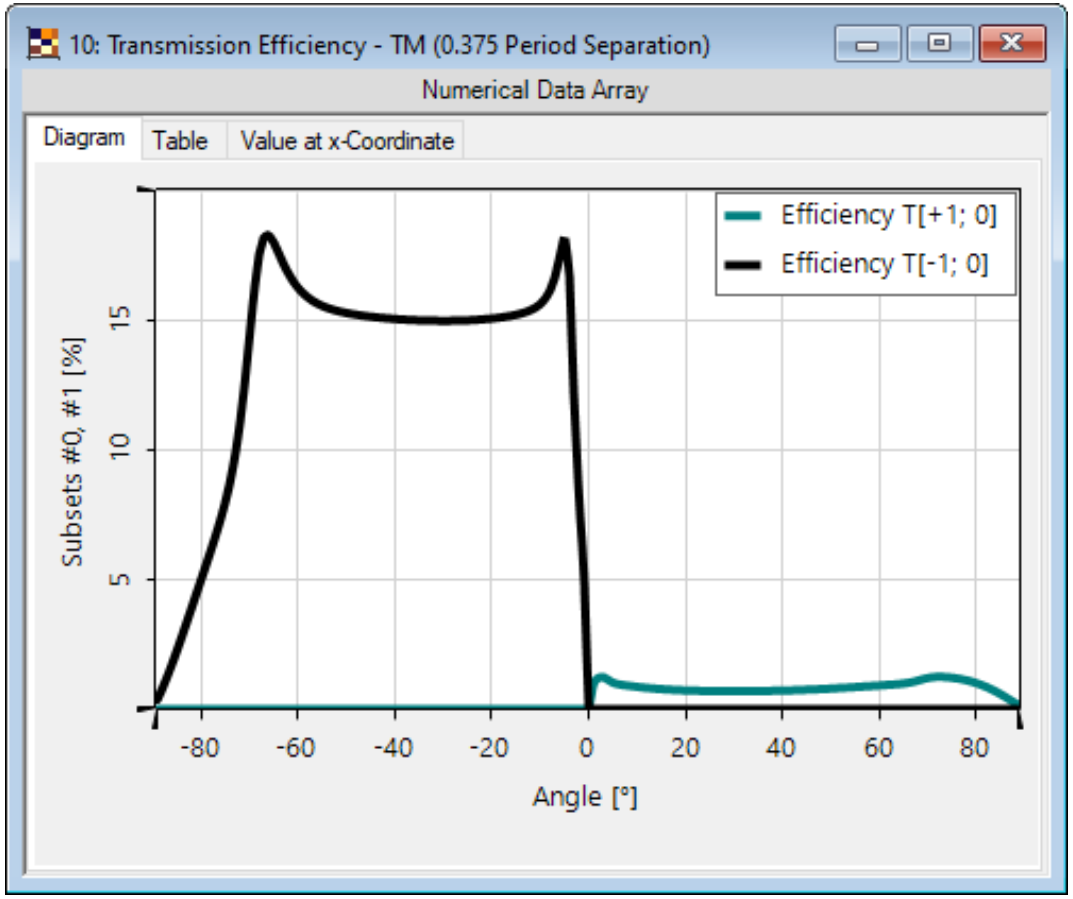
Diffraction Property of a Passive Parity-Time Grating

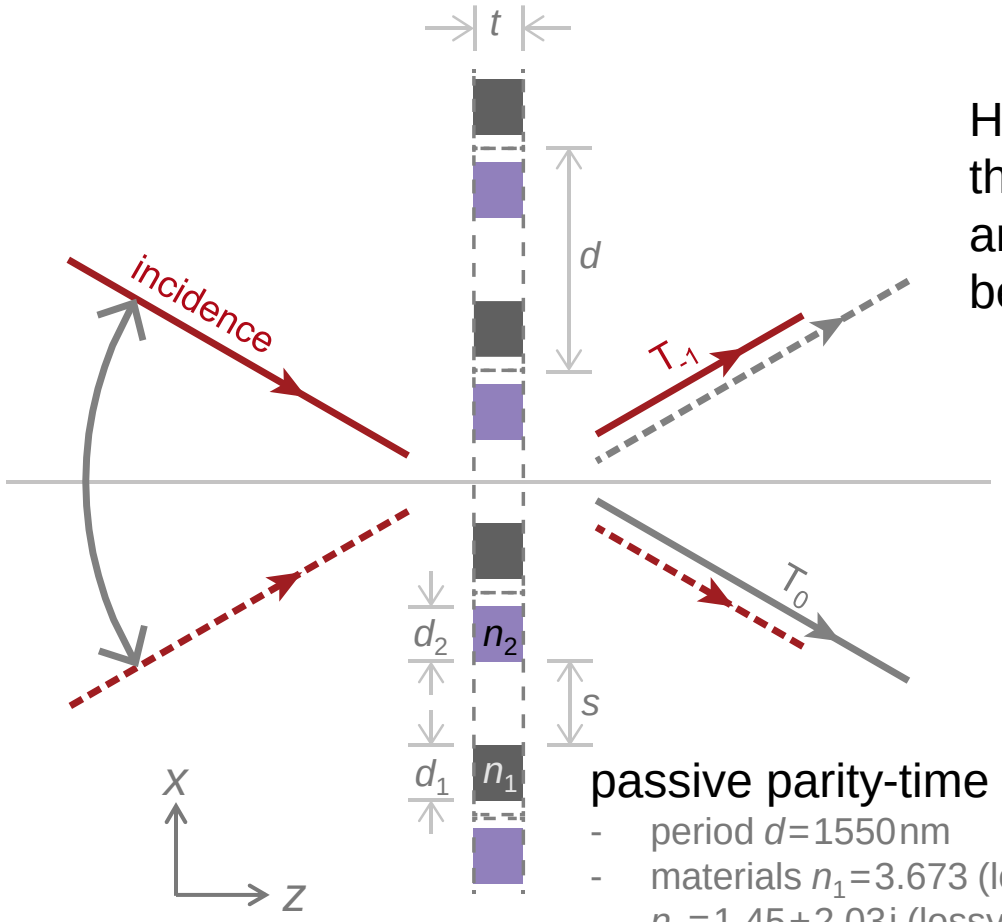
Abstract



Certain optical systems and optical components have been used as equivalence to study corresponding quantum mechanics effects. For example, a passive parity-time (PT) grating has been reported by Zhu *et al*. [Appl. Phys. Lett. 109, 111101 (2016)]. In this example, we construct a passive PT grating following Zhu, and use the Fourier modal method (FMM) for investigation. Particularly, we show the asymmetric diffraction effect with selected grating structure parameters and the polarization of light.

Modeling Task

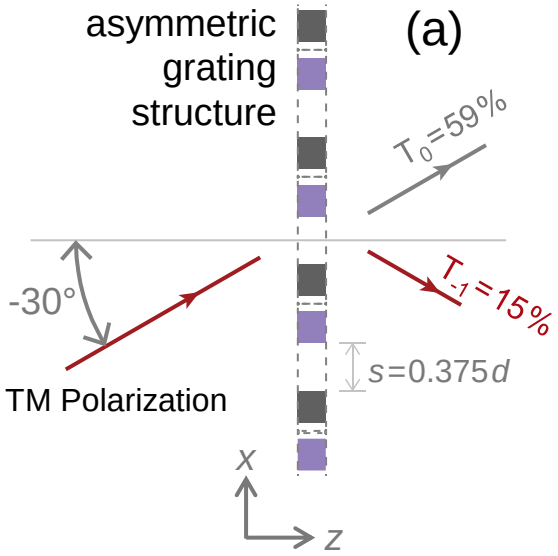
input plane wave
- wavelength 1550 nm
- polarization TM or TE
- incidence angle varying from -89 to 89°

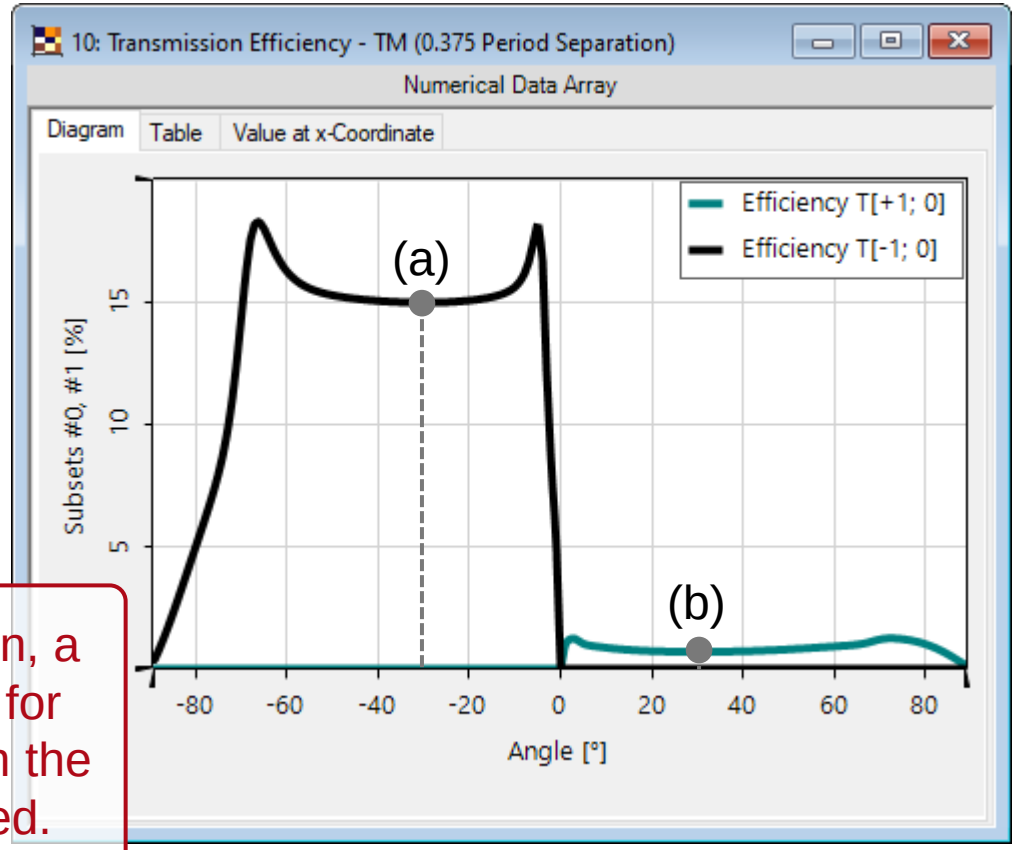


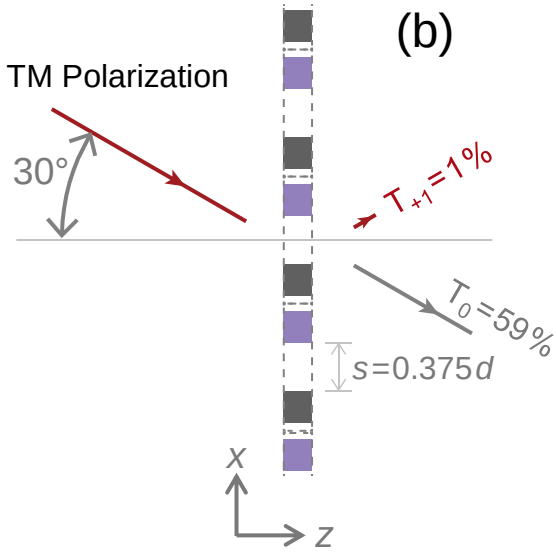
How does the diffraction property of the grating depends on the incidence angle, and the separation (*s*) between the grating stripes?

passive parity-time grating
- period d=1550 nm
- materials n_1=3.673 (lossless), n_2=1.45+2.03i (lossy)
- widths of stripes d_1=d_2=0.25d
- varying separation (s) between stripes

Stripe Separation ($s=0.375d$) – TM Polarization







With proper stripe separation, a clear contrast can be seen for the diffraction behavior when the incidence direction is flipped.

Stripe Separation ($s=0.375d$) – TM Polarization

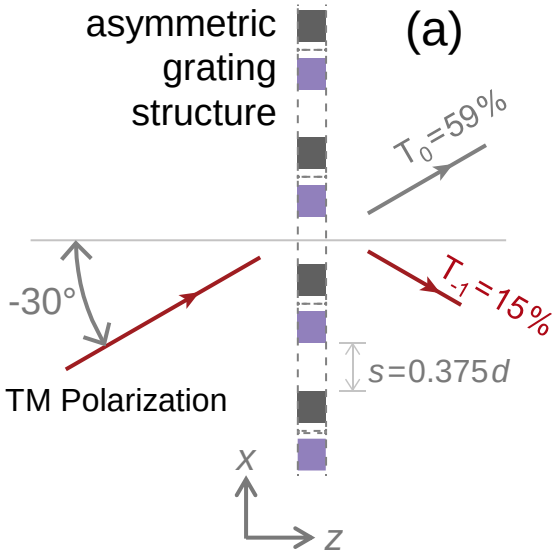
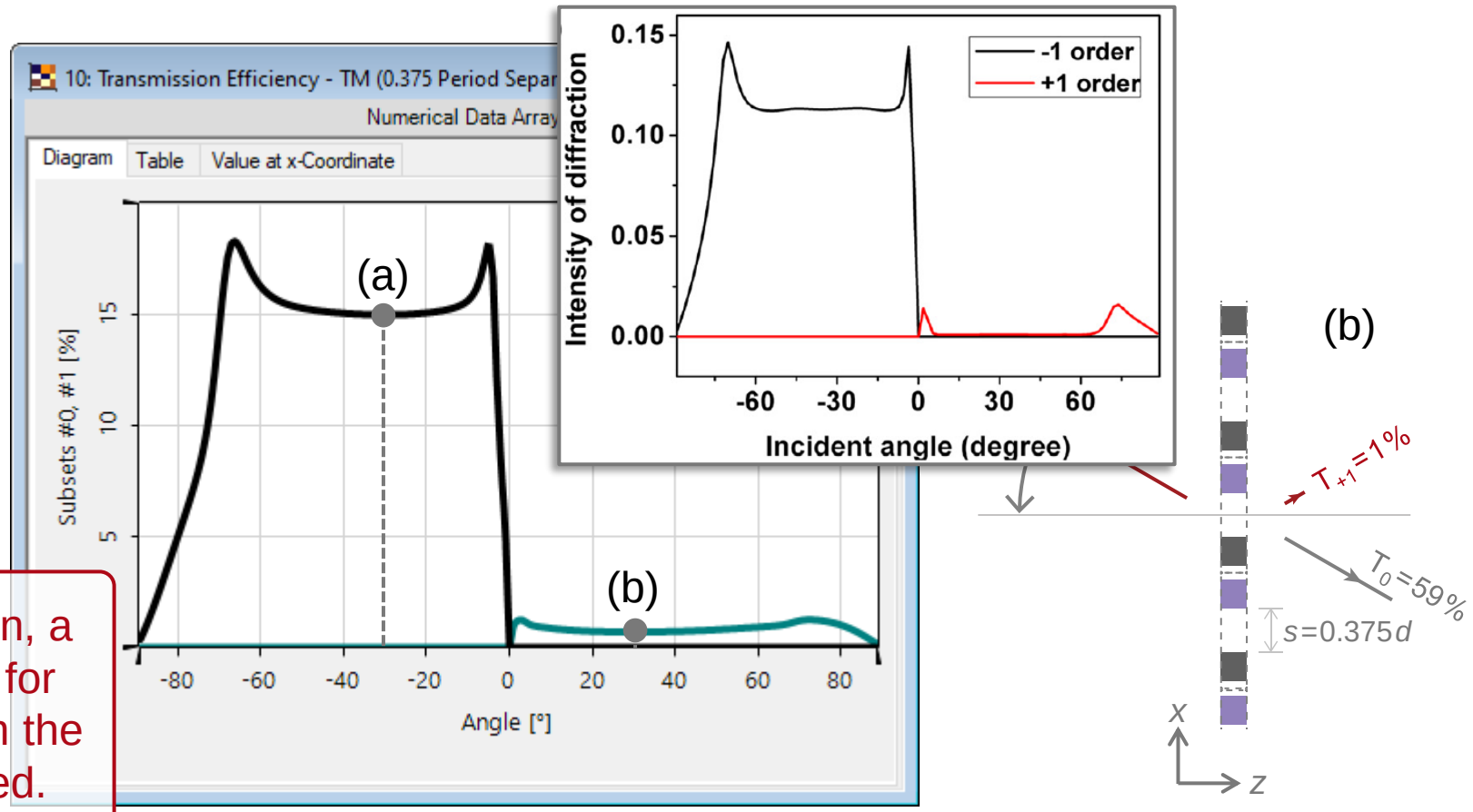
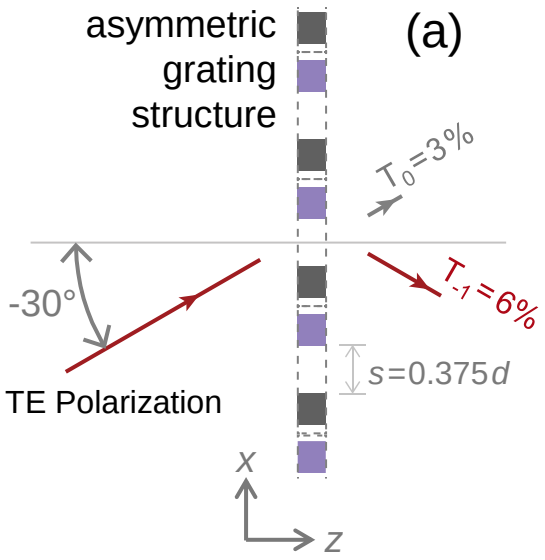


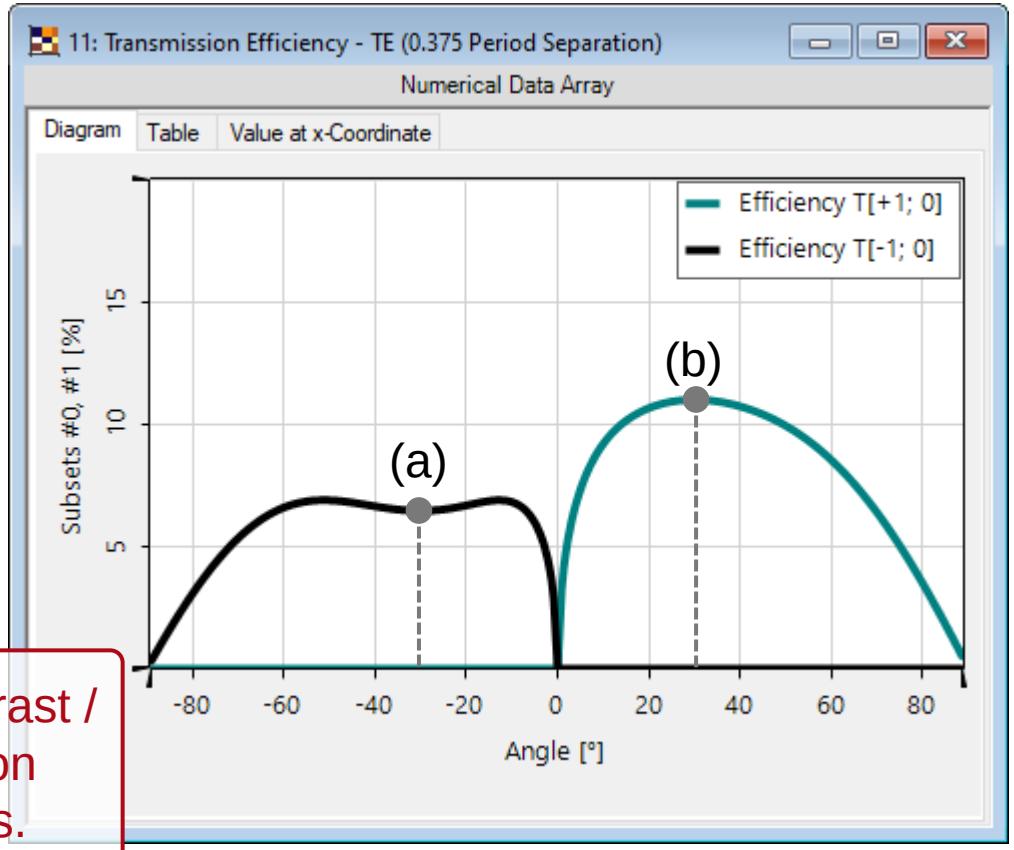
Fig. 5(b) from X. Zhu, *et al.*,
Appl. Phys. Lett. 109, 111101 (2016)

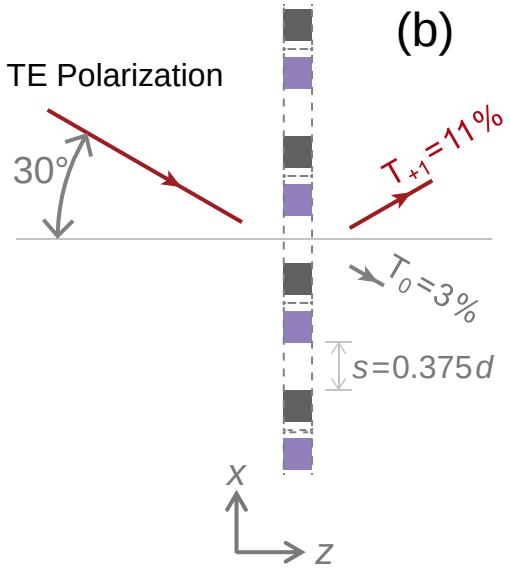


With proper stripe separation, a clear contrast can be seen for the diffraction behavior when the incidence direction is flipped.

Stripe Separation ($s=0.375d$) – TE Polarization

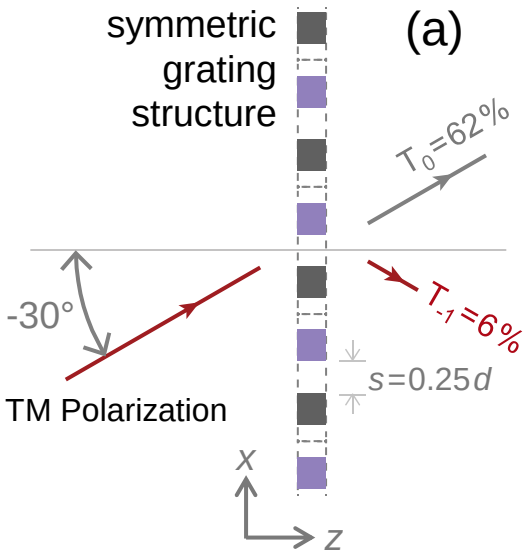


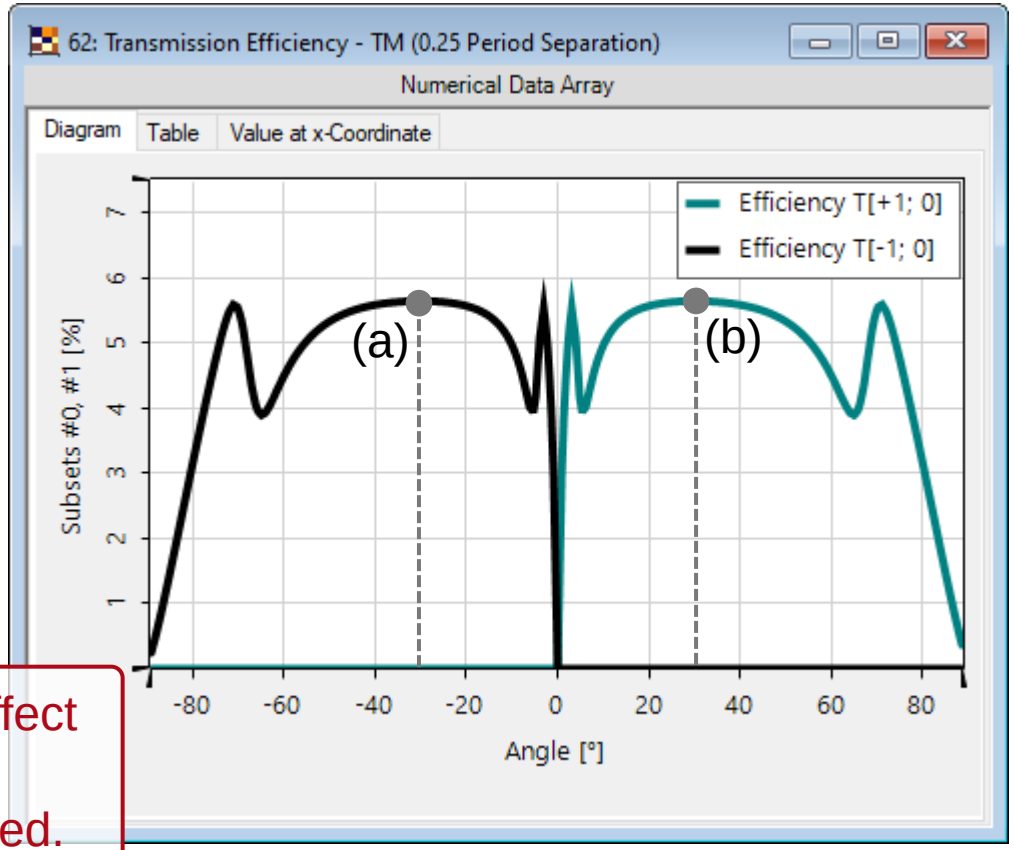


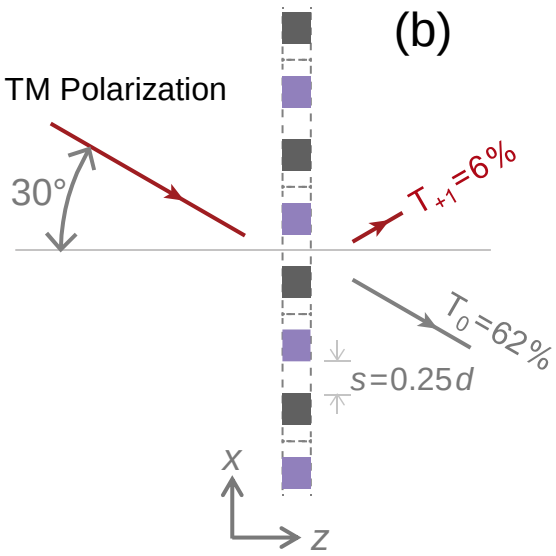


For TE polarization, the contrast / asymmetry of the diffraction effect is no longer obvious.

Stripe Separation ($s=0.25d$) – TM Polarization

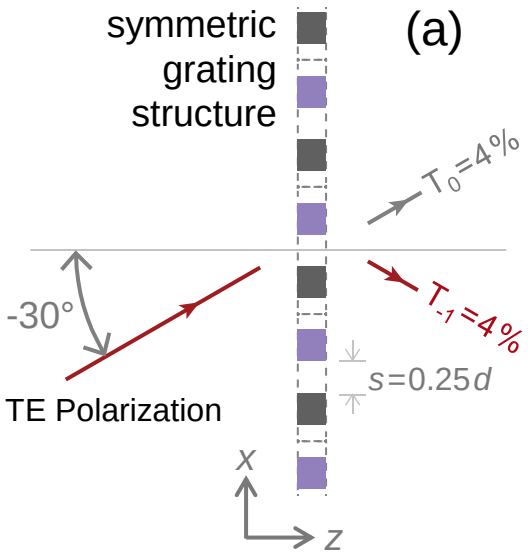


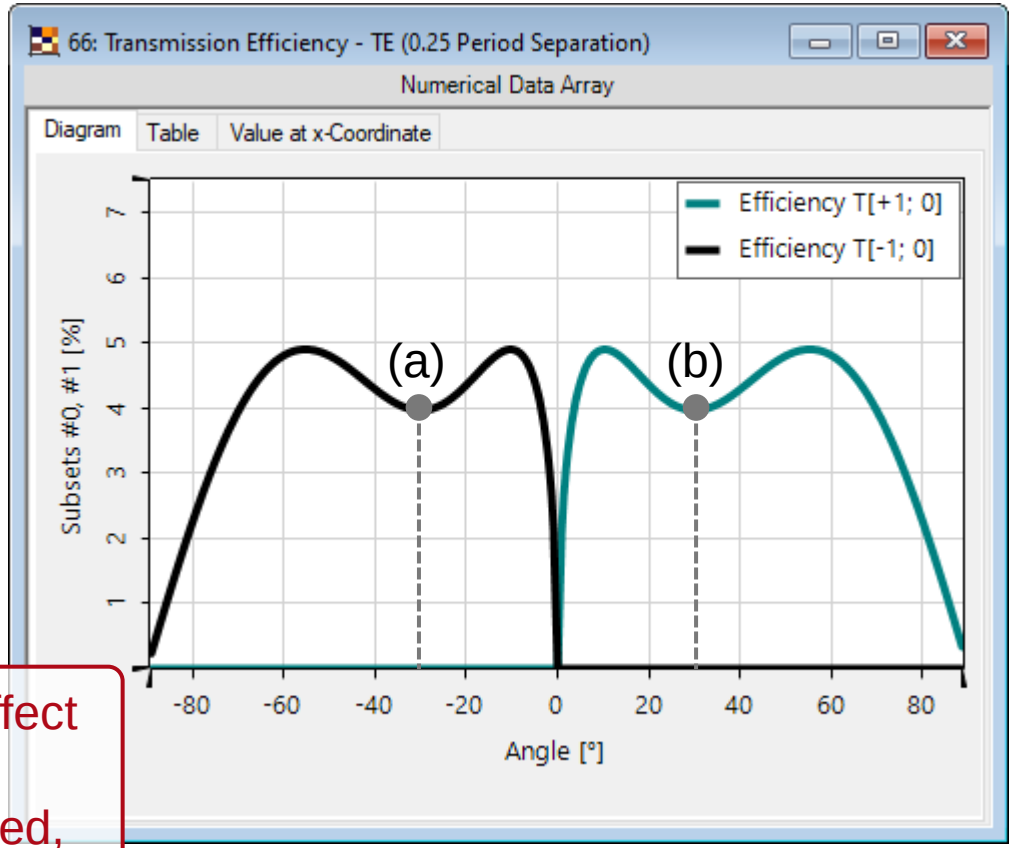


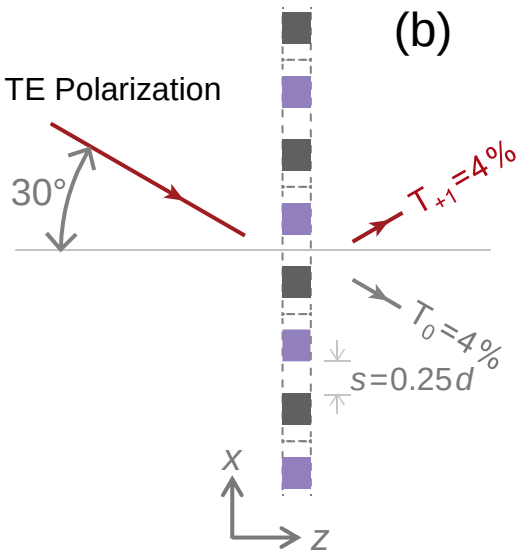


No asymmetric diffraction effect is seen when the stripe separation is evenly designed.

Stripe Separation ($s=0.25d$) – TE Polarization

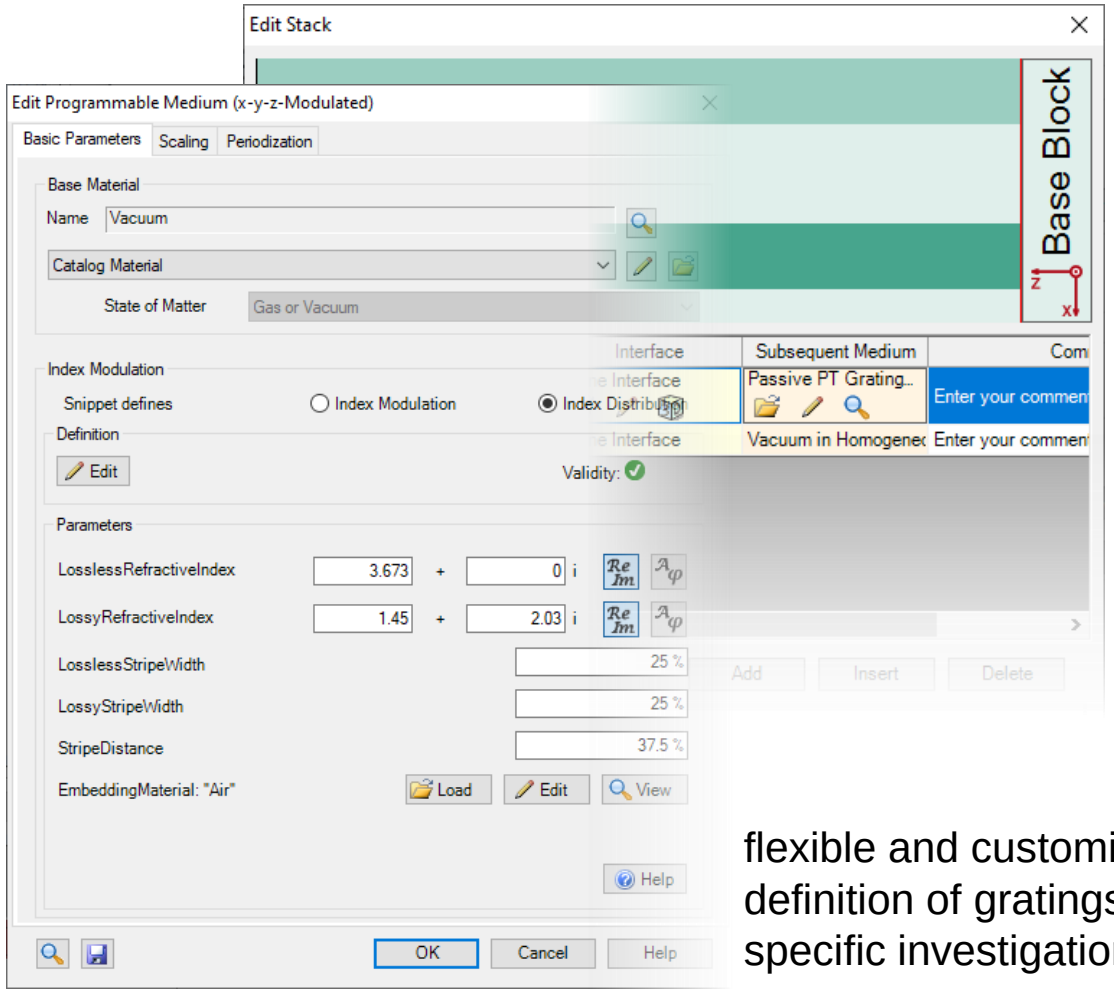






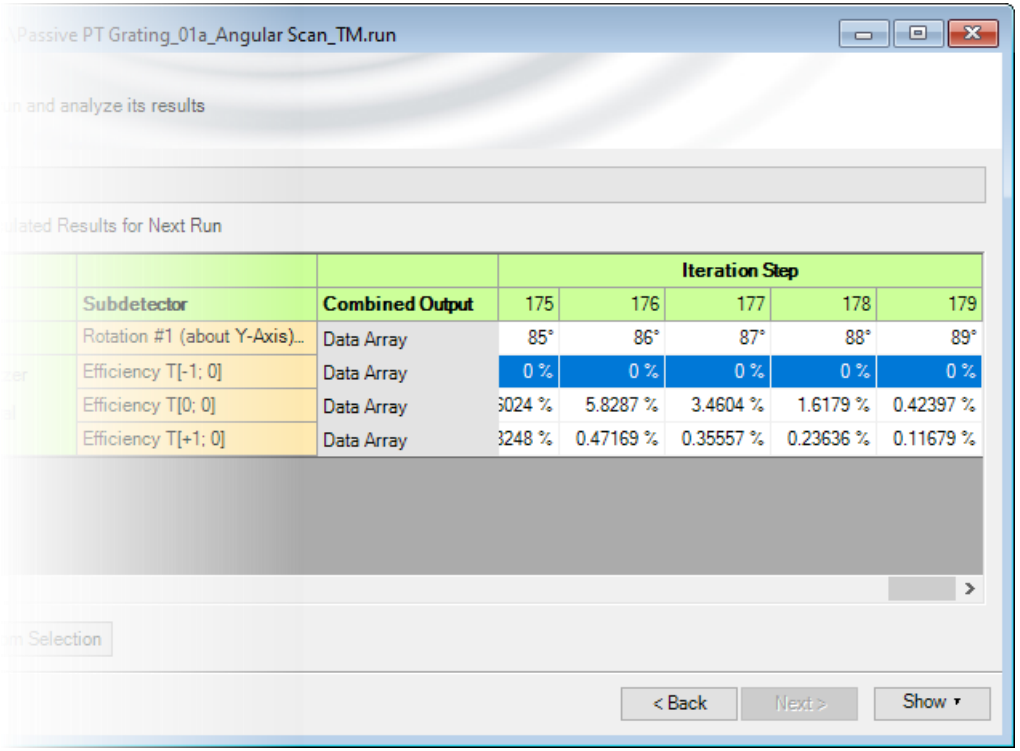
No asymmetric diffraction effect is seen when the stripe separation is evenly designed, regardless of polarization.

Peek into VirtualLab Fusion



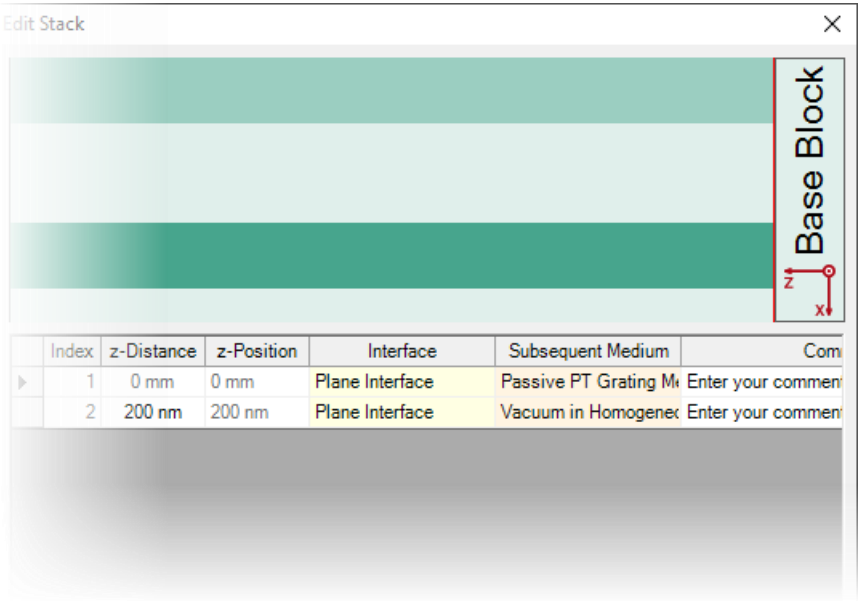
flexible and customizable definition of gratings for specific investigation

parameter scanning for performance analysis

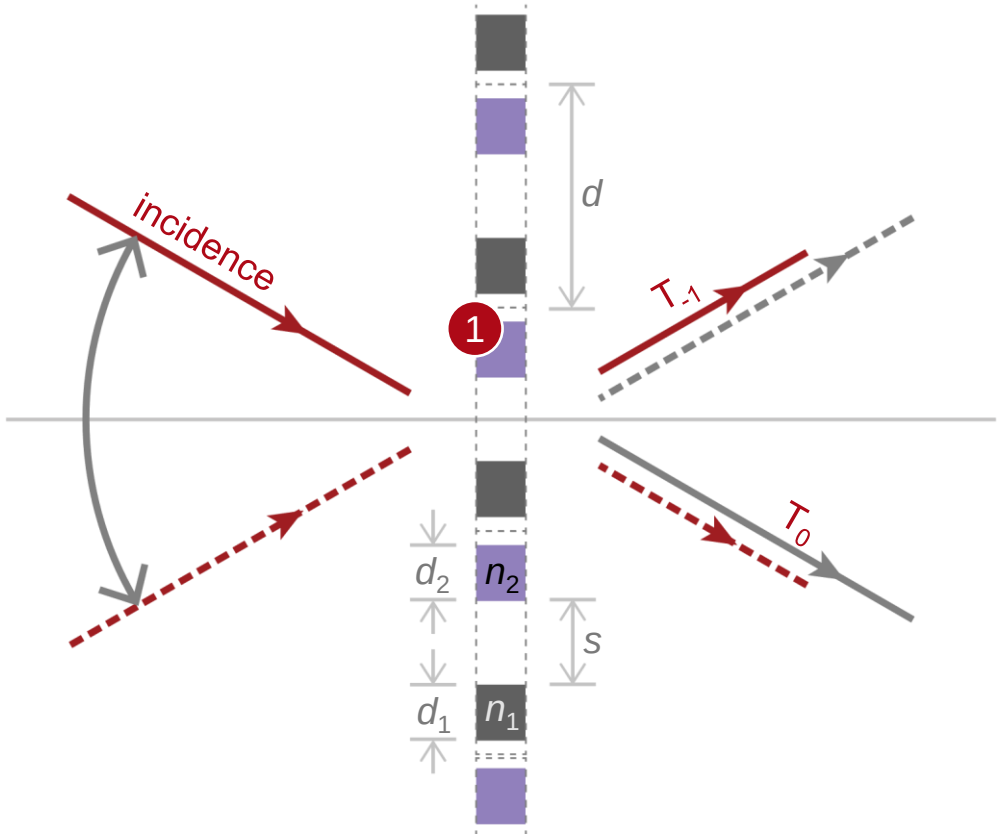


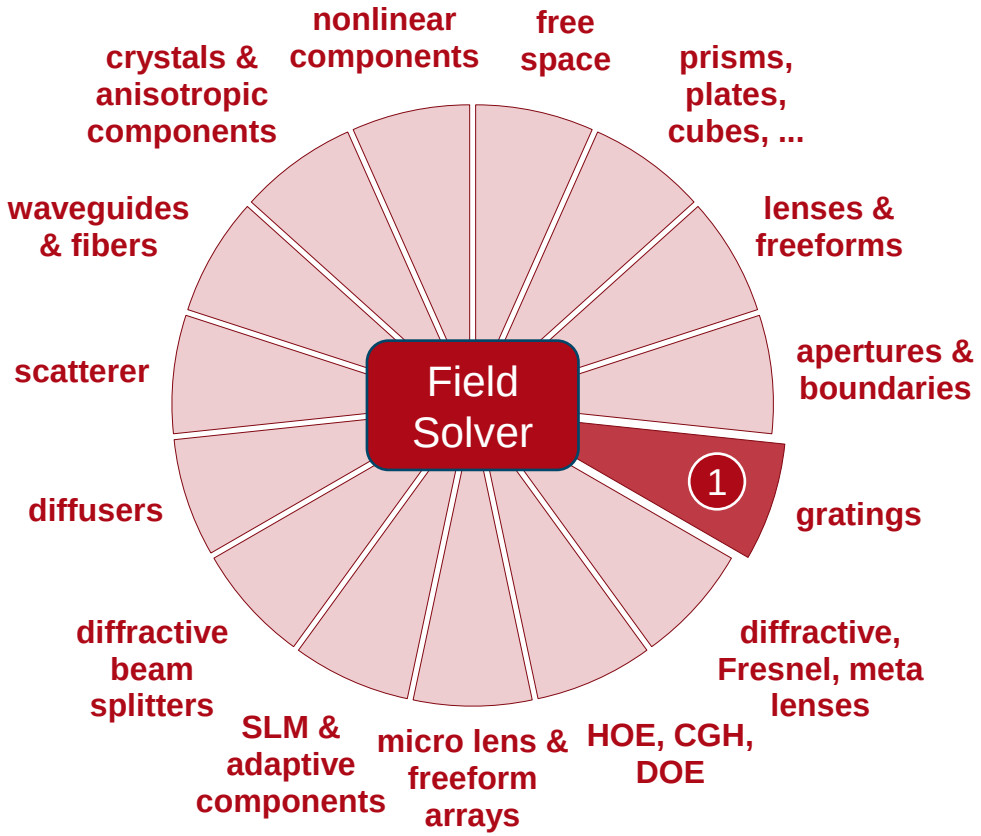
Workflow in VirtualLab Fusion

- Construct grating structure
  - Configuration of Grating Structures by Using Special Media [Use Case]
- Analyze grating diffraction efficiency
  - Grating Order Analyzer [Use Case]
- Check influence from different parameters with Parameter Run
  - Usage of the Parameter Run Document [Use Case]



VirtualLab Fusion Technologies





Document Information

title	Diffraction Property of a Passive Parity-Time Grating
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software version	2020.1 (Build 1.202)
category	Application Use Case
further reading	- Ultra-Sparse Dielectric Nano-Wire Grid Polarizers - Rigorous Analysis of Nanopillar Metasurface Building Block