

# NEMTO: Neural Environment Matting for Novel View and Relighting Synthesis of Transparent Objects

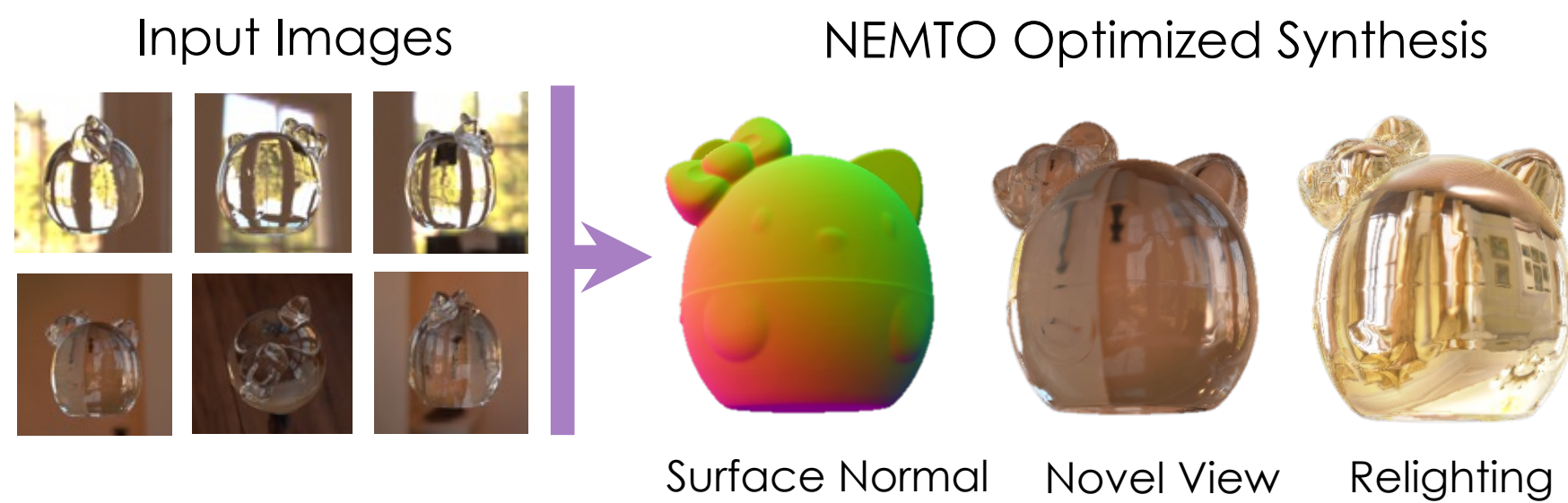
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ICCV23  
PARIS

## Problem

The **entangled** geometry and illumination-dependent appearance of **transparent objects** make it hard to create their 3D representations through 2D images.

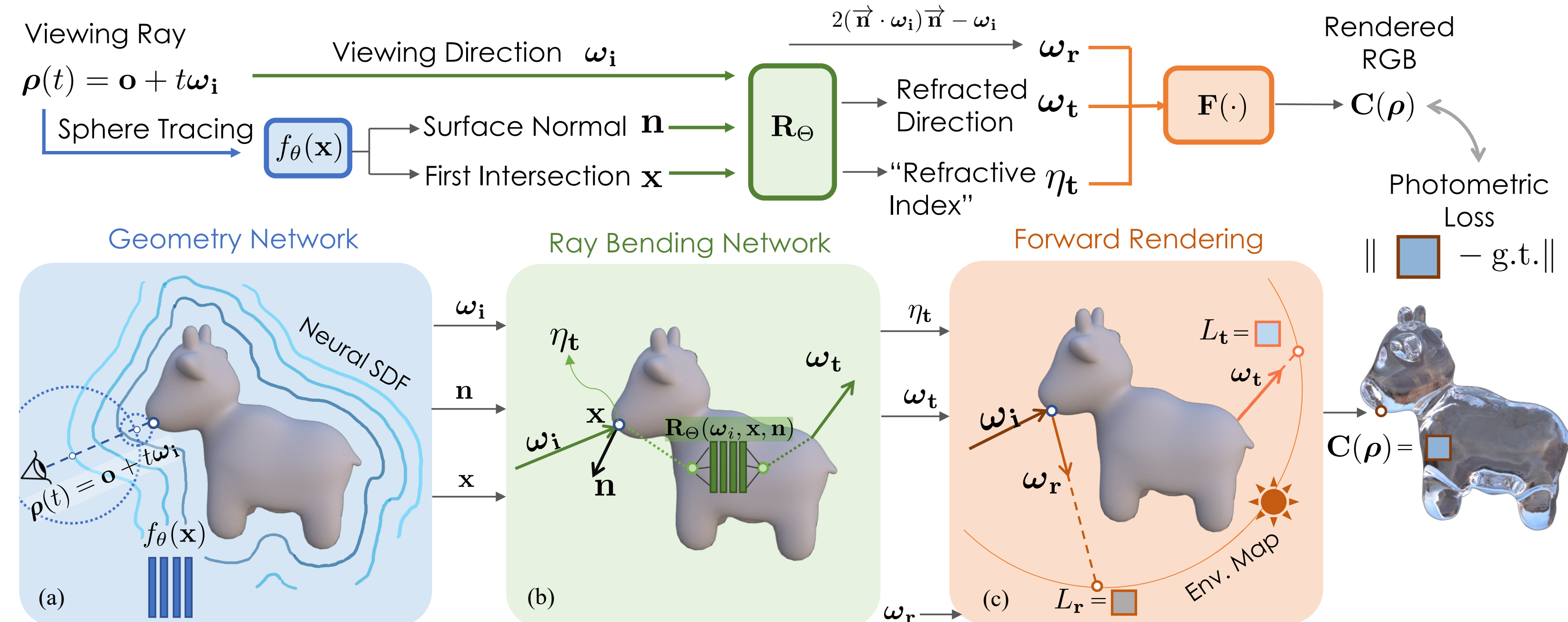


NEMTO synthesizes **high-quality novel view and relighting** by **disentangling** the geometry and illumination-dependent appearance of a transparent object.

## Contributions

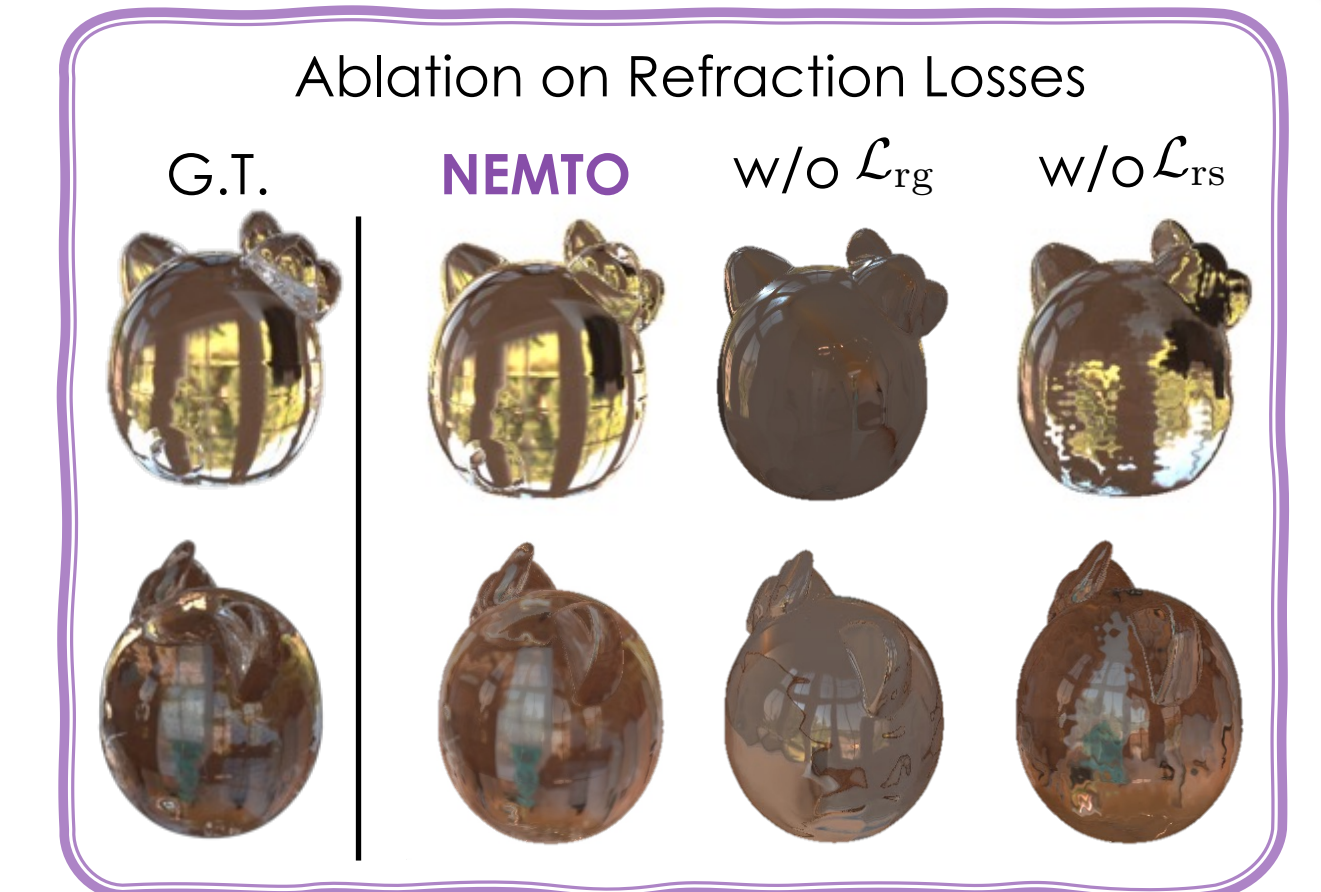
- NEMTO is the first end-to-end method for novel view synthesis and scene relighting for transparent objects.
- A physically-guided **Ray Bending Network (RBN)** for predicting ray paths through the transparent object with **better error tolerance** for the estimated geometry than analytically calculated refraction.
- Can model **real-world** transparent objects by hand-captured image.

## Overview of NEMTO Framework

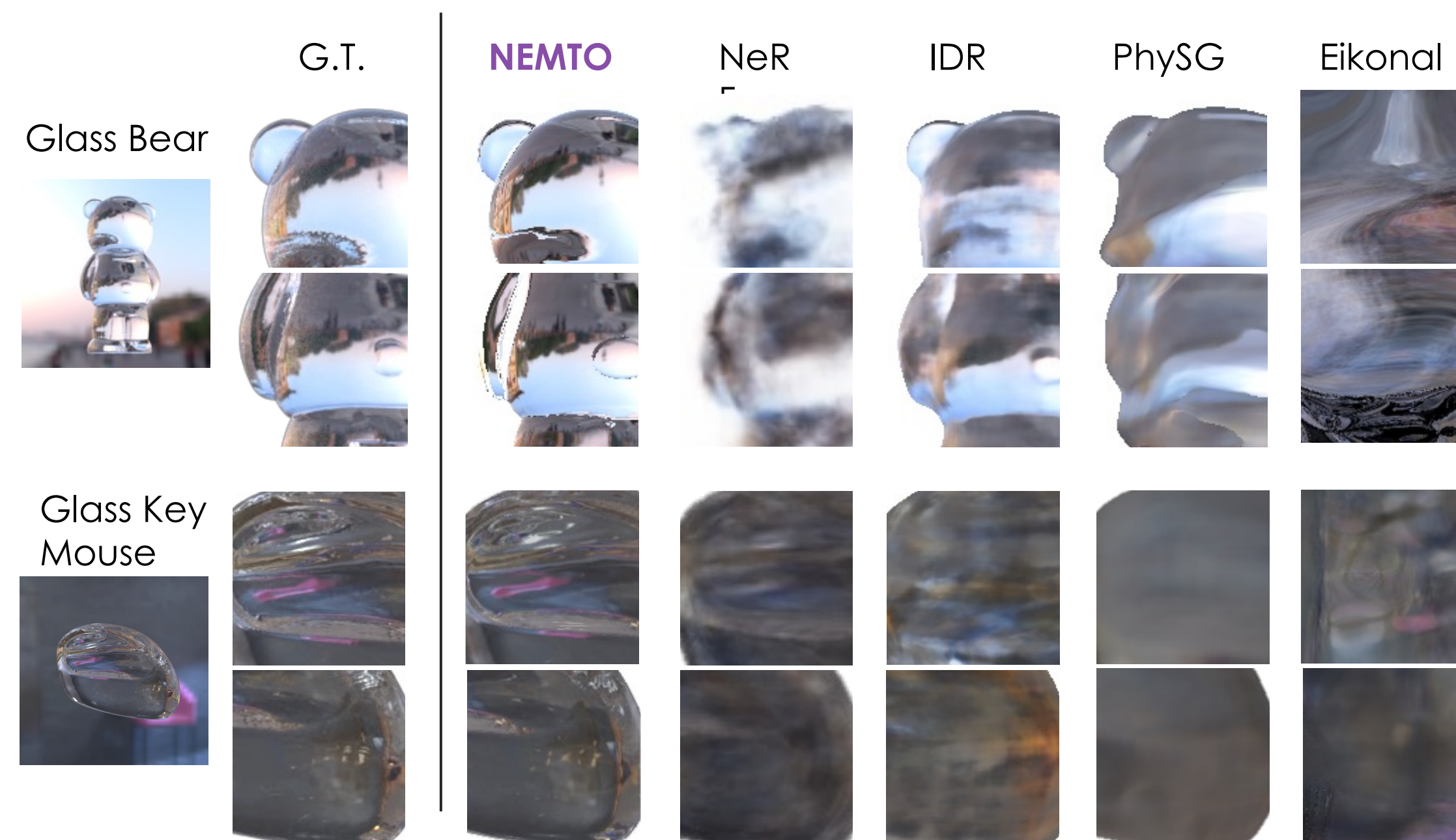


## Loss Functions

For ray refraction estimation, we use two losses:  
 $\mathcal{L}_{rg}$  guides the refraction direction exiting the object toward the analytical solution.  
 $\mathcal{L}_{rs}$  encourages locally smooth refraction directions.



## Novel View Comparison to Baseline Methods

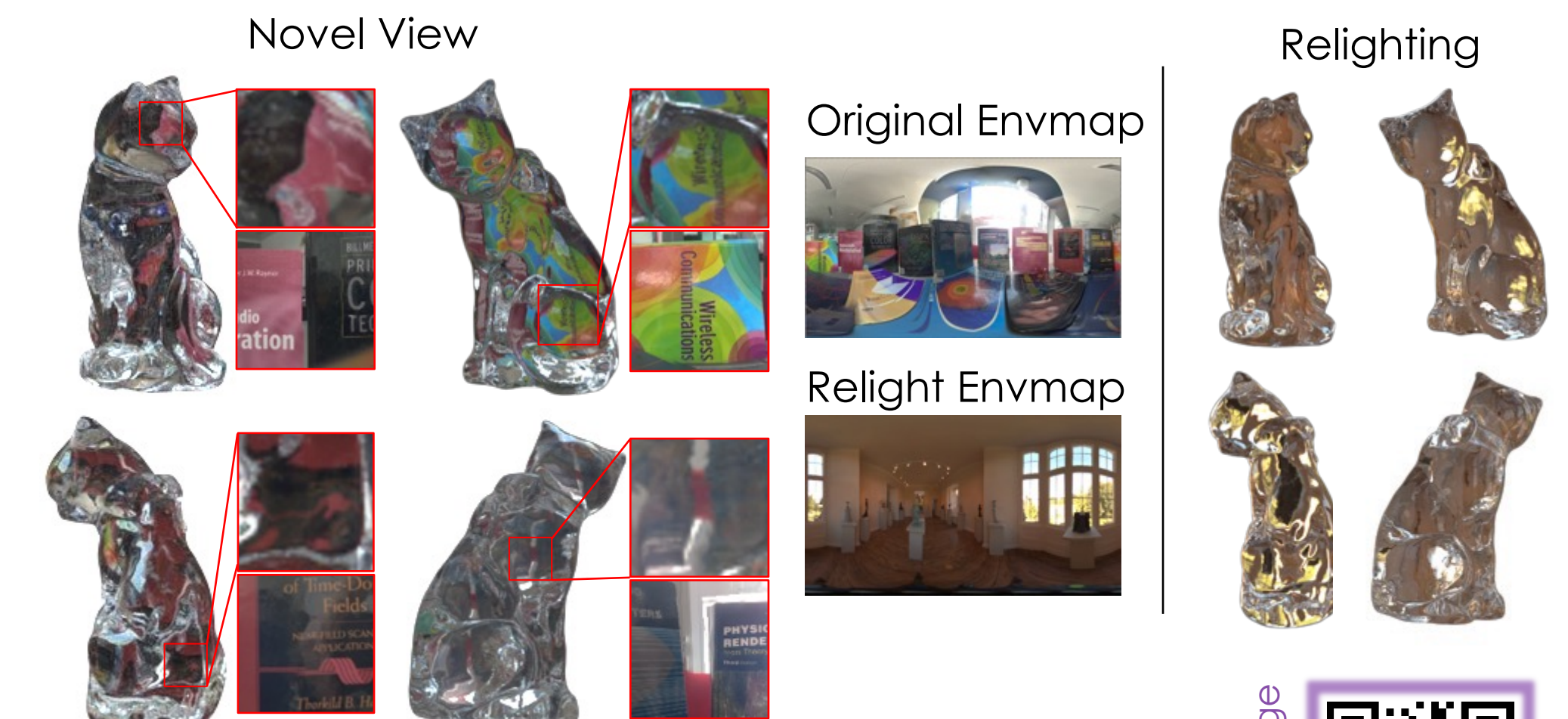


## Relighting Results



## Synthesis on Real-World Captured Dataset

Despite the **inaccuracy** in real-world camera poses and captured environment maps, NEMTO synthesizes **visually-plausible** novel views and relighting results,



## Comparison of Relevant Methods

Methods	A	B	C	D	E	F	Task
Mildenhal et al. [2020]	✗	✓	✗	✓	✓	✗	Img-Based Synthesis
Bemana et al. [2022]	✓	✓	✗	✓	✓	✗	
Yariv et al. [2020]	✗	✓	✗	✓	✓	✗	
Zhang et al. [2021]	✗	✓	✓	✓	✗	✓	
NEMTO	✓	✓	✓	✓	✓	✗	Geo. Est.
Xu et al. [2022]	✓	✗	✗	✗	✗	✗	
Li et al. [2020]	✓	✗	✗	✓	✗	✗	

- A. Explicitly models light refraction for non-opaque objects.  
B. Allows direct novel view synthesis with unknown IOR.  
C. Allows direct scene relighting with unknown IOR.  
D. No complex setup for dataset image capture.  
E. Method works on transparent materials with unknown IOR.  
F. Joint estimation of illumination during training.

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Project Page

