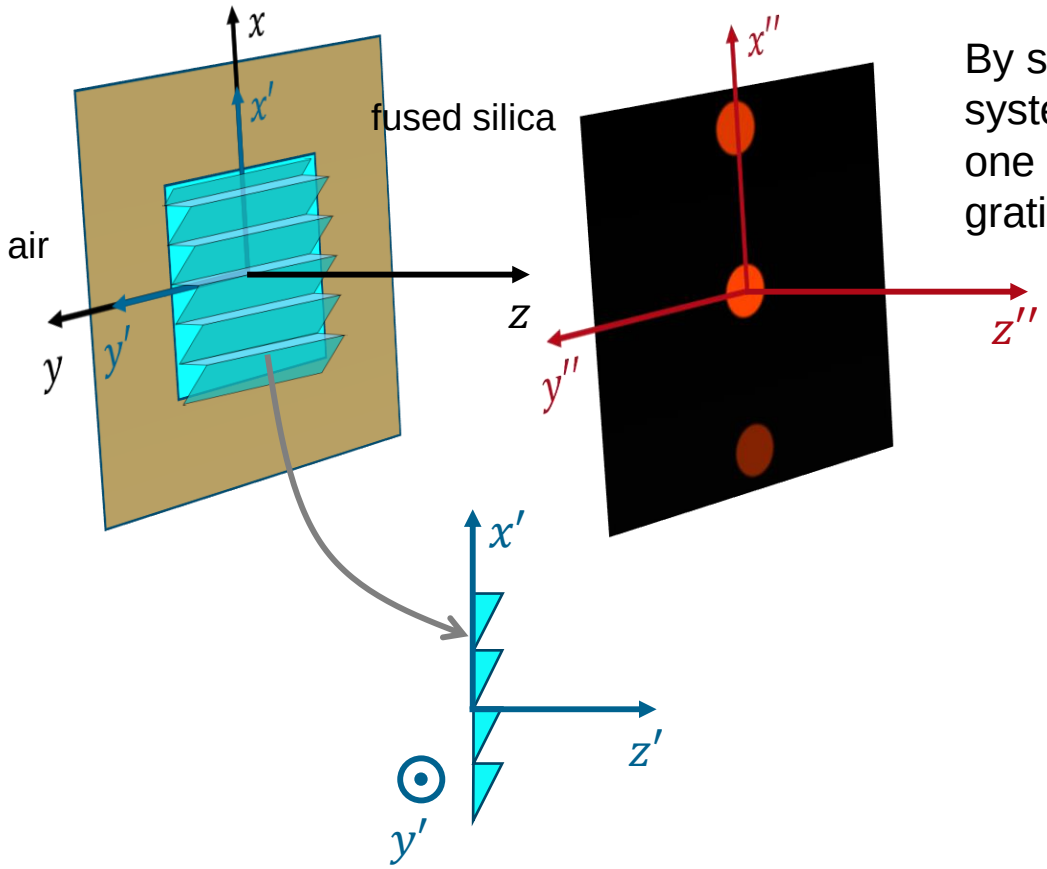
Modeling Task



grating	
period	613.2 nm

- define the orientation of grating in a grating region on an surface by using
  - Orientation (Rotation about z-Axis), illustrated by using sawtooth grating
  - Rotation about y-Axis by 180°, illustrated by using rectangle grating

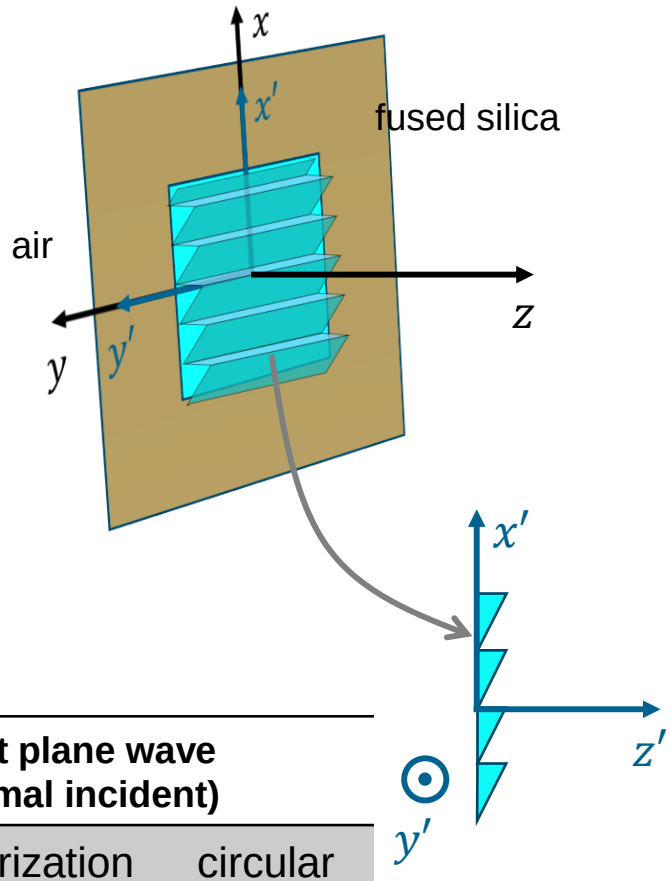
Demonstration



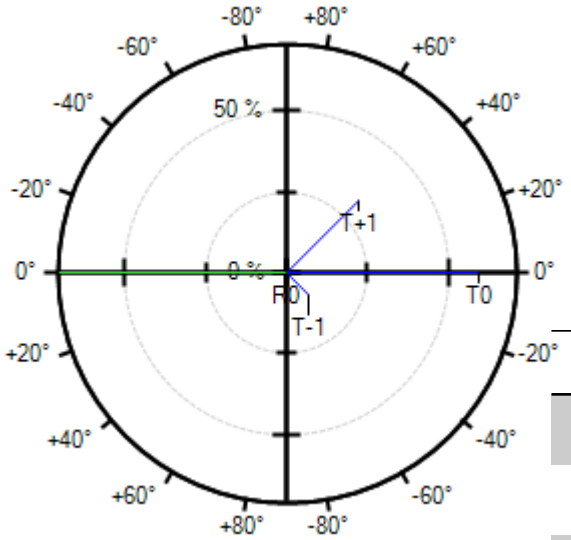
By setting the relation of coordinate system (CS) of grating and interface, one can define the orientation of grating on the interface.

- Grating is represented in blue CS, while interface CS is the black one.
- By setting *Orientation (Rotation about z-Axis)* and *Rotation about y-Axis by 180°*, the CS of grating is rotated in CS of interface.
- We will also show the diffraction order in detector plane far away from the grating to give a feeling of the orientation of grating.

Illustration of Rotation about z-Axis



polar diagram

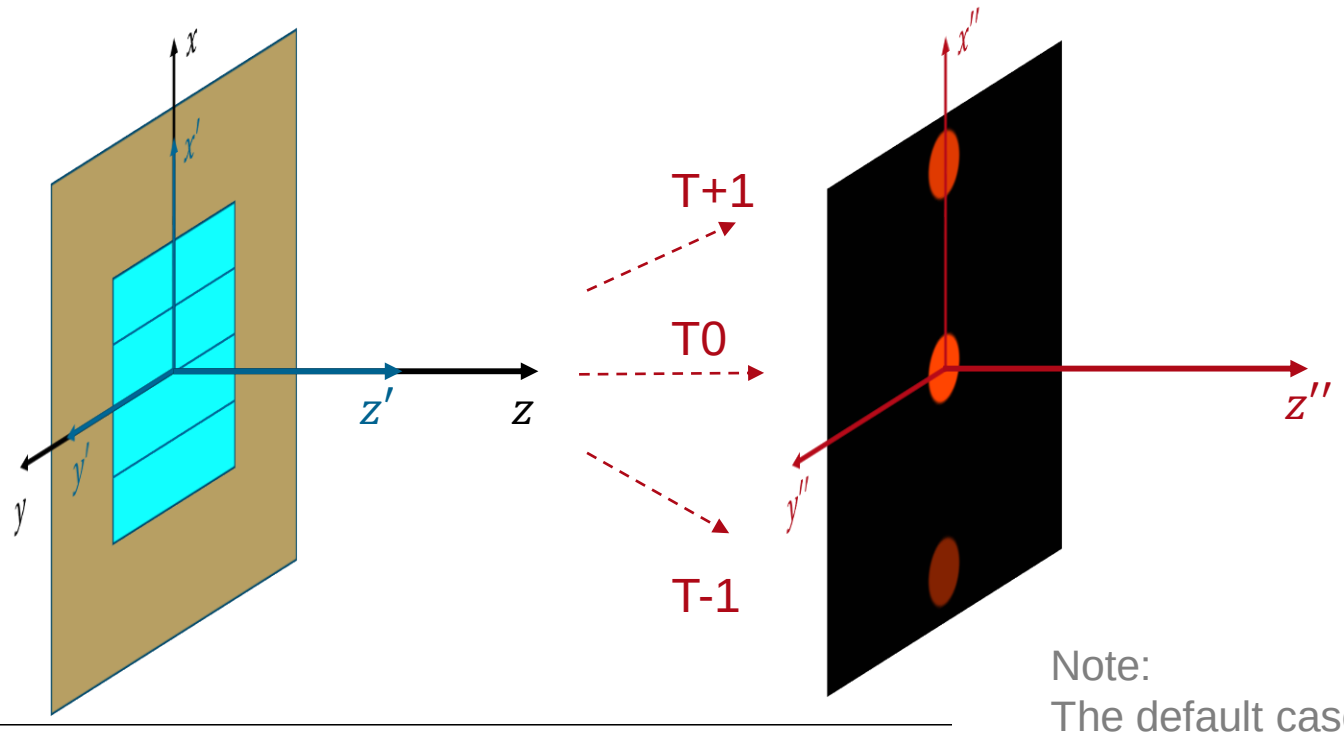


grating efficiency	
T+1	31.2%
T0	59.4%
T-1	9.4%

input plane wave (normal incident)	
polarization	circular
wavelength	632 nm

Sawtooth grating is used to illustrate *Orientation (Rotation about z-Axis)*.
The grating is asymmetric about y-axis, so the diffraction efficiencies of +1st and -1st orders are not symmetric. Therefore, we can easily see the effect caused by grating rotation from the detected diffraction order.

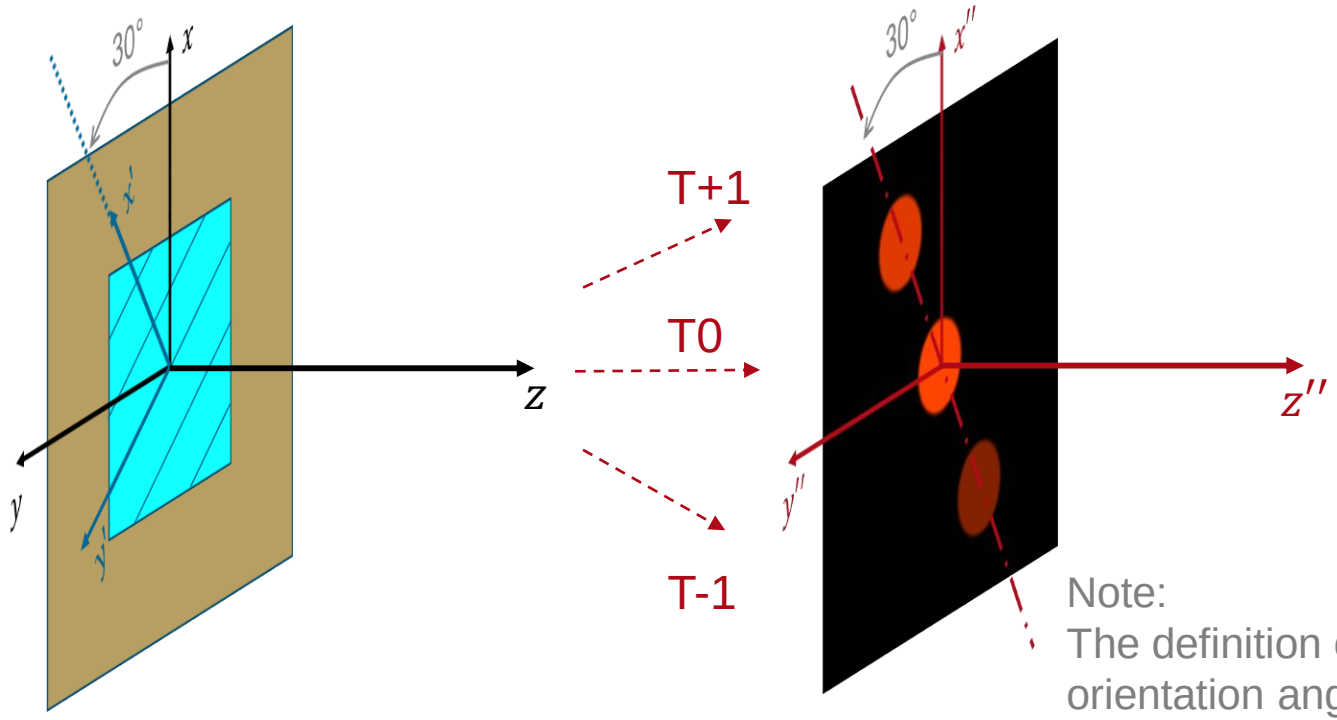
Orientation (Rotation about z-Axis): 0°



Angles	
Orientation (Rotation about z-Axis)	0°
Rotation about y-Axis by 180°	uncheck

Note:
The default case is that all the based vectors (x, y, z vectors) of CSs are identical.

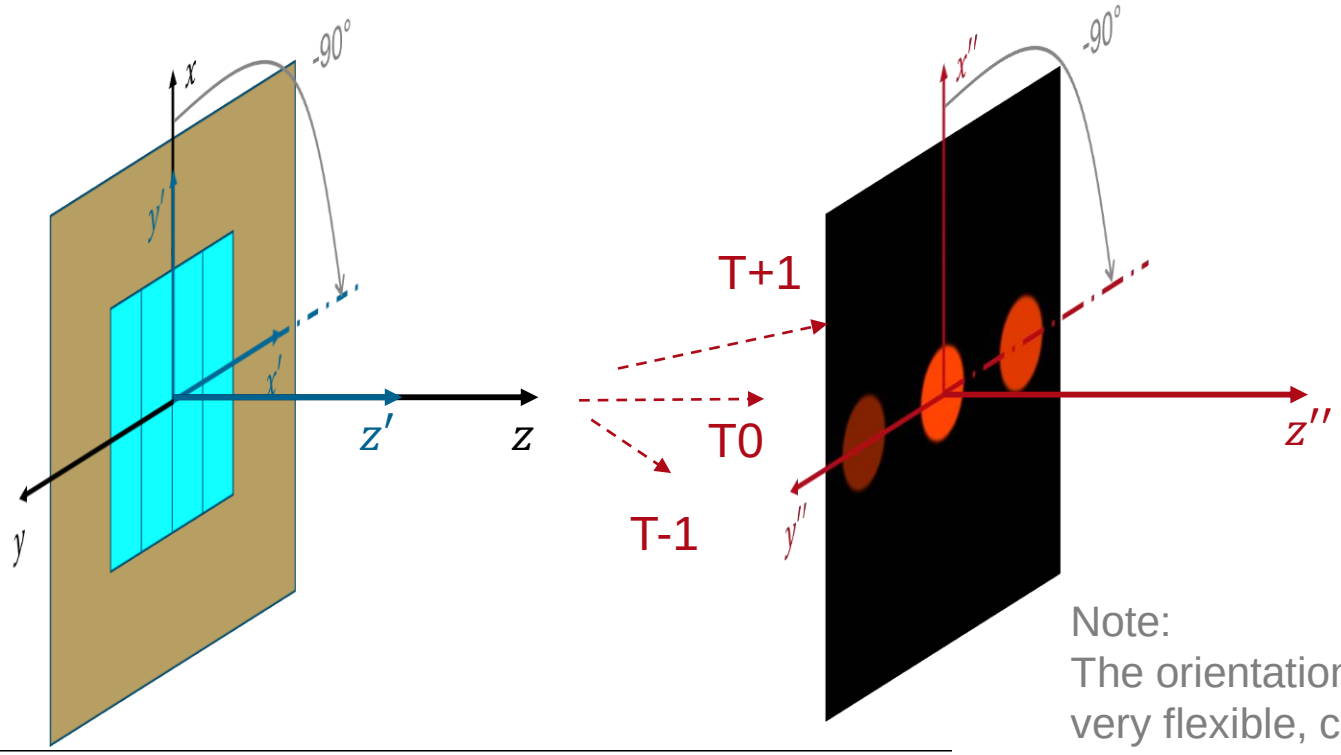
Orientation (Rotation about z-Axis): 30°



Angles	
Orientation (Rotation about z-Axis)	30°
Rotation about y-Axis by 180°	uncheck

Note:
The definition of orientation angle is
- about z-axis of CS of interface
- counterclockwise as positive

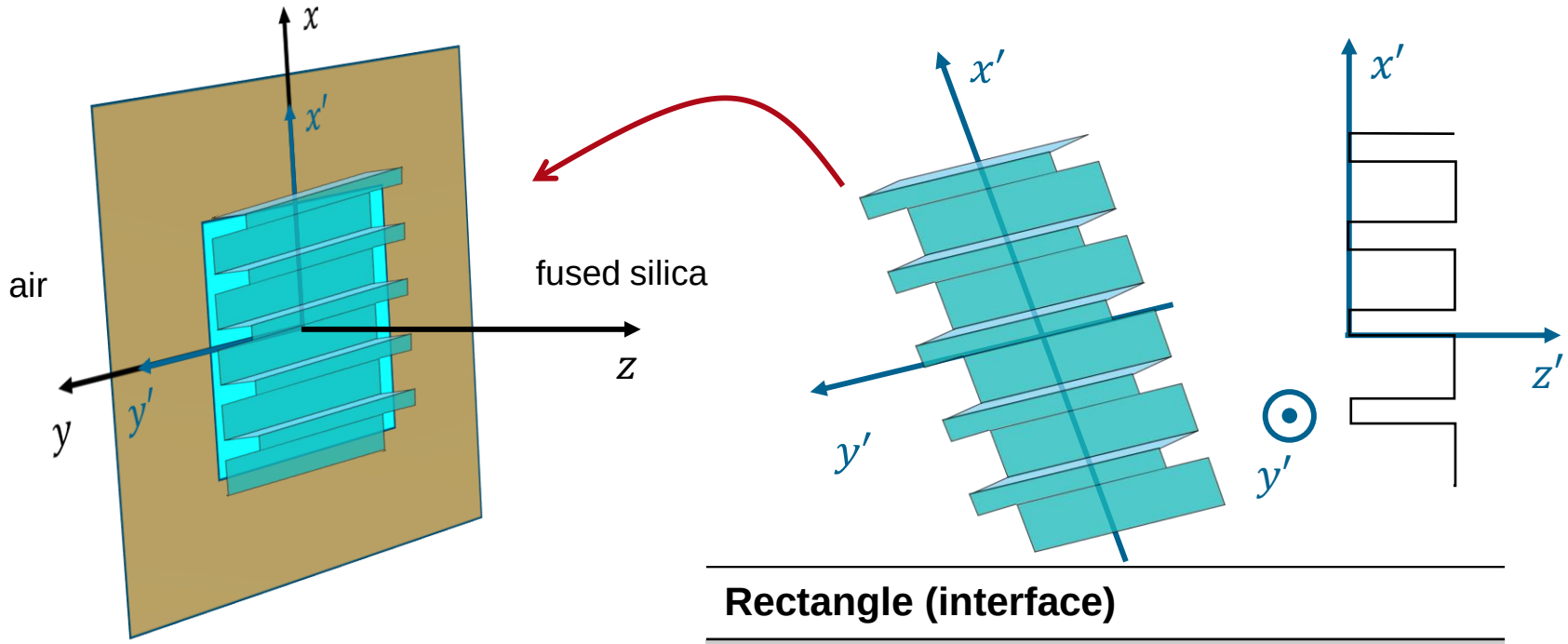
Orientation (Rotation about z-Axis): -90°



Angles	
Orientation (Rotation about z-Axis)	-90°
Rotation about y-Axis by 180°	uncheck

Note:
The orientation angle is very flexible, can be defined from -360° to 360°, depends on users preference.

Illustration of Rotation about y-Axis by 180°

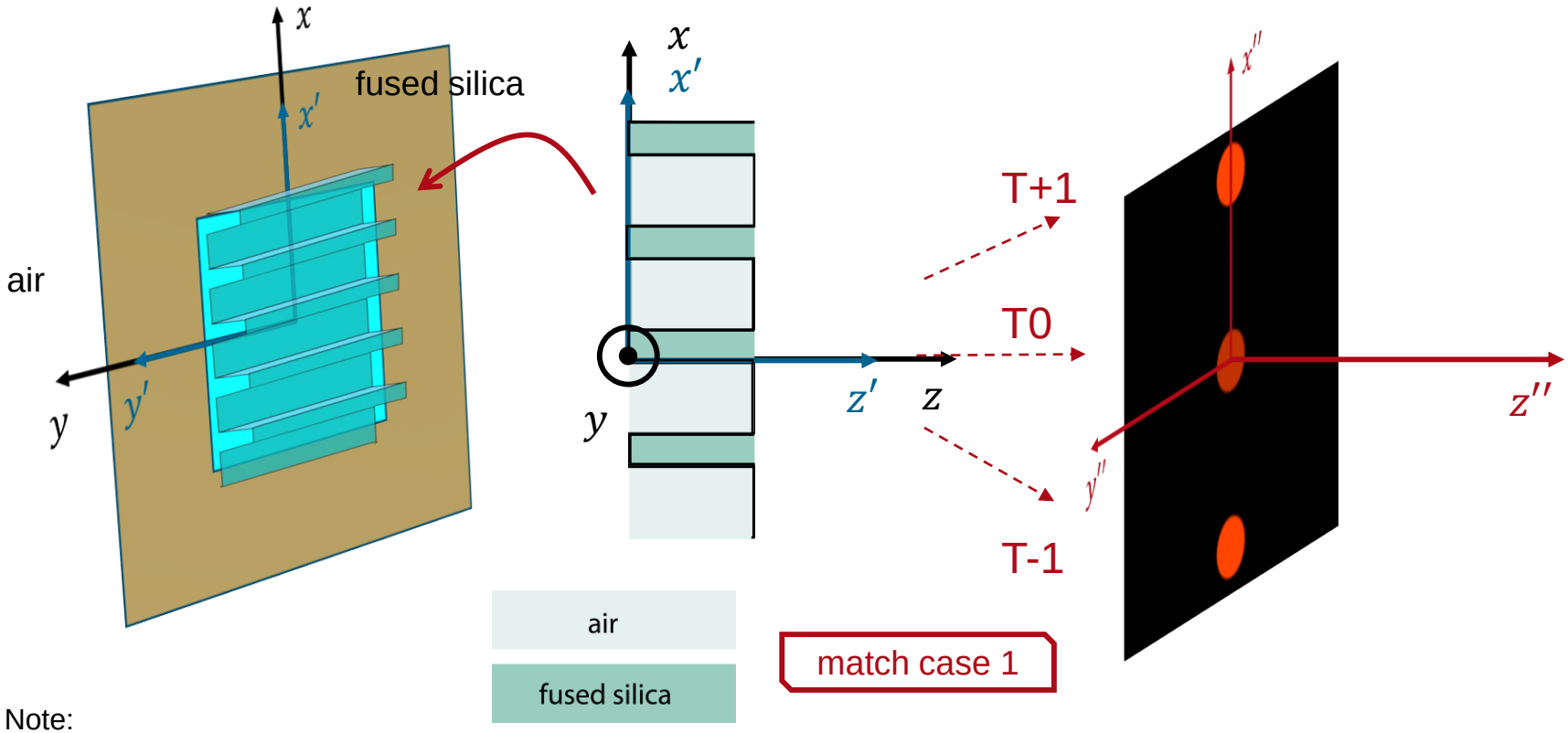


input plane wave (normal incident)	
polarization	TE (90°)
wavelength	632 nm

Rectangle (interface)	
relative slit width	65%

A rectangular grating interface (note that grating stacks can also be placed on a interface) is used to illustrate *Rotation about y-Axis by 180°*. When the relative slit width is not 50%, and materials of both side of interface is fixed, rotation before and after gives two different grating stacks, which result in different distributions of diffraction efficiencies.

Rotation about y-Axis by 180° (Uncheck)



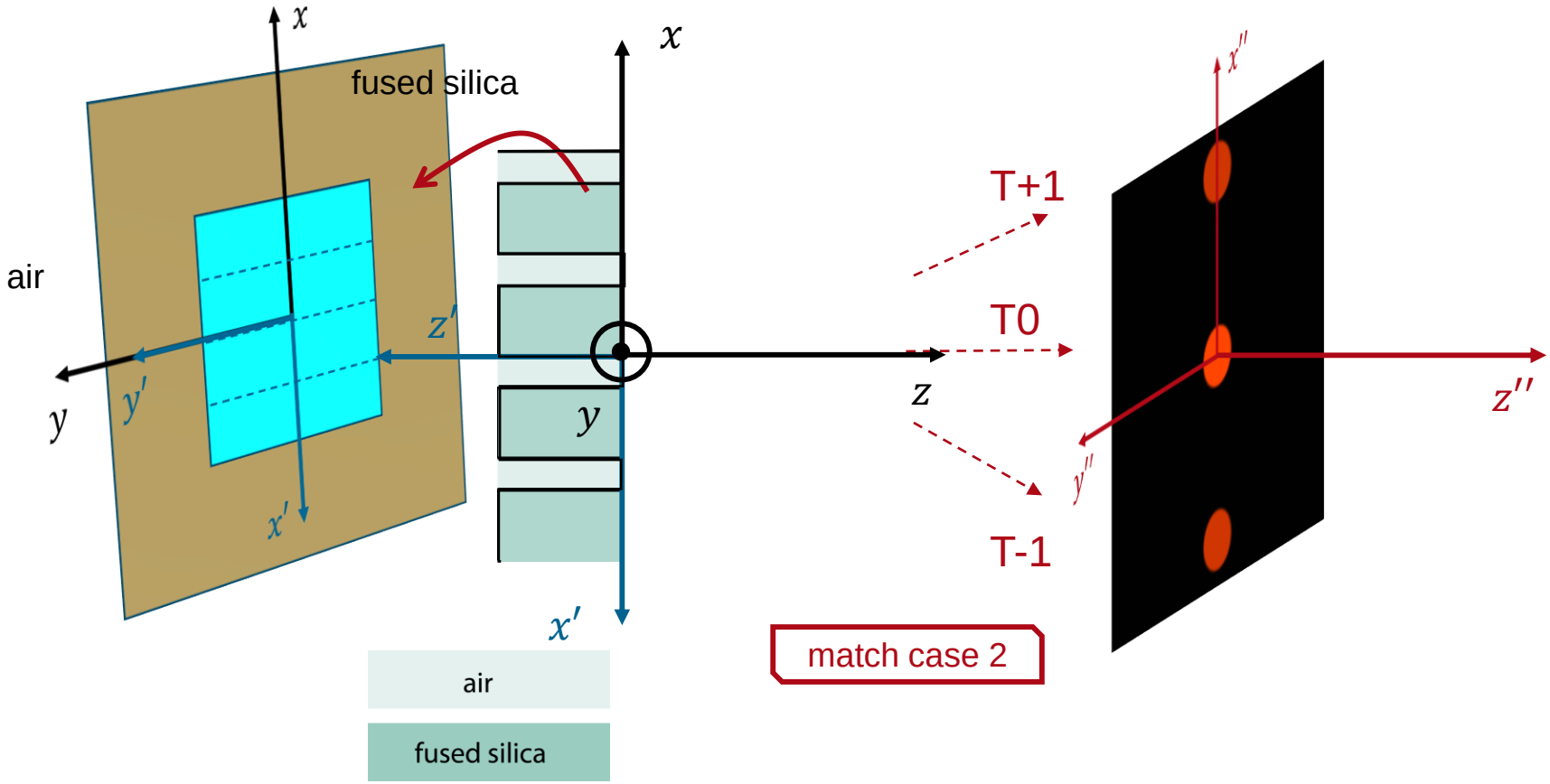
Note:

By default, grating is added to the right side of the optical interface (z-axis and z'-axis identical), to keep the CS of grating and that of interface is overlap.

The CS definition is slightly different from that of grating toolbox, because in grating toolbox

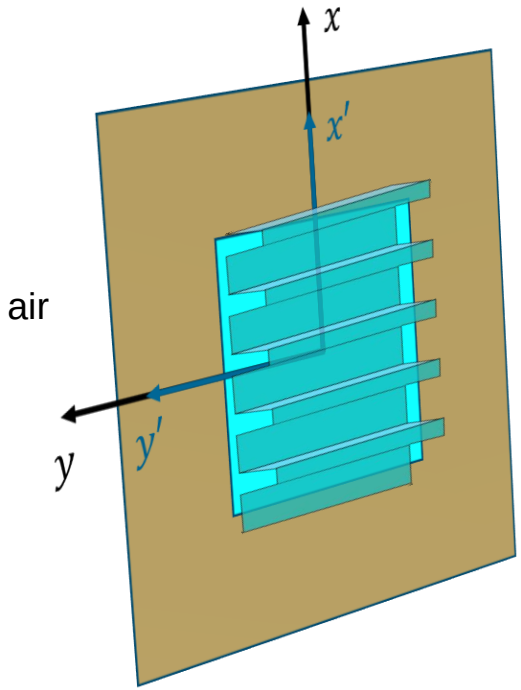
- If the grating interface is added on the first interface of subtract, whose z -axis and x -axis has completely opposite direction with those of the plane interface here.
- If it is added on the second interface of subtract, the CSs are completely identical, but the material before and after the second interface is opposite, compared with here(assume subtract is fused silica).

Rotation about y-Axis by 180° (Check)

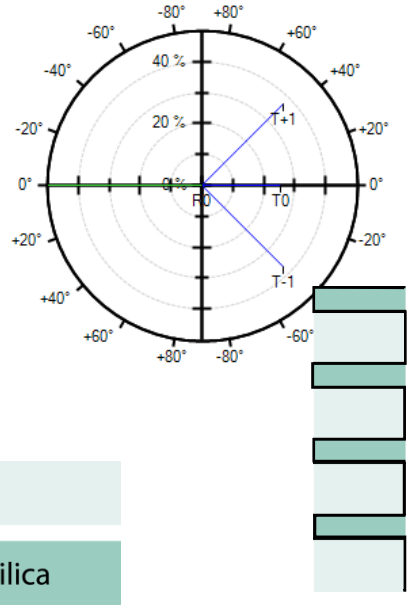


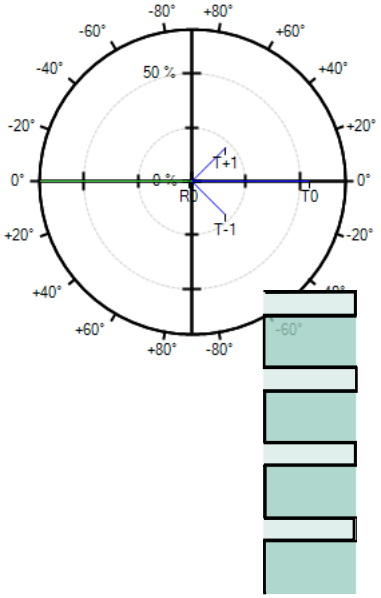
Note:
The rectangle grating interface is rotated around y-axis of the optical interface by 180°, so the grating interface sees that materials on both side of it switched, so the grating stack becomes case 2.

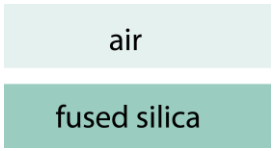
Additional Information on Case 1 and Case 2



polar diagram







input plane wave (normal incident)	
polarization	TE (90°)
wavelength	632 nm

Case 1	
T+1/-1	37.2%
T0	25.4%

Case 2	
T+1/-1	22.2%
T0	54.4%

Document Information

title	Orientation of Gratings within a Grating Region
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VL version used for simulations	7.3.0.50
category	Feature Use Case